OCS EIS/EA
MMS 2004-028

Environmental Assessment

Proposed Oil and Gas Lease Sale 195
Beaufort Sea Planning Area

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APPENDICES

I OBJECTIVES OF THE ENVIRONMENTAL ASSESSMENT

The Minerals Management Service (MMS) prepared this Environmental Assessment (EA) to determine whether or not new information indicates that the proposed lease sale would cause new significant impacts, ones not addressed in the final Environmental Impact Statement (EIS) for Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, and 202 (USDOI, MMS, 2003a) (the multiple-sale EIS). This EA incorporates all of the relevant material in the multiple-sale EIS by reference. It also re-examines the potential environmental effects of the Proposed Action and alternatives as a result of new information on potential impacts and issues that were not available at the time we completed the multiple-sale EIS in February 2003.

Federal regulations allow for an agency to analyze several similar proposals in one EIS (40 CFR 1502.4). Because the Beaufort Sea sale proposals and projected activities are very similar, if not almost identical for each lease sale, MMS prepared a single EIS for all three Beaufort Sea sales in the 5-Year Outer Continental Shelf (OCS) Leasing Program for 2002-2007 (USDOI, MMS, 2002a). The multiple-sale approach focuses the National Environmental Policy Act (NEPA)/EIS process on the identification of differences among the proposed sales and on new information and issues. Although the multiple-sale EIS addressed three proposed sale actions, the Secretary of the Interior (Secretary) made decisions for only the September 2003 Beaufort Sea Sale 186. The multiple-sale EIS and this EA are the NEPA evaluations for proposed Sale 195, which is scheduled for March 2005.

II. PURPOSE AND NEED FOR THE PROPOSAL

As described in Section I of the multiple-sale EIS, the purpose of Lease Sale 195 is to meet the requirements of the OCS Lands Act by making available for leasing those areas that may contain economically recoverable oil and gas resources in the Beaufort Sea Planning Area. The need for Sale 195 is related to energy use in the United States and the resource potential of the proposed lease area. The Beaufort Sea OCS lies next to the Prudhoe Bay fields, which constitute one of America’s major oil-producing areas and has proved to be a steady and reliable source of crude oil for more than 20 years. Oil from the adjacent Beaufort Sea shelf can help to reduce the Nation's need for oil imports, extend the economic lifespan of the Trans-Alaska Pipeline System (TAPS) and, through continued use of the TAPS, reduce the environmental risks associated with tankering of imported oil.

III. Proposed Action and Alternatives

The proposed Sale 195 area is identical to that offered in Sale 186. As explained in Section I.F of the multiple-sale EIS (USDOI, MMS, 2003a), the Secretary will have the full suite of options available for Sale 195 when those decisions are made in 2005. The Secretary may choose the same options that were selected for Sale 186 or different options. For that reason, all of the alternatives in the EIS are summarized below.

III.A. Proposed Action

As required by the NEPA and the Council on Environmental Quality (CEQ) regulations, MMS identified a preferred alternative in the multiple-sale EIS. This option is included in the EA as the Proposed Action or Alternative I, offering for lease the entire Program Area in EA Map 1 (which is similar to EIS Map 1). The area encompasses 1,877 whole or partial blocks that encompass 9,770,000 acres (about 3,954,000 hectares).

Since the multiple-sale EIS was issued in February 2003, the only oil and gas-related activities on the Beaufort Sea OCS have been the issuance of the Sale 186 leases, MMS approval of a permit application for geophysical (seismic) exploration, and the relinquishment of the McCovey leases after unsuccessful exploratory drilling. A series of wells have been drilled nearshore in State waters off Milne Point. We received no unanticipated information through the Request for Information, published in the *Federal Register* (*FR*) on December 16, 2003; therefore, we have no new oil and gas resource information. The discussion of the oil and gas resources and the projected activities in the multiple-sale EIS reflect the best available information. Therefore, this assessment of proposed Sale 195 evaluates the same range of resource estimates that was assessed in the multiple-sale EIS but in the context of new environmental information.

As we did in the multiple-sale EIS, we assume three different exploration and development scenarios for the three proposed OCS sales. Generally, we expect that leasing, exploration, and development activities will expand into more remote, deeper water during the course of the three-sale program. As indicated for the scenarios, the Proposed Action would range from 340-570 million barrels (MMbbl), assuming a market price of oil between $18 and $30 per barrel (in 2000$). For purposes of analysis, we again use a single production estimate of 460 MMbbl of oil.

III.A.1. Leasing Incentives

The analysis in the multiple-sale EIS is based on a hypothetical model (scenario) of future industrial activities that could occur as a result of offshore leasing. The MMS used a petroleum-resource assessment of the Beaufort Sea completed during spring 2001 as the basis for our EIS assumptions. The resource assessment represents an optimistic view in that the model conducts a simulated discovery and development of all prospects in the database, many of which are not identified by mapping. In contrast, industry carefully selects the best prospects for leasing and exploration drilling based on economic, regulatory, and technological factors. Realistically, many small, remote, or difficult to identify prospects will not be leased or drilled by industry, because they will not meet the investment standards for leasing and exploration funding. Our resource assessment provides only one view of the economic potential of the area, which may not be shared by industry.

To increase the number of tracts leased and to encourage exploration and development, the MMS implemented royalty reductions on oil production for Beaufort Sea Sale 186. The MMS could continue to offer various forms of incentives for future sales in the area to meet program goals. The MMS also lowered the required minimum bid amount and rental rates for tracts leased in Sale 186 and plans to do the same for Sale 195. Lease terms and conditions are reviewed and could be modified for future lease sales.

The 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 this challenging area. Recognizing the low historical level of activities in the Beaufort Sea, we believe that the development scenario analyzed in the multiple-sale EIS is more likely to occur with the new incentives than without them. Without the leasing incentives, the present situation of low industry interest in leasing and exploration likely would continue into the future. The royalty reduction incentives will be offered through the price range ($18-30 per barrel) used to define the activity scenario. At very high prices ($39 per barrel in constant dollars) the incentives would not be offered, nor would they be needed, to spur exploration and development activity.

III.A.2. Scenario

We acknowledge that the exploration and development scenario generated for purposes of environmental analysis is optimistic compared to historical trends in the Beaufort Sea. An optimistic development scenario ensures that the environmental analysis covers the potential effects at the high-end of the range of reasonably projected 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 EIS are a valid representation of the consequences of any Beaufort Sea sale as scheduled in the current 5-Year Offshore Oil and Gas Leasing Program.

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 (USDOI, MMS, 2003a:Table II.A-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 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. The assumed pattern of leasing did not occur during Sale 186 (nearly half of the total bids were received in the Far Zone), although it remains to be seen if exploration activities (marine seismic and drilling) will occur on the remote leases. However, 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 expect 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.A-1, which is similar to Table II.A-1 in the multiple-sale EIS (USDOI, MMS, 2003a), has been updated to include the leasing results from Sale 186. Our estimates for the total sales-related activities remain unchanged.

We assume that timeframes for Sale 195 exploration and development would be similar to those projected prior to Sale 186. The total number of exploration and development wells drilled and the type of exploration and production platforms are assumed to be the same (Table III.A-2, which is the same as USDOI, MMS, 2003a:Table IV.A-2). We assume that exploration drilling would begin in 2007, 2 years after the proposed sale. A commercial discovery is assumed to occur 3 years after the sale, and installation of a production platform is assumed to occur 4 years later. We assume that two new fields would be discovered, ranging in production potential for each field from 120-340 MMbbl of oil. The first production platform would be online in 2013. Production from Sale 195 leases is projected to continue until 2036, about 3 years beyond the projected end of Sale 185 production. Pipeline-landfall sites for this sale are assumed to be the same as for Sale 186. However, because new fields leased in Sale 195 could be farther from existing infrastructure, a new onshore support facility could be needed in either the National Petroleum Reserve-Alaska (NPR-A) or the eastern North Slope. Plans are 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 area for industrial expansion on the eastern North Slope. Future onshore projects in the Point Thomson area are likely to be used by OCS operations in the eastern Beaufort Sea.

III.B. Alternatives to the Proposed Action

Alternative II – No Sale: This alternative would cancel proposed Sale 195 and defer leasing until at least proposed Sale 202.

Alternative III – Barrow Subsistence Whaling Deferral: This alternative would be similar to the Proposed Action (Alternative I), except it would not offer for lease a subarea in the western portion of the proposed sale area. Alternative III encompasses 1,851 whole or partial blocks, comprising 9,632,000 acres (about 3,898,000 hectares). The areas that would be removed by the Barrow Subsistence Whaling Deferral (see EA Map 2, which is similar to EIS Map 2) consist of 26 whole or partial blocks, equaling approximately 138,000 acres or 1% of the Proposed-Action area. As explained in Section I.C.2.a(3) of the multiple-sale EIS, we developed this alternative in response to comments during public hearings in Barrow. This deferral was developed as a way to reduce conflicts between bowhead whale subsistence hunters and offshore oil and gas operations, and was based on bowhead whale-strike data provided by the Alaska Eskimo Whaling Commission (AEWC). The effects of this alternative were assessed in the multiple-sale EIS, and the assessment is updated in this EA. The update evaluates the potential protection of Barrow subsistence-use zones and wildlife areas, particularly in an area where whales have been taken (based on received whale-strike data). This assessment helps to determine if the deferral would provide increased protection to bowhead whales in a subsistence area from potential noise and disturbance due to exploration, developments, and/or production activities. Most of the subsistence whale-hunting area near Barrow is in a portion of the Chukchi Sea that already was removed from leasing consideration in the 5-Year Offshore Oil and Gas Leasing Program for 2002-2007 (USDOI, MMS, 2002a). Requests for protection of the Barrow subsistence area were made during Sale 186 by the Alaska Eskimo Whaling Commission (AEWC) and the North Slope Borough (NSB). Similar requests for protection during Sale 195 were made by the Inupiat Community of the Arctic Slope (ICAS), AEWC and the NSB.

A/lternative IV – Nuiqsut Subsistence Whaling Deferral: This alternative would be similar to the Proposed Action (Alternative I), except it would not offer for lease a subarea where Nuiqsut subsistence hunters harvest bowhead whales near Cross Island. Alternative IV encompasses 1,827 whole or partial blocks, comprising 9,608,000 acres, (about 3,888,000 hectares). The area that would be removed by the Nuiqsut Subsistence Whaling Deferral (see EA Map 3, which is similar to EIS Map 3) consists of 30 whole or partial blocks, equaling approximately 162,000 acres or 2% of the Proposed-Action area. This option was assessed in the multiple-sale EIS, and is assessed in this EA, to evaluate the protection of Nuiqsut subsistence-use zones and wildlife areas where whales have been taken (based on received whale-strike data). Requests for protection of the Nuiqsut subsistence area were made during Sale 186 by the AEWC, the Native Village of Nuiqsut, and the NSB. Similar requests for protection during Sale 195 were made by the ICAS, AEWC and NSB.

Alternative V - Kaktovik Subsistence Whaling Deferral: This alternative would be similar to the Proposed Action (Alternative I), except it would not offer for lease a subarea near Barter Island. Alternative V encompasses 1,849 whole or partial blocks, comprising 9,649,000 acres (about 3,905,000 hectares). The area that would be removed by the Kaktovik Subsistence Whaling Deferral (see EA Map 2, which is similar to EIS Map 2) consists of 28 whole or partial blocks, equaling approximately 121,000 acres or 1% of the Proposed-Action area. This area is being considered for deferral in response to a request by the Native Village of Kaktovik because of the potential disturbance to Kaktovik's traditional subsistence-whaling area. Requests for protection of the Kaktovik subsistence area were made during Sale 186 by the AEWC, the Native Village of Kaktovik, and the NSB. Similar requests for protection during Sale 195 were made by the AEWC and the NSB. The area was delineated by MMS, using whale-strike maps provided by the AEWC.

Alternative VI – Eastern Deferral: This alternative would be similar to the Proposed Action (Alternative I), except it would not offer for lease a subarea to the east of Kaktovik. Alternative VI encompasses 1,817 whole or partial blocks, comprising 9,487,000 acres (about 3,839,000 hectares). The area that would be removed by the Eastern Deferral (see EA Map 2, which is similar to EIS Map 2) consists of 60 whole or partial blocks, equaling approximately 283,000 acres or 3% of the Proposed-Action area. It adjoins an area that the State of Alaska has deferred from recent State sales. This option evaluates the reduction of potential overall impacts, as requested by three groups (the Native village of Kaktovik, the AEWC, and the NSB) because of the area's importance to bowhead whales and other natural resources.

III.C. Mitigation

The standard mitigating measures for the Proposed Action are listed below and described fully in Appendix A of this EA:

- Stipulation No. 1, Protection of Biological Resources
- Stipulation No. 2, Orientation Program
- Stipulation No. 3, Transportation of Hydrocarbons
- Stipulation No. 4, Industry Site-Specific Bowhead Whale-Monitoring Program
- Stipulation No. 5, Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvesting Activities

Following are the optional mitigating measures for the Proposed Action:

- Stipulation No. 6, Pre-Booming Requirements for Fuel Transfers
- Stipulation No. 7, Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders
- Stipulation No. 8a, No Permanent Facility Siting in the Vicinity Seaward of Cross Island
- Stipulation No. 8b, No Permanent Facility Siting in the Vicinity Shoreward of Cross Island

Please note that the above stipulation titles and the stipulation text are identical to the stipulation language used in the EIS, but the numbers of Stipulations 6, 7, and 8a and 8b have changed.

The Information to Lessees (ITL) for proposed Sale 195 also are presented in Appendix A of this EA.

IV. IMPACT ANALYSIS

The impact analysis is separated into five subsections: (A) update of information on oil spill risk (B) updated information on the affected environment, (C) updated impact analyses for the Proposed Action, (D) updated impact analyses for other alternatives, and (E) the updated cumulative analyses. New information on spill-response plans is summarized in EA Sections IV.A.2 and IV.C.1.c.

As explained in EA Section IV.B.1, the multiple-sale EIS concluded that "no significant effects are anticipated from routine permitted activities"; however, with respect to the effects of a large oil spill, it concluded that: "In the unlikely event of such an oil spill, significant adverse effects could occur to local water quality; common, spectacled, and Steller's eiders; long-tailed ducks; subsistence harvests; and sociocultural systems."

This EA, updating the assessment for proposed Lease Sale 195, concludes in Sections IV.C.2 and IV.F. **that no new significant impacts were identified for the proposed lease sale that were not already assessed in the multiple-sale EIS.**

The multiple-sale EIS also assessed the cumulative impacts; part of the general conclusion is that: "Potential cumulative effects on the bowhead whale, subsistence, sociocultural systems, spectacled eider, boulder patch, polar bear, and caribou would be of primary concern and warrant continued close attention and effective mitigation practices." The assessment in this EA includes some projected effects of climate change in the Arctic (Section IV.E and Appendix I). Based on the analysis, **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.**

IV.A. Update of Information on Oil-Spill Risk

The following sections focus on the effects of a large oil spill. A large oil spill is defined as greater than or equal to 1,000 barrels. Before summarizing new resource information and updating the effects of a large oil spill, we briefly review the oil-spill analysis in the Beaufort multiple-sale EIS (USDOI, MMS, 2003a) and provide new information on oil spills and oil-spill response.

IV.A.1. 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 Alternative I, the Proposed Action and its alternatives. This information has become available since the publication of the Beaufort multiple-sale EIS in February 2003.

Information regarding the source, type, and sizes of oil spills; their behavior; the estimated path they follow; and the conditional and combined probabilities remain the same as discussed in the multiple-sale EIS in Section IV.A and Appendix B. 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.

A recent laboratory study on the biodegradation of weathered Alaska North Slope crude indicates that low-dose oil locations are bioremediated more effectively than high-dose locations (Lepo et al., 2003). Prince et al. (2003) discuss three northern spills and demonstrate that photo-oxidation and biodegradation play an important role in the long-term weathering of crude oils. Photo-oxidation and biodegradation would continue to weather the 28-65% of the oil remaining.

After 30 days under landfast ice:

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

Oil spreading and floe motion were studied to determine how floe motion, ice concentration, slush concentration, and oil types affect spreading in ice. Spreading rates were lowered as ice concentrations increased; but for ice concentrations less than 20-30%, there was very little effect. Slush ice rapidly decreased spreading. If the ice-cover motion increased, then spreading rates increased, especially with slush ice present (Gjosteen and Loset, 2004). The new information helps to determine the specific behavior of oil under ice but does not change the above assumptions.

The chance of one or more large spills occurring is derived from two components: (1) the spill rate and (2) the resource volume estimates. The oil resource volume estimate remains 460 billion barrels (Bbbl), as discussed in the Beaufort multiple-sale EIS (USDOI, 2003a:Section II.B). 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., 2002). 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.

Considering only the variance in the 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 0.25 oil spills (95% confidence interval 0.21-0.30 oil spills) per billion barrels produced. Considering only the variance in the Arctic effects, we are 95% confident that the spill rate for large spills from platforms and pipelines will be no more than 0.30 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 4-5%, and the chance of one or more large platform spills would be 7% for Alternative I, the Proposed Action and its alternatives. The chance of one or more large spills from platforms and pipelines combined ranges from 10-11% for Alternative I, the Proposed Action and its alternatives based on the spill rate. Using the spill rate at the 95% confidence interval, the chance of one or more large spills from platforms and pipelines combined for Alternative I, the Proposed Action, and its alternatives ranges from 9-13%. Appendix B discusses how these spill rates were derived, and the reader is directed to Appendix B for more detail.

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

The multiple-sale EIS explains that the confidence estimate includes only part of the variability in the Arctic effects on the spill rate. The confidence estimate does not consider the variance in the baseline data (Gulf of Mexico and Pacific OCS spill statistics) or in the Sale 195 production estimate. Inclusion of these variances would, in our opinion, increase the range in the confidence interval.

During Fiscal Year 2004, the MMS is preparing for the procurement of 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 confidence intervals due to non-Arctic effects are to be addressed in this study. The study would be based on a fault-tree method that modifies the Gulf of Mexico oil-spill rates to expected Arctic oil. Results of this study will not be available for Sale 195 analysis but should be available for Sale 202 analysis.

IV.A.2. Oil-Spill Responses

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 area for all three operating seasons in the Arctic: solid ice, open water, and broken ice (USDOI, MMS, 2003a:Section 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 multiple-sale EIS explained that research was ongoing (EIS Section IV.A.6.d). Recent spill demonstrations and drills have shown that the effectiveness of response equipment still is reduced greatly by broken ice. For example, an industry spill-response consortium has designed tactics and equipment for the pools of oil that tend to form around broken pieces of ice. Response demonstrations have been conducted on small test “spills” in broken ice with fireproof booms and in situ burning. Response demonstrations also have been conducted with free-skimming techniques around blocks of ice during the late spring and summer, where skimming operations are carried out without the use of containment booms. Responders would rely on the ice edge in such broken-ice conditions to contain and concentrate the oil. If a pool of oil formed along the ice edge, the responders would maneuver a boat into position and lower a skimmer into the pool for recovery operations. By eliminating the need for containment booms, the boats would be much more maneuverable, could react more quickly to changing conditions, and could access tighter spaces. As opposed to broken-ice conditions during spring, broken-ice conditions during autumn are very different; as noted in the multiple-sale EIS (USDOI, MMS, 2003a:Section IV.A.6.a). Once ice crystals are present in the water during the autumn broken-ice season, skimming systems essentially are shut down. Therefore, the basic assumptions about spill response in the multiple-sale EIS remain unchanged for this EA: we assess the probable effects of a 1,500 bbl or 4,600 bbl spill in spite of spill response capabilities.

IV.B. Update of Information on the Affected Environment

For this EA, MMS evaluated the information and comments we received on the Call for Information and Nominations, the comments received on the multiple-sale EIS, new information pertinent to each resource evaluated, and the previous evaluation of potential effects in the past EIS's. On the basis of this, we determined the resources to be evaluated and level of analysis presented in this EA.

First, we evaluated existing information and the comments received to determine whether there were any new resources that needed to be added to our list of resources to be analyzed. We determined there were none.

After we evaluated the comments and new information, we organized the analysis that follows into five general groups. These groups progress generally from those with significant effects in the EIS to those with negligible effects in the multiple sale EIS but with new information. The last groups are those for which there is no new information.

The first group includes marine and coastal birds, subsistence-harvest patterns, sociocultural systems, and local water quality. Endangered eiders are discussed with other marine and coastal birds. The analysis in the EIS for these resources determined that the potential effects from an unlikely oil spill could exceed the significance threshold. This determination alone warranted that we evaluate the potential effects further. In this EA, we summarize the new information available for these resources and provide a new conclusion for the Proposal, all alternatives, and the cumulative effects.

The second group is a single resource, the endangered bowhead whale. While potential effects to this resource were not expected to exceed any significant threshold in the EIS, it is a very important resource to the indigenous population on the North Slope. We found new relevant information pertaining to this resource, and some of it could alter the potential level of effects. We also understand that the resources that are of concern to the North Slope residents warrant a more in-depth description of available information and analysis of potential effects than other resources. The analysis of effects to bowhead whales is the most extensive evaluation in the EA. Potential effects are presented for the Proposal, all alternatives, and cumulative effects.

The third group (Other Marine Mammals, Fishes and Essential Fish Habitat, and Environmental Justice) were evaluated fully in the EIS. We found new relevant information pertaining to these resources, some of which could alter the possible levels of effects. In this EA, we summarize the new information and provide a new conclusion for the Proposal, all alternatives, and cumulative effects. For environmental justice, the reader should note that the evaluation criteria are not whether a NEPA significance threshold has been reached, but whether there would be a "disproportionately high adverse effect."

The fourth group (air quality and other resources) includes air quality, terrestrial mammals, vegetation and wetland, and lower trophic-level organisms—resources that were evaluated extensively in the EIS. For these resources we include some new information about the resource in the EA. However, the new information about the resource does not result in any substantial potential change in effects for the Proposed Action, alternatives, mitigation, or the cumulative analysis. The effects are essentially identical to those stated in the EIS.

The fifth group (economy, archaeology, land use plans and coastal zone management plans) were evaluated fully in the EIS, but we determined that no new relevant information pertaining to these resources was available that would alter the potential levels of effects. The analysis and conclusions for the Proposed Action, all of the alternatives, mitigating measures, and cumulative analysis would be essentially identical to those stated in the EIS. The EIS found the potential effects to these resources and government plans from the potential oil and gas leasing, including Sale 195, were small to negligible.

IV.B.1. Introduction

The MMS guidelines explain that EA's shall focus on those aspects of the Proposed Action that could cause adverse effects that are significant (40 CFR 1508.27) or that could be minimized or avoided through application of reasonable mitigation (40 CFR 1500.2(f)). The effects of a large oil spill are assessed in Section IV.C in the multiple-sale EIS and summarized in the Executive Summary (Section ES.1.e(2)). The summary is that: "In the unlikely event of such an oil spill, significant adverse effects could occur to local water quality; common, spectacled and Steller's eiders; long-tailed ducks; subsistence harvests; and sociocultural systems." In contrast, the EIS concluded that "no significant effects are anticipated from routine permitted activities" (USDOI, MMS, 2003a:Section ES.1.e(1). For this reason, the following updates of new information and updated assessments focus on spill-related information.

IV.B.2. Update of Information on the Resources

This section summarizes new information that has become available since publication of the multiple-sale EIS. Because the multiple-sale EIS found significant effects related only to oil spills, the following summaries focus on information that relates to the probable effects of a large oil spill, such as substantial population declines or redistributions of vulnerable species into high-risk areas. One exception is the bowhead whale information review which, as noted in Section IV.B.2.d, is a species of special concern to the residents on the North Slope. The bowhead whale analysis includes summaries and evaluates a broader range of information.

IV.B.2.a. Marine and Coastal Birds

This section updates information provided in the multiple-sale EIS (USDOI, MMS, 2003a) with recently obtained research results on size, status, trends, and distribution of eider and long-tailed duck populations potentially at risk of significant 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 and to conclude in a memorandum to the Fish and Wildlife Service (FWS) that no new information requiring reinitiation of formal consultation has been received by the MMS (Appendix C).

Principal bird species seasonally occurring in the Alaskan Beaufort Sea that are considered to have a high potential for significant effects from oil and gas activities following proposed Lease Sale 195 include spectacled eider, Steller's eider, king eider, common eider, and long-tailed duck. Spectacled and Steller's eiders are listed as threatened under the ESA (ESA). Brant; snow goose; and several loon, shorebird, and seabird species are considered to have a lower potential for significant effects.

IV.B.2.a(1) Species with Higher Potential for Substantial Effects

Spectacled Eider: The 2002 and 2003 FWS eider breeding population aerial surveys of the Arctic Coastal Plain (Larned, Stehn, and Platte, 2003a,b) resulted in spectacled eider population estimates of 6,662 and 7,149, respectively. These values are somewhat below and above, respectively, the 1993-2003 mean (6,919) but within the range of annual variation. This population continues to exhibit a very slight nonsignificant downward mean growth rate of 0.993 (stable population = 1.00). Density was estimated to be 0.22 and 0.23 birds per square kilometer (km^2), respectively. An intensive aerial survey of the eider sampling area near Barrow recorded a density of 0.14 birds per km^2 in 2002, well below the typical range of 0.22-0.25 observed from 1999-2001 (Ritchie and King, 2002). Aerial surveys of transects southeast of Teshekpuk Lake recorded a prenesting "linear" density of 0.02 birds per km^2 (Noel et al., 2002a). A prenesting aerial survey of the Colville River Delta and the Phillips-Anadarko CD-North project area on the delta in 2001, a continuation of the series of surveys conducted since 1993 (ABR, Inc., 2002; Johnson et al., 2004), found a density of 0.07 birds per km^2 (8-year mean = 0.10). Spectacled eider densities were found to be two to three times higher on the outer delta nearer the coastline in all years (mean = 0.20 per km^2). Prenesting density in the Kuparuk Oilfield (as determined from aerial survey data) was 0.06 birds per km^2 in 2002, compared to a range of 0.06-0.17 from 1993-2002 (FWS data in Anderson et al., 2003). Nest success was 50%. Further to the east, Troy (TERA, 2002) found a very low density of approximately 0.01 pairs per km^2 in the Point Thomson area, reinforcing the view that there exists a decreasing gradient of abundance from west to east across the Arctic Coastal Plain.

Postbreeding movements of spectacled eiders in northern Alaska have been tracked recently using satellite telemetry (Troy, 2003). Most males, departing in early June-early July (median date 22 June ±11 days) when use of Beaufort Sea habitats typically is restricted by extensive ice cover, migrated onshore but parallel to the coast. All females, departing later in the season after raising their broods, used nearshore waters that were substantially ice-free by that time. Other investigators have recorded males and females migrating a median distance of 6.6 km and 16.5 km offshore, respectively (Petersen, Larned, and Douglas, 1999). Results of other telemetry studies have suggested that residence time in the Beaufort Sea by migrating individuals is variable, but most remain about 3-4 days. Harrison and Smith bays appear to be important staging areas.

Spectacled eiders in the wintering area south of St. Lawrence Island were found to prey only on clams, avoiding other prey species that are known to be used elsewhere (Lovvorn et al., 2003). Evidence that the dominant clam prey has changed and its implication for foraging energy requirements and long-term benthic ecosystem changes has been examined by Richman and Lovvorn (2003). Body mass of females prior to departing the wintering area was lower than reported at arrival on the breeding areas 4-8 weeks later, suggesting that areas used between wintering and breeding areas are critical for acquiring energy reserves for reproduction (Lovvorn et al., 2003). Stout et al. (2002) found baseline contaminant concentrations of cadmium, copper, lead, and selenium in many spectacled eider liver and kidney tissue samples to be below toxic thresholds but high relative to other waterfowl and thus of some potential concern. Examination of several genetic markers on chromosomes of cell mitochondria revealed a high degree of regional (Russia versus Alaska) differentiation, and together with evidence from other markers indicates that females are much more likely to return to their natal area to breed than males (Scribner et al., 2001). Genetic evidence also suggests there may be relatively high rates of inbreeding in these populations.

Steller's Eider: Although the breeding distribution of the Steller's eider may not have decreased substantially in recent decades, the frequency of breeding attempts probably has declined except in the vicinity of Barrow (Quakenbush et al., 2002). However, the few quantitative historical records of breeding makes such determinations difficult (USDOI, FWS, 2002a). Possible increases in predator populations and an apparent direct relationship between cycles of small mammal numbers and jaeger and snowy owl nesting may exert a strong influence on the variability of Steller's eider breeding success and nesting attempts, respectively (Quakenbush et al., 2002a). Any protective benefit derived from nesting near jaeger or owl nests may be lost after ducklings disperse from the nest site when predator populations are elevated (Obritschkewitsch and Martin, 2002).

Estimates of Steller's eiders present on the Arctic Coastal Plain have ranged from low hundreds to low thousands (Mallek, Platte, and Stehn, 2002, 2003). In some years few (2003) or none (2002) are observed during FWS aerial surveys of the Arctic Coastal Plain (Larned, Stehn, and Platte, 2003a,b; Mallek, Platte, and Stehn, 2003), indicating a low return rate in those years, or atypical timing of arrival relative to the survey dates. Because the area near Barrow apparently is an exceptionally important Alaskan nesting area, intensive aerial surveys have been undertaken there since 1999 (Ritchie and King, 2002). Population estimates for this area have ranged from 8-224. Densities generally have ranged from 0.03-0.08 birds per km^2 except in 2002 and 2003, when they were present in extremely low numbers. Low Steller's eider presence in the Barrow area in these years also was indicated by no nests being observed during ground surveys of the area (Obritschkewitsch and Martin, 2002; Rojek and Martin, 2003); no males were observed in the survey area in 2002. Substantial annual variation in numbers present appears to be a characteristic of the Alaska population. The sparse data obtained during the FWS eider aerial surveys indicates a slight upward trend with a mean population growth rate of 1.007 (Larned, Stehn, and Platte, 2003b). Aerial surveys in southwestern Alaska during spring migration in 2003 resulted in a conservative population estimate of 77,369 Steller's eiders (Larned, 2003).

A majority of Steller's eiders equipped with satellite transmitters near Barrow initially flew to various sites on the Chukotka Peninsula in Russia, staying into August. All individuals flew to sites in the Bristol Bay-Alaska Peninsula region, especially the Kuskokwim Shoals area, in August and September to molt, and wintered at several sites along the Alaska Peninsula. All spring migrant birds staged at Kuskokwim Shoals. Of the six birds with transmitters still functioning when they undertook spring migration, two were last recorded in early June at Chukotka sites and one in the vicinity of Wainwright in northwest Alaska (Martin, 2002, pers. commun.).

King Eider: More than 76,000 king eiders were observed passing Point Barrow during spring migration in 2003; this would extrapolate to a projected total passage of 362,237 (Suydam et al., 2004). Presumably, most of these individuals continue on into Canada, because the 2003 mean estimated Arctic Coastal Plain king eider population derived from counts during the eider breeding population aerial survey in mid-June was 12,853 (Larned, Stehn, and Platte, 2003b). The 2002 estimate for the Arctic Coastal Plain was 14,730. Based on this survey, the population exhibits a slightly increasing mean growth rate of 1.024 (stable population = 1.00). Calculated densities in these years were 0.42 and 0.48 birds per km^2, respectively. An aerial strip-transect survey for broods southeast of Teshekpuk Lake in 2001 recorded 0.55 birds per km^2 (Noel et al., 2002a). During nearshore aerial surveys from Kasegaluk Lagoon to the Canadian border in late July-early August 2002 and 2003, 2,396 and 4,149 king eiders were recorded, respectively (Lysne, Mallek, and Dau, 2004).

Movements of king eiders equipped with satellite transmitters in the Kuparuk area in June 2002 have been tracked through portions or all of an annual cycle (Powell et al., 2003, 2004). Males staged an average of 17 km offshore in the Beaufort Sea for 7-17 days in late June or the first half of July before undertaking a molt migration that brought 7 of 10 to molt locations on Chukotka and Kamchatka peninsulas in Russia in late July or early August. The other three molted in Alaska at St. Lawrence Island or in Kuskokwim Bay. Females staged an average of 14 km offshore for 9-32 days, departing the Beaufort Sea area in late July or later, presumably after raising their brood; five of nine reached Russian molting locations from about mid-August to mid-September, and the other four molted at Arctic Coastal Plain, St. Lawrence Island, Alaska Peninsula, or Kuskokwim Bay sites. Transmittered males wintered at areas along Chukotka and Kamchatka peninsulas in Russia and Kvichak Bay, Alaska Peninsula, Chirikof Island, and Togiak Bay in Alaska. With the exception of Togiak Bay, females wintered at these same locations and also at a southwest Kenai Peninsula site. All six females with transmitters still functioning returned to the Kuparuk study area in summer 2003. Of nine males still transmitting, only one returned to the Kuparuk area; the others were tracked to the Barrow area (1), offshore (3) and onshore (2) sites in Canada, and onshore (2) sites in Russia. As of late July 2003, the six females were still in the Beaufort Sea, and the males were in molt migration in the Beaufort, Chukchi, and western Bering seas. Also as of late July, all females equipped with transmitters in June 2003 were still in the Beaufort Sea area. All but two males left the Beaufort by late July and were tracked to Point Lay, Icy Cape, Kuskokwim Bay, and the Chukotka Peninsula (Powell et al., 2003, 2004).

Male king eiders implanted with satellite transmitters in June 2003 on Victoria Island in the central Canadian arctic remained in the capture region until late July or early August, then moved fairly quickly westward through the Canadian and Alaskan Beaufort Sea, leaving the latter from late July to mid-August (Dickson, 2003, pers. commun.). Molting and wintering areas for these individuals, like Alaskan breeding birds, included sites around the Chukotka Peninsula, St. Lawrence Island, Bristol Bay, and the Alaska Peninsula. Females remained in the capture region until mid-August and then crossed and exited the Alaskan Beaufort Sea by late August-early September.

Studies comparing king eider breeding at relatively undisturbed Teshekpuk Lake with that in the developed Kuparuk area in 2002 found an apparent 33.3% nesting success at the former and 42.9% at the latter (Powell, Suydam, and McGuire, 2003a). In 2003, these values were 17.5% and 35.1% (Powell, Suydam, and McGuire, 2003b, Powell, McGuire, and Suydam, 2004). An investigation at Northstar Island, an oil-production island in the Beaufort Sea, used ornithological radar to track king and common eiders (as well as other species) during the fall migration period to document any behavioral response to this structure under different lighting regimes (Day et al., 2003). The tested anticollision lighting system had a weak and inconsistent effect on eider response to the island.

Common Eider: About 24,000 common eiders were observed passing Point Barrow during spring migration in 2003 (Suydam et al., 2004). This would extrapolate to a projected total passage of 119,809. Counts during aerial surveys of Chukchi and Beaufort Sea barrier island-lagoon systems and other coastal habitats east to the Canadian border in late June 2003 recorded 2,123 common eiders (Dau and Hodges, 2003). This represents a 50%-plus reduction from the 4,449 counted in 2002 (Dau and Anderson, 2002). However, this probably does not represent actual losses so much as Canadian birds, the bulk of the population, not stopping in the count area as they are suspected of doing in 2002 because of ice conditions that temporarily interrupted migratory progress. Average number counted in 1999-2003 was 2,682. During nearshore aerial surveys from Kasegaluk Lagoon to the Canadian border in late July-early August 2002 and 2003, 3,334 and 6,776 common eiders were recorded, respectively (Lysne, Mallek, and Dau, 2004). Aerial surveys and nest monitoring on barrier islands in the central Beaufort Sea area indicate a continuing decline in nesting effort (Flint et al., 2003), although numbers nesting on some islands have remained steady or increased (Noel, Rodrigues, and Johnson, 2002). This may be due in part to eiders forgoing nesting when poor conditions on the breeding areas exist (for example, late ice breakup allowing predator access).

Nesting females, equipped with satellite transmitters in July 2001 at Egg Island northwest of Prudhoe Bay, wintered at sites around the Chukotka Peninsula, St. Lawrence Island, and Pribilof Islands (Petersen, 2002, pers. commun.). On their northward migration in 2002 several individuals staged in the Ledyard Bay area, eastern Chukchi Sea from mid- to late May before their early June arrival near the site where they were marked. Others remained in the northern Bering Sea through April and most of May before flying to the marking area in early June without many intervening stops.

Most male common eiders equipped with satellite transmitters near Cambridge Bay, Nunavut, Canada in mid-June 2003 spent little time traversing the Alaskan Beaufort Sea, remaining in Canadian waters generally until early October and then transiting fairly quickly to the Chukchi Sea (Dickson, 2003, pers. commun.). Several left Canadian waters by late July or early August and had departed the Alaskan Beaufort before mid-August. Females often were still in the Alaskan Beaufort in late October to early November. Both sexes molted in Canadian arctic waters, females in particular near the capture site, and wintered at sites around the Chukotka Peninsula in Russia. Birds implanted in mid-June 2001 and 2002 at a different Nunavut site undertook similar movements with comparable timing (Dickson, Bowman, and Hoover, 2003). Again, females molted near the nesting area and most males molted a variable distance to the west in Canadian waters. Both sexes wintered at sites around the Chukotka Peninsula. Males generally departed the molting areas by early October and dates of transit through the Beaufort Sea on fall migration to wintering areas ranged from October 4 to October 26. Females generally remained in molting areas from late July/early August to early to mid-October and then migrated through the Beaufort Sea area in mid- to late October (range from October 13 to October 22). Likewise, males implanted with transmitters east of Bathurst Inlet, Nunavut (Dickson et al., 2003), remained near the nesting colony several weeks, departing in July to molt near the Chukotka Peninsula (one-third of individuals) or western Canadian waters (two-thirds of individuals). Females molted within 50 km of the nesting colony. All but one of these tagged individuals stopped at least once during fall migration through the Beaufort Sea to wintering areas in Russia.

Genetic evidence for geographic isolation of common eiders from widespread breeding areas in the Beaufort Sea currently is being investigated (Sonsthagen et al., 2003, 2004). Demonstration of genetically isolated populations would provide support for managing them as separate populations. Supporting the concept of isolated populations meriting separate management within the Pacific common eider range, physical evidence that the western Beaufort breeding population remains largely geographically isolated from the Yukon-Kuskokwim Delta breeding population, for example, already has been obtained by determining from satellite transmitter locations that throughout the year there was little or no overlap of areas used by females from the two areas (Petersen and Flint, 2002). Levels of trace elements detected in common eider eggs and blood, and of persistent organic pollutant residues in eggs (Franson et al., 2004) generally were below levels that have been reported to cause adverse effects in several species of birds (Grand et al., 2002).

Long-Tailed Duck: The long-tailed duck is the most common sea duck species observed on aerial breeding pair surveys of the Arctic Coastal Plain. Recent (2000-2002) aerial surveys of the Arctic Coastal Plain resulted in estimates ranging from 67,010-104,055 (Mallek, Platte, and Stehn, 2003). Although the 2003 population estimate was well below the mean of the past 2 decades, data from the early June eider survey exhibit a nonsignificant, only slightly decreasing mean growth rate of 0.995 (stable population =1.00; Larned, Stehn, and Platte, 2003b). Late June surveys suggest a slightly steeper decline of 0.975 (Mallek, Platte, and Stehn, 2003). A substantial proportion of the population (10-30,000) concentrates in the Beaufort Sea lagoon system for the postbreeding molt period mid-July to mid-September. During nearshore aerial surveys from Kasegaluk Lagoon to the Canadian border in late July-early August 2002 and 2003, 74,061 and 95,074 long-tailed duck were recorded, respectively (Lysne, Mallek, and Dau, 2004). Average densities of molting birds along identical transects in barrier island and mid-lagoon habitat west of Prudhoe Bay ranged from 6.1-164.9 birds per km^2 in 2000 (Noel, Johnson, and Rodrigues, 2002) and 1.3-125.9 birds per km^2 in 2001 (Noel, Johnson, and O'Doherty, 2003). Over the period 1977-2001, average density in barrier island habitat ranged from 99.5-306.8 birds per km^2 along western transects to 192.2-394.9 birds per km^2 along eastern transects. Site fidelity of long-tailed ducks during the 3-week molt period was highly variable; since flocks of individuals are observed consistently in the same locations, this data suggests that there is a high rate of turnover within the flocks (Flint et al., 2004). Studies of habitat use by these ducks found that although initially they relied upon stored reserves for feather regrowth, nutritionally they were not resource limited (Howell, 2002).

Body condition was not negatively affected by experimental boat disturbance or proximity to industrial development in any detectably significant manner (Flint et al., 2003). Movement patterns, habitat use, and foraging effort were not found to be affected significantly by disturbance, including underwater seismic surveys (Lacroix et al., 2003). Weather patterns, especially wind, appear to be the primary influence on these activities. An adenovirus was identified as the cause of poor body condition and elevated mortality in 2000. Results of these studies suggest that natural phenomena such as wind and disease influence molting long-tailed ducks more than human disturbance (Flint et al., 2003; Franson et al., 2004; Hollmén et al., 2003).

After occupying various coastal locations in the Beaufort and Chukchi seas until September or October, most long-tailed ducks equipped with satellite transmitters at Point Thomson in August 2002 proceeded to various sites in Chukotka in November and December. These ducks overwintered at widespread localities from northern Japan and the Kamchatka Peninsula to St. Lawrence Island, the Alaska Peninsula, and western Canada (Petersen, 2002, pers. commun.).

Summary: The new information reviewed for this update suggests no substantial change in the status, distribution, or other characteristics of Alaskan spectacled eider, Steller's eider, king eider, common eider, or long-tailed duck populations since publication of the Beaufort Sea multiple-sale EIS. Alaskan spectacled eider and long-tailed duck populations have exhibited slight downward trends over the past decade, the king eider a slight upward trend, the Steller's eider a slight upward trend with substantial annual variation, and the common eider a mixed pattern among the various Beaufort Sea barrier island groups. Some proportion of Alaska-breeding Steller's, king, and common eider and long-tailed duck populations spend part of the year in Russian coastal waters. Specific studies completed recently have found spectacled eider tissue contaminant loads sufficiently high to be of some concern, and that various sources of disturbance do not appear to affect long-tailed duck body condition or habitat use significantly. None of this new information suggests that any assumptions underlying analyses in the multiple-sale EIS or resulting conclusions should be modified. Analyses of potential effects from oil and gas development on these populations (see Section IV.C.1.a) have been updated with regard to the new information.

IV.B.2.a(2) Species with Lower Potential for Substantial Effects

Tundra swan, brant, snow goose, and several loon, shorebird, and seabird species exist as small, sensitive, or otherwise vulnerable populations in the Beaufort Sea area. However, as discussed in USDOI MMS, (2003a:Section IV.C.6), none of these species is thought likely to experience significant adverse effects from this Proposed Action. This is due to much of the development activity taking place when these species are absent from the area (October-May), and the existence of mitigating measures and standard operating procedures that prevent interference with breeding, staging, and migrating birds. Also, relatively small numbers of most of these species are likely to be present in areas where a low-probability large oil spill is most likely to occur, or engage in behavior for extensive periods that would predispose them to oiling.

Aerial surveys in the Kuparuk oilfield west of Prudhoe Bay in 2002 and 2003 (Anderson et al., 2003, 2004) have recorded numbers of tundra swans that are within the range of recent counts and continue a significantly increasing trend recorded over the past 15 years in this area. This trend also is evident in FWS survey data (Mallek, Platte, and Stehn, 2004). Nest success was similar between a core area in the Kuparuk oilfield and an area remote from infrastructure. Total broodrearing adult and young brant counted in 2003 were the highest in the 15-year history of counts in this area.

Continuing surveys under the Alpine monitoring program on the Colville River Delta, and surveys of proposed Alpine satellite development areas on the delta north, south, and west of Alpine, and in the Northeast Planning Area of NPR-A, have provided baseline information on several bird species (Burgess et al., 2002a,b, 2003a,b; Johnson et al., 2002, 2003a,b, 2004; Jorgensen et al., 2003). Although much annual variability in nesting effort was observed at the original Alpine site, only white-fronted geese and ducks as a group exhibited clearly decreasing trends from preconstruction to construction periods. However, because of the coincidence of cool temperatures and late spring nesting schedules with heavy construction years, it was not possible to link declines in numbers of nests directly with levels of disturbance. Differences in distribution for most species relative to the airstrip during years of varying levels of activity were not detectable; white-fronted geese were found to shift nests farther from the airstrip in heavy-construction years. Although increased stress from disturbance is implicated in this change, as well as in longer or more frequent incubation recesses, other variables accounted for more variation in these nesting features. Little evidence of an effect of Alpine on nest success and productivity has been found. Surveys in the other Colville Delta areas previously noted and in the adjacent northeastern NPR-A found up to 20 species nesting, with white-fronted geese and long-tailed ducks the most abundant species. Numbers of birds observed nesting in each of these areas in recent years has been relatively stable.

Surveys on the Sagavanirktok River delta (Noel et al., 2002b) found that recent nesting effort by snow geese has been lower than during the mid-1990's. Nest failure, primarily from predation, has been high in five of the last ten years, and there is concern about new oil developments in traditional brood-rearing areas. Aerial surveys to monitor brant and snow goose colonies along the western Beaufort Sea coast (Ritchie and Shook, 2003, 2004; Ritchie et al., 2002) over a 9-year period recorded an average 324 brant nests, and 5,406 individuals during broodrearing surveys. Numbers of snow goose nests at one of two colonies monitored increased from 55 or fewer individuals in the 1990's to 918 in 2002. Yellow-billed loons have been observed in small numbers on recent surveys of the Colville River delta (Johnson et al., 2003b). This species has a small estimated Alaska population of 3,650 (Fair, 2002), and appears on the FWS list of Species of Conservation Concern (USDOI, FWS, 2002b) and National Audubon Society Alaska Watchlist (Senner, 2003, pers. commun.). Aerial coastal plain surveys since 1986 have sighted an average of 2,919 individuals of this species (Mallek, Platte, and Stehn, 2004). During nearshore aerial surveys from Kasegaluk Lagoon to the Canadian border in late July – early August 2002 and 2003, 210 and 86 yellow-billed loons were recorded, respectively (Lynse, Mallek, and Dau, 2004). Surveys at point Thomson (Rodrigues, 2002a,b) found the avian community dominated by Lapland longspurs and shorebirds. Nest densities were similar to other coastal plain areas, about 60 nests/km^2. Gill (2004) lists 10 current studies that focus on or include shorebird distribution and abundance, behavior, breeding ecology, survey methods, and habitat use on the Arctic Coastal Plain. A conservation plan for Alaskan shorebirds has been developed (Alaska Shorebird Group, 2004).

Summary: There is no indication in the results of the investigations outlined herein that species characterized as having a lower potential for significant effects from oil and gas development currently are more susceptible than was concluded in the multiple-sale EIS. Most have exhibited relatively stable populations in recent surveys, although populations of yellow-billed loon, black guillemot, and several shorebird species are of some concern. Also important is the determination of all such factors may have a substantial effect upon species of concern.

IV.B.2.b. Subsistence-Harvest Patterns and Sociocultural Systems

This discussion updates the Beaufort Sea multiple-sales EIS (USDOI, MMS, 2003a) with more recent information on subsistence-harvest patterns, subsistence resources, and sociocultural systems. 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 195. 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, 2003a); nevertheless, harvest areas can be fluid and change from season to season. The BLM's Alpine Satellite Development Plan draft 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 was published.

Subsistence-harvest pattern information, along with new research on subsistence resources and sociocultural systems that might influence the previous effects' assessments, are 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 (2002b) and the Bureau of Land Management's (BLM's) recent Northwest NPR-A final Integrated Activity Plan (IAP)/EIS (USDOI, BLM and MMS, 2003) also are summarized and incorporated by reference.

IV.B.2.b(1) Subsistence-Harvest Patterns

Barrow: Barrow residents 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, 2002b) and BLM's recent Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), and the BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004). Subsistence resources used by Barrow are listed in tables provided in these same documents. Figure 1, Bowhead Whale-Harvest Locations near Barrow, was inadvertently omitted from the Beaufort Sea multiple-sale EIS and is included in this EA. No substantial changes to long-term subsistence-harvest practices, subsistence cycles, and types of resources harvested have occurred since the Beaufort Sea multiple-sales EIS and the subsequent analyses mentioned herein.

For BLM's Alpine Satellite Development Plan draft 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 south of Barrow. Barrow hunters also described occasionally traveling to the Kalikpik-Kogru River areas for caribou, if animals are unavailable closer to Barrow. Winter snowmobile travel for caribou, wolf, wolverine, and fox as far east as Fish and Judy creeks also was reported.

Nuiqsut: The Inupiat community of 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 the Liberty final EIS (USDOI, MMS, 2002b), BLM's recent Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), and BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004). Subsistence resources used by Nuiqsut are listed in tables provided in these same documents. See Appendix H, Evaluation of Potential Impacts on Subsistence Whaling from MMS-Permitted Activities in the Cross Island and Smith Bay Areas, for a discussion of subsistence-whaling activity in the Cross Island area. Also see Figures H-1 and H-2 in Appendix H tracking Nuiqsut whaling-crew voyages for the 2001 and 2002 whaling seasons. These data were gathered as part of the ongoing MMS Arctic Nearshore Impact Monitoring in Development Area monitoring effort in the region. No substantial changes to long-term subsistence-harvest practices, subsistence cycles, and types of resources harvested have occurred since the Beaufort Sea multiple-sale EIS and the subsequent analyses mentioned herein.

For BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (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 (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 for the BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004) also included additional traditional and local knowledge testimony. In her testimony at a 2003 public hearing for the Alpine Slope Development Plan, Nuiqsut's Mayor Rosemary Ahtuangaruak related that villagers were seeing changes in caribou and fish that left them with tumors and lesions, and they believed this came 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.

Kaktovik: Kaktovik is situated on Barter Island off the Beaufort Sea coast. 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 MMS's Liberty final EIS (USDOI, MMS, 2002b), BLM's recent Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), and BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004). Subsistence resources used by Kaktovik are listed in tables provided in these same documents. No substantial changes to long-term subsistence-harvest practices, subsistence cycles, and types of resources harvested have occurred since the Beaufort Sea multiple-sale EIS and the subsequent analyses mentioned herein.

In 1992, the NSB surveyed subsistence harvests in eight NSB communities. The analysis of these surveys was not published until 1999 when 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* appeared. Information from this report was incorporated in BLM's Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003) for Barrow and Nuiqsut, but 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. 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 (1999) 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. Also, five walruses 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, 1999).

IV.B.2.b(2) Sociocultural Systems

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 in the early years. In the 2000 Census, Barrow's Inupiat population remained undiminished at 64.0% of the total Barrow population (USDOC, Bureau of the Census, 1991, 2001; Harcharek, 1992). Barrow's social characteristics, systems, and conditions are described in detail in MMS's Liberty final EIS (USDOI, MMS, 2002b), BLM's recent Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), and BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004). No substantial changes to long-term social characteristics have occurred since the Beaufort Sea multiple-sale EIS and the subsequent analyses mentioned herein.

Nuiqsut: Nuiqsut sits on the west bank of the Nechelik Channel of the Colville River Delta, about 25 miles inland from the Arctic Ocean and approximately 150 miles southeast of Barrow. The population was 433 (89.1% Inupiat) in 2000 (USDOC, Bureau of the Census, 1991, 2001). Nuiqsut is experiencing rapid social and economic change due to the development of new local infrastructure, including natural gas hookups coming 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 MMS's Liberty final EIS (USDOI, MMS, 2002b), BLM's recent Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), and BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004). No substantial changes to long-term social characteristics have occurred since the Beaufort Sea multiple-sale EIS 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, 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.

Kaktovik: Kaktovik, incorporated in 1971, is the easternmost village in the NSB. In 2000, it had a population of 293 (84.0% Inupiat) (USDOC, Bureau of the Census, 1991, 2001). 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 miles east of Barrow. Kaktovik abuts the Arctic National Wildlife Refuge. Kaktovik's social characteristics, systems, and conditions are described in detail in MMS's Liberty final EIS (USDOI, MMS, 2002b), BLM's recent Northwest NPR-A final IAP/EIS (USDOI, BLM and MMS, 2003), and BLM's Alpine Satellite Development Plan draft EIS for potential expansion of Alpine field production near Nuiqsut (USDOI, BLM, 2004). No substantial changes to long-term social characteristics have occurred since the Beaufort Sea multiple-sale EIS and the subsequent analyses mentioned herein.

IV.B.2.c. Local Water Quality

The multiple-sale EIS section on chemical oceanography and water quality (USDOI, MMS, 2003a:Section III.A.5) contains background information for assessing the effects of both spills and discharges in the proposed sale area. Discharges of drilling fluids and other wastes would be regulated by the U.S. Environmental Protection Agency (USEPA) so as not to cause “unreasonable degradation” on water quality (i.e., no significant adverse changes [USDOI, MMS, 2003a:Section III.A.5.b]). In general, the USEPA permits the on-ice discharge of drilling fluids in water more than 20 m deep where there would be rapid dilution/deposition of these fluids. Since publication of the multiple-sale EIS, there has been no change in the regulations, although the USEPA has started updating their discharge regulations for OCS oil and gas exploration facilities. This EA is focused on updates of the background information for potentially significant effects. New information does not reveal any new potentially significant effects due to discharges, so discharges are not discussed further in this EA.

In contrast, the EIS concluded that a large oil spill would cause significant water-quality effects, and this EA summarizes new information on existing hydrocarbons in the proposed lease area. The EA summarizes studies of trace hydrocarbons in water and organisms that derived from anthropogenic sources (from crude and/or refined oils) and natural sources (from vegetation, peat, coal, and/or natural seeps). It also summarizes new information about the hydrocarbons that are transported by North Slope rivers into the coastal waters. Further, it summarizes new information about an EIS conclusion that the Beaufort Sea remains relatively unpolluted by human activities (USDOI, MMS, 2003a:Section III.A.5.a).

Six recent studies update water-quality information in the multiple-sale EIS. Headley et al. (2002) measured the concentration and distribution of polynuclear aromatic hydrocarbons (PAH’s) in sediment cores of the Mackenzie River Delta just to the east of the proposed lease area. Headley et al. (2002) found that the river flows past natural petrogenic sources of hydrocarbons (oil seeps and bitumen deposits) as well as anthropogenic sources (for example, industrial developments and oil production at Norman Wells). They concluded that a petrogenic source appears to be dominant, based on relative contributions to the overall PAH budget. They also concluded that the degree of anthropogenic influence on the PAH load in the delta is small. Yunker et al. (2002) also measured hydrocarbons in suspended particulate matter and sediments of the Mackenzie River and concluded that Mackenzie River particulates and sediments have the hopane and sterane ratios characteristic of immature bitumens, shales or coals.

Rember and Trefry (2004) measured dissolved organic carbon (DOC) in two rivers (the Kuparuk and Sagavanirktok) adjacent to the proposed lease area. Their results indicate that the large influx of DOC to the Beaufort Sea occurs just before the usual broken-ice season from mid-June to mid-July, while DOC peak occurs at the time of river breakup during early June.

Valette-Silver et al. (1999) measured the concentration of PAH’s in surficial sediments, clams, and other mollusks of the western Beaufort Sea (the western portion of the proposed lease area and included samples from the Barrow subsistence-whaling area). Their study concluded that: “compared to other coastal areas off Alaska, the Arctic, and the conterminous United States, Beaufort Sea contamination appears generally low.” The study also concluded that the diagnostic ratios of various PAH compound in the samples did not suggest crude oil as the main source of PAH’s. The study lists other possible sources as river outflow, coastal erosion, natural oil seeps, diagenesis, and long-range atmospheric transport.

Naidu, Kelley, and Goering (2003a) measured PAH concentrations in Elson Lagoon sediments of the western Beaufort Sea and concluded that the compositions of the PAH’s were characteristic of biogenic origin, and very little petroleum input is reflected in their composition. The molecular compositions of alkanes and polycyclic aromatic hydrocarbons were similar to those reported in our previous study for sediments of the Colville Delta-Prudhoe Bay Region (Naidu et al., 2001; Naidu, Kelley, and Goering (2003b).

Spies et al. (2003) found traces of anthropogenic hydrocarbons in organisms near Prudhoe Bay. The study was conducted at five sites that were a short distance to the east and west of Prudhoe Bay and also near two offshore production facilities, Northstar and Endicott, neither of which allows discharges. The study measured the concentration of hydrocarbons and other substances in the tissues of five fish species. The hydrocarbon results are summarized here, and the results for other substances are summarized in this EA in Section IV.C.1.e on fish. To help pinpoint the sources of the hydrocarbons, the concentration was measured by several methods: in units of total PAH, as low-molecular-weight PAH, and as high-molecular-weight PAH. Table 9 in Spies et al. (2003) shows that each type of PAH was present in each species and hydrocarbons were widespread in the study area, which is consistent with previous studies. However, the authors found hydrocarbons that are associated with petroleum; they conclude that the strongest evidence for anthropogenic influences from petroleum development is the concentrations of PAH and two biomarkers that respond to PAH (Spies et al., 2003:2). The authors also caution that the results are based on relatively small numbers of samples, and the relationship should be interpreted cautiously. The MMS is planning a followup study.

Summary: These studies indicate that hydrocarbons in particulates and sediments were characteristic of immature bitumens, shales, or coals; that the degree of anthropogenic influence on the polycyclic aromatic hydrocarbon load in the Mackenzie River delta was small; and that 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. 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.

IV.B.2.d. Bowhead Whales

The bowhead whale is an endangered species and the subject of a detailed Biological Evaluation in Appendix C. Bowheads are also an important subsistence resource for the indigenous people on the North Slope of Alaska. For those reasons, the following is a brief summary of the new information in the Biological Evaluation.

Information provided in this section updates the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003a) with more recent information on the Western Arctic stock of the bowhead whale. This new information has been considered in our update of our analyses of the potential effects of the Proposed Action provided in Section IV.C.1.d(1) of the multiple-sale EIS. An update of information related to evaluating potential cumulative anthropogenic impacts on this population is provided in Section IV.E of this EA.

Since the preparation of our multiple-sale EIS, other documents that provide and synthesize information on this population have become available. The National Marine Fisheries Service (NMFS) issued their *Biological Opinion on Issuance of Annual Quotas Authorizing the Harvest of Bowhead Whales to the Alaska Eskimo Whaling Commission for the Period 2003 through 2007* (NMFS, 2003a). Relatedly, in February 2003 the NMFS published the *Final Environmental Assessment for Issuing Subsistence Quotas to the Alaska Eskimo Whaling Commission for a Subsistence Hunt on Bowhead Whales for the Years 2003 through 2007* (NMFS, 2003b). The International Whaling Commission (IWC) reviewed and critically evaluated new information available on the bowhead whale at their 2003 meeting. This information and the associated discussions are summarized in the *Report of the Subcommittee on Bowhead, Right and Gray Whales* (IWC, 2003). The 2002 Alaska Marine Mammal Stock Assessment for this stock remains the most recent stock assessment available. We refer interested readers to these documents for details on topics that might lie outside the scope of the material provided in our multiple-sale EIS and updated here.

The IWC will be conducting an in-depth status assessment of this population in 2004 (IWC, 2003) at their annual meeting.

IV.B.2.d(1) Current Population Status and Potential Delisting of the Western Arctic Stock of Bowhead Whales

In the 2003 *Report of the Sub-Committee on Bowhead, Right and Gray Whales* for the IWC, the completed analysis of the 2001 ice-based census of bowhead whales in Barrow was critically evaluated. The analysis is summarized in Appendix C, Sections III.B. It explains in part that Dr. Zeh provided a revised abundance estimate for 2001 of 10,020 (standard error of 1,290, 95% confidence interval (CI) of 7,800-12,900). This revised abundance estimate was based on a revised (from data presented in the preliminary estimate in 2002) estimate from the acoustic location data, which incorporated acoustic data from the entire season, and the original (presented to the IWC in 2002) estimate from the visual data. The standard error of this 2001 abundance estimate was more than twice that of the 1993 estimate. Such a high standard error was expected due to poor viewing conditions in 2001 (IWC, 2003). Zeh also reported an annual rate of increase of 3.4% (95% CI 2.1% to 4.8%), an estimate nearly identical to the rate of increase of 3.3% based on data from the 1978-1993 time period**.**

As noted in the multiple-sale final EIS (USDOI, MMS, 2003a), 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 [Bering-Chukchi-Beaufort Seas) bowhead [BCBB]) 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. Based on two models, Shelden et al. (2001) evaluated each proposed distinct population segment to determine whether one or more should be reclassified. 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. In a recent response to this paper, Taylor (2003) criticized Shelden et al. (2001) for underestimating the extinction risk of this population. Shelden et al. (2003) responded to, and rebutted, the criticisms. We refer readers to Section III.A of the Biological Evaluation (Appendix C) for more details on this important topic.

IV.B.2.d(2) Survival Estimation

Estimates of survival are important indicators of population status. Recent survival estimates for this bowhead population are summarized in the Biological Evaluation in Appendix C, Section III.C.

IV.B.2.d(3) Bowhead Feeding

In October 2002, Richardson and Thomson (2002) finalized the report from the study *Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information*, funded by and conducted for MMS. The primary study area for this study extended the westward boundary about 1 degree longitude from that of the 1985-1986 study. Thus the boundary for the latter study was near the middle of Camden Bay (145 degree 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.

As summarized by Richardson et al. (2002:xvi), "This report is an integrated account of traditional knowledge, previous scientific knowledge, and results from recent scientific studies concerning the use of the study area for feeding" by bowheads. The project was an extension, with additional fieldwork (mainly in September of 1998, 1999, and 2000), of a previous study conducted in 1985 and 1985. This study was planned and undertaken with extensive local input into design, objectives, and implementation. Richardson et al. (2003) summarized that:

> Local cooperation and participation was considered critical to the success of the study. Including the July 1998 scientific Review Board (SRB) Meeting, we met with representatives of the Kaktovik Whaling Captains Association…Alaska Eskimo Whaling commission (AEWC, and NSB [NSB]) on six occasions during Year 1.

They met with the Kaktovik Whaling Captains Association, AEWC, and NSB during a Scientific Review Board meeting in June 1999. Project participants also met with Katovik whaling captains and other residents in June and September 1999 and August 2000. "One key objective of …these meetings was to develop and refine a field plan that whalers would accept as non-interfering and likely to be effective in assessing the importance of the area" for feeding by bowhead whales.

With regards to the findings from the study, Richardson and Thomson (2002:xliii) summarized that "In an average year, the population of bowhead whales derives an estimated 2.4% of annual energetic requirements in the" eastern Alaskan Beaufort Sea.

> 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% CI 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."

They concluded that an average bowhead spends approximately 3.8 days in the area from Flaxman Island to the Alaska/Canada border during the late summer/autumn period, or ~1.4 days longer than expected for a whale that swims steadily across that area. Averages in various years ranged from ~2.5-6.3 days. Although the average was less than 7 days in all years studied, it might exceed 7 days in a small minority of the years, based on the calculated upper 95% confidence bounds. Of the individual bowheads that travel through the eastern Alaskan Beaufort Sea, some spend at least 7 days between the Alaska/Canada border and Flaxman Island during late summer and autumn. 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%" (Richardson and Thomson, 2002:xliii).

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 the factors are that influence residency times.

Regarding the importance of feeding in the eastern Beaufort Sea, isotopic evidence seems to indicate that especially adult bowhead whales feed primarily on prey from the Bering and/or Chukchi Sea. However, as noted by the Richardson and Thomson (2002:xxxviii):

> …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.

Based on stomach content data supplemented by behavioral evidence, far more than 10% of the bowheads that pass through the eastern Alaskan Beaufort Sea during late summer and autumn feed there. Of the whales harvested at Kaktovik, 24 out of 32 whales had been feeding. The status of three other whales was uncertain. Of the 24 feeding whales, there were estimates of stomach contents for 18 whales. Eleven of these 18 whales had less than 20 L of stomach contents and 7 whales out of the 18 had 20 L or more of stomach contents.

Thomson, Koski, and Richardson (2002) offered a feeding scenario 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. Several aspects of this scenario are speculative.

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.

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).

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. 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. Both MMS and the NSB agree that, with regards to understanding bowhead feeding within the Alaskan Beaufort Sea, major questions remain to be answered (Stang and George, 2003).

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. 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.

We refer readers to Section III.D of the Biological Evaluation (Appendix C) for additional information about bowhead feeding.

IV.B.2.d(4) Distribution

Treacy (2002) documented variability in the distance offshore that bowhead whales were detected. He 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.

Other information on bowhead distribution is summarized in Appendix C, Section III.B.

Summary. 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 seas bowhead whale population since the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003a). All recent available information indicates that the population continues to increase in abundance. The estimated current annual rate of increase is similar to the estimate for the 1978-1993 time series. There is discussion in the scientific and regulatory communities regarding the potential delisting of this population. Available new information also does not indicate there has been any significant change in the distribution of this population since the multiple-sale EIS. Thus, there is no new information suggesting that the basic assumptions about the status, characteristics, or distribution of this population that underlie our analyses in the multiple-sale EIS should be modified. We have taken the detailed new information into account in the update of our analyses of potential effects on this population (see EIS Section IV.C.1.d(1)).

IV.B.2.e. Other Resources (Other Marine Mammals, Fishes and Essential Fish Habitat, etc.)

This section summarizes new information on other marine mammals, fishes and essential fish habitat, air quality, lower trophic-level organisms, vegetation and wetlands, and terrestrial mammals.

IV.B.2.e(1) Other Marine Mammals

This section addresses species of marine mammals other than the endangered bowhead whale that commonly occur in the Alaskan Beaufort Sea habitats and that may be affected by the proposed sale. The discussion is focused on recent information that might influence the previous assessments of large-spill effects and other effects of Sale 195. Species covered include the polar bear; ringed, bearded, and spotted seals; walrus; and beluga and gray whales.

Polar Bear: The Southern Beaufort Sea's population of polar bears (from Icy Cape to Cape Bathurst, Northwest Territories, Canada) is about 1,800 (Gorbics, Garlich-Miller, and Schliebe, 1998). The current stock assessment is 2,272 bears with a minimum estimate of 1,971 bears (67*FR* 14959-14963). This population has increased over the past 20-30 years at 2% or more per year and is believed to be increasing slightly or stabilizing near its carrying capacity (Amstrup, 1995; USDOI, FWS, 1995a). Their seasonal distribution and local abundance vary widely in the Alaskan Beaufort Sea. Amstrup, Durner, and McDonald (2000) assumed a bear density of one animal per 25 km^2 in seasonal concentration areas.

No genetic discontinuities were found in the world's population of polar bears that would suggest evolutionary significant periods of isolation between stocks of polar bears (Paetkau et al., 1999). The genetic diversity of the world's polar bear population is believed to have developed in response to differences in seasonal sea ice cover and the effects of these differences on the distribution, abundance, and availability of seals (Paetkau et al., 1999; Ferguson, Taylor, and Messier, 2000; Ferguson et al; 2000).

Polar bear habitat use and distribution may reflect more than prey availability; it also may reflect time allocated for hunting prey and the use of retreat habitats (Mauritzen et al., 2003). Heavy ice in the eastern Beaufort Sea during the 1970's and 1980's adversely affected the productivity of ringed seals and, in turn, reduced the productivity of polar bears in the region (Stirling, 2002). The modeling of polar bear ice habitat selection in the Beaufort showed that bears preferred shallow-water areas where different ice types intersected (Durner et al., 2004)

A recent study of polar bear feeding habitats reports that cannibalism of cubs and juvenile bears by adult bears is not uncommon (Dyck and Daley, 2002; Derocher and Wiig, 1999). Polar bear predation and predation behavior on/towards reindeer and caribou have been reported (Derocher, Wiig, and Bangjord, 2000; Brook and Richardson, 2002).

Recent information on polar bear use of terrestrial habitat for maternity denning in and near the Prudhoe Bay oil field indicates that dens were located or associated with pronounced landscape features such as coastal and river banks and also lake shores and abandoned oil field gravel pads (Durner, Amstrup, and Fischbach, 2003). Recent information on polar bear use of local coastal areas, where whale carcasses are available, indicate that polar bears spend weeks not only feeding and resting but also swimming near the carcasses (Kalxdorff, Proffitt, and Schliebe 2003). These behaviors slightly influence the vulnerability of bears to potential oil spills in these locations but do not change the conclusions reached in the multiple-sale EIS.

The Polar Bear Management Agreement between the NSB and the Inuvialuit Game Council from Canada has been successful in regulating the harvest of polar bears in the Beaufort Sea region by limiting the harvest of female bears and limiting the total harvest to a sustainable level (Brower et al., 2002). Overall, this new information would not affect the conclusion about an insignificant population level of effect on polar bears in the multiple-sale EIS.

Ringed Seal: The most recent population estimate for the Alaskan Beaufort Sea is still 80,000 during the summer and 40,000 during the winter (Frost and Lowry, 1981). A preliminary estimate for part of the Beaufort Sea range was more than 245,000 seals (Bengston et al., 2000 as cited by Angliss and Lodge, 2002). Ferrero et al. (2000) explain that there currently is no reliable estimate for the Alaskan stock of ringed seals, but there is no reason to believe that the minimum abundance is less than 50,000 animals. Recently recorded ringed seal densities ranged from 0.81 seals per km^2 in 1996 to 1.17 seals per km^2 in 1999, with the highest densities occurring in water depths from greater than 5 meters (m) and at 25 m. More seals were found on flatter, less deformed ice than on highly deformed ice (Frost et al., 2002; Moulton et al., 2002). A recent tagging study (Kelly, Harding, and Kunnasranta, 2003) indicates that ringed seal distribution and behavior (for example, timing of lair abandonment) is highly variable. This recent information does not change the conclusion about an insignificant population level of effect on ringed seals in the multiple-sale EIS.

Bearded Seal: Most of the bearded seals in Alaskan OCS areas are found in the Bering and Chukchi seas. Estimates on the abundance of bearded seals in the Beaufort Sea and in Alaskan waters currently are unavailable; however, the minimum population in Alaskan waters is expected to be at least 50,000 animals (Ferrero et al., 2000; Angliss and Lodge, 2002). This information does not change the conclusion about an insignificant population level of effect on bearded seals in the multiple-sale EIS.

Spotted Seal: The suggested minimum and maximum population estimate of spotted seals occurring along the western Alaskan coast is about 7,000 and 55,000 animals, respectively (Rugh, Shelden, and Withrow, 1997). Ferrero et al. (2000) and Angliss and Lodge (2002) estimated the population at about 59,000 animals. This species is a seasonal visitor in the Beaufort Sea from populations in the Bering/Chukchi seas, as indicated by satellite-tagged animals (Lowry et al., 2000). Alaskan spotted seals occur primarily in the nearshore during August-October and 100-200 km offshore during January-June (Lowry et al., 2000). The distribution of spotted seals is strongly influenced by recent changes in the seasonal extent and location of the marginal ice zone along the pack-ice front in the Bering, Chukchi, and Beaufort seas (Picco, McNutt, and Quakenbush, 2003). This recent information does not change the conclusion about an insignificant population level of effect on spotted seals in the multiple-sale EIS.

Walrus: The Pacific walrus population was estimated at about 201,000 animals in 1990 (Seagars, 1992; Gilbert et al., 1992; USDOI, FWS, 1995b), comprising about 80% of the world population. Between 1975 and 1990, the population estimates were higher, ranging from about 200,000-300,000 animals (USDOI, FWS, 2002). A reliable estimate of the current population is not available (USDOI, FWS, 2002). In general, most of the population is associated with the moving pack ice year-round. Walruses spend the winter in the Bering Sea; and the majority of the population summers throughout the Chukchi Sea, including the westernmost part of the Beaufort Sea. Ratios of young to adult female walruses observed in 1998 suggest a low reproductive rate and/or high rates of juvenile mortality and the low ratios of young to adult females likely represent a declining population (Kelly, Taras, and Quakenbush, 1999).

Snails occurred nearly as often in the diet of walruses as did clams, while decapod crustaceans, amphipods, and priapulid worms occurred more often in walruses in the Chukchi Sea than in the Bering Sea (Sheffield, Fay, and Kelly, 1999). However, snails and crustaceans were the most persistent prey items in stomachs after 2 hours of digestion (Sheffield et al., 2001). Serological data on the presence of viral and bacterial antibodies in “free-ranging” Pacific walruses did not detect the presence of phocine distemper virus antibodies; however, antibodies for caliciviruses (San Miguel sea lion virus 12) and for one or more subtypes of influenza A virus were detected in 18% and 21%, respectively, of walruses tested (Calla et al., 2002). This recent information does not change the conclusion about an insignificant population level of effect on walruses in the multiple-sale EIS.

Beluga Whale: The Beaufort population of beluga whales was currently estimated to be in excess of 32,000 individuals (Ferrero et al., 2000; Angliss and Lodge, 2002). Fall migration of this eastern Beaufort Sea stock occurs along the shelf break and far offshore in the Alaskan Beaufort Sea. During the summer, belugas travel hundreds of miles from the Mackenzie Delta, and they do not avoid dense pack ice (Richard Martin and Orr, 2001).

During summer, 2,500-3,000 belugas are estimated to inhabit the Chukchi Sea and the northwestern Beaufort Sea, including the coastal areas such as Peard Bay and Kasegaluk Lagoon (Frost, Lowry, and Burns, 1986; Frost, Lowry, and Carroll, 1993). Ferrero et al. (2000) and Angliss and Lodge (2002) estimated this eastern Chukchi Sea stock at a minimum of about 3,700 whales. Satellite tags on 23 belugas from this stock indicate that these whales inhabit the eastern Beaufort Sea during the summer season (Suydam et al., 2001). Satellite-tagging studies of eastern Chukchi Sea belugas from 1998-2002 indicate that belugas use coastal habitats in the Chukchi Sea and in the Barrow canyon, but that they rarely use coastal habitats in the Beaufort Sea OCS shelf area (Suydam, Lowry, and Frost, 2003). In the Beaufort Sea, they frequent habitats along the shelf break and far to the north of the shelf break. This information suggests that these whales are not likely to be exposed to OCS activities occurring near the coast and on the Beaufort Sea shelf. This recent information does not change the conclusion about an insignificant population level of effects on beluga whales in the multiple-sale EIS.

Gray Whale: Since receiving protection by the IWC in 1946, the eastern Pacific gray whale population has increased from the few thousand individuals that survived commercial whaling to more than 26,600 individuals (Hobbs and Rugh, 1999 as cited by Angliss and Lodge, 2002). Evidence that the population had approached and exceeded pre-exploitation levels (Rice, Wolman, and Braham, 1984) prompted the NMFS to issue a determination that the eastern North Pacific stock should be removed from the List of Endangered and Threatened Wildlife (59 *FR* 31094-31095). The current minimum gray whale estimate is 26,635 individuals with an estimated annual increase rate of 2.4% from 1967/1968 to 1995/1996 (Ferrero et al., 2000). Changes in gray whales use of foraging habitats in the northern Bering Sea may be related to declines in amphipod productivity in the Chirikov Basin (Moore, Grebmeier, and Davies, 2003) and may affect their habitat use of the Chukchi Sea adjacent to the Beaufort Sea Planning Area. Fluctuations in gray whale productivity were positively correlated with the length of the ice-free season on the primary feeding habitats during the previous year (Perryman et al., 2002). This recent information would not change the conclusion about an insignificant population level of effects on gray whales in the multiple-sale EIS.

Summary: The recent information on other marine mammals, including polar bears; ringed, bearded, and spotted seals; walruses; and beluga and gray whales, does not indicate substantial changes in the population levels or distributions within the proposed lease area.

IV.B.2.e(2) Fishes and Essential Fish Habitat

There are a few new information sources describing fish resources of the Alaskan Beaufort Sea region. Most notably are *Fishes of Alaska* by Mecklenburg, Mecklenburg, and Thorsteinson (2002) and *Fish Ecology in Arctic North America* by Reynolds (1997). *Fishes of Alaska* is a comprehensive, systematic list of fishes documented throughout Alaska, including both State and Federal waters. From it, we revised the species list of known fishes occurring in the Beaufort Sea lease region (Appendix D, Table D-1). *Fish Ecology in Arctic North America* includes a suite of papers resulting from the American Fisheries Society 1990 symposium; the purpose of the symposium was to summarize current knowledge of the biology and ecology of freshwater, anadromous, and marine fishes in arctic Alaska and Canada.

The Arctic is noted for its low species diversity of fish, with many species occurring at the northern limits of their ranges. Mecklenburg, Mecklenburg, and Thorsteinson (2002) documented 13 orders, 22 families, and 77 species of fish as occurring in freshwater, nearshore brackish, or marine waters of the Alaskan-Beaufort Sea region (Appendix D, Table D-1). Representative taxa include: lampreys, sleeper sharks, herrings, suckers, pikes, mudminnows, smelts, whitefishes, graylings, trout and salmon, lanternfishes, cods, sticklebacks, greenlings, sculpins, fathead sculpins, poachers, lumpsuckers, snailfishes, eelpouts, pricklebacks, wolffishes, sand lances, and righteye flounders. Table D-2 in Appendix D lists an additional 27 species that are documented as occurring in waters immediately adjacent to the Alaskan Beaufort Sea

(Alaskan Chukchi Sea and/or Canadian Beaufort Sea) (Mecklenburg, Mecklenburg, and Thorsteinson, 2002); these species may occur in the Alaskan Beaufort Sea region; however, they have yet to be documented as such. By comparison, more than 100 species have been collected in the Canadian Arctic (McAllister, 1975). Additional species are likely to be found in the Alaskan Beaufort Sea when marine waters are more thoroughly surveyed. For example, the shulupaoluk (*Lycodes jugoricus*) was collected by N. J. Wilimovsky in the Chukchi Sea (Walters, 1955); and McAllister (1962) collected two specimens in brackish waters of the Beaufort Sea at Herschel Island, Yukon Territory, Canada. Shulupaoluk is a name applied by Ungava Eskimos to an eelpout (Dunbar and Hildebrand, 1952). To date, a shulupaoluk has yet to be documented as occurring in the Alaskan Beaufort Sea; however, based on the noted collections, the species is likely to occur there.

The diverse fishes of the Alaskan Beaufort Sea region use a range of waters and substrates for spawning, breeding, feeding, or growing to maturity. The range of waters and substrates are hierarchically organized in Appendix D, Table D-3 for suitable analysis of fishes relative to their environment. Table D-3 also portrays each species occurrence by ecological category.

Biologists studying arctic fishes of Alaska have classified them into primary assemblages by occurrence in basic aquatic systems and by life-history strategies that allow the fishes to survive in the frigid polar conditions (for example, Craig, 1984; Craig, 1989; Moulton and George, 2000; Gallaway and Fechhelm, 2000). A life-history strategy is a set of co-adapted traits designed, by natural selection to solve particular ecological problems (Craig, 1989 citing Stearns, 1976). Each species' strategy is a combination of unique variables such as age at maturity, fecundity (for example, clutch size), or juvenile survivorship. Such variables and strategies determine, in part, species abundance within a geographic region; they are useful to study organisms with similar and dissimilar patterns. Table D-4 in Appendix D is a compilation of life-history characteristics that was assembled primarily from FishBase (Froese and Pauly, 2003). Additionally, Table D-4 includes regional abundance data by species that was brought together from such references as Frost and Lowry (1983); Schmidt, McMillan, and Gallaway (1983); Craig and Halderson (1986); Thorsteinson, Jarvela, and Hale (1990); Griffiths et al. (1998); Jarvela and Thorsteinson (1999); Gallaway and Fechhelm (2000); Moulton and George (2000); and Fechhelm and Griffiths (2001).

There is considerable ecological heterogeneity of arctic fish fauna, as evident by the variety of ecological assemblages (freshwater-lacustrine; freshwater-fluvial; neritic-demersal; neritic-pelagic; cryopelagic; oceanic-pelagic; oceanic-demersal; diadromous; and the Pacific salmon). However, there is sparse basic biological/ecological information needed for assessing potential impacts of natural and environmental stresses. Freshwater and diadromous fishes are the best studied fishes in the region. Additional studies of discrete populations for arctic fishes using modern scientific methods would be useful. The literature abounds with casual references made of various fish populations without having delimited the population other than by perhaps using arbitrary boundaries of a study area, or presenting data discriminating one discrete population unit from another. Additionally, a few marine species are regarded as widespread and/or abundant, but distribution and density statistics for discrete populations are scarce. The distribution, abundance, ecology, and life-history statistics of the vast majority of marine species in the region under consideration also are poorly known, if known at all. Several species are known only from a single specimen of each species; others are known from perhaps a handful of specimens collected years to decades ago. The only survey of demersal fishes in the region is more than 20 years old. Fish assemblages and populations in other marine ecosystems of Alaska have undergone major shifts during the last 20 years; 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. Pacific salmon occur in the region; however, studies directed at investigating their population dynamics, migration, and habitat use, particularly that of early life-history stages, are nonexistent.

Regardless of the data-deficient environment, we gathered available information obtained primarily from Mecklenburg, Mecklenburg, and Thorsteinson (2002) and FishBase (Froese and Pauly, 2003) covering the occurrence, abundance, and life-history statistics of arctic fishes of the Alaskan Beaufort Sea region (Appendix D, Tables D-3 and D-4). This information, in addition to that referenced in the Appendix D, is the baseline from which we analyzed the proposed action and cumulative-impacts sections.

IV.B.2.e(3) Air Quality and Other Resources

This section covers new information on air quality, vegetation and wetlands, terrestrial mammals, and lower-trophic level organisms.

Information on air quality that became available after publication of the multiple-sale EIS was summarized in the Northwest NPR-A IAP/EIS (USDOI, BLM and MMS, 2003:Section III.A.3.b), The latter assessment notes that North Slope air quality exceeds the standards set by the National Ambient Air Quality Standards and Alaska air-quality laws and regulations, and that concentrations of regulated air pollutants are far less than the maximum allowed levels. It also notes that North Slope residents have noticed haze around the Prudhoe Bay logistical base (USDOI, BLM and MMS, 2003:III-43).

Information on wetlands was updated in the NPR-A IAP/EIS (USDOI, BLM and MMS, 2003: Section IV.B.7). The section includes no new information on the effects on offshore spills. The multiple-sale EIS (USDOI, MMS, 2003: Section IV.C.9.a(2)(b)) concluded the following with respect to the effects of offshore spills on vegetation and wetlands:

> An estimated 29-40 kilometers of coastline could be oiled from a 1,500 or 4,600-barrel spill. The shoreline of the planning area contains some habitats with fairly high values (1 being the lowest and 10 being the highest) for oil-spill retention (lagoonal beaches have a value of 5, and peat shores have a value of 6) along river deltas and near the mouths of other streams. Stranded oil on sheltered intertidal areas, especially along peat shorelines, likely would persist for many years.

This conclusion in the multiple-sale EIS about effects of spills on vegetation and wetlands is still up-to-date.

Recent information on terrestrial mammals shows that the populations adjacent to the OCS lease area have not changed substantially in size and have not relocated to new coastal areas where they might be more vulnerable to offshore spills. Some information is summarized in an EIS on the Northwest NPR-A IAP/EIS (USDOI, BLM and MMS, 2003:Section III.B.5.a). For example, the IAP/EIS summarizes the results of recent surveys of caribou in the Central Arctic herd, which has increased in size:

> The CAH was estimated to number 23,000 in 1992, but declined to about 18,100 animals in 1995 (Lenart, 1999a). Photocensuses conducted in 1997 and 2000 resulted in population estimates of 19,700 and 27,100 caribou, respectively (Lenart, In press). The 2002 population estimate for the herd is 31,857 caribou (Pers. Comm., ADF&G).
>
> Calving grounds may shift gradually over years or change abruptly because of environmental conditions…. During calving, the CAH caribou are found on the coastal plain between the Colville and Canning rivers. In the 1980's calving was relatively common in the Kuparuk oil field. The proportion of CAH calving southwest of the Kuparuk oil field appears to have been higher in the 1990's than in the 1980's (Lenart, In press).

The new information on the Boulder Patch kelp community is not relevant to assessments, but relevant new information is available on other types of lower trophic-level organisms and, specifically, the zooplanktonic prey of bowhead whales in the Alaskan Beaufort Sea. The information was summarized initially in Section III.B.4.a(1) of the multiple-sale EIS and is updated in this EA in Section IV.B.2.d(3) and in Section III.D of the Biological Evaluation in Appendix C. These updates explain that zooplanktonic euphausiids and copepods are the main prey. A recent study examined the body composition of such zooplankton, and particularly the composition of their fatty acids (Iverson, Lowry, and Sheffield, 2002). The purpose of the study was to determine if fatty-acid analyses would be useful for a future study of bowhead feeding behavior. Additional studies have not been completed yet, but such studies eventually could help to determine the relative importance of prey from the Beaufort Sea as opposed to prey from the Chukchi and/or Bering seas. A second study identified the two species of copepods, *Calanus hyperboreus* and *C. glacialis*, which bowheads consumed most frequently (Iverson, Lowry, and Sheffield, 2002). These species are widespread throughout the Arctic Ocean and are not neustonic (inhabiting the water surface); therefore, they would not be particularly vulnerable to oil spills.

Two other studies examined the epontic community on the underside of the ice cover, which is described in the multiple-sale EIS in Section III.B.1.a. One study examined the biological activity in the community, determining that the amphipods on the ice underside grazed on ice-bound organic matter, such as ice algae and detritus (Werner, 2000). The second study measured the substances produced by microorganisms in ice brine channels (Krembs et al., 2002). The study concluded that the microorganisms released a previously unrecognized form of organic matter, and that the organic matter may contribute to polar ocean carbon cycles. Even though the level of biological activity was relatively low compared to open-water primary production, the studies helped to determine the types of biological processes that might be affected by an under-ice spill from a pipeline.

The multiple-sale EIS includes two satellite images of the Beaufort Sea distribution of phytoplankton concentration (USDOI, MMS, 2003a:Figures III.B-1a and III.B-1b) as measured by chlorophyll concentrations, or the "greenness" of the water. A new Web site, hosted by the Fisheries Centre at the University of British Columbia, includes a month-by-month analysis of many such satellite images: www.seaaroundus.org/lme/lme.aspx. Then select "LME," "Beaufort Sea," "Ecosystems," and "Primary Production." (The analysis of primary production is located within the "Ecosystems" folder.) The images indicate that the summer bloom of primary production begins near the Mackenzie River Delta and spreads westward into Alaskan waters as the ice cover begins to disintegrate during June. The images also indicate that, aside from a coastal band of high production, there is a second band of high production beyond the shelf break; i.e., that the area of high primary production in the Beaufort Sea might be more extensive that illustrated in the multiple-sale EIS.

A recent review of the oceanography of the Canadian Beaufort Sea (Carmack and MacDonald, 2002) discusses the inflow of freshwater from rivers that floats on the heavier marine waters and spreads out in a thin layer under the landfast ice. The review explains that the fresh inflow forms a large pool that is impounded by the thicker ice offshore in the stamukhi zone. The review helps to delineate the area that would be affected by an under-ice spill from a pipeline.

A comparison of the zooplankton biomass in plankton tows from the Canadian Beaufort Sea during the 1980's and in the Alaskan Beaufort Sea in 1986, 1998, and 1999—both areas where bowhead whales feed—was prepared by Griffiths, Thomson, and Bradstreet (2002). They concluded that the lowest biomass in any of the plankton tows conducted at 17 stations was 545 milligrams per cubic meter (mg/m^3). For 4 of the 17 stations the highest biomass measured was 771-807 mg/m^3, and for 12 of 17 stations the highest value was greater than or equal to 1,000 mg/m^3. The importance of this biomass to bowhead whales is discussed further in Section III.D of the Biological Evaluation in Appendix C.

As noted in Section IV.B, recent summaries of information on other resources, such as vegetation and wetlands (USDOI, BLM and MMS, 2003:Section III.B.2), do not include information that is more recent than the Beaufort Sea multiple-sale EIS, indicating that there are no substantial changes that would increase the effects of a large offshore oil spill.

This section summarized new information related to potential spill effects on air quality, terrestrial mammals, and lower trophic-level organisms. The new information on air quality and terrestrial mammals does not reveal any new potentially significant effects; however, the implications for lower trophic-level organisms are discussed in this EA in Section IV.C.1.f.

IV.B.2.f. Environmental Justice

Alaska Inupiat Natives, a recognized minority, are the predominant residents of the NSB (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.

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. Specifically, the Executive Order requires an evaluation in the EIS as to whether the proposed project would have "disproportionately high adverse human health and environmental effects…on minority populations and low income populations."

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, 2003a). Environmental Justice concerns were taken back to MMS management and incorporated into environmental study designs and new mitigating measures incorporated into the EIS.

On December 16, 2003, MMS published a notice in the *Federal Register* requesting information for proposed Beaufort Sea Lease Sale 195 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 195 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 the ICAS on February 5, 2004 and meetings with the NSB and the AEWC on February 10, 2004.

New stakeholder issues raised since the completion of the multiple-sale EIS include:

- the need for larger deferral areas in the vicinity of Barrow, Nuiqsut (Cross Island), and Kaktovik;
- bowhead whale migration may be deflected around noise caused by small vessels;
- multiple industrial operations may have a cumulative adverse impact on bowhead whale migration;
- the need to reevaluate the oil-spill-risk analysis;
- more specific analysis of Smith Bay area lease blocks;
- further analysis of effects on offshore bowhead whale feeding areas;
- the need to pursue an Memorandum of Understanding with the NSB to ensure that their concerns are addressed by MMS;
- 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 prepare a Supplemental EIS instead of an EA; and
- the "disconnect" between MMS and the residents of the North Slope on how lease-sale decisions are made.

These issues are addressed in Section IV.C.1.f, Updated Effects on Environmental Justice, of this EA.

IV.B.3. Summary of Updated Information on the Affected Environment

The new information on marine and coastal birds that was reviewed for this update suggests no substantial change in the status, distribution, or other characteristics of Alaskan spectacled eider, Steller's eider, king eider, common eider, or long-tailed duck populations since publication of the Beaufort Sea multiple-sale EIS. Alaskan spectacled eider and long-tailed duck populations have exhibited slight downward trends over the past decade, the king eider a slight upward trend, the Steller's eider a slight upward trend with substantial annual variation, and the common eider a mixed pattern among the various Beaufort Sea barrier island groups. Some proportion of Alaska-breeding Steller's, king, and common eider and long-tailed duck populations spend part of the year in Russian coastal waters. Specific studies completed recently have found spectacled eider tissue contaminant loads sufficiently high to be of some concern, and that various sources of disturbance do not appear to affect long-tailed duck body condition or habitat use significantly. None of this new information suggests that any assumptions underlying analyses in the multiple-sale EIS or resulting conclusions should be modified. Analyses of potential effects from oil and gas development on these populations (see Section IV.C.1.a) have been updated with regard to the new information. Further, there is no indication in the results of the bird investigations outlined above that species characterized as having a lower potential for significant effects from oil and gas development currently are more susceptible than was concluded in the multiple-sale EIS. Most have exhibited relatively stable populations in recent surveys, although populations of yellow-billed loon, black guillemot, and several shorebird species are of some concern. It is evident that decisionmakers would benefit from additional information on potentially vulnerable species concerning their ecology and responses to potentially adverse factors. Also important is the determination of all such factors may have a substantial effect upon species of concern.

Three recent studies of local water quality indicate that hydrocarbons in particulates and sediments were characteristic of immature bitumens, shales, or coals; that the degree of anthropogenic influence on the polycyclic aromatic hydrocarbon load in the Mackenzie River delta was small; and that 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. 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.

Available new information on bowhead whales does not indicate that there has been any significant negative or other change in the population status of the Bering-Chukchi-Beaufort seas bowhead whale population since the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003a). All recent available information indicates that the population continues to increase in abundance. The estimated current annual rate of increase is similar to the estimate for the 1978-1993 time series. There is discussion in the scientific and regulatory communities regarding the potential delisting of this population. Available new information also does not indicate there has been any significant change in the distribution of this population since the multiple-sale EIS. Thus, there is no new information suggesting that the basic assumptions about the status, characteristics, or distribution of this population that underlie our analyses in the multiple-sale EIS should be modified. We have taken the detailed new information into account in the update of our analyses of potential effects on this population (see Section IV.C.1.d).

The recent information on polar bear, ringed, bearded, and spotted seals, walruses, beluga and gray whales would not change the conclusion about insignificant population level effects on other marine mammals.

IV.C. Updated Effects of the Proposed Action

The first part of this section updates the resource-specific effects of an assumed large oil spill due to activities resulting from the Proposed Action; the second part summarizes those updated effects. The effects of the alternatives are assessed in Section IV.D, and the effects of the lease sale in the context of other activities and changes are assessed in Section IV.E on cumulative effects.

IV.C.1. Resource-Specific Updates of the Effects

The MMS has reviewed and closely examined the new information and the level of spill effects for all of the resources. The following sections provide updates first for the significantly affected resources followed by updates for other resources. The oil-spill assumptions remain unchanged from the multiple-sale EIS, as explained in Section IV.A.1. The multiple-sale EIS estimated the size of the area that would be affected by an assumed 1,500-bbl or 4,600-bbl spill. The discontinuous area affected by the spill was estimated to be 44 or 77 km^2, respectively, within 10 days (USDOI, MMS, 2003a:Tables IV.A-6a and IV.A-6b). The estimated length of coastline that would be affected is 29 km for a summer spill and 32 km for a meltout spill.

IV.C.1.a. Marine and Coastal Birds

The multiple-sale EIS (USDOI, MMS, 2003a) assessed the effects of disturbance and an oil spill of 1,500 bbl or 4,600 bbl accidentally released during development or production activities occurring on leases purchased in proposed Sales 186, 195, and 202. This was discussed in general terms in Sections IV.A.3 and 4 and analyzed in Section IV.C.5.b(1) and c(1) (endangered and threatened species) and Section IV.C.6.a(2) (marine and coastal birds) of that document, 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, and for biological resources, including nonendangered marine and coastal birds, respectively, 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"; and "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."

These conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS, reviewed in Section IV.B.2.a of this document.

Data from recent aerial surveys on spectacled eider population estimates confirm that the Arctic Coastal Plain population continues to exhibit a very slight downward mean growth rate of 0.993 (stable population = 1.00). Total indicated birds along aerial transects were below average in 2002 but above average in 2003. There is no suggestion in these recent values that potential mortality of spectacled eiders from collisions with structures (for example, there have been no known collisions with the Northstar facility) or contact with spilled oil associated with activities following Sale 195 would exceed that estimated for Sale 186. The recent development of small, implantable transmitters and advances in satellite telemetry have allowed eiders to be tracked after they leave the nesting areas. Such studies have clarified postbreeding movements of eiders and timing of these, although sample sizes are too small to determine overall adult survival. However, although this new information may enhance our ability to predict the hazards that eiders face during these movements in the nonbreeding season with greater confidence, the fact remains that 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. Thus the updated potential level of effect on the Alaskan spectacled eider population still is expected to be significant, as stated in the multiple-sale EIS, and recovery from substantial mortality would not occur while the population exhibits a declining trend. 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. The FWS concurred. Their Biological Opinion required the adoptions of Stipulation No. 7, Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders. We have updated that stipulation that resulted as a result of meetings between MMS and FWS in March 2004.

Because so few Steller's eiders are detected by the protocol used during eider surveys on the Arctic Coastal Plain, reliable Alaska population estimates for this area are not available. Even results of intensive surveys in the most consistently used area, the "Barrow Triangle," have varied considerably. The sparse FWS aerial survey data indicate a slight upward mean growth rate of 1.007. Results of satellite telemetry studies do not suggest any refinement in Alaska population estimates or trend. With such a small population, it is likely that only low mortality would result from an oil spill, but recovery would not occur while the regional population is declining. Thus, the updated potential level of effect on the Alaskan Steller's eider population is expected to be the same as stated in the multiple-sale EIS.

King eider population estimates, based on data from recent aerial surveys confirm that the Arctic Coastal Plain population, continue to exhibit a slight positive mean growth rate (1.024), although total indicated birds along aerial transects was below average in 2003; numbers were above average in 2001 and 2002. There is no suggestion of significant change in the status or trend of the Alaskan-breeding population in these values that indicates potential mortality of king eiders from contact with spilled oil associated with activities following Sale 195 would exceed that estimated for Sale 186. 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 this species 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. Thus, the updated potential level of effect on the king eider population is expected to be the same as stated in the multiple-sale EIS.

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 updated potential level of effect on the common eider population is expected to be the same as stated in the multiple-sale EIS. However, recent data from common eiders equipped with satellite transmitters indicates that fall-migrant individuals stop at least once while crossing the Beaufort Sea and potentially are more vulnerable to contact by an oil spill than previously considered.

The long-tailed duck is the most abundant sea duck in the Beaufort Sea Planning Area. Data from recent mid-June aerial surveys of population estimates confirm that the Arctic Coastal Plain population continues to exhibit a slightly decreasing mean growth rate of 0.995, while late June surveys indicate a somewhat steeper decline. Recent studies suggest that weather patterns and viral disorders are likely to adversely influence this species more than human disturbance. There is no suggestion of significant change in the status or trend of the Alaskan-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 195 would exceed that estimated for Sale 186. Due to 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. 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.

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 195 than was stated for Sale 186 in the multiple-sale EIS.

Following completion of the multiple-sale EIS, the Northwest NPR-A Integrated Activity Plan (IAP)/EIS was completed by the BLM (USDOI, BLM and MMS, 2003). That document included an assessment of the effects of small spills (500 or 900 bbl) on endangered and threatened birds in northwestern NPR-A estuaries and bays. The Northwest NPR-A IAP/EIS, in Section V.B.11.e, concludes that:

> Minor to moderate effects are likely for these eider populations if a spill were to enter a river delta or nearshore marine habitats during a period when occupied by substantial numbers of brood-rearing, staging, or migrating individuals. There is a potential for significant impact as a result of an oil spill in these circumstances. Quantitative effects may be difficult to separate from natural variation in population numbers. Stipulations would…help prevent fuel and oil pollution and degradation of important bird habitats.

This conclusion is similar to that in the multiple-sale EIS and provides recent confirmation of the multiple-sale conclusion. The use of numerical mortality estimates for expressing potential severity of losses in the multiple-sale EIS instead of the subjective terms appearing in the Northwest NPR-A IAP/EIS more explicitly states the likely magnitude of losses that were considered in arriving at descriptors of impact in the latter document. Because species susceptible to oiling are non-uniformly distributed in the Beaufort Sea, spill location and size relative to bird-concentration areas would represent primary factors influencing whether oil reaches an area occupied by birds, and the magnitude of effects from a spill. In turn, this would vary depending on the particular annual cycle of activity ongoing at the time of spill occurrence (for example, nesting, migration, or winter season). Aside from spill size, effects also would be influenced by spill-cleanup response (industry consortium required to stockpile response equipment in the Prudhoe area for OCS operations in all three arctic seasons—solid ice, open water, and broken ice); water depth (mixing effect—slightly larger area affected in shallow water and dilution of oil—if mixed into deeper water, for example, 20 m deep); and ice conditions (for example, response equipment is effective in solid ice and open-water situations, but effectiveness is reduced greatly in broken ice). Efforts currently are underway to develop a model to determine recovery rates of avian populations following a catastrophic-mortality event such as a major oil spill (Grand et al., 2003, 2004).

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 significant population 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 could represent a significant effect, as noted in the multiple-sale EIS, and recovery of Alaskan populations of species currently exhibiting a decline (all but king eider) is not likely to occur.

Four stipulations and two ITL clauses could moderate the potential for adverse effects from activities, presence of structures, or an oil spill. The Protection of Biological Resources stipulation (No. 1) could result in alteration of operations or relocation of structures to decrease the potential for disturbance of birds or risk of collision with structures. The Orientation Program stipulation (No. 2) could promote decreased disturbance of birds. The Pre-Booming Requirements for Fuel Transfer stipulation (No. 6) would not reduce the risk of spills from fuel barges, but it would increase the speed and effectiveness of response, thereby reducing the risk of bird contact. The Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders stipulation (No. 7) requires 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. Such protocols will involve a lighting design to minimize the outward radiation of light, which is presumed to attract birds, and/or marking or warning protocols as a means of decreasing the potential for collisions. In this regard, a letter was forwarded to Beaufort Sea lease holders on March 29, 2004, informing them that in accordance with Stipulation No. 7 (which is based on nondiscretionary Terms and Conditions contained in the FWS Biological Opinion, dated October 22, 2002), MMS and FWS have 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. Various measures that could reduce light radiation or otherwise decrease the potential for collision are listed, and other approaches encouraged, but direction of lessees to incorporate specific measures is deferred until additional information becomes available. The ITL on Bird and Marine Mammal Protection advises lessees on requirements of the Endangered Species Act (ESA) for protecting listed bird species and establishes minimum approach distances to decrease potential for disturbance. The ITL on spectacled and Steller's eiders advises lessees that these two species are listed under the ESA when they occur on the Arctic Coastal Plain. These mitigating measures are discussed in Sections IV.C.5.b, IV.C.5.c, and IV.C.6.a of the multiple-sale EIS.

Summary. 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, but such losses would represent 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 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 195 would exceed the small losses estimated for Sale 186, 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.1.b. Subsistence-Harvest Patterns and Sociocultural Systems

The Beaufort Sea multiple-sale EIS for Sales 186, 195 and 202 concluded that routine, permitted activities as a result of these sales would have no significant effects; however, in the unlikely event of a large oil spill, there could be significant effects on subsistence-harvest patterns and sociocultural systems.

IV.C.1.b(1) Subsistence-Harvest Patterns

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:

> Overall, 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, bowhead whales could be rendered unavailable for use. 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 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 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. Overall, such effects are not expected from routine activities and operations. 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.
>
> 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.

The 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.

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.C.14.b(2) and IV.C.14.d(1) of the assessment summarize the effects of an offshore spill on subsistence resources and subsistence-harvest patterns:

> For the most part, onshore oil spills would be very local in their effects and would not be expected to significantly contaminate or alter caribou, moose, and muskoxen habitat. For most spills, control and cleanup operations at the spill site would frighten these terrestrial mammals away from the spill and prevent the possibility of these animals grazing on oiled vegetation. For grizzly bear, if an oil spill contaminated beaches and tidal flats along the Beaufort Sea coast, where bears catch fish and find carrion in the summer and fall, some bears are likely to ingest contaminated food, which would result in the loss of a few bears. Small mammals and furbearers could be affected by spills from oiling or ingestion of contaminated forage or prey; impacts would be localized around the spill area and would not have population level impacts. Fuel and oil spills are not expected to have a measurable effect on freshwater and marine fish populations although some marine fish in the immediate area of an offshore spill or diesel fuel spill could be lethally or sublethally affected, particularly if the spill occurred when marine fish were migrating and feeding nearshore in summer or in overwintering areas. An offshore spill during August or September when ice cover is less than 50 percent…could contact loons and flocks of brant, long-tailed duck, and eiders staging before or stopping during migration in protected coastal habitats, as well as black guillemots year round or Ross' gulls in fall (e.g., Elson Lagoon, Dease Inlet, Smith Bay, and near barrier islands). Lethal effects are expected to result from moderate to heavy oiling of any birds contacted. Light to moderate exposure could reduce future reproductive success as a result of pathological effects caused by oil ingested by adults during preening or feeding that interfere with the reproductive process. Some brood-rearing, molting, or staging loons, brant, long-tailed ducks, or other waterfowl could contact oil in coastal habitats. Mortality of molting long-tailed ducks from a spill entering protected areas could be substantial, but the population effect would be difficult to determine because of natural population fluctuations. Flocks of staging eiders could contact oil in nearshore or offshore areas. King eider populations and common eiders nesting on barrier islands and along the coast have declined, so substantial mortality could be significant. Onshore spills would not be expected to impact migrating bowhead whales. An offshore spill occurring in Dease Inlet would be expected to disperse before it reached bowhead migration routes and offshore habitats where bowhead could potentially be exposed to the spill. Some seals could be exposed a Dease Inlet spill during the open water season. Such a spill could result in the loss of 10 to 50 spotted seals, but the population would likely replace this loss in 1 year. If the spill occurred during spring breakup, 86 to 116 ringed seals could be affected, with the overall population replacing this loss in 1 year. A Dease Inlet spill is not expected to affect bearded seals, walrus, beluga, and gray whale because these species tend to occur offshore of Dease Inlet and Admiralty Bay; such a spill is expected to disperse before it reached offshore habitats and migration routes where these species could be exposed. Food chain effects on these marine mammals are not likely. The likelihood of a large oil spill from Northwest NPR-A activities is low. However, if one occurred, oil-spill employment (response and cleanup) could disrupt subsistence-harvest activities for at least an entire season…. If a large spill contacted and extensively oiled coastal habitat, the presence of hundreds of humans, boats, and aircraft would displace subsistence species and alter or reduce access to these species by subsistence hunters.

The conclusions about the effects of offshore spills on subsistence resources are consistent in the multiple-sale EIS and in the more recent Northwest NPR-A EIS.

A detailed analysis of the effects on subsistence of certain offshore facilities is contained in Appendix H. The separate analysis was prepared in response to NSB requests for an analysis of specific facilities on existing leases.

The conclusions and definitions in the multiple-sale EIS about effects on subsistence-harvest patterns remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was summarized in Section IV.B of this EA. In other words, the conclusion of significant oil-spill effects on subsistence-harvest patterns that was reached in the multiple-sale EIS for proposed Sale 195 is not altered by recent information.

Several mitigating measures are proposed for the Beaufort Sea multiple sales. The text of these stipulations is found in Appendix A. 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 Mechanism s 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 agreement between the AEWC and oil companies.

Optional stipulations for 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 provided by Stipulation 5.

Conclusion: The conclusion in the multiple-sale EIS for Sale 195 about oil-spill effects on subsistence-harvest patterns remains the same in light of recent information. Further, recent information does not suggest that disturbance effects on subsistence-harvest patterns, resources, or practices from activities associated with Sale 195 would change from those evaluated in the multiple-sale EIS.

IV.C.1.b(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.

The 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."

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). Section IV.C.15.b(2) of the assessment summarizes the effects of a coastal spill on sociocultural resources:

> The likelihood of a large oil spill from Northwest NPR-A activities is low. However, if one occurred, oil-spill employment (response and cleanup) could disrupt subsistence-harvest activities for at least an entire season and disrupt some sociocultural systems. Most likely, it would not displace these systems. If a large spill contacted and extensively oiled coastal habitat, the presence of hundreds of humans, boats, and aircraft would displace subsistence species and alter or reduce access to these species by subsistence hunters.

The conclusions about the effects of a coastal oil spill on sociocultural resources are consistent in the multiple-sale EIS and in the more recent Northwest NPR-A EIS.

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 (Section IV.A.2) that would reduce concerns about the tainting of bowhead meat.

Conclusion: The conclusions and definitions about sociocultural resources remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this EA. In other words, the conclusion about oil-spill effects on sociocultural systems that was reached for Sale 195 in the multiple-sale EIS does not change in the context of the new information.

IV.C.1.c. Local Water Quality

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 Sections IV.C.1.b(1) and ES.1.e(2) that: "Hydrocarbons from…a large oil spill could exceed the 1.5 parts per million acute toxic criteria during the first day of a spill and the 0.015 parts per million chronic criteria for up to a month in an area the size of a small bay." The specific size of the area that would be affected by an assumed 1,500-bbl or 4,600-bbl spill is a discontinuous area of, respectively, 44 or 77 km^2 within 10 days, as explained in Section IV.C.1.

The multiple-sale EIS in Section IV.A.1 defined “significance” for water quality as: 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) (µg/L [1.5 ppm), the assumed acute (toxic) criteria, for more than 1 day and 15 (µg/L (0.015 ppm), the assumed chronic criteria and the State of Alaska ambient-water-quality standard, for more than 5 days.

The conclusion and definition are appropriate in context of the new information that was reviewed in Section IV.B.2.c. Several studies, including one with samples from the Barrow subsistence-whaling area, confirm that the Beaufort Sea remains relatively unpolluted by hydrocarbons from human activities. One recent study found traces of PAH’s in several species within the proposed lease area (Spies et al., 2003). However, several studies indicate that the PAH’s probably came from rivers, which carry a substantial amount of natural hydrocarbons into the Beaufort Sea. Three of the studies concluded specifically that the anthropogenic influence on the PAH load in coastal waters is small compared to other coastal areas off Alaska, the Arctic, and the contiguous United States (Valette-Silver et al., 1999; Headley et al., 2002; Naidu et al., 2003a). Considering the unpolluted condition of Beaufort Sea coastal water, the effects of a large oil spill probably would be measurable and could exceed the 1.5 ppm acute toxic criteria during the first day of a spill and the 0.015 ppm chronic criteria for up to a month in an area the size of a small bay.

After the multiple-sale EIS was completed, an EIS was completed for the Northwest NPR-A (USDOI, BLM and MMS, 2003). That document included an assessment of the effects of small spills (500 or 900 bbl) on water quality in the NPR-A estuaries and bays. The NPR-A EIS concludes in Section IV.C.5.d that:

> If a small spill occurred during the open water, it might form a slick or become dissolved in the water column. A slick from a 500- or 900-bbl spill would contaminate approximately two thirds of the coastline in an estuary like Admiralty Bay. Hydrocarbons dispersed in the water column from a small spill would probably exceed the 1.5-ppm acute (toxic) criterion during the first day in the immediate vicinity of the spill. Several types of contingency responses would help to reduce the effect of such a spill on estuarine water quality.

The conclusion is similar to that in the multiple-sale EIS and, in that sense, provides recent confirmation of the multiple-sale conclusion. The slight differences in the water-quality assessments in the multiple-sale EIS and the NPR-A EIS illustrate some of the environmental factors that would cause the magnitude of spill effects to vary. The magnitude would depend on (aside from spill size) water depth, spill responses, and ice conditions. Water depth would influence slightly the duration and extent of the effect on the surface layer of water because in deeper water the hydrocarbons would be mixed deeper, diluting the effect. For example, the effect would last slightly longer and affect a slightly larger area in a shallow bay than in water 20 m deep. Water depth is one of the reasons (aside from typical spill trajectories) that serious water-quality effects would be less like to occur in the 20-m deep water of the bowhead-migration corridor.

The effect to water quality from spills also would be influenced by spill responses and ice conditions. As summarized in Section IV.A.2 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, 2003a:Section 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 example, the Cook Inlet EIS (USDOI, MMS, 2003b) concludes on page IV-26 that the effects of a spill greater than 1,000 bbl in the Cook Inlet lease area, which is usually free of ice, “would not significantly degrade the quality of Cook Inlet water.” For the broken-ice season, the Beaufort Sea multiple-sale EIS explained that research was ongoing (USDOI, MMS, 2003a:Section 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 the late spring and summer. However, as noted in the multiple-sale EIS (USDOI, MMS, 2003a:Section IV.A.6.a), once ice crystals were present in the water during the autumn broken-ice season, skimming systems were effectively shut down. Therefore, we still conclude that large arctic spills in broken ice would lead to concentrations of hydrocarbons in the surface water in excess of the toxic and chronic criteria.

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 ice-covered waters (compared to the strong tidal turbulence in Cook Inlet) 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 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. This is a refinement of the conclusion in the multiple-sale EIS and is not a conclusion about a new effect.

Other effects on local water quality would not change, including the effects of permitted discharges. As discussed in the multiple-sale EIS, USEPA permits the discharge of drilling muds and cuttings in only deep water where the material can be diluted rapidly (USDOI, MMS, 2003a:Section IV.C.1.a(1).

Two optional stipulations would moderate the probable effects of spills on water quality: proposed Stipulation No. 3 Transportation of Hydrocarbons and optional Stipulation No. 6 Pre-Booming Requirements for Fuel Transfers. The stipulations are described fully in Appendix A, and their probable effectiveness is described in the multiple-sale EIS in Section IV.C.1.a(4). The latter section explains that Stipulation 6 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. Further, spill responses would moderate the effects of spills on local water quality. Spill-response equipment and tactics have continued to improve, but the change in broken-ice equipment has been conceptual in nature rather than fundamental—broken-ice still limits the effectiveness of existing response equipment.

In summary, the multiple-sale EIS assumes that a spill of 1,500 bbl or 4,600 bbl could occur as a result of the three proposed sales. The magnitude and duration of the effect would vary with—aside from spill volume—the ice conditions and corresponding spill responses.

Conclusion: 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.

IV.C.1.d. Bowhead Whales

The multiple-sale EIS assessed potential effects of Sales 186, 195, and 202 on endangered bowhead whales in Section IV.C.5.a. On page IV-81, it concluded the following:

> 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 be effective in preventing a delay or blockage of the migration. Any effects from the discharge of muds and cuttings or suspension of sediment in the water column would be primarily localized around the drill rig because of the rapid dilution/deposition of these materials…Effects on the bowheads prey species likely would be negligible. Whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. The stipulation on Pre-Booming Requirements for Fuel Transfers should ensure that no fuel spills would affect bowhead whales during their migration.

We concluded that no significant impacts to this endangered species are expected. The threshold for significance by which we evaluate threatened and endangered species is 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.

Based on our consideration of information available since the production of the multiple-sale EIS and of previously available information, our reanalysis of potential effects for bowhead whales supports this same general conclusion. No significant effects are expected on the Bering-Chukchi-Beaufort seas population of bowhead whales due to activities associated with proposed Lease Sale 195.

However, because this species is endangered and because of the significance of this species to Alaskan Native residents of the Arctic, we provide additional information and comments regarding potential impacts to this species due to spills and noise.

Potential Effects of Large Spills. As noted, we previously concluded that whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. We believe this conclusion is supported by the best available information, as summarized in Sections IV.C. of the Biological Evaluation (Appendix C). However, as discussed more fully in the introductory comments of Section IV.C, and in Sections IV.C. 1 and IV.C.8 of the Biological Evaluation, there is uncertainty regarding the potential effects on bowheads in the unlikely event of a large oil spill, especially in instances where whales are aggregated and/or their movements are constrained. There are, in some years and in some locations, relatively large aggregations of feeding bowhead whales within the proposed lease-sale area. If a large amount of fresh oil contacted a significant portion of such an aggregation, effects potentially could be greater than typically would be assumed. Based on literature on other mammals indicating serious adverse effects of inhalation of the toxic aromatic components of fresh oil, mortality of cetaceans could occur if they surfaced in large quantities of fresh oil. However, based on available information about the effects of oil on large cetaceans, we see no evidence that any impact on this population from an oil spill would be likely to result in a significant effect. The population is robust, and the population is, as evidenced by its continued increase despite a documented lethal removal in the subsistence hunt, resilient to relatively small (relative to the population size) removals. Based on published information, the amount of mortality, if any, due to an unlikely large oil spill, is not likely to be large. Thus, 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.

In the Biological Opinion for Federal Oil and Gas Leasing and Exploration by the MMS within the Alaskan Beaufort Sea, and its Effects on the Endangered Bowhead Whale, NMFS (2001:51) stated that:

> It is difficult to accurately predict the effects of oil on bowhead whales (or any cetacean) because of a lack of data on the metabolism of this species and because of inconclusive results of examinations of baleen whales found dead after major oil releases….

We refer readers to the aforementioned sections of the Biological Evaluation for a complete discussion of the uncertainty associated with evaluating the effects of a large oil spill on bowheads and of available information relevant to evaluating spill effects on this species.

New Information Regarding Potential Impacts of Noise from Production Facilities. As noted in the multiple-sale final EIS (USDOI, MMS, 2003a), it has been documented that bowhead and other whales avoid various industrial activities if the received sound levels associated with the activity are sufficiently strong (see summaries and references in Richardson et al., 1995 and NRC, 2003). The information is presented in the Biological Evaluation in Appendix C, Section IV.A and summarized in Section IV.A.7. Information available to MMS since the multiple-sale final EIS is summarized in Section IV.A.6.

An updated and expanded analysis and discussion of potential cumulative effects on bowhead whales, including cumulative effects of noise, are provided in Section IV.E of this EA and in Sections V and VI of the Biological Evaluation (in Appendix C).

Conclusion: 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 Requirements 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 (see further discussion in sections IV.A. and IV. E of the Biological Evaluation, Appendix C). The Industry Site-Specific Bowhead Whale-Monitoring Program should effectively detect a delay or blockage of the migration, thereby altering 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.1.e. Other Resources (Other Marine Mammals, Fishes and Essential Fish Habitat, etc.)

This section updates the effects of the proposed action on other marine mammals, fishes and essential fish habitat, air quality, lower trophic-level organisms, vegetation and wetlands, and terrestrial mammals.

IV.C.1.e(1) Other Marine Mammals

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 the effects from activities associated with Sale 195 exploration and development are estimated to include the potential loss of small numbers of pinnipeds, polar bears, 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, perhaps 6-10 bears, and fewer than 10 beluga and gray whales) from assumed oil spills, with populations recovering within about 1 year (USDOI, MMS, 2003a:Section IV.C.7.b(2). The effects of oil on gray whales and marine mammals in general are discussed further in Section IV.C.1.d; the effects on other marine mammals are assessed also in Section IV.E.2.e(1).

Conclusion: The new information on other marine mammals does not change the conclusion of no significant population-level effects due to the proposed lease sale.

IV.C.1.e(2) Fishes and Essential Fish Habitat

Potential Effects Common to the Proposed Action. Fishes inhabiting the arctic region are listed in various tables Appendix D. The “significance threshold” for fish resources is defined 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. Although some species’ populations may be described as “abundant, it should be understood that arctic fish populations are of low abundance relative to what might be described as an “abundant” species inhabiting the Gulf of Alaska or the Bering Sea.

The ability of a population to recover from a perturbation is largely a factor of the remaining population number and demography, as well as three important life history characteristics: fecundity (i.e., clutch size), juvenile survivorship, and mean generation time. Fecundity and generation times for arctic fish resources may be found in Table D-4; listed data were obtained from FishBase (Froese and Pauly, 2003).

To give the reader some reference points from which to gauge significant impacts relating to changes in distribution or abundance of an indicated population requiring three or more generations for it to recover to its former status, we provide here examples of generation times for several fish species occurring in the Alaskan Beaufort Sea region. The mean generation time for arctic cisco is 7.5 years; hence, three generations is 22.5 years. The mean generation time of fourhorn sculpin is 4 years, and three generations is 12 years. Likewise, the mean generation time for pink salmon is 2 years, and three generations is 6 years. As demonstrated by these examples, there are considerable differences by species in the timeframes considered for whether an impact would be significant or not.

Impact Producing Factors: Impact-producing factors associated with the leasing of OCS lands for hydrocarbon exploration and development include: accidental chemical spills (chiefly hydrocarbons); permitted discharges; seismic exploration; vessel traffic; the introduction of nonindigenous invasive species; and the permitted construction, operation, decommissioning, and abandonment of structures and infrastructure for the exploration, extraction, and transport of hydrocarbon resources to the TAPS. Each identified impact-producing factors is capable of adversely impacting the quality of habitat available to arctic fishes or decreasing the fitness or health of some members of a population

Effects of a Large Oil Spill on Fish Resources and Habitat: Oil spills can affect fish resources in many ways, including the following:

- cause mortality to eggs and immature stages, abnormal development, or delayed growth due to acute or chronic exposures in spawning or nursery areas;
- impede the access of migratory fishes to spawning habitat because of contaminated waterways;
- alter behavior;
- displace individuals from preferred habitat;
- constrain or eliminate prey populations normally available for consumption;
- impair feeding, growth, or reproduction;
- contaminate organs and tissues and cause physiological responses, including stress;
- reduce individual fitness and survival, thereby increasing susceptibility to predation, parasitism, zoonotic diseases, or other environmental perturbations;
- increase or introduce genetic abnormalities within gene pools; and
- modify community structure that benefits some fish resources and detracts others.

Evidence indicates that populations of free-swimming fishes 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 fishes. Earlier studies documented 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 lethal concentrations are encountered, or sublethal concentrations are encountered over a long-enough periods, fish mortality is likely to occur. Sublethal effects are more likely and include changes in growth, feeding, fecundity, and temporary displacement. 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 fishes, crustaceans, and mollusks is very wide. Usually, these concentrations vary between 0.01 and 1.0 milligrams per liter, 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 (for example, 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 (for example, 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 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 that: (1) polycyclic aromatic hydrocarbons are released from oil films and droplets at progressively slower rates with increasing molecular weight leading to greater persistence of larger polycyclic aromatic hydrocarbons; (2) eggs from demersally spawning fish species accumulate dissolved polycyclic aromatic hydrocarbons released from oiled substrates, even when the oil is heavily weathered; and (3) polycyclic aromatic hydrocarbons accumulated from aqueous concentrations of less than 1 part per billion (ppb) can lead to adverse sequelae 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 polycyclic aromatic hydrocarbons. Therefore, oil poisoning is slow acting following embryonic exposure, and adverse consequences 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 (Patin, 1999:Tables 29 and 30).

Several studies demonstrated indirect and chronically adverse effects of oil to intertidal fishes 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. Heintz, Short, and Rice (1999) 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, 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 polycyclic aromatic hydrocarbon 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). 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 population. If oil spills enter small areas of intertidal habitats, small-scale impacts to affected egg and larval habitats could last for one or more generations of a population.

Using the mean spill rates, the chance of one or more large pipeline spills would be 4-5%, and the chance of one or more large platform spills would be 5-6% for the Proposal and alternatives.

The combination of factors suggests that effects to fishes in nearshore waters are expected to be moderate (an effect upon a population or portion of a population that changes abundance and/or distribution but would recover to its former status within one generation). High effects (an impact affecting a population or portion of a population that changes abundance and/or distribution requiring one or two generations to recover to its former status) are possible for some diadromous species and capelin if spawning-year individuals, aggregated multi-age assemblages, or a year-class of young were affected. However, because delta areas are unlikely to be contacted, these high effects are not expected to occur. For pelagic species or those in offshore water, effects of an oil spill are expected to be moderate, given the small number of spills projected, the widespread distributions of these fishes, and the relatively small area that a spill would cover.

In general, the effect of spilled oil on fishes for a 1,500-bbl or 4,600-bbl spill is expected to be moderate for most fish species, although high effects are possible for some diadromous species (for example, arctic cisco, arctic char, least cisco, and broad whitefish) and capelin if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected. These high effects are not expected to occur, partly because the length of coastline that would be affected by a 1,500-bbl spill is estimated to be only 29 km (Section IV.C.1). Oil on that much coastline would affect only a local population or sub-population rather than the regional population in the proposed lease area.

Conclusion. 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.1.e(3) Air Quality and Other Resources

As part of the assessment of proposed Sale 195 in the multiple-sale EIS, we examined the effects of a large spill (1,500-bbl platform spill or 4,600-bbl offshore pipeline spill) on air quality, vegetation and wetlands, terrestrial mammals, and lower trophic-level organisms. This section updates those assessments.

With regard to air quality, the multiple-sale EIS noted that air quality generally was good, that it would be affected adversely and temporarily by in-situ burning as part of a cleanup of spilled oil, and that the effects from both Sale 186 and 195 would be low. Furthermore, it notes that the effects of Sale 195 probably would be lower than for Sale 186, because the activities might be shifted away from Prudhoe Bay into the Midrange Zone. The conclusion is supported by the conclusion in the more recent Northwest NPR-A IAP/EIS, as explained in Section IV.B.2.e(3). The Northwest NPR-A IAP/EIS notes that North Slope residents have noticed haze around the Prudhoe Bay logistical base (USDOI, BLM and MMS, 2003:III-43), but that North Slope air quality generally exceeds the standards set by the National Ambient Air Quality Standards and Alaska air-quality laws and regulations, and that concentrations of regulated air pollutants are far less than the maximum allowed levels. Therefore, the recent information does not change the level of effect on air quality due to large oil spills.

The multiple-sale EIS had the following conclusion about the effects of a large oil spill on vegetation and wetlands:

> The main potential effects on vegetation and wetlands include oil-fouling, smothering, asphyxiation, and poisoning of plants and associated insects and other small animals. Complete recovery of oiled wetlands could take perhaps 10 years or longer. A second main effect is the disturbance of wetlands from spill-cleanup activities. Complete recovery of oiled coastal wetlands from these disturbances could take several decades. Effects on coastal vegetation-wetlands would occur only if a spill occurred during the summer open-water season. In winter, bottomfast ice covers the lagoon and coastal shorelines, and snow buffers the oil from the tundra. (USDOI, MMS, 2003a:Section IV.C.9.a(2))

There is no new information on vegetation and wetlands that would change the level of effect of a large offshore oil spill, as noted in Section IV.B.2.e(3).

The multiple-sale EIS had the following conclusion about the effects of a large oil spill on terrestrial mammals:

> 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. (USDOI, MMS, 2003a:Section IV.C.8.b(2))

The new information on terrestrial mammals, including caribou (Section IV.B.2.e(3)), does not indicate that their population level or distribution adjacent to the proposed lease area has changed; therefore, there is no change in the level of effect of a large oil spill.

The multiple-sale EIS had the following conclusion about the effects of a large oil spill on 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 lease area, and recovery would occur within two weeks. Some of the spilled oil would probably drift to shore. For example, a spill in the Eastern Deferral area and/or Kaktovik Subsistence-Whaling Deferral area would have a 50% probability of contacting the coastline of the Arctic National Wildlife Refuge within 30 days. (USDOI, MMS, 2003a:Section IV.C.2.b(1))

Recent information on the effect of oil on crustaceans and other planktonic organisms is summarized in the previous section on fish (Section IV.C.1.e). Recent information is available also on the persistence of spilled oil in intertidal habitats. The multiple-sale EIS in Section IV.C.2.a(3)(b)2) explains that "a small amount of spilled oil probably would persist in sediments for more than a decade in spite of cleanup responses." Several new studies help to refine the persistence of spilled oil in shoreline sediments. Two studies reassessed the persistence of the 264,000 bbl of *Exxon Valdez* oil that spilled into Prince William Sound (Peterson et al., 2003; Short, 2004). The fieldwork examined the amount and composition of *Exxon Valdez* oil that remained on the shoreline sediment about 12 years after the spill. The studies estimated that 55,600 kilograms (778 bbl) of slightly-weathered *Exxon Valdez* oil remained in intertidal subsurface sediments. A laboratory study on the biodegradation of weathered Alaska North Slope crude indicates that low-dose oil locations are bioremediated more effectively than high-dose locations (Lepo et. al., 2003). The recent information indicates that this assessment is correct to conclude that "a small amount" of a hypothetical 1,500- or 4,600-bbl spill would persist in spite of spill responses.

Recent studies update another part of the information summarized in the multiple-sale EIS. The EIS referred to an *Exxon Valdez* oil-spill study by Gilfillan et al. (1993) that reported oiled shorelines were at toxic hydrocarbon levels for less than a year. However, the recent studies by Peterson et al. (2003) and Ballachey et al. (2004) describe some long-term effects on the attached intertidal organisms, such as kelp and mussels, and on the animals that consume them, such as fish and birds. The studies indicate that the oil that becomes buried in shoreline sediments remains toxic. However, the winter ice cover in the Beaufort Sea prevents the growth of attached intertidal organisms, and the trophic effects that occurred in Prince William Sound probably would not occur as a result of the proposed sale

The multiple-sale EIS also noted that oil would persist in shoreline sediments for "more than a decade." The Northwest NPR-A EIS similarly noted that spilled oil would persist on some types of shorelines "possibly for more than a decade" (USDOI, BLM and MMS, 2003:IV-148). Two recent studies help to refine the persistence. The study by Ballachey et al. (2004) documents that *Exxon Valdez* oil has persisted on the Prince William Sound shoreline through 2003, 14 years after the spill. Another study examined the site of the Baffin Island oil spill, which was a small experimental oil spill on the northern tip of Baffin Island (Prince et al., 2002). The study site is in the high arctic compared to the Alaskan Beaufort Sea coast; for example, the Baffin Island shoreline sediments are frozen for about 10 months per year. Prince et al. describe bacterial degradation as the only in situ biological process on the oil that became buried in the shoreline sediment. The Baffin Island study concluded that the vast majority of the initial oil was gone within 2 decades after the spill, but that there remained small patches of essentially unaltered oil. Two of these studies help to determine whether or not there would be related foodweb effects. As noted, Prince et al. describe bacterial degradation as the only in situ biological process in the shoreline sediment after the Baffin Island oil spill. Also, the trophic effects that were observed in Prince William Sound by Peterson et al. (2003) and Ballachey et al. (2004) probably would not occur in the proposed Sale 195 Sale area, because the assumed pipeline spill would be relatively small in comparison with the *Exxon Valdez* spill and because the winter ice cover prevents the growth of attached intertidal organisms in the Beaufort Sea.

The multiple-sale EIS in Section IV.A.1 defined "significance" for biological resources 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 previously explained, the updated effect of a large oil spill from Sale 195 on lower trophic-level organisms would not cause a decline in abundance and/or change in distribution of lower trophic-level organisms, requiring three or more generations for recovery. Therefore, this new information helps to refine the effects of a large spill on lower trophic-level organisms but would not change the level of effect.

Conclusion: 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.1.f. Environmental Justice

Alaska 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 Environmental Justice Executive Order includes consideration of potential effects to Native subsistence activities.

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 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; effects on polar bears and seal would be less so. 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, but because the chance of one or more large spills [greater than or equal to 1,000 barrels] occurring and entering offshore waters is low (on the order of 10%); it is unlikely that disproportionately high adverse effects to Alaskan Natives would occur from Beaufort Sea multiple-sale activities. Any potential effects on subsistence resources and subsistence harvests are expected to be mitigated substantially, though not eliminated.

The EIS defines "significant" effects on environmental justice as: disproportionate high adverse impacts to low income and minority populations.

Since July 2003, MMS and the NSB have been in constant consultation and coordination on a number of issues that include conflict avoidance, oil-spill-risk analysis, peer review of scientific studies, disturbance effects on subsistence resources, cumulative effects recommendations of the 2003 NRC (2003) Report *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope*, bowhead whale feeding in the Beaufort Sea, deferral area boundaries, and ways to improve stakeholder communication. This ongoing dialogue may result in the development of new mitigation, scientific studies, and avenues of cooperation. The effectiveness of the mitigating-measures discussion for subsistence-harvest patterns and sociocultural systems in Section IV.C.1.b applies also to environmental justice.

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 that was described in Section IV.B of this EA. In other words, 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 195 in the multiple-sale EIS does not change in the context of the new information.

IV.C.2. Summary of Updated Effects for the Proposed Action

The multiple-sale EIS (USDOI, MMS, 2003a) concluded that routine, permitted activities as a result of Sales 186, 195, and 202 would have no significant effects; however, in the unlikely event of a large oil spill, there could be significant effects on (1) several bird species, (2) subsistence-harvest patterns and sociocultural systems, and (3) local water quality.

The following are the resource-specific conclusions about the updated effects of Sale 195.

Marine and Coastal Birds: 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-plus long-tailed ducks, and few Steller's eiders could result from a spill of 1,500 bbl or 4,600 bbl assumed to occur as a result of proposed Sales 186, 195, and 202. The magnitude of the effect would vary with spill volume, the spill response, and ice conditions, as concluded in the multiple-sale EIS. However, such losses would represent significant effects in the case of these species, and recovery of their Alaskan populations is not likely to occur for species currently exhibiting a decline (i.e., all but 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 195 would exceed the small losses estimated in the multiple-sale EIS, and none of these factors is 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.

Subsistence-harvest Patterns and Sociocultural Systems: With respect to subsistence-harvest patterns, the multiple-sale EIS assumes that a spill of 1,500 bbl or 4,600 bbl would occur as a result of Sales 186, 195 and 202. The conclusion in the multiple-sale EIS for Sale 195 about oil-spill effects on subsistence-harvest patterns remains the same in light of recent information. Further, recent information does not suggest that disturbance effects on subsistence-harvest patterns, resources, or practices from activities associated with Sale 195 would change from those evaluated in the multiple-sale EIS.

With respect to sociocultural systems, the conclusions and definitions about sociocultural resources remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this EA. In other words, the conclusion about oil-spill effects on sociocultural systems that was reached for Sale 195 in the multiple-sale EIS does not change in the context of the new information.

Local Water Quality: The conclusion in the multiple-sale EIS about the effects of large spills on local water quality is still appropriate, partly because of the limited effectiveness of spill responses in broken ice. The conclusion is still that such spills in broken ice could 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.

Bowhead Whales: Bowhead whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil 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. The optional stipulation on Pre-Booming Requirements for Fuel Transfers should ensure rapid responses to fuel spills, thereby reducing the likelihood that they 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 be effective in detecting a delay or blockage of the migration, thereby alerting regulatory agencies. Based on our consideration of information available since the production of the multiple-sale 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.

Other Resources: The updated effects on other marine mammals still are estimated to include the potential loss of small numbers of pinnipeds, polar bears, 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, perhaps 6-10 bears, and fewer than 10 beluga and gray whales) from assumed oil spills, with populations recovering within about 1 year.

The update on fish and essential fish habitat indicate that, in the unlikely event of a large oil or diesel fuel spill, the effects on most species (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 anticipated effects of the Proposed Action.

The level of effects would be the same for air quality, vegetation and wetlands, and terrestrial mammals as concluded in the multiple-sale EIS. The conclusion for lower trophic-level organisms has been updated. In the unlikely event of a large oil spill, 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. This new information helps to refine the effects of a large spill on lower trophic-level organisms but would not change the level of effect.

Environmental Justice: 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. In other words, 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 195 in the multiple-sale EIS does not change in the context of the new information.

Overall, no new significant impacts were identified for the proposed lease sale that were not already assessed in the multiple-sale EIS.

IV.D. Updated Effects of the Other Alternatives

The effects of the alternatives are assessed with the preceding summary in Section IV.C.2, documenting any differences in the effects among the alternatives. All of the deferral alternatives (Alternatives III, IV, V, and VI) would provide some environmental protection from disturbances and potential use conflicts to the flora and fauna in the immediate area. Potential use conflicts between subsistence users and industry would be reduced in the immediate areas of the deferrals, in addition to the protection offered by Stipulation 5. However, leasing and oil and gas related activities could still occur in the areas nearby that are not deferred. The analysis in the sections that follow, evaluate the overall effects to the resources that could to be affected from potential oil and gas leases to the remaining area offered, unless Alternative II is chosen.

IV.D.1. Effects of Alternative II – No Sale

This alternative would cancel proposed Sale 195 and defer leasing to proposed Sale 202. There would be no environmental effects on the area due to the deferral; however, the deferral might have economic effects. As described in the multiple-sale EIS (USDOI, MMS, 2003:Section IV.B), under this alternative, the leasing actions proposed in the Beaufort Sea multiple-sale EIS would not be approved. Should this occur, there would be no Federal leases offered in the Beaufort Sea through 2007. Any oil and gas exploration on the leases would be deferred. Development and production of the potential 1.38 Bbbl of oil would be produced (460 MMbbl from each sale) would be deferred. The economic benefits, royalties, and taxes to the Federal and State governments would be deferred.

To replace the potential 1.38 Bbbl of oil not developed from this Beaufort Sea multiple-sale program, a large portion of the oil would be imported from other countries. The associated environmental impacts from producing oil and transporting it to market still would occur. These imports have attendant environmental effects and negative effects on the Nation's balance of trade.

IV.D.1.a. The Most Important Substitutes for Lost Production

The energy that would have flowed into the United States' economy from this development would need to be provided from a substitute source. Possible sources include:

- other domestic oil production
- imported oil production
- other alternative energy sources such as
- imported methanol
- ethanol
- gasohol
- compressed natural gas
- electricity
- conservation in the areas of transportation, heating, or reduced consumption of plastics
- fuel switching
- reduction in the consumption of energy

If the proposed multiple-sale initiative is denied, substitute energy likely would be a mix of the above sources largely from imported oil production followed by conservation, additional domestic production, and fuel switching.

A new paper from the recent 5-Year OCS Oil and Gas Program entitled *Energy Alternatives and the Environment* (USDOI, MMS, 2001a), which is incorporated here by reference, discusses a long list of potential alternatives to oil and natural gas and evaluates their potential to replace a critical part of our county's energy sources. The costs and reliability of these alternative sources make them less viable than oil and gas resources. It seems very likely that during the life of this project, oil and gas resources at or above the current levels will be used in the United States and the world to fuel our economies.

This paper also indicates that imports and additional domestic production will replace most of the lost oil production, while conservation and fuel switching will decrease the demand for fuel. Every fuel alternative, however, imposes its own negative environmental effects. The following list shows the approximate percent and quantity we expect would substitute for the lost oil (1.38 Bbbl). The quantity of conservation and fuel switching are in barrels of oil equivalent.

- Additional imports: 88% of the loss of production equivalent to 1.214 Bbbl.
- Conservation: 5% of the loss in production equivalent to 69 MMbbl.
- Additional domestic production: 4% of the loss in production equivalent to 55 MMbbl.
- Fuel switching: 3% of the loss in production equivalent to 41 MMbbl.

IV.D.1.b. Environmental Impacts from the Most Important Substitutes

The most like sources of substitutes for domestic production in the offshore Beaufort Sea are additional oil imports, conservation, additional domestic production at other locations, fuel switching, and other substitutes. Below are the potential impacts associated with each of these substitutes.

IV.D.1.b(1) Additional Oil Imports

Energy Alternatives and the Environment (USDOI, MMS, 2001a) indicates that if imports are increased to satisfy the demand for oil, the effects to the environment would be similar in kind to those of the Proposal but would happen in a different location. The species of animals and plants affected may be different, depending on the location of the development. Some of these effects still could occur within the United States from accidental or intentional discharges of oil, whether from tanker or pipeline spills. These events would:

- generate greenhouse gases and air pollutants from transportation and dockside activities;
- degrade air quality from emissions of nitrogen oxides and volatile organic compounds;
- degrade water quality; and
- destroy flora, fauna, and water.

The impacts of oil spills from additional imported oil are not likely to occur on the shores of the Arctic Ocean or, for the most part, in Alaska. Imported oil imposes negative environmental impacts in producing countries and in countries along trade routes. By not producing our own domestic oil and gas resources and relying on imported oil we are exporting, from a global perspective, at least a sizeable portion of the environmental impacts to those countries from which the United States imports and through or by which our imported oil is transported.

IV.D.1.b(2) Conservation

Substituting energy-saving technology (adding insulation to buildings or more efficient engines in vehicles, etc.) or consuming less energy (lowering thermostat settings during the winter; using public transportation rather than private automobiles) will conserve energy. The former could result in positive net gains to the environment but may require additional manufacturing. The amount of gain would depend on the extent of negative impacts from such manufacturing. Consuming less energy generally would have a positive environmental effect.

IV.D.1.b(3) Additional Domestic Production

Onshore oil production has notable negative impacts on surface water, groundwater, and wildlife. It also can cause negative impacts on soils, air quality, and vegetation and cause or increase noise and odors.

Offshore oil production may result in impacts similar to those of the Proposal, but they would occur in a different location. To the extent other offshore production offsets the potential loss of these resources, the effects will be similar to those of the Proposal but would occur in a different location. Offshore activities also may have adverse impacts to subsistence activities, recreation, and tourism.

IV.D.1.b(4) Fuel Switching

Consumers probably could switch to natural gas to heat their homes and businesses and for industrial uses. While natural gas production will create environmental impacts, these impacts would be at a lower level than those impacts normally associated with oil spills. Other alternative transportation fuels may constitute part of the fuel-substitution mix noted here. This mix depends on future technical and economic advances. At this time, no single alternative fuel appears to have the advantage.

IV.D.1.b(5) Other Substitutes

The Federal Government could impose regulations mandating other substitutes for oil. The most likely sectors to target would be transportation, electricity generation, or various chemical processes; however, there are many possibilities. The reader is referred to the paper *Energy Alternatives and the Environment* (USDOI, MMS, 2001a), which discusses many of the alternatives at too great a level of detail to reproduce in this EIS.

If this alternative (No Lease Sale) is adopted, the projected effects of the Proposal would not occur. Similar effects would occur elsewhere, but they would be in a different location and probably of a different magnitude. Natural resources in the Arctic Ocean and the Beaufort Sea still would be exposed to other ongoing oil and gas activities in the area, as analyzed in Section V on cumulative impacts.

IV.D.2. Effects of Alternative III – Barrow Subsistence Whaling Deferral

This alternative would offer for lease all of the area described for the Proposed Action except for a subarea in the western portion of the proposed sale area. The areas that would be removed by the Barrow Subsistence Whaling Deferral is shown in EA Map 2 (which is similar to EIS Map 2).

Effects on Marine and Coastal Birds: This review of new information confirms the conclusions in the multiple-sale EIS (USDOI, MMS, 2003a) that mortality of fewer than 100 spectacled eiders, low hundreds of king and common eiders, 1,000-plus long-tailed ducks, and few Steller's eiders could result from a substantial accidental oil spill. Such losses would represent significant effects in the case of these species, and recovery of their Alaskan populations is not likely to occur for species currently exhibiting a decline (i.e., all but king eider). There is no suggestion in recent studies results that disturbance effects or potential mortality of birds from collisions with structures associated with activities following Sale 195 would exceed the small losses estimated in the multiple-sale EIS, and none of these factors are expected to result in significant effects. There is little indication at present that deferring the Barrow Subsistence Whaling area would affect significantly the numbers of sea ducks colliding with offshore structures. 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.

Effects on Subsistence-harvest Patterns and Sociocultural Systems: With respect to subsistence-harvest patterns, recent information does not suggest that disturbance effects on the patterns, resources, or practices from activities associated with Sale 195 would change from those estimated in the multiple-sale EIS. 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, and the 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 Sale 195.

With respect to sociocultural systems, conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this EA. The conclusion of significant oil-spill effects on sociocultural systems that was reached in the multiple-sale EIS does not change for proposed Sale 195.

Effects on Local Water Quality: The conclusion in the multiple-sale EIS about the effects of large spills on local water quality is still appropriate, partly because of the limited effectiveness of spill responses in broken ice. The conclusion is still that such 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. The deferral of the Barrow area would decrease slightly the possible effect of spills on water quality in an area where bowhead whales feed, but existing leases and possible State leases would still present a risk. The optional Pre-Booming requirement might decrease the effects on water quality, because the response to fuel spills might be faster. The measure would apply only to large fuel transfers in the bowhead whale migration corridor during the period before and during migration. Therefore, the optional Pre-Booming requirement would decrease the effects of some large fuel spills on water quality.

Effects on Bowhead Whales: Based on our consideration of information available since the production of the multiple-sale 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 Sale 195. The threshold for significance by which we evaluate threatened and endangered species is 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.

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 be effective in detecting a delay or blockage of the migration, thereby alerting regulatory agencies. Any effects from the discharge of muds and cuttings or suspension of sediment in the water column would be localized primarily around the drill rig because of the rapid dilution/deposition of these materials. Effects on the bowhead's prey species likely would be negligible. Whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. The optional stipulation on Pre-Booming Requirements for Fuel Transfers should ensure rapid responses to fuel spills, thereby reducing the likelihood that they would affect bowhead whales during their migration.

We reiterate that there is uncertainty about effects on bowheads (or any large cetacean) in the unlikely event of a very large spill. However, 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 Alternative III on this population.

Effects on Other Resources: The effects on other marine mammals are estimated to include the potential loss of small numbers of pinnipeds, polar bears, 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, perhaps 6-10 bears, and fewer than 10 beluga and gray whales) from assumed oil spills, with populations recovering within about 1 year.

Effects on arctic fishes (including Pacific salmon) due to a large oil or diesel fuel spill 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 anticipated effects of Alternative III.

Two rare demersal fish species, the saddled eelpout and pale eelpout, have been collected in only a few locations in the Beaufort Sea. The saddled eelpout was collected in the vicinity of the Barrow deferral area. The next nearest collection of this species in the Beaufort Sea Planning Area is in the vicinity of the Eastern Deferral Area. Deferral of the Barrow area may avoid disturbing this species or its habitat.

The level of effects would be the same for air quality, vegetation and wetlands, and terrestrial mammals as concluded in the multiple-sale EIS. The conclusion for lower trophic-level organisms has been updated. In the unlikely event of a large oil spill, some of the oil probably would drift to shore. The oil-spill risk to the coastline near Barrow would be slightly lower with the Barrow deferral than with Alternative III, but the main spill risk would relate to existing leases. If an oil did drift to shore, 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. This new information helps to refine the effects of a large spill on lower trophic-level organisms but would not change the level of effect.

Effects on Environmental Justice: Conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this 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 Alternative III in the multiple-sale EIS does not change in the context of the new information.

IV.D.3. Effects of Alternative IV – Nuiqsut Subsistence Whaling Deferral

This alternative would offer for leasing all of the area described for the Proposed Action except for a subarea where Nuiqsut subsistence hunters harvest whales near Cross Island. The area that would be removed by the Nuiqsut Subsistence Whaling Deferral is illustrated in EA Map 2 (which is similar to EIS Map 2).

Effects on Marine and Coastal Birds: This review of new information confirms the conclusions in the multiple-sale EIS (USDOI, MMS, 2003a) that mortality of fewer than 100 spectacled eiders, low hundreds of king and common eiders, 1,000-plus long-tailed ducks, and few Steller's eiders could result from a substantial accidental oil spill. Such losses would represent significant effects in the case of these species, and recovery of their Alaskan populations is not likely to occur for species currently exhibiting a decline (i.e., all but king eider). There is no suggestion in recent studies results that disturbance effects or potential mortality of birds from collisions with structures associated with activities following Sale 195 would exceed the small losses estimated in the multiple-sale EIS, and none of these factors are expected to result in significant effects. There is little indication at present that deferring the Nuiqsut Subsistence Whaling area would affect significantly the numbers of sea ducks colliding with offshore structures. 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.

Effects on Subsistence-harvest Patterns and Sociocultural Systems: With respect to subsistence-harvest patterns, recent information does not suggest that disturbance effects on the patterns, resources, or practices from activities associated with Sale 195 would change from those estimated in the multiple-sale EIS. 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, and the conclusion reached 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 Sale 195.

With respect to sociocultural systems, conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this EA. The conclusion of significant oil-spill effects on sociocultural systems that was reached in the multiple-sale EIS does not change for proposed Sale 195.

Effects on Local Water Quality: The conclusion in the multiple-sale EIS about the effects of large spills on local water quality is still appropriate, partly because of the limited effectiveness of spill responses in broken ice. The conclusion is still that such 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. The deferral of the Cross Island area would decrease slightly the likelihood that spills would affect water quality in an area where there is subsistence hunting, but existing Federal and possible State leases would still present a risk. The optional Pre-Booming requirement might decrease the effects on water quality because the response to fuel spills might be faster. The measure would apply only to large fuel transfers in the bowhead whale migration corridor during the period before and during migration. Therefore, the optional Pre-Booming requirement would decrease the effects of some large fuel spills on water quality.

Effects on Bowhead Whales: Based on our consideration of information available since the production of the multiple-sale 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 Alternative IV of proposed Sale 195. The threshold for significance by which we evaluate threatened and endangered species is 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.

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 be effective in detecting a delay or blockage of the migration, thereby alerting regulatory agencies. Any effects from the discharge of muds and cuttings or suspension of sediment in the water column would be localized primarily around the drill rig because of the rapid dilution/deposition of these materials. Effects on the bowhead's prey species likely would be negligible. Whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. The optional stipulation on Pre-Booming Requirements for Fuel Transfers should ensure rapid responses to fuel spills, thereby reducing the likelihood that they would affect bowhead whales during their migration.

We reiterate that there is uncertainty about effects on bowheads (or any large cetacean) in the unlikely event of a very large spill. However, 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 Alternative IV on this population.

Effects on Other Resources: The effects on other marine mammals due to Alternative IV are still estimated to include the potential loss of small numbers of pinnipeds, polar bears, 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, perhaps 6-10 bears, and fewer than 10 beluga and gray whales) from assumed oil spills, with populations recovering within about 1 year.

Effects on arctic fishes (including Pacific salmon) due to a large oil or diesel fuel spill 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 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 significantly modify anticipated effects of Alternative IV.

The other rare demersal fish, the pale eelpout, was collected in the vicinity of the Nuiqsut Subsistence Whaling Deferral Area. Mecklenburg, Mecklenburg, and Thorsteinson (2002) noted that there may be more records of this latter species in the region; however, the identification of the specimens in question. Deferral of this area may avoid disturbing this species or its habitat.

The level of effects would be the same for air quality, vegetation and wetlands, and terrestrial mammals as concluded in the multiple-sale EIS. The conclusion for lower trophic-level organisms has been updated. In the unlikely event of a large oil spill, some of the oil probably would drift to shore. The oil-spill risk to the coastline near Cross Island would be slightly lower with the Cross Island deferral than with Alternative IV, but the main spill risk would relate to existing leases. If an oil did drift to shore, 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. This new information helps to refine the effects of a large spill on lower trophic-level organisms but would not change the level of effect.

Effects on Environmental Justice: Conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this 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 Alternative IV in the multiple-sale EIS does not change in the context of the new information.

IV.D.4. Effects of Alternative V – Kaktovik Subsistence Whaling Deferral

This alternative would offer for lease all of the area described for the Proposed Action except for a subarea near Barter Island. The area that would be removed by the Kaktovik Subsistence Whaling Deferral is illustrated in EA Map 2 (which is similar to EIS Map 2).

Effects on Marine and Coastal Birds: This review of new information confirms the conclusions in the multiple-sale EIS (USDOI, MMS, 2003a) that mortality of fewer than 100 spectacled eiders, low hundreds of king and common eiders, 1,000-plus long-tailed ducks, and few Steller's eiders could result from a substantial accidental oil spill. Such losses would represent significant effects in the case of these species, and recovery of their Alaskan populations is not likely to occur for species currently exhibiting a decline (i.e., all but king eider). There is no suggestion in recent studies results that disturbance effects or potential mortality of birds from collisions with structures associated with activities following Sale 195 would exceed the small losses estimated in the multiple-sale EIS, and none of these factors are expected to result in significant effects. There is little indication at present that deferring the Kaktovik Subsistence Whaling area would affect significantly the numbers of sea ducks colliding with offshore structures. 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.

Effects on Subsistence-harvest Patterns and Sociocultural Systems: With respect to subsistence-harvest patterns, recent information does not suggest that disturbance effects on the patterns, resources, or practices from activities associated with Sale 195 would change from those estimated in the multiple-sale EIS. 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, and the conclusion reached 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 Sale 195.

With respect to sociocultural systems, conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this EA. The conclusion of significant oil-spill effects on sociocultural systems that was reached in the multiple-sale EIS does not change for proposed Sale 195.

Effects on Local Water Quality: The conclusion in the multiple-sale EIS about the effects of large spills on local water quality is still appropriate, partly because of the limited effectiveness of spill responses in broken ice. The conclusion is still that such 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. The deferral of the Kaktovik area would decrease slightly the possible effect of spills on water quality in an area where bowhead whales feed, but State leasing might still present a spill risk. The optional Pre-Booming requirement might decrease the effects on water quality because the response to fuel spills might be faster. The measure would apply only to large fuel transfers in the bowhead whale migration corridor during the period before and during migration. Therefore, the optional Pre-Booming requirement would decrease the effects of some large fuel spills on water quality.

Effects on Bowhead Whales: Based on our consideration of information available since the production of the multiple-sale 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 Alternative V of proposed Sale 195. The threshold for significance by which we evaluate threatened and endangered species is 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.

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 be effective in detecting a delay or blockage of the migration, thereby alerting regulatory agencies. Any effects from the discharge of muds and cuttings or suspension of sediment in the water column would be primarily localized around the drill rig because of the rapid dilution/deposition of these materials. Effects on the bowhead's prey species likely would be negligible. Whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. The optional stipulation on Pre-Booming Requirements for Fuel Transfers should ensure rapid responses to fuel spills, thereby reducing the likelihood that they would affect bowhead whales during their migration.

We reiterate that there is uncertainty about effects on bowheads (or any large cetacean) in the unlikely event of a very large spill. However, 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 Alternative V on this population.

Effects on Other Resources: The effects on other marine mammals due to Alternative V are still estimated to include the potential loss of small numbers of pinnipeds, polar bears, 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, perhaps 6-10 bears, and fewer than 10 beluga and gray whales) from assumed oil spills, with populations recovering within about 1 year.

Effects on arctic fishes (including Pacific salmon) due to a large oil or diesel fuel spill, 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 anticipated effects of Alternative V.

Analysis found no rare fish species documented in the vicinity of the Kaktovik Subsistence-Whaling Deferral Area.

The level of effects would be the same for air quality, vegetation and wetlands, and terrestrial mammals as concluded in the multiple-sale EIS. The conclusion for lower trophic-level organisms has been updated. In the unlikely event of a large oil spill, some of the oil probably would drift to shore. If an oil did drift to shore, 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. A summer spill from the Kaktovik Subsistence-Whaling Deferral area and/or Eastern Deferral area would have a 50% probability of contacting the coastline of the Arctic National Wildlife Refuge within 30 days. A small percentage of the oil probably would become buried in the sediments and persist for a decade in spite of cleanup responses. 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%.

Effects on Environmental Justice: Conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this 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 Alternative V in the multiple-sale EIS does not change in the context of the new information.

IV.D.5. Effects of Alternative VI – Eastern Deferral

This alternative would offer for lease all of the area described for the Proposed Action except for a subarea to the east of Kaktovik. The area that would be removed by the Eastern Deferral is illustrated in EA Map 1 (which is similar to EIS Map 2).

Effects on Marine and Coastal Birds: This review of new information confirms the conclusions in the multiple-sale EIS (USDOI, MMS, 2003a) that mortality of fewer than 100 spectacled eiders, low hundreds of king and common eiders, 1,000-plus long-tailed ducks, and few Steller's eiders could result from a substantial accidental oil spill. Such losses would represent significant effects in the case of these species, and recovery of their Alaskan populations is not likely to occur for species currently exhibiting a decline (i.e., all but king eider). There is no suggestion in recent studies results that disturbance effects or potential mortality of birds from collisions with structures associated with activities following Sale 195 would exceed the small losses estimated in the multiple-sale EIS, and none of these factors are expected to result in significant effects. There is little indication at present that deferring the area termed the Eastern Deferral would affect significantly the numbers of sea ducks colliding with offshore structures. 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.

Effects on Subsistence-Harvest Patterns and Sociocultural Systems: With respect to subsistence harvest patterns, recent information does not suggest that disturbance effects on the patterns, resources, or practices from activities associated with Sale 195 would change from those estimated in the multiple-sale EIS. 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, and the conclusion reached 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 Sale 195.

With respect to sociocultural systems, conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this EA. The conclusion of significant oil-spill effects on sociocultural systems that was reached in the multiple-sale EIS does not change for proposed Sale 195.

Effects on Local Water Quality: The conclusion in the multiple-sale EIS about the effects of large spills on local water quality is still appropriate, partly because of the limited effectiveness of spill responses in broken ice. The conclusion is still that such 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. The deferral of the Eastern Alaskan Beaufort Sea area would decrease slightly the possible effect of spills on water quality in an area where bowhead whales feed, but possible State leases might still present a risk. The optional Pre-Booming requirement might decrease the effects on water quality. The optional measure would not decrease the likelihood of fuel spills (because booms do not prevent spills); however, the optional measure would mean that the response to fuel spills might be faster. The measure would apply only to large fuel transfers in the bowhead whale migration corridor during the period before and during migration. Therefore, the optional Pre-Booming requirement would decrease the effects of some large fuel spills on water quality.

Effects on Bowhead Whales: Based on our consideration of information available since the production of the multiple-sale 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 Sale 195. The threshold for significance by which we evaluate threatened and endangered species is 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.

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 be effective in detecting a delay or blockage of the migration, thereby alerting regulatory agencies. Any effects from the discharge of muds and cuttings or suspension of sediment in the water column would be localized primarily around the drill rig because of the rapid dilution/deposition of these materials. Effects on the bowhead's prey species likely would be negligible. Whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. The optional stipulation on Pre-Booming Requirements for Fuel Transfers should ensure rapid responses to fuel spills, thereby reducing the likelihood that they would affect bowhead whales during their migration.

We reiterate that there is uncertainty about effects on bowheads (or any large cetacean) in the unlikely event of a very large spill. However, 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 Alternative VI on this population.

Effects on Other Resources: The effects of Alternative VI on other marine mammals are estimated to include the potential loss of small numbers of pinnipeds, polar bears, 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, perhaps 6-10 bears, and fewer than 10 beluga and gray whales) from assumed oil spills, with populations recovering within about 1 year.

Effects on arctic fishes (including Pacific salmon) due to a large oil or diesel fuel spill 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 anticipated effects of Alternative VI.

The saddled eelpout, a rare demersal fish, was collected in the vicinity of the deferral area. The next nearest collection of this species in the Beaufort Sea Planning Area is in the vicinity of the Barrow Subsistence Whaling Deferral Area. Deferral of the Eastern area may avoid disturbing this species or its habitat.

The level of effects would be the same for air quality, vegetation and wetlands, and terrestrial mammals as concluded in the multiple-sale EIS. The conclusion for lower trophic-level organisms has been updated. In the unlikely event of a large oil spill, some of the oil probably would drift to shore. A summer spill from the Eastern Deferral area would have a 50% probability of contacting the coastline of the Arctic National Wildlife Refuge within 30 days. A small percentage of the oil probably would become buried in the sediments and persist for a decade in spite of cleanup responses. Deferral of leasing in the Eastern area would not eliminate the risk to the Refuge’s coastline but would lower the maximum risk by about 25%.

Effects on Environmental Justice: Conclusions and definitions remain appropriate in the context of the new information that has become available since publication of the multiple-sale EIS and that was described in Section IV.B of this 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 Alternative VI in the multiple-sale EIS does not change in the context of the new information.

IV.E. Updated Cumulative Effects of Proposed Sale 195

The general conclusions in the multiple-sale EIS about cumulative effects (Section V.A.6) are that:

- Potential cumulative effects on the bowhead whale, subsistence, sociocultural systems, spectacled eider, Boulder Patch kelp habitat, polar bears, and caribou would be of primary concern and warrant continued close attention and effective mitigation practices.
- The incremental contribution of Sale 195 to the cumulative effects likely would be quite small. Construction and operations related to the Beaufort Sea multiple sales primarily would be concentrated in the Near Zone, and oil output would be a small percentage (approximately 7%) of the total estimated North Slope/Beaufort Sea production.
- Sale 195 would contribute a small percentage of offshore oil spills (about 18%) (0.11 spills out of 0.65 total; the most likely number of spills is zero) to resources in State and Federal waters in the Beaufort Sea. Any subsequent spills are not expected to contact the same resources or to occur before those resources recover from the first spill.
- Potential Environmental Justice effects would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik within the NSB. In the unlikely event a large 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 impacts would be considered disproportionately high adverse effects on Alaskan Natives.

In this section, new information is summarized and some conclusions are updated.

IV.E.1. Information Updates

This section summarizes new cumulative information on oil and gas fields and related infrastructure and then the effects on the environment. The latter is based partly on the NRC's report *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* (NRC, 2003) and the cumulative assessment in the Northwest NPR-A IAP/EIS (USDOI, BLM and MMS, 2003).

North Slope Oil and Gas Fields and Related Infrastructure. Basic infrastructure and transportation assumptions for the North Slope have not changed substantially since completion of the Beaufort Sea multiple-sale EIS, but some proposals have become more definite. The changes are described in detail in Appendix E and are summarized here. The State of Alaska repeatedly has indicated a desire to expand the North Slope road networks connecting the North Slope villages with access to interior Alaska and the North American road network. In November 2003, the State announced that it was going to submit its wetlands development application to the Corps of Engineers for the construction of a 105-mile long highway, joining the Dalton Highway with the community of Nuiqsut (*Anchorage Daily News*, 2003). The road would begin at the Dalton Highway 57 mi south of Deadhorse and 357 mi north of Fairbanks, and would parallel the Brooks Range before swinging north for 40 miles to Nuiqsut. The cost of such a road was estimated at $350-$400 million. Given current budgetary constraints, the State Department of Transportation determined that the foothills route was a less preferred project to one that would directly connect the existing North Slope spine road with the community of Nuiqsut. The Colville River road would join Nuiqsut to the spine road via an 18-mi, all-season road that would be built from the spine road to the Colville River crossing site. The coast of the project is estimated at $150-$200 million. The highway would provide all-season access to the Dalton Highway and Deadhorse Airport for the residents of Nuiqsut. Although still desired by the State of Alaska, the Foothills route must be categorized as speculative at best. Some surveys have been conducted for the Colville road route, and it is closer to reality; however, the State has set aside no funds for such a road and bridge. Given the tight budget of the State, the Colville River road is still considered speculative. Additional information on the routes is available on the State of Alaska, Department of Transportation and Public Facilities internet site at www dot. state.ak.us./stwplng/industrialroads/northoilroads.html.)

Another development is the plan for a gas pipeline. Table V-1b of the multiple-sale EIS shows the various routes by which North Slope gas could be transported to market. Although these concepts remain valid, the Alaska voters in November 2003 added an additional facet to the future of gas transportation. In that election, voters authorized the establishment of the Alaska Natural Gas Development Authority. The Authority was vested with power to arrange financing, and to select potential routes (USDOI, MMS, 2003a:Table V-1b) and, since its inception, has attempted to market an Alaska gas pipeline to potential investors and product users. In addition to the Alaska Natural Gas Development Authority, numerous other consortiums have been formed and been dissolved, each attempting to secure the right mixture of funding and political support to effect their pipeline construction plan. Congressional attempts to hasten the construction of the gas pipeline through Federal subsidies have not yet succeeded. Therefore, we still categorize the construction of a gas pipeline as speculative.

While there is considerable information that global warming has affected the arctic over the past several decades, there is not agreement that global warming will continue at the same rate into the future. In the cumulative assessment, we are considering what would occur in the future. There are researchers and information that dispute whether climate change will continue along the current trend into the future; hence, MMS has chosen to consider that information speculative. However, we include a brief analysis of climate change in Appendix I.

IV.E.2. Resource-Specific Cumulative Effects

The following sections assess the cumulative effects of the proposed lease sale in the context of infrastructure developments. The assessments focus on four major resource categories (birds, subsistence, marine mammals, and fish). The section concludes with a brief summary of the cumulative effects in Section IV.E.3.

IV.E.2.a. Marine and Coastal Birds

The multiple-sale EIS concludes generally with regard to cumulative effects on threatened and endangered species that: "Potential cumulative effects on the…spectacled eider…would be of primary concern and

warrants continued close attention and effective mitigation practices" (USDOI, MMS, 2003a:Section V.A.6). More specifically, it was 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…. 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…." With regard to the other threatened eider species: "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…." It also states: "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."

Subsequently, the Northwest NPR-A IAP/EIS was prepared (USDOI, BLM and MMS, 2003); the assessment of potential cumulative effects in this document concluded that with regard to threatened eiders "…an oil spill reaching marine areas could result in substantial eider mortality, a significant effect that would interfere with recovery of these species." With regard to non-listed bird species, "…none of the routine management or industrial activities are likely to cause significant population effects"; however, "Substantial losses of long-tailed ducks, (king eiders), or common eiders (from a large oil spill entering the marine environment) would be a significant effect."

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.

Conclusions. The updated information suggests, as stated in the multiple-sale EIS, that: "The incremental contribution of Sale [195] 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 relatively substantial and represent a significant effect for any sea duck 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.b. Subsistence-Harvest Patterns and Sociocultural Systems

Cumulative effects on subsistence-harvest patterns and sociocultural system are updated in sections 1 and 2, correspondingly. Cumulative effects on environmental justice are updated in Section IV.E.2.f

IV.E.2.b(1) Subsistence-Harvest Patterns

Cumulative effects on subsistence-harvest patterns include effects from Sale 195 exploration and development and other past, present, and reasonably foreseeable projects on the North Slope. The Proposed Action for Sale 195 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 in Section V.C.11.b(3) 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.

After publication of the multiple-sale EIS, the effects of a proposed lease sale in the Northwest NPR-A and an expansion of the Alpine field were assessed (USDOI, BLM and MMS, 2003; USDOI, BLM, 2004). Sections IV.F.8.n of 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.

Section 4.F.7.3.13 of the Alpine draft EIS (USDOI, BLM, 2004) assessment summarizes the effects of an offshore spill on subsistence resources and subsistence-harvest patterns; it tiers off of and reaches a similar conclusion to the Northwest NPR-A conclusion quoted herein.

IV.E.2.b(2) Sociocultural Systems

Cumulative effects on sociocultural systems include effects of Sale 195 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 and an expansion of the Alpine field were assessed (USDOI, BLM and MMS, 2003; USDOI, BLM, 2004). 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).

Section 4.F.7.1.2 of the Alpine draft EIS assessment summarizes the effects of an offshore spill on sociocultural systems; it tiers off of and reaches a similar conclusion to the Northwest NPR-A conclusion quoted herein.

Summary and Overall Conclusion: The incremental contribution of Sale 195 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, and Northeast and Northwest NPR-A) and offshore (Northstar and Liberty). In the unlikely event of a large spill from Sale 195, 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, though not eliminated.

Sale 195 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 greater than or equal to 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 195 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 unlikely event of a spill from Sale 195, 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 195 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. Disturbance effects periodically could disrupt, but not displace, ongoing social systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources. Community activities and traditional practices for harvesting, sharing, and processing subsistence resources 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 significant cumulative effects be expected from Sale 195.

Because the occurrence of a large oil spill is unlikely, attaining a level of significant effect also is unlikely. These conclusions and updated levels of effect on subsistence-harvest patterns and sociocultural systems, including the contribution of Sale 195 leases, would be the same as in the multiple-sale EIS.

Conclusion: We still conclude that potential cumulative effects on subsistence and sociocultural systems would be significant, warrant continued close attention, and effective mitigation practices.

IV.E.2.c. Local Water Quality

The multiple-sale EIS concludes that, with regard to cumulative effects on local water quality:

> 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 have the greatest impact in the immediate vicinity of the activity.

Two other recent assessments of the cumulative effects contain similar conclusions. 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 cumulative effects of estuarine spills on local water quality in Section IV.B.8.e, concluding that the effects would be negligible.

Cumulative effects on water quality were assessed also for an NRC review of the cumulative effects of oil and gas activities on the North Slope (NRC, 2003). The NRC review included the cumulative effects of operations in the nearshore Beaufort Sea, such as the bowhead whale migration corridor. The summary chapter includes information on the cumulative effects of permitted construction and accidental oil spills, but does not document any cumulative effects. With respect to permitted construction, the summary chapter states that many facilities have been abandoned without complete removal (for example, the artificial islands named Niakuk, Sag, Duck, Resolution, Endeavor, etc.). However, the review does not describe any cumulative environmental effects of the abandoned facilities. With respect to accidental spills, the chapter explains that, although no large oil spills have occurred in the marine waters off the North Slope, their potential is such a major concern that the committee suggests research into mitigation.

The Proposed Action for Sale 195 likely would contribute about 17% of cumulative offshore spills. The estimated mean number of cumulative offshore spills is 0.65; for purposes of analysis, we assess the effects of one spill.

Conclusion: We still conclude that the cumulative effects, including the contribution of Sale 195 leases, would be no greater than the effects of the Proposed Action, assessed in Section IV.C.1.c.

IV.E.2.d. Bowhead Whales

The potential for cumulative effects to adversely affect bowhead whales is of great concern because of their current endangered status, which resulted from past human activity (overexploitation by commercial whalers), and because of their importance as a subsistence species to Alaskan Native residents of coastal villages adjacent to their range. In our general conclusions about cumulative effects in the Beaufort Sea multiple-sale final EIS (USDOI, MMS, 2003a), we stated:

> Potential cumulative effects on the bowhead whale…[and other key resources]…would be of primary concern and warrant continued close attention and effective mitigation practices.
>
> The incremental contribution of Sale 186 to the cumulative effects likely would be quite small. Construction and operations related to the Beaufort Sea multiple sales primarily would be concentrated in the Near Zone, and oil output would be a small percentage (approximately 7%) of the total estimated North Slope/Beaufort Sea production.

With respect to potential cumulative effects on bowhead whales specifically from Beaufort Sea, North Slope, and Transportation Activities, we summarized and concluded (USDOI, MMS, 2002b:Section V.C.5.a(2)):

> Bowhead whales might experience cumulative effects from OCS activities, such as oil spills or noise from drilling, vessel and aircraft traffic, construction, seismic surveys, or oil-spill-cleanup activities, and from non-OCS activities. Bowhead whales temporarily may move to avoid noise-producing activities and may experience temporary, nonlethal effects, if oil spills occur during activities associated with any past, present, or reasonably foreseeable future development projects in the arctic region.
>
> We do not expect bowhead whales to die from noise produced while exploring, developing, and producing offshore oil and gas, but some whales could experience temporary, nonlethal effects. Some bowheads temporarily may move to avoid vessels and activities conducted for seismic surveys, drilling, and construction. Contact with spilled oil in the Beaufort Sea could cause some temporary, nonlethal effects to some bowhead whales, and a few could die from prolonged exposure to freshly spilled oil. There is no clear indication that disturbance from oil and gas exploration and development activities since the mid-1970's has had an additive or synergistic effect on the bowhead whale population. The bowhead whale population has been steadily increasing at the same time that oil and gas activities have been occurring in the Beaufort Sea and throughout the bowhead whale's range. Bowhead whales should not be affected by oil spills or activities associated with the transport of oil through the Trans-Alaska Pipeline System or by marine transportation along the tanker routes to market.
>
> Activities that are not related to oil and gas also could have cumulative effects on bowhead whales. A small number of whales may be injured or killed as a result of entrapment in fishing nets or collisions with ships. Native whalers from Alaska harvest bowheads for subsistence and cultural purposes under a quota authorized by the IWC. Native whalers from Russia also are authorized to harvest bowhead whales under a quota authorized by the IWC. However, the status of the population is closely monitored these activities are closely regulated.

We also concluded that:

> Overall, exposure of bowhead whales to noise from oil and gas operations is not expected to kill any bowhead whales, but some could experience temporary, nonlethal effects. Whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. The incremental contribution of effects from Beaufort Sea Sale 186 to the overall effects under the cumulative case is not likely to cause an adverse effect on the bowhead whale population.

In addition to the detailed coverage in the Beaufort Sea multiple-sale final EIS, several other documents have become available recently that are particularly useful as sources of information about potential cumulative effects on this population. These documents also provide information helpful in evaluating the potential significance of effects on the status and health of this population. These include: The NMFS's *Biological Opinion on Issuance of Annual Quotas Authorizing the Harvest of Bowhead Whales to the Alaska Eskimo Whaling Commission for the Period 2003 through 2007* (NMFS, 2003a); their *Final Environmental Assessment for Issuing Subsistence Quotas to the Alaska Eskimo Whaling Commission for a Subsistence Hunt on Bowhead Whales for the Years 2003 through 2007* NMFS, 2003b); papers evaluating whether this population should be delisted (Shelden et al., 2001, 2003; Taylor, 2003); and the NRC's report *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* (NRC, 2003a). The IWC (IWC) reviewed and critically evaluated new information available on the bowhead whale at their 2003 meeting. This information and the associated discussions are summarized in the *Report of the Subcommittee on Bowhead, Right and Gray Whales* (IWC, 2003). The 2002 Alaska Marine Mammal Stock Assessment for this stock remains the most recent stock assessment available. We refer interested readers to these documents, to references cited in the multiple-sale final EIS, and to new references cited in the following text for details and additional discussion of potential cumulative effects on this population. We note that the IWC will be conducting an in-depth status assessment of this population in 2004 (IWC, 2003) at their annual meeting.

After consideration of all the information available to us, including information available to us since the finalization of the Beaufort Sea multiple-sale final EIS, we believe that the general conclusions presented in the multiple-sale EIS about potential cumulative effects on bowhead whales are still valid and apply to proposed Sale 195. However, because of the Endangered Species Act status of this stock and its importance to Alaska Native residents of the Beaufort, Chukchi, and Bering seas bowhead-hunting communities, and because NOAA Fisheries indicated, during informal ESA consultation with them related to this sale, that we should expand our discussion of cumulative issues, we supplement, but do not repeat, the detailed information provided in the multiple-sale EIS.

We refer readers to sections V and VI of the Biological Evaluation (Appendix C.) where we present more detailed information about potential cumulative effects on bowheads. Because of differences between NEPA and ESA in the definition of cumulative effects, we provide information on past, present and potential anthropogenic effects (not related to the proposed action) on bowhead whales in both of these sections of the Biological Evaluation.

We analyze potential effects on the subsistence hunting of bowhead whales in EA Section IV.C.1.d. In this section, our focus is on the potential cumulative effects on the whales themselves.

IV.E.2.d(1)(a) Introductory Information Relevant to Evaluation and Interpretation of Potential Cumulative Effects on Bowheads

"Evidence is accumulating" that suggests at least some bowhead "whales live a very, very long time. If estimates are correct, some whales may be over 100 years old" (C. George, as cited in U.S. Dept. of Commerce, 2002). These data add to previous estimates that these whales may live to 50-75 years of age. The NOAA Fisheries (U.S. Dept. of Commerce, 2002) points out that "…some whales alive today may have been alive at the end of the commercial whaling period." Thus, evaluation of potential cumulative effects, both at the individual level and at the level of the population, needs to take a very long view both into the past and into the future.

That said, varying, sometimes considerable, amounts of uncertainty are associated with conclusions about the potential for particular effectors to have impacted bowheads, to be impacting them, and especially to cause impact in the future.

Much of the uncertainty is unavoidable and cannot be remedied. Because the potential effects of at least some specific factors are uncertain, an even greater level of uncertainty exists about the cumulative impact of all of the potential factors, especially over the long timeframes that must be considered for this species. In general, the uncertainty about potential cumulative effects becomes greater the further into the future we try to predict and the more likely the potential effector may affect bowheads in a manner that is difficult to directly monitor (for example, effects of contaminants).

While such uncertainty exists about the details of some but not all cumulative effects, the Western Arctic stock of bowheads is relatively very well studied and monitored. The current status of this population is not uncertain, despite the inherent uncertainty associated with some factors that might be having some adverse (or even positive) effects on it. Because some of the potential cumulative effects on this population are highly regulated (for example, subsistence hunting), we know clearly the level of at least some effects. These two points are important. We are able to view other potential effects against relatively detailed knowledge of population status and in light of rather detailed knowledge about the population level consequences of at least some known cumulative effectors (for example, subsistence hunting, past levels of offshore industrial activity).

Additional introductory information on potential cumulative effects is summarized in the introductory portion of Section VI, and in Section VI.A, of the Biological Evaluation in Appendix C.

IV.E.2.d(1)(b) Geographic and Temporal Scope of the Cumulative Analyses

As noted, under NEPA cumulative effects are those effects that result from the incremental impact of actions which added to other past, present and reasonably foreseeable actions regardless of what federal or nonfederal agency or person undertakes such action. Cumulative impacts can result from individually minor, but collectively significant, actions taking place over time.

In our cumulative effects analyses, we have considered all factors that we believed potentially could contribute to cumulative effects on bowhead whales from the Western Arctic stock (also referred to as the Bering-Chukchi-Beaufort seas population) anywhere in their range.

Our baseline date for cumulative analysis was the initiation of commercial whaling of this population in 1848, and our endpoint is the likely period of effect of reasonably foreseeable potential effectors that could be expected to occur over the expected life of the project, a period of approximately 30-40 years.

IV.E.2.d(1)(c) Factors Identified that could Contribute to Cumulative Effects.

We identified the following types of past, present, and reasonably foreseeable human-related actions and factors that potentially could contribute to cumulative effects on the Western Arctic stock of bowhead whales:

- Historic Commercial Whaling
- Subsistence Hunting
- Activities Related to Offshore Petroleum Extraction
- Commercial Fishing and Marine Vessel Traffic
- Research Activities
- Pollution and Contaminants

The potential factors that we identified include those that were identified in the multiple-sale final EIS. However, because of the importance of this population, we have expanded our discussion of our analyses of cumulative effects, especially the potential for climate change (see Section VI.C.4 of the Biological Evaluation in Appendix C), and potential associated changes in human activity during open water to impact this population. Following a suggestion from B. Smith of the NMFS, we also have included research activities in our cumulative analyses.

IV.E.2.d(1)(c)1) Historical Commercial Whaling

It is clear that commercial whaling of this population between 1848 and 1915 was the primary human impact on this population. While various estimates exist, prior to such exploitation this population probably numbered between a minimum of 10,000 and 23,000 (Woodby and Botkin, 1993). As noted in the affected environment section, the current population estimate is 10,020 (SE of 1,290, 95% DI of 7,800-12,900) (Zeh, as cited in IWC, 2003). Commercial whaling also may have caused the extinction of some subpopulations and some temporary (but last several years) changes in distribution.

Although commercial hunting greatly depleted the population, some authors (Shelden et al., 2001, 2003) concluded that this population should be removed from the list of endangered species under the ESA.

IV.E.2.d(1)c)2) Subsistence Hunting

Native hunters from 10 villages in Alaska harvest bowheads for subsistence and cultural purposes under a quota authorized by the IWC. Chukotkan Native whalers from Russia also are authorized to harvest bowhead whales under the same authorized quota. However, the status of the population is closely monitored, and these activities are closely regulated. In Table IV.E.1, we reproduce data presented by NOAA Fisheries (NMFS, 2003b) on bowhead whales taken by Alaskan Native subsistence hunters between 1978 and 2002. The cumulative effect of subsistence hunting is summarized further in Section V.B of the Biological Evaluation in Appendix C.

IV.E.2.d(1)(c)3) Activities Related to Offshore Petroleum Extraction

In the multiple-sale final EIS, we concluded that:

> Some effects on bowhead whales may occur because of activities from previous and proposed lease sales of State and Federal areas offshore. Generally, bowhead whales remain far enough offshore to be mainly in Federal waters, but they move into State waters in some areas, such as the Beaufort Sea southeast and north of Kaktovik and near Point Barrow.
>
> To date, activities conducted in State waters or on the OCS in the Beaufort Sea as a result of previous Federal lease sales since 1979 apparently have not had adverse effects on the bowhead

whale population. Although numerous exploration wells have been drilled in the Beaufort Sea from a variety of platforms, including gravel islands, ice islands, bottom-founded drilling platforms, submersibles, and drillships and extensive seismic surveys have been conducted, no bowhead whale mortality has been reported. The bowhead whale population has continued to increase over that timeframe. However, Inupiat whalers have stated that noise from these activities at least temporarily displaces whales farther offshore, especially if the operations are conducted in the main migration corridor. Whales may avoid areas where seismic surveys or drilling operations are being conducted. Recent monitoring studies (Miller et al., 1997, 1999; Miller, Elliot, and Richardson, 1998) indicate that most whales migrating in the fall avoid an area with a radius about 20-30 kilometers around a seismic vessel operating in nearshore waters.

In general, development projects such as Endicott or Northstar, and reasonably foreseeable future development projects such as Liberty, are not likely to harm bowhead whales.

Some bowhead whales could be disturbed if development proceeds at the Kuvlum and Hammerhead units or other reasonably foreseeable future development projects, such as the Sandpiper or Flaxman Island units.

Overall, cumulative effects to bowhead whales could include behavioral responses to seismic surveys; aircraft and vessel traffic; exploratory drilling; construction activities, including dredging/trenching and pipelaying; and development drilling, production operations, and oil-spill-cleanup operations that take place at varying distances from the whales.

We discuss the potential effects from oil- and gas-related activities in detail in Section V.C.5.a(1)(b) of the Beaufort Sea multiple-sale final EIS and in the Beaufort Sea Sale 170 final EIS (USDOI, MMS, 1998). In Section V.C.5.a(1)(a) of the multiple-sale EIS, we provided considerable detail on current and reasonably foreseeable oil- and gas-related projects that may affect bowhead whales. We do not repeat such detailed information here.

The McCovey Prospect was one project for which an exploration plan had been approved northwest of Cross Island. This project was considered reasonably foreseeable at the time of the multiple-sale EIS. We concluded that: "if this results in submittal of a future development and production plan, coordination with Native groups will be necessary to maintain traditional hunting in the area." The exploration well drilled at this location has been capped and abandoned. Thus, the potential for incremental cumulative effects from oil and gas exploration projects in this region may be somewhat overstated in the multiple-sale EIS at least over the next decade.

We are not aware of any information that suggests potential effects from other offshore projects will be qualitatively different or differ in general degree from those summarized in the Beaufort Sea multiple-sale EIS, which we incorporate by reference. Available information indicates that these conclusions are valid. Overall, bowhead whales exposed to noise-producing activities associated with offshore petroleum extraction activities would be most likely to experience temporary, nonlethal behavioral effects such as avoidance behavior.

There is some uncertainty about whether effects could be longer term, if sufficient oil and gas activity were to occur in a localized area. For example, there is some indication that long-term displacement has occurred in some cetaceans, albeit rarely, due to noise and/or disturbance associated with increased vessel traffic effects and noise associated with other (not oil- and gas-associated) sources. For example, shipping and dredging associated with an evaporative saltworks project in Guerrero Negro Lagoon in Baja California (National Research Council, 2003b) caused gray whales to abandon the lagoon through most of the 1960's. When boat traffic declined, the lagoon was reoccupied first by single whales, and later by cow-calf pairs (Bryant, Lafferty, and Lafferty, 1984). Morton and Symonds (2002) reported that killer whale use of Broughton Archipelago in British Columbia declined significantly when high-amplitude acoustic harassment devices were installed at salmon farms in an attempt to deter seal predation. Almost no whales were observed in the archipelago between 1993 and 1999, when the acoustic harassment devices were in use. Killer whales reoccupied the archipelago within 6 months of the removal of the devices in 1999 (Morton and Symonds, 2002; National Research Council, 2003b).

There is no indication that any of the activities proposed here, or the cumulative effects of all human activities (other than historic commercial whaling), has caused, or is likely to cause, such a long-term displacement. Over the timeframe of the proposed project (about 30 years), available information does not indicate that it is likely a level of noise and/or related disturbance would be reached that would have such an effect. Additionally, existing regulatory authority under both the Marine Mammal Protection Act and the ESA is sufficient to keep such a situation from occurring and to mitigate many of the potential impacts from noise and other disturbance.

Native hunters believe that there is potential for increased noise (for example, from shipping and/or oil and gas development) to drive whales farther from shore, decreasing their availability to subsistence hunters, and potentially reducing mortality from this source. If such an effect occurred, it could produce a countervailing effect to adverse effects on the whale population. As noted in the section on subsistence hunting, cumulative noise and disturbance associated with oil and gas activities, shipping and subsistence hunting could potentially have an additive or even synergistic effect on bowhead whale habitat use. However, at present, we are aware of no other information that suggests such an effect would be likely to occur or that such effects have occurred.

Effects of a large oil spill are most likely to result in nonlethal temporary or permanent effects. The most likely effects of oil on adult bowhead whales would be essentially as described in Section IV.C.5 of the Beaufort Sea multiple-sale EIS. As summarized in the multiple-sale EIS and in National Marine Fisheries Service (2003), individuals exposed to spilled oil may inhale hydrocarbon vapors, experience some damage to skin or sensory organs, ingest spilled oil or oil-contaminated prey, feed less efficiently because of baleen fouling, and lose some prey killed by the spill. Prolonged exposure to freshly spilled oil, or possibly exposure to high concentrations of freshly spilled oil, could kill or injure whales. Because of existing information available for other mammals regarding the toxic effects of fresh crude oil, and because of inconclusive results of studies on cetaceans after the *Exxon Valdez* oil spill, we are uncertain about the potential for mortality of more than a few individuals. Such potential probably is greatest if a large aggregation of feeding or milling whales, especially an aggregation containing relatively high numbers of calves, was contacted by a very large slick of fresh oil. Such aggregations occasionally have been observed in open-water conditions off Dease Inlet. Even in such a case, available evidence indicates most effects would be nonlethal. However, we reiterate that due to the limitations of available information and due to the limitations inherent in study baleen whales, there is uncertainty about the range of potential effects of a very large spill on bowhead whales, especially if a large aggregation of females with calves were to be contacted by a large or very large spill of fresh oil. The NOAA Fisheries also has concluded that, given the abundance of plankton resources in the Beaufort Sea (Bratton et al., 1993), it is unlikely that the availability of food resources for bowheads would be affected.

Available information suggests that the potential for oil-industry activities outside of the Beaufort Sea to contribute to cumulative effects on this stock of bowhead whales is still limited. In the multiple-sale EIS, we concluded that the potential for oil-industry activities outside of the Alaskan Beaufort Sea, but within the range of this whale stock, appears to be limited. This remains the case.

In the multiple-sale EIS, we concluded that in the Canadian Beaufort Sea, the main area of industry interest has been around the Mackenzie River Delta and offshore of the Tuktoyaktuk Peninsula. This remains the case. Offshore development and production in this area likely would have greater potential to have adverse impacts on the whales than development elsewhere in the Beaufort Sea.

We refer readers to Sections V.F and VI.C.2 of the Biological Evaluation in Appendix C for more information on some of the topics raised above and on the potential cumulative effects on bowhead whales of activities related to offshore petroleum extraction.

IV.E.2.d(1)(c)4) Commercial Fishing and Marine Vessel Traffic

Potential effects on bowhead whales from commercial-fishing activities include incidental take in the fisheries and/or entanglement in derelict fishing gear resulting in death, injury, or effect on the behavior of individual whales; disturbance resulting in temporary avoidance of areas; and whales being struck and injured or killed by vessels. For further information on potential cumulative effects of commercial fishing and marine vessel traffic on bowhead whales we refer the reader to Sections V.C and VI.C.3 of the Biological Evaluation (Appendix C).

IV.E.2.d(1)(c)6) Pollution and Contaminants

In the Beaufort Sea multiple-sale EIS, we reviewed information that was available to us regarding levels of contaminants in bowhead whales. We concluded that the levels of metals and other contaminants measured in bowhead whales appear to be relatively low. Since the finalization of the multiple-sale EIS, additional information on contaminants in BCB bowheads has become available. This information supports this general conclusion. Based on the use of autometallography (AMG) to localize inorganic mercury in kidney and liver tissues for five bowhead whales, Woshner et al. (2002:209) reported that "AMG granules were not evident in bowhead tissues, confirming nominal mercury (Hg) concentrations." Detected concentrations ranged from 0.011-0.038 micrograms per gram wet weight for total mercury. Mössner and Ballschmiter (1997) reported that total levels of 310 nanograms per gram (ng/g) polychlorinated biphenyls and chlorinated pesticides in bowhead blubber from the North Pacific/Arctic Ocean, an overall level many times lower than that of other species from the North Pacific or Arctic Ocean (beluga whales [2,226 ng/g]; northern fur seals [4,730 ng/g]) and than that of species from the North Atlantic (pilot whale [6,997 ng/g]; common dolphin [39,131 ng/g]; and harbor seal [70,380 ng/g]). However, while total levels were low, the combined level of 3 isomers of the hexachlorocyclohexanes was higher in the bowhead blubber (160 ng/g per gram) tested than in either the pilot whale (47 ng/g), the common dolphin (130 ng/g), and the harbor seal (140 ng/g). The NMFS (2003:17) cited an unpublished study by Willetto et al. (2002) that indicated that there may be differences in the vertical distribution of organochlorines as well as lipid content among differ strata of blubber in bowhead whales. The NMFS (2003) cites this same study as indicating that organochlorine levels fluctuated consistently with seasonal migration between the Beaufort and Bering Seas and in water along the bowhead's migratory path (NMFS, 2003). These results confirmed results expected due to the lower trophic level of the bowhead relative to the other marine mammals tested.

We refer the reader to Sections V.E and VI.C.6 of the Biological Evaluation (Appendix C) for more detailed information on potential cumulative effects of pollution and contaminants on this stock.

IV.E.2.d(1)(c)7) Research Activities

The Western Arctic bowhead has been the focus of research activities that could, in some instances, cause harassment and, possibly, temporary displacement of individual whales. Such activities could add to cumulative levels of noise in the whales' environment. At present, available information does not indicate that such noise is having behavioral or physiological adverse effects on the bowheads in this stock. We are not aware of any information that suggests long-term displacement from important habitats or that would indicate the population is suffering any significant population-level effect from any single effector, or that the cumulative effects, including from this source, would have such an effect.

The cumulative effects of studies and research activities are further discussed and summarized in Sections V.D. and VI.C.5 of the Biological Evaluation (Appendix C). The MMS is continuing to evaluate information about cumulative effects from research activities as it becomes available.

Summary: The best available information on past, current, and reasonably foreseeable anthropogenic actions on the Western Arctic stock of bowhead whales supports the conclusion that it is unlikely that there would be significant cumulative impacts on the Western Arctic stock of bowhead whales over the lifetime of the proposed project. The incremental contribution of Sale 195 to the cumulative effects likely would be small. While there is uncertainty about the exact level and nature of potential effects that presently may be associated with, or that could result from, particular activities or effectors, available data indicate that this population is robust and is increasing at a healthy rate. It is highly unlikely to become extinct over the next 100 years (Shelden et al., 2001). This population also is highly regulated and relatively well monitored. Whatever adverse effects it currently is suffering, or historically has suffered, from human activities, there is no indication such effectors currently have important adverse effects on this population. There are multiple regulatory tools available to adequately protect this population from many of the potential adverse human-related effects.

Most effects are not expected to be additive or synergistic, as many of the potential effects would be expected to occur in different areas and, by chance, affect different individuals. However, we acknowledge some uncertainty about this conclusion. If certain activities were clustered in space (for example, shipping and offshore petroleum development both increase in the area of the Beaufort Sea offshore of the Mackenzie River where bowheads commonly aggregated to feed in the summer), there could be additive or synergistic effects on this population. This would be particularly true if there is a threshold level of noise/disturbance that causes bowheads, or some key component of the bowhead population, to avoid an area that otherwise would hold benefit to them.

Conclusion: We still conclude that cumulative effects on this population are of primary concern and, thus, warrant continued close attention and effective mitigation practices.

IV.E.2.e. Other Resources (Other Marine Mammals, Fishes and Essential Fish Habitat, etc.)

The multiple-sale EIS concludes generally with regard to cumulative effects on other resources "that potential cumulative effects on … Boulder Patch kelp habitat, polar bears, and caribou would be of primary concern…."

IV.E.2.e(1) Other Marine Mammals

Beaufort Sea Sale 195 and other ongoing or planned projects (Map 1) also may affect ringed and bearded seals, walruses, beluga and gray whales, polar bears, and caribou by causing noise and disturbance, altering habitat, and accidentally spilling oil. The Beaufort Sea multiple-sale EIS contains detailed assessments of the cumulative effects of oil and gas activities on these animals (USDOI, MMS, 2003a), concluding in Section V.A.6 that the "(p)otential cumulative effects on…polar bear…would be a primary concern and warrant continued close attention and effective mitigation practices."

IV.E.2.e(1)(a) Effects of Noise and Disturbance and Habitat Alteration

Only three "lethal takes" of polar bears were related to industrial activities on the North Slope over the past 20 years (Gorbics, Garlich-Miller, and Schliebe, 1998). These small, detectable losses of polar bears have had no effect on the population. More than 40 exploration-drilling units (gravel islands, drill ships, and other platforms) have been installed or constructed in the Beaufort Sea as a result of past Federal and State oil and gas leases. These activities may have displaced a few bears during island construction but have had no detectable effect on the polar bear population. The FWS concluded that existing onshore development, proposed exploration activities, and the Northstar development would have negligible effects on polar bears (65 *FR* 16828).

Development would alter a small amount of the habitat for Sale 195's one production island versus an estimated 40 past or existing exploration and production platforms in the Beaufort Sea. These platforms have not had any apparent lasting additive or synergistic effect on seal, walrus, beluga whale, gray whale, and polar bear distribution and abundance in the Beaufort Sea. The number of production platforms in the Beaufort Sea over the next 20 years is uncertain, but an optimistic estimate would be about eight, which includes six from Sales 186 and 195, Liberty, and Northstar. That number is expected to have little or no effect on the ice habitats of seals and polar bears in the Beaufort Sea.

Sale 195 is expected to contribute about 2-4% of the local short-term noise and disturbance effects on seals and polar bears (based on 10-20 flights per day/450 helicopter roundtrips/day during busy construction periods on the North Slope). Activities from Sale 195 should only briefly and locally disturb or displace a few seals, walruses, beluga and gray whales, and polar bears. A few polar bears could be temporarily attracted to the production island, with no significant effects on the population's distribution and abundance.

IV.E.2.e(1)(b) Effects of Oil Spills

Over their lifetime, fields from Sale 195 would contribute a mean (0.11) number of spills to potential offshore oil spills and potential effects on seals and polar bears. The estimated mean number of cumulative offshore spills is 0.65, but the most likely number of offshore spills is 1 (USDOI, MMS, 2003a). The contribution of spilled oil from Sale 195 is estimated at 0.11 spills, with the most likely number of spills being zero (USDOI, MMS, 2003a). The estimated 6-10 or fewer polar bears lost to a large (greater than or equal to 1,000-bbl) spill assumed under the cumulative analysis represents a severe event. The more likely loss of polar bears from Sale 195 development would be fewer than six bears, assuming a bear density of one bear per 25 km^2 (Amstrup, Durner, and McDonald, 2000). In the likely cumulative case, pinnipeds, polar bear, and beluga and gray whale populations in the Beaufort Sea Planning Area are expected to recover within 1 year, assuming one large spill (greater than or equal to 1,000 bbl) occurs. Sale 195 is expected to contribute 0.41 spills and about an equal fraction of the potential oil-spill effects on other marine mammals along the tanker route to the U.S. west coast. Potential cumulative oil spills along the tanker route to the U.S. west coast could have long-term (more than perhaps 5-10 years) effects on sea otters and other marine mammals.

IV.E.2.e(1)(c) Effects of Persistent Organic Pollutants

Persistent organic pollutants, through their ability to partition between the atmosphere gas phase and a particle or liquid phase are capable of reentering the atmosphere once deposited to the earth's surface (Barrie et al., 1992). This spreads these contaminants over a large part of the world, making them truly global pollutants. Marine mammals in the temperate northern hemisphere, particularly fish-eating species of the midlatitudes of Europe and North America , show the greatest organochlorine levels with extremely high levels found in the Mediterranean Sea and certain locations on the west coast of the U.S. (Aguilar, Borrell, and Reijnders, 2002). The polar regions have shown the lowest levels of DDT's and PCB's but moderate to high levels of HCH's, chlordanes, and HCB in the cold waters of the North Pacific (Aguilar, Borrell, and Reijnders, 2002). During recent decades, concentrations have tended to decrease in the regions where pollution was initially high but have increased in the polar regions far from most of the pollution sources as a consequence of atmospheric and oceanic transport and redistribution (Andersen et al., 2001; Aguilar, Borrell, and Reijnders, 2002). It is likely that the Arctic, and to a lesser extent the Antarctic, will become major sinks for organochlorines in the future (Proshutinsky and Johnson, 2001; Aguilar, Borrell, and Reijnders, 2002).

The contaminants of greatest concern are persistent lipophilic organic pollutants such as organochlorines that are resistant to biodegradation and biomagnify up the food chain (Andersen et al., 2001). Polar bears, because of their high-fat diet of mostly sealskin and blubber, and because of their position at the top of the arctic food chain, are biological sinks for lipophilic organochlorine 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). In the Antarctic, high levels were found in the eggs of south polar skua (Kumar et al., 2002). Within polar bear populations, the highest levels of PCB's were found in Svalbard, Norway and east Hudson Bay, with lower levels found in polar bears in the Barrow area and in the Chukchi Sea (Andersen et al. 2001; Kucklick et al., 2002). However, higher pesticide levels were found in bears from the western Chukchi Sea-Russian Arctic and the Norwegian Arctic (Lie et al., 2003).

Organochlorines were shown to adversely affect marine mammal reproduction and immune systems in temperate regions (Aguilar, Borrell, and Reijnders, 2002). A decline in the survival of polar bear cubs in Svalbard, Norway may be related to the high levels of PCB's in the population that are passed from mother to cub through the placenta and in the milk (Cone, 2003). In Svalbard polar bears, plasma PCB levels were associated with immunoglobulin decrease, and PCB concentrations were within the same order as tissue levels in experimental animals where immunotoxic effects or reduced immune response and infection resistance were found (Bernhoft et al., 2000). High levels of PCB's may be associated with retinol (vitamin A) deficiency and reduced thyroid hormone levels in Svalbard polar bears (Skaare et al., 2001). Levels of PCB's have been correlated with adverse reproductive effects in polar bears (Norstrom, 1995).

The role that organochlorine pollutants might play in affecting arctic marine mammal populations is unknown. Marine mammal populations, particularly polar bears, biomagnify concentrations of PCB's in their tissues because of their position at the top of the arctic food chain and because of their predominant diet of seal blubber, the tissue that PCB's accumulate in (Norstrom et al., 1988). Polar bear populations with very high levels of PCB's could be adversely affected by a disease outbreak due to suppression of their immune system from high levels of PCB's (Bernhoft et al. 2000). The populations also could be adversely affected with possible thyroid hormone and retinol deficiency and reproductive abnormalities, which could affect the survival of polar bear clubs (Skaare et al., 2001; Norstrom, 1995).

The overall effects (mainly from one oil spill assumed for this analysis) is the potential loss of perhaps up to 10 polar bears and a few hundred seals and walruses, and small numbers (probably fewer than 10) of beluga and gray whales. In the likely cumulative case, pinniped, polar bear, and beluga and gray whale populations are expected to recover within 1 year, assuming only one large spill (greater than or equal to 1,000 bbl) occurs. Potential cumulative oil spills along the tanker route to the U.S. west coast could have long-term (more than one generation or perhaps 5-10 years) effect on sea otters and perhaps harbor seals and other marine mammals. Cumulative noise and disturbance in the Beaufort Sea Planning Area is expected to briefly and locally disturb or displace a few seals, walruses, beluga and gray whales, and polar bears. A few polar bears could be temporarily attracted to the production island, with no significant effects on the population's distribution and abundance. Persistent organic pollutants have accumulated in arctic marine mammals, especially polar bears. These pollutants (particularly organochlorines) have biomagnified in the blubber of marine mammals, with the highest levels found in polar bears and seal-eating walruses. High levels of organochlorines have been associated with adverse effects on polar bear reproduction, immune-system response, and hormone levels. Persistent organic pollutants have the potential to affect polar populations in the next 20-30 years.

The contribution of Sale 195 is expected to be about 2-4% of the local, short-term disturbance and habitat effects on pinnipeds, polar bears, and beluga and gray whales (based on 0.46-Bbbl/11.5-Bbbl oil reserves in Table V-12 of the multiple-sale EIS). The Proposed Action for Sale 195 likely would contribute about 17% of cumulative offshore spills. The estimated mean number of cumulative offshore spills is 0.65, but the most likely number of offshore spills is zero (USDOI, MMS, 2003a).

Conclusion: Because of the effects of spills' persistent organic pollutants, we still conclude that the potential cumulative effect on polar bears would be a primary concern and warrants continued close attention and effective mitigation practices.

IV.E.2.e(2) Fishes and Essential Fish Habitat

Past, present, and future cumulative effects to fish resources and Essential Fish Habitat (EFH) may result in reasonable and foreseeable activities in or near the Beaufort Sea from the following sources:

- commercial, subsistence, and sport fishing
- community growth
- development in the Arctic
  - offshore oil and gas exploration and development, including structures, facilities, pipelines, and support vessel traffic
  - onshore oil and gas exploration and development including structures, facilities, pipelines, roads, and support vessel traffic
  - oil and diesel spills
  - military facilities and operations
  - research
- increased vessel traffic (shipping) and associated infrastructure and activities
- non-native, invasive species introductions

Section IV.I.2.c of the final multiple-sale EIS (USDOI, MMS, 2003a) evaluated the cumulative effects to fish and determined no measurable effects to fish are expected during the winter because of their very low numbers and wide area of distribution. Effects to fish and EFH are more likely to occur from an oil spill moving into nearshore waters in the summer. We concluded that "some fish in the immediate area of a spill may be killed; however, it is not expected to be a measurable effect on marine and migratory fish populations." Recovery of the fish populations to their previous levels within three generations is expected.

Factors identified for past, present, and reasonable and foreseeable future activities have the potential to alter aquatic environments in or near the Beaufort Sea. Changes may produce beneficial or adverse effects to fish resources, populations, or habitats. An adverse effect to one or several fish populations may be beneficial to others. Hence, some populations may decrease as a result of one factor, or multiple factors interacting with one another; other populations may increase due to such interactions. Additionally, one factor may depress a population, while another factor may stimulate recovery of the same population.

Rates of population decline and/or recovery are influenced by interaction factors. For example, a population of fish recovering from the impact of an offshore oil spill might recover more slowly or rapidly as a result of changes attributable to other cumulative factors.

Cumulative Impacts Analysis Conclusions. The Proposed Action has the potential to alter fish habitats and adversely impact fish populations. Offshore structures and supporting infrastructure will alter fish habitat, although it is not anticipated to result in a significant impact to fish populations. Oil spills (large or small) have the potential to adversely impact fish populations and habitat, as might other activities. Habitat alteration and disturbance associated with the cumulative effects, including the contribution of Sale 195 leases, probably would be incremental and not result in substantial impacts to fish or essential fish habitat, as concluded in the multiple-sale EIS (USDOI, MMS, 2003a:Sections V.C.3 and 4).

Impacts from activities beyond the scope of the Proposed Action may beneficially and/or adversely impact fish resources and EFH in the region. Past, present, and future exploration and development of onshore and offshore hydrocarbons in the region have the potential to alter fish habitats and adversely impact fish populations. Oil spills (large or small) from these activities have the potential to adversely impact fish populations and habitat, as may other activities. Community development and fishing pressure are anticipated to increase in the region; vessel traffic also is expected to increase. The introduction of non-native, invasive species into aquatic environments of the Beaufort Sea (chiefly nearshore and marine waters) is a concern as vessel traffic increases in the region; however, it appears premature to specify which non-native, invasive species might be capable of colonizing the harsh environmental conditions present in the region. Fish habitat in the region is expected to be increasingly modified, and fish populations are anticipated to be increasingly adversely impacted by ever-increasing human activities in the region.

Conclusion: Over the life of any fields developed on Sale 195 leases, the habitat alteration and disturbance associated probably would be incremental and not result in substantial impacts to fish or EFH.

IV.E.2.e(3). Air Quality and Other Resources

This section updates the cumulative effects on air quality, vegetation and wetlands, terrestrial mammals, and lower trophic-level organisms. With regard to air quality, the multiple-sale EIS concluded in Section V.C.15 that:

> The cumulative effects of all projects affecting the North Slope of Alaska in the past and occurring now have caused generally little deterioration in air quality, which remains better than required by national standards.

With regard to vegetation and wetlands, information on the cumulative effects was updated in the NPR-A IAP/EIS (USDOI, BLM and MMS, 2003: Section IV.F.8.g). The section includes no new information on the cumulative effects on offshore spills. The multiple-sale EIS (USDOI, MMS, 2003: Section IV.C.9.b) concluded the following with respect to the cumulative effects of offshore spills on vegetation and wetlands:

> We assume that one large offshore oil spill greater than or equal to 1,000 barrels would occur during development over the life of these potential fields. Complete recovery of oiled coastal wetlands could take several decades to fully recover from this spill and associated cleanup activities.

This conclusion in the multiple-sale EIS about the cumulative effects of spills on vegetation and wetlands is still up-to-date.

We are aware of no information that would change this conclusion. With regard to the effects of offshore spills on terrestrial mammals, the multiple-sale EIS concluded in part (Sec. V.C.8) that:

> Thus, some caribou of the Central Arctic and Teshekpuk Lake herds…could be directly contacted and harmed by a spill along the beaches and in shallow waters while they are escaping from insects. However, even in a severe situation…fewer than 100 caribou are likely to contact the spilled oil and die from inhaling and absorbing toxic hydrocarbons. Either of the caribou herds would replace these losses within 1 year.

Recent information on terrestrial mammals was summarized in EA Section IV.B.2.e(3); none of the information would change this conclusion. With respect to vegetation and wetlands, the multiple-sale EIS concluded in Section V.C.9 that:

> We assume one large offshore oil spill greater than or equal to 1,000 barrels would occur during development over the life of these potential fields. Complete recovery of oil wetlands could take several decades…from the spill and associated cleanup activities.

Cumulative oil and gas activities on the Arctic Slope of Alaska have had some local effects on the Central Arctic caribou herd's calving distribution and use of habitats with 4 km (2.48 mi) of oil field roads and other facilities. However, we are aware of no information that would change this conclusion. With respect to lower trophic-level organisms, the multiple-sale EIS concluded (Sec. V.C.2) in part that:

> One offshore oil spill greater than 1,000 barrels is assumed for the past, present, and reasonably foreseeable developments. About half of the reasonably foreseeable developments would be outside of the barrier islands, and the cumulative risk to river deltas and other sensitive portions of the coastline would not increase proportionally.

The proposed OCS sale would increase slightly the likelihood of offshore spills, but any leases from Sale 195 would probably be farther offshore than the leases from Sale 186, so the proportional risk to the river deltas, the Boulder Patch kelp community, and other sensitive portions of the coastline would be lower. In summary, recent information would not change substantially the conclusions about cumulative effects on air quality, terrestrial mammals, vegetation and wetlands, and lower trophic-level organisms.

With respect to the effects of offshore spills, the multiple-sale EIS concluded that any effect would be small and local, as summarized in EIS V. A. G including the Boulder Patch kelp community.

Conclusion: We still conclude that potential cumulative effects on the Boulder Patch kelp community would be of primary concern and warrant continued close attention.

IV.E.2.f. Environmental Justice

Alaskan Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by Sale 195 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.b, would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik.

For environmental justice, the multiple-sale EIS concludes in Section V.C.16 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.

After publication of the multiple-sale EIS, the effects of a proposed lease sale in the Northwest NPR-A and an expansion of the Alpine field were assessed (USDOI, BLM and MMS, 2003; USDOI, BLM, 2004). Sections IV.F.8.p of the NPR-A 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.

Section 4.F.7.4.1 of the Alpine draft EIS assessment summarizes the effects of an offshore spill on environmental justice; it tiers off of and reaches a similar conclusion to the Northwest NPR-A conclusion quoted herein.

Summary: The incremental contribution of Sale 195 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, and Northeast and Northwest NPR-A) and offshore (Northstar and Liberty). In the unlikely event of a large spill from Sale 195, 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 product 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 potential exists for the communities of Barrow and Kaktovik, as Beaufort Sea areawide leasing, exploration, and development proceed on- and offshore.

Sale 195 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 greater than or equal to 500 barrels 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 195 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 unlikely event of a spill from Sale 195, 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 195 to cumulative effects on 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. Disturbance effects periodically could disrupt, but not displace, ongoing social systems; community activities; and traditional practices for harvesting, sharing, and processing subsistence resources. Community activities and traditional practices for harvesting, sharing, and processing subsistence resources 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 195.

Conclusion for Environmental Justice: Because potential cumulative impacts on marine and terrestrial ecosystems in the Arctic could cause impacts on subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities on the NSB would be expected to experience disproportionate, high, adverse environmental and health effects. We still conclude that potential environmental justice effects would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik within the NSB; such cumulative impacts would be considered disproportionately high adverse effects on Alaska Natives.

IV.E.3. Summary of Cumulative Effects

The update focuses primarily on the effects of the proposed lease sale in the context of infrastructure developments. The following are the conclusions of the resource-specific cumulative assessments.

Marine and Coastal Birds: The updated information suggests, as stated in the multiple-sale EIS, that: "The incremental contribution of Sale [195] 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, production of young resulting from exposure of these species to disturbance factors, or mortality from collision with structures, warrant continued close attention and effective mitigation practices. Mortality from a large oil spill, an unlikely event, could be relatively substantial and represent a significant effect for any sea duck 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.

Subsistence-Harvest Patterns and Sociocultural Systems: The incremental contribution of Sale 195 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, and Northeast and Northwest NPR-A) and offshore (Northstar and Liberty). In the unlikely event of a large spill from Sale 195, 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 increasing 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. This potential exists for the communities of Barrow and Kaktovik, as Beaufort Sea areawide leasing, exploration, and development proceed on- and offshore. Potential Environmental Justice effects would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik; 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.

Because the occurrence of a large oil spill is unlikely, attaining a level of significant effect also is unlikely. These conclusions and updated levels of effect on subsistence-harvest patterns, sociocultural systems, and Environmental Justice would be the same as in the multiple-sale EIS. We still conclude that potential cumulative effects on subsistence and sociocultural systems would be significant, warrant continued close attention, and effective mitigation practices. Also, we still conclude that potential environmental justice effects would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik within the NSB; such cumulative impacts would be considered disproportionately high adverse effects on Alaskan Natives.

Local Water Quality: Cumulative effects on water quality were assessed also for an NRC review of the cumulative effects of oil and gas activities on the North Slope. The NRC review included the cumulative effects of operations in the nearshore Beaufort Sea, such as the bowhead whale migration corridor. The summary chapter includes information on the cumulative effects of permitted construction and accidental oil spills, but does not document any cumulative effects. With respect to permitted construction, the summary chapter states that many facilities have been abandoned without complete removal (for example, the artificial islands named Niakuk, Sag, Duck, Resolution, Endeavor, etc.). However, the review does not describe any cumulative environmental effects of the abandoned facilities. With respect to accidental spills, the chapter explains that, although no large oil spills have occurred in the marine waters off the North Slope, their potential is such a major concern that the committee suggests research into mitigation.

The Proposed Action for Sale 195 likely would contribute about 17% of cumulative offshore spills. The estimated mean number of cumulative offshore spills is 0.65; for purposes of analysis, we assess the effects of one spill. We still conclude that the cumulative effects, including the contribution of Sale 195 leases, would be no greater than the effects of the Proposed Action, assessed in Section IV.C.1.c.

Bowhead Whales: The best available information on past, current, and reasonably foreseeable anthropogenic actions on the Western Arctic stock of bowhead whales supports the conclusion that it is unlikely that there would be significant cumulative impacts on the Western Arctic stock of bowhead whales over the lifetime of the proposed project. The incremental contribution of Sale 186 to the cumulative effects likely would be small. While there is uncertainty about the exact level and nature of potential effects that presently may be associated with, or that could result from, particular activities or effectors, available data indicate that this population is robust and is increasing at a healthy rate. It is highly unlikely to become extinct over the next 100 years (Shelden et al., 2001). This population also is highly regulated and relatively well monitored. Whatever adverse effects it currently is or historically has suffered from human activities, there is no indication such effectors currently have important adverse effects on this population. There are multiple regulatory tools available to adequately protect this population from many of the potential adverse human-related effects.

Most effects are not expected to be additive or synergistic, as many of the potential effects would be expected to occur in different areas and, by chance, affect different individuals. However, we acknowledge some uncertainty about this conclusion. If certain activities were clustered in their space (for example, shipping and offshore petroleum development both increase in the area of the Beaufort Sea offshore of the Mackenzie River where bowheads commonly aggregated to feed in the summer), there could be additive or synergistic effects on this population. This would be particularly true if there is a threshold level of noise/disturbance that causes bowheads, or some key component of the bowhead population, to avoid an area that otherwise would hold benefit to them. We still conclude that cumulative effects on bowhead whales are of primary concern and, thus, warrant continued close attention and effective mitigation practices.

Other Resources: With regard to other marine mammals, the contribution of Sale 195 is expected to be about 2-4% of the local short-term disturbance and habitat effects on pinnipeds, polar bears, and beluga and gray whales (based on 0.46-Bbbl/11.5-Bbbl oil reserves in Table V-12 of the multiple-sale EIS). The Proposed Action for Sale 195 likely would contribute about 17% of cumulative offshore spills. The estimated mean number of cumulative offshore spills is 0.65, but the most likely number of offshore spills is zero (USDOI, MMS, 2003a). We still conclude that potential cumulative effects on polar bears would be a primary concern.

With regard to fishes, the Proposed Action has the potential to alter their habitats and adversely impact populations. Offshore structures and supporting infrastructure will alter fish habitat, although it is not anticipated to result in a significant impact to fish populations. Oil spills (large or small) have the potential to adversely impact fish populations and habitat, as may other activities. Habitat alteration and disturbance associated with the Proposed Action are assumed to be incremental and not result in significant impacts.

Impacts from activities beyond the scope of the Proposed Action may beneficially and/or adversely impact fish resources and essential fish habitat in the region. Past, present, and future exploration and development of onshore and offshore hydrocarbons in the region have potential to alter fish habitats and adversely impact fish populations. Oil spills (large or small) from these activities have potential to adversely impact fish populations and habitat, as may other activities. Community development and fishing pressure are anticipated to increase in the region, as is vessel traffic expected to increase. The introduction of non-native, invasive species into aquatic environments of the Beaufort Sea (chiefly nearshore and marine waters) is a concern as vessel traffic increases in the region, however, it appears premature to specify what non-native, invasive species might be capable of colonizing the harsh environmental conditions present in the region. If ship traffic increases, such colonization by invasive species introduced by vessels may become more likely. Fish habitat in the region is expected to be increasingly modified, and fish populations are anticipated to be increasingly adversely impacted by ever-increasing human activities in the region.

Recent information would not change substantially the conclusions about cumulative effects about air quality, vegetation and wetlands, and terrestrial mammals. We still conclude that potential cumulative effects on the Boulder Patch kelp community are a primary concern.

Environmental Justice: Potential Environmental Justice effects would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik; 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 the subsistence practices are factored together. Such impacts would be considered disproportionately high adverse effect 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 harvest are expected to be mitigated substantially though not eliminated. Because the occurrence of a large oil spill is unlikely, attaining a high adverse effect on Alaskan Natives also is unlikely. The conclusions and updated levels of effect on Environmental Justice would be the same as in the multiple-sale EIS.

IV.F. Overall Summary of Section IV

As explained in Section IV.B.1, 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; however, with respect to the effects of a large oil spill, it concluded that: “In the unlikely event of such an oil spill, significant adverse effects could occur to local water quality, common, spectacled and Steller’s eiders; long-tailed ducks, subsistence harvests and sociocultural systems.”

This EA, updating the assessment for proposed Lease Sale 195 (Section IV.C.2), concludes that no new significant impacts were identified for the proposed lease sale that were not already assessed in the multiple-sale EIS.

As noted in the introduction to EA Section IV.E, a general conclusion in the multiple-sale EIS about cumulative effects (EIS Section V.A.6) is that potential cumulative effects on the bowhead whale, subsistence, sociocultural systems, spectacled eider, Boulder Patch kelp habitat, polar bears, and caribou would be of primary concern and warrant continued close attention and effective mitigation practices. We still conclude that these species warrant continued close attention and effective mitigation practices.

The assessment in this EA includes some projected effects of climate change (Appendix I). Based on the latter analyses, 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.

V. CONSULTATION AND COORDINATION

The consultation and coordination for the multiple-sale EIS was very extensive, as summarized in Section VI of the EIS (USDOI, MMS, 2003a). There was additional written and other communication for proposed Lease Sale 195.

The written communication is summarized in Appendix F. As explained in the appendix, the communication included the publication of a Request for Information and Notice of Intent (NOI) to prepare an EA that was published in the *Federal Register* on December 16, 2003. The Request for Information requested comments on any significant new information that has become available since the MMS issued its February 2003 Beaufort Sea multiple-sale EIS. Three comments were received in response to the Request for Information and Notice of Intent. They were received from the State of Alaska, Office of Project Management and Permitting; the Mayor of the NSB; and the Executive Director of the Alaska Eskimo Whaling Commission. The comments and MMS responses to them are summarized in Appendix F.

The other communications for proposed Lease Sale 195 is summarized in Appendices G and H. Appendix G contains summaries of the following three meetings: Government-to-Government Meeting with the Inupiat Community of the Arctic Slope (ICAS) in Barrow on February 5, 2004, an MMS meeting with the NSB and AEWC in Anchorage on February 10, 2004, and an MMS meeting with the NSB and ICAS in Anchorage on May 28, 2004.

During the information-gathering process for proposed Lease Sale 195, representatives from the NSB, AEWC and ICAS requested that MMS evaluate the potential effects of oil and gas activities at two specific areas that are in and “upstream” of traditional subsistence whaling areas: near Cross Island and the leased areas off Smith Bay. The assessment of leased areas off Smith Bay would be outside of the scope of the National Environmental Policy Act assessment for proposed Sale 195, so a separate evaluation, *Evaluation of Potential Impacts on Subsistence Whaling from MMS-Permitted Activities in the Cross Island and Smith Bay Areas*, was prepared and is contained in Appendix H.

VI. REFERENCES CITED

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Table III.A-1
Possible Sales-Related Activities, (Updated with the Percentage of Leases Issued during Sale 186)

	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.A-2.
Representative Development Schedule for Sale 195 (the same as USDOI, MMS, Alaska OCS Region, 2003a: Table IV.A-2)

Year	Exploration Wells	Delineation Wells	Exploration Drilling Rigs	Production Platforms	Production Wells	Injection Wells	Production Drilling Rigs	Offshore Pipelines (miles)	New Shore Bases	Field #1 Oil Production (MMbbl)	Field #2 Oil Production (MMbbl))	Combined Oil Production (MMbbl)	Cumulative Oil Production (MMbbl)
2003	—	—	—	—	—	—	—	—	—	—	—	—	—
2004	—	—	—	—	—	—	—	—	—	—	—	—	—
2005	—	—	—	—	—	—	—	—	—	—	—	—	—
2006	—	—	—	—	—	—	—	—	—	—	—	—	—
2007	1	—	1	—	—	—	—	—	—	`—	—	—	—
2008	1	—	1	—	—	—	—	—	—	—	—	—	—
2009	—	2	1	—	—	—	—	—	—	—	—	—	—
2010	1	—	1	—	—	—	—	—	—	—	—	—	—
2011	—	—		—	—	—	—	—	—	—	—	—	—
2012	2	—	2	1	3	3	1	10	—	—	—	—	—
2013	1	2	2	—	10	4	1	—	—	7.9	—	7.9	7.9
2014	—	2	1	—	10	4	1	—	—	15.7	—	15.7	23.6
2015	—	—	—	—	—	—	—	—	—	15.7	—	15.7	39.3
2016	—	—	—	1	3	3	1	30	—	15.7	—	15.7	55.1
2017	—	—	—	1	13	7	2	—	—	13.0	21.5	34.5	89.5
2018	—	—	—	—	20	8	2	—	—	10.7	28.6	39.4	128.9
2019	—	—	—	—	10	4	1	—	—	8.8	28.6	37.5	166.3
2020	—	—	—	—	—	—	—	—	—	7.3	28.6	35.9	202.3
2021	—	—	—	—	—	—	—	—	—	6.0	28.6	34.7	236.9
2022	—	—	—	—	—	—	—	—	—	5.0	28.6	33.6	270.5
2023	—	—	—	—	—	—	—	—	—	4.1	25.2	29.3	299.8
2024	—	—	—	—	—	—	—	—	—	3.4	22.2	25.6	325.4
2025	—	—	—	—	—	—	—	—	—	2.8	19.5	22.3	347.7
2026	—	—	—	—	—	—	—	—	—	2.3	17.2	19.5	367.2
2027	—	—	—	—	—	—	—	—	—	1.9	15.1	17.0	384.2
2028	—	—	—	—	—	—	—	—	—	—	13.3	13.3	397.5
2029	—	—	—	—	—	—	—	—	—	—	11.7	11.7	409.2
2030	—	—	—	—	—	—	—	—	—	—	10.3	10.3	419.5
2031	—	—	—	—	—	—	—	—	—	—	9.1	9.1	428.6
2032	—	—	—	—	—	—	—	—	—	—	8.0	8.0	436.5
2033	—	—	—	—	—	—	—	—	—	—	7.0	7.0	443.6
2034	—	—	—	—	—	—	—	—	—	—	6.2	6.2	449.7
2035	—	—	—	—	—	—	—	—	—	—	5.4	5.4	455.2
2036	—	—	—	—	—	—	—	—	—	—	4.8	4.8	460.0
2037	—	—	—	—	—	—	—	—	—	—	—	—	—
—	6	6	—	3	69	33	—	40	—	120	340	460	—

Source:
USDOI, MMS, Alaska OCS Region**.**
Notes:
Each oil-production column represents annual production from a single field. There are two fields assumed for this sale. A combined production stream and cumulative production stream are also provided. All other activities represent a sum of activities associated with these two fields.

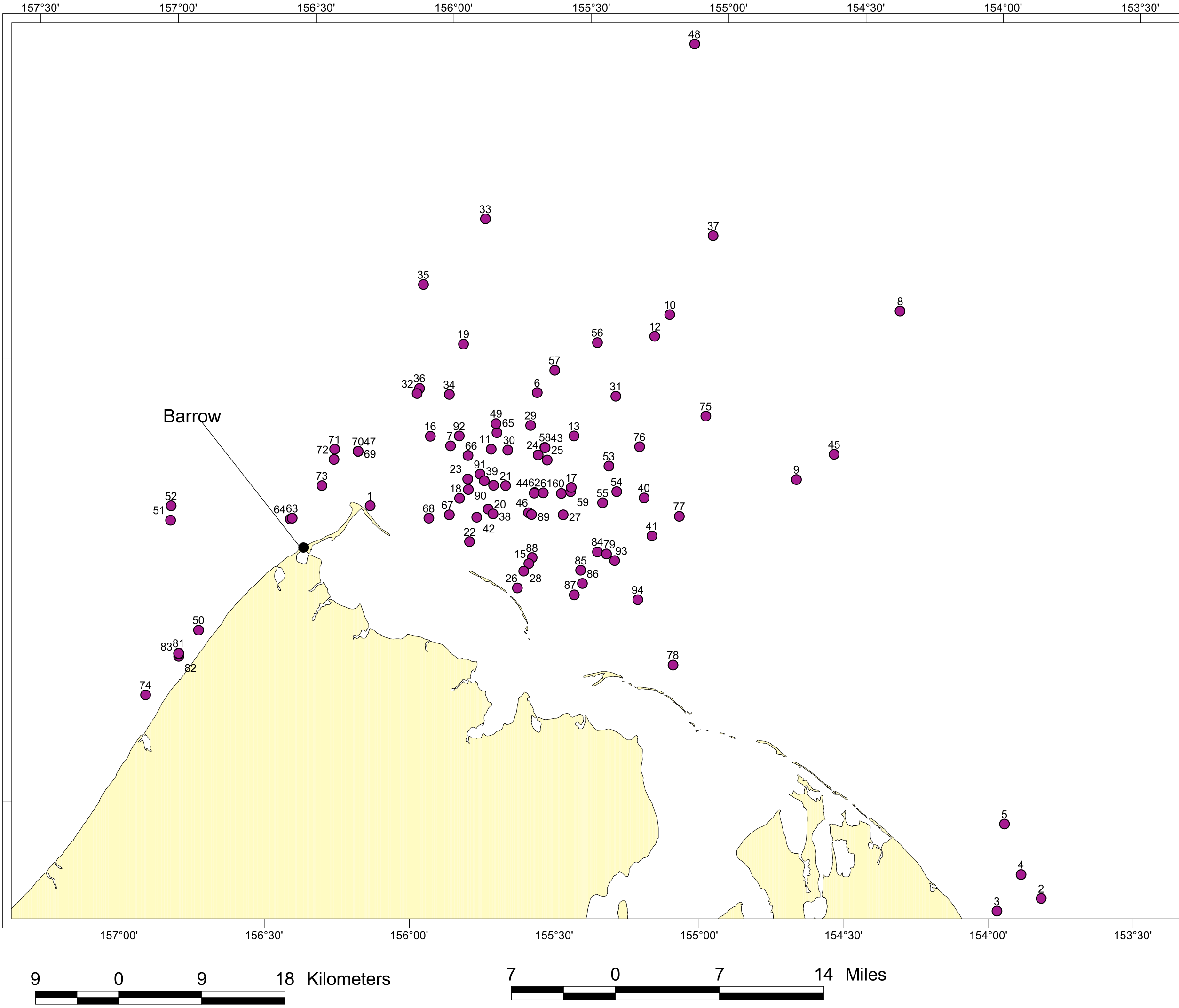
Table IV.E-1
Bowhead Whale Takes by Alaska Natives, 1978-2002

Year	Harvested	Struck/Lost	Total Take
1978	12	6	18
1979	12	15	27
1980	16	18	34
1981	17	11	28
1982	8	11	19
1983	9	9	18
1984	12	13	25
1985	11	6	17
1986	20	8	28
1987	22	9	3
1988	23	6	29
1989	18	8	26
1990	30	14	44
1991	27	19	46
1992	38	12	50
1993	41	11	52
1994	34	12	46
1995	43	14	57
1996	39	5	44
1997	48	18	66
1998	41	13	54
1999	42	5	47
2000	35	12	47
2001	49	26	75
2002	39[6]	11	50

Note:
In addition, 5 landed Western Arctic bowhead whales are included in the annual quota for takes by Chukotka Natives in Russia under the IWC quota for the Western Arctic bowhead stock, (IWC, 1988).

Data from: NMFS (2003;15-16)

[6] This number includes 2 animals which were abandoned due to weather.



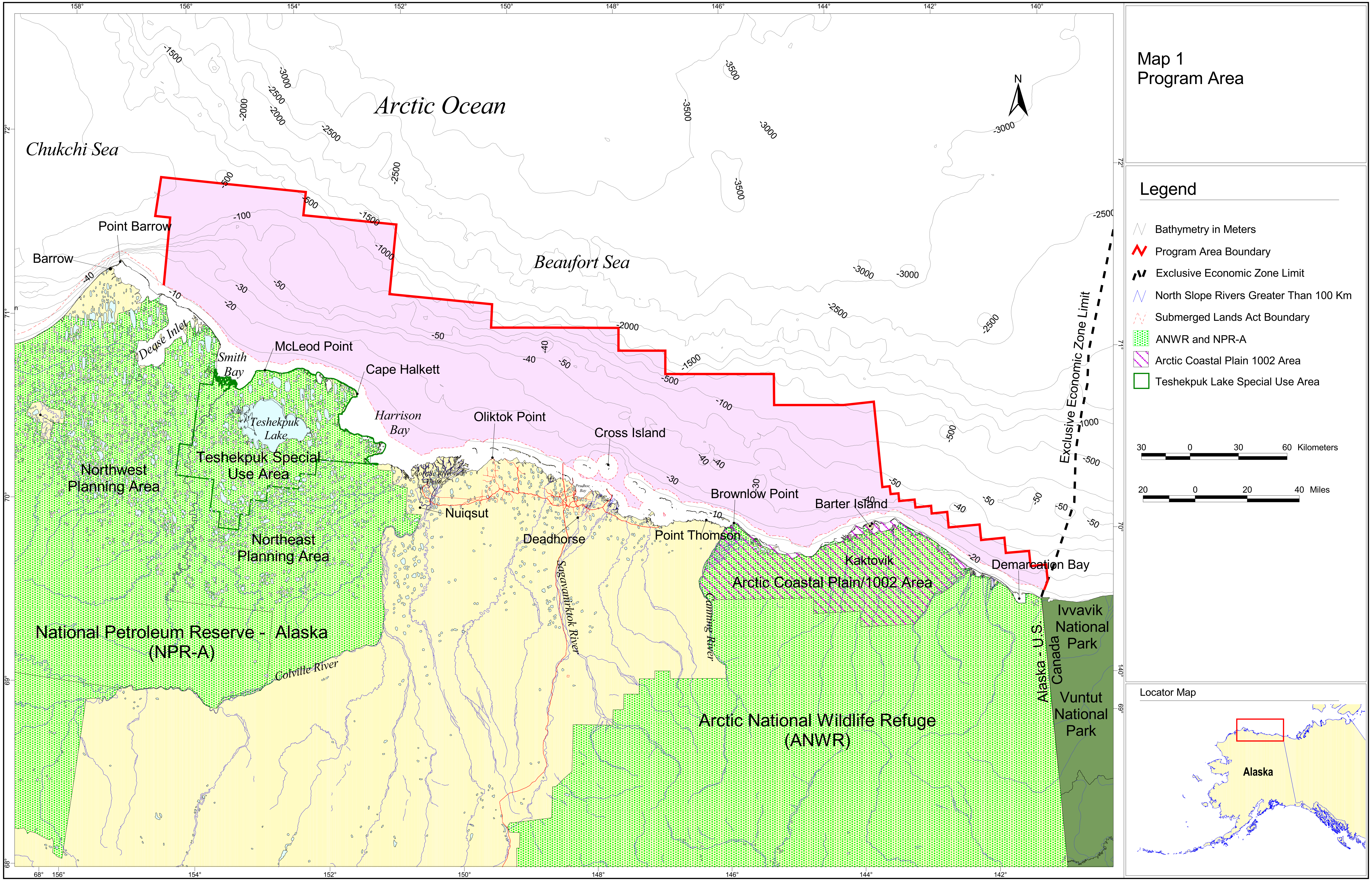
Numbe	Id	Year
74	98B3	1998
83	98B8	1998
82	98B9	1998
81	98B7	1998
80	98B6	1998
50	97B10	1997
51	97B6	1997
52	97B3	1997
64	97B4	1997
63	97B5	1997
73	98B1	1998
72	97B4	1997
71	97B1	1997
70	97B5	1997
47	97B7	1997
69	97B8	1997
68	97B21	1997
67	97B20	1997
66	97B23	1997
65	97B17	1997
49	97B18	1997
46	97B13	1997
62	97B27	1997
61	97B14	1997
60	97B25	1997
59	97B23	1997
58	97B15	1997
57	97B19	1997
56	97B26	1997
55	97B11	1997

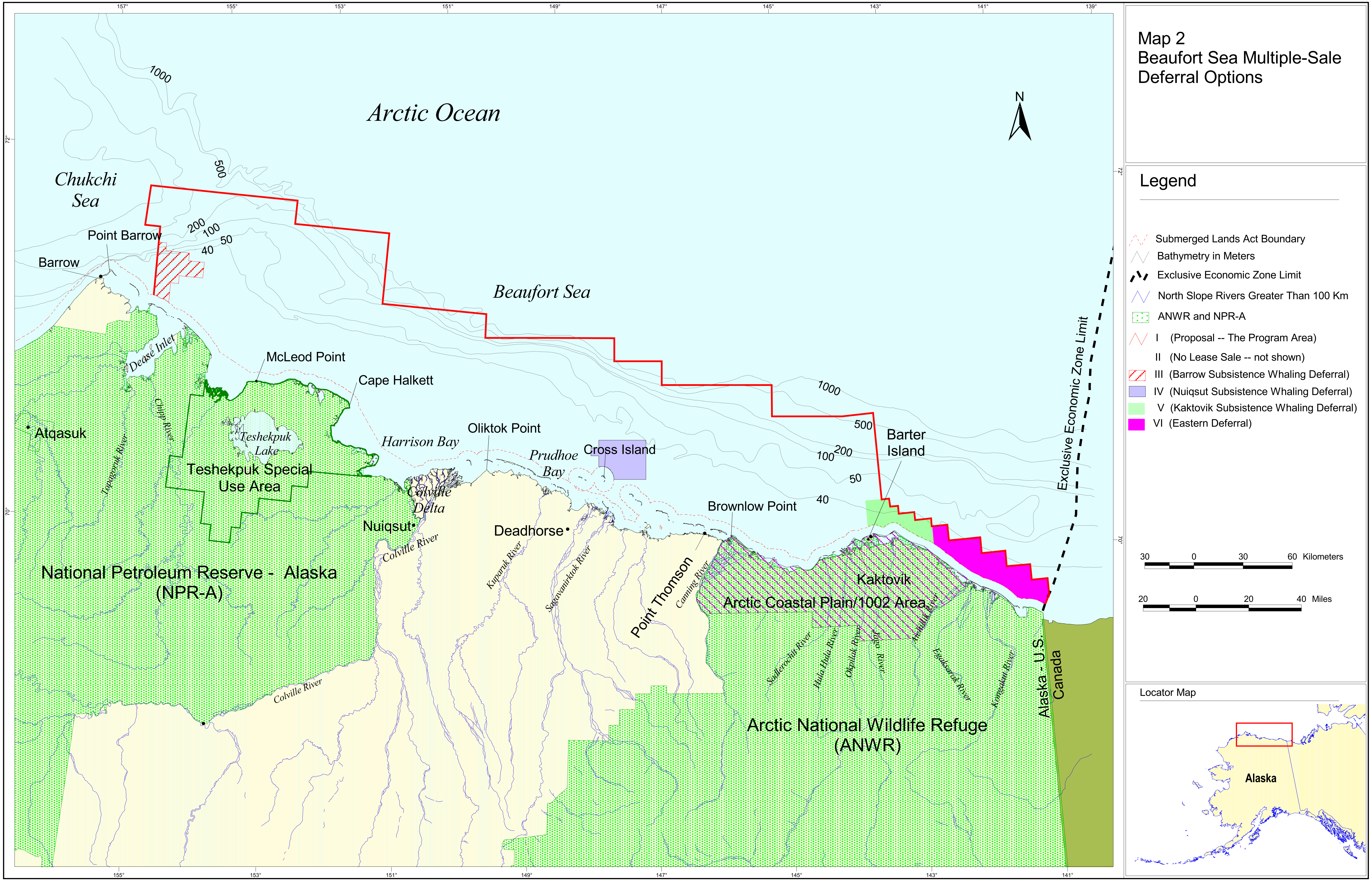
Numbe	Id	Year
74	98B3	1998
83	98B8	1998
82	98B9	1998
81	98B7	1998
80	98B6	1998
50	97B10	1997
51	97B6	1997
52	97B3	1997
64	97B4	1997
63	97B5	1997
73	98B1	1998
72	97B4	1997
71	97B1	1997
70	97B5	1997
47	97B7	1997
69	97B8	1997
68	97B21	1997
67	97B20	1997
66	97B23	1997
65	97B17	1997
49	97B18	1997
46	97B13	1997
62	97B27	1997
61	97B14	1997
60	97B25	1997
59	97B23	1997
58	97B15	1997
57	97B19	1997
56	97B26	1997
55	97B11	1997
54	97B12	1997

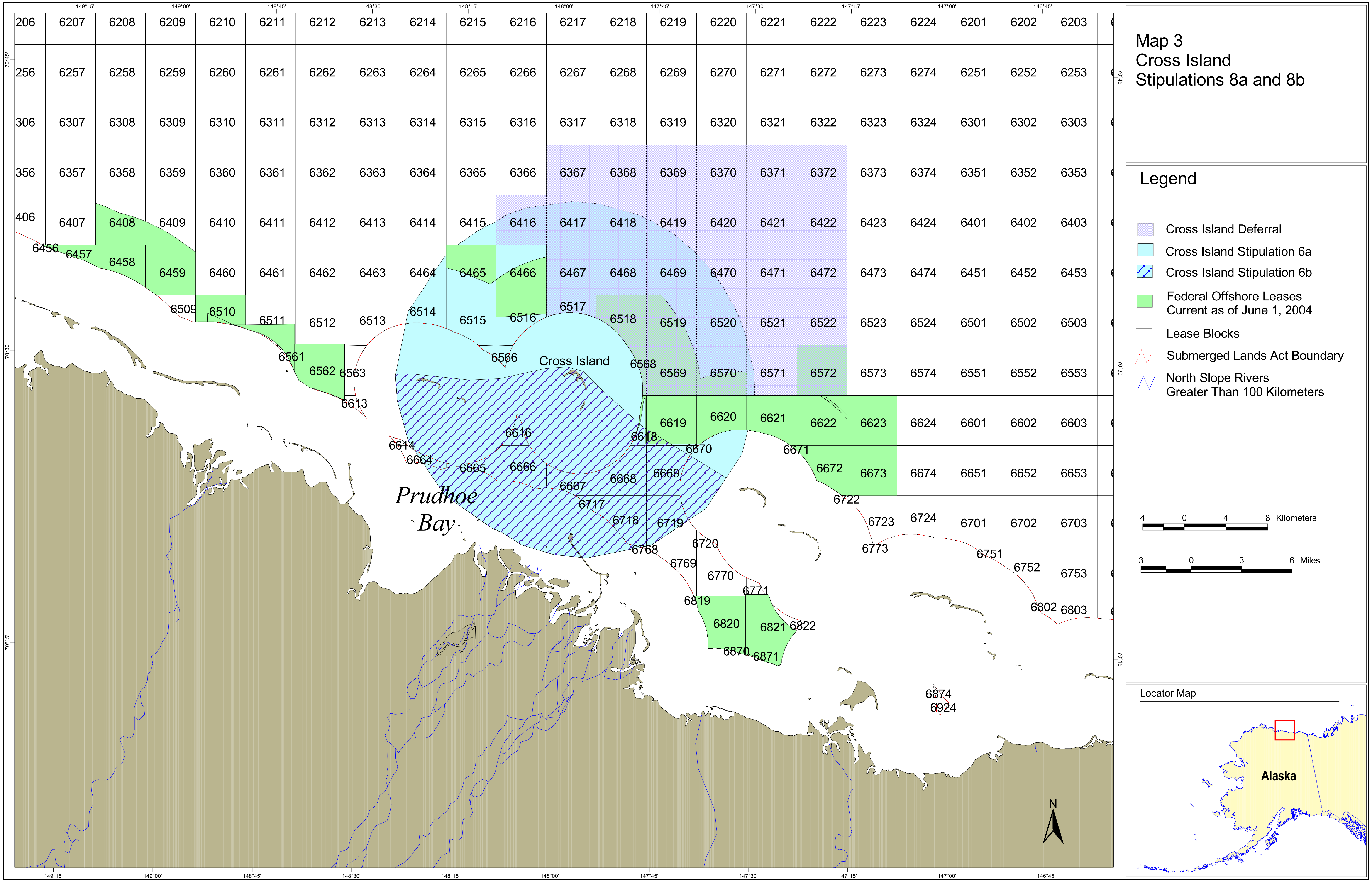
Numbe	Id	Year
74	98B3	1998
83	98B8	1998
82	98B9	1998
81	98B7	1998
80	98B6	1998
50	97B10	1997
51	97B6	1997
52	97B3	1997
64	97B4	1997
63	97B5	1997
73	98B1	1998
72	97B4	1997
71	97B1	1997
70	97B5	1997
47	97B7	1997
69	97B8	1997
68	97B21	1997
67	97B20	1997
66	97B23	1997
65	97B17	1997
49	97B18	1997
46	97B13	1997
62	97B27	1997
61	97B14	1997
60	97B25	1997
59	97B23	1997
58	97B15	1997
57	97B19	1997
56	97B26	1997
55	97B11	1997
54	97B12	1997
53	97B24	1997
48	97B30	1997

Sources: long, 1996: North Slope Borough Planning Dept., 1993; Bowhead Strikes 1937-2001

Figure I Bowhead Whale harvest Locations Near Barrow.


Map 1
Program Area
Legend
Bathymetry in Meters
Program Area Boundary
Exclusive Economic Zone Limit
North Slope Rivers Greater Than 100 Km
Submerged Lands Act Boundary
ANWR and NPR-A
Arctic Coastal Plain 1002 Area
Teshekpuk Lake Special Use Area
30 0 30 60 Kilometers
20 0 20 40 Miles
Locator Map
Alaska
Arctic Ocean
Chukchi Sea
Beaufort Sea
Point Barrow
Barrow
Dease Inlet
Smith Bay
McLeod Point
Cape Halkett
Harrison Bay
Teshekpuk Lake
Teshekpuk Special Use Area
Northwest Planning Area
Northeast Planning Area
National Petroleum Reserve - Alaska (NPR-A)
Colville River
Oliktok Point
Cross Island
Nuiqsut
Deadhorse
Sagavanirktok River
Point Thomson
Brownlow Point
Canning River
Barter Island
Kaktovik
Arctic Coastal Plain/1002 Area
Demarcation Bay
Arctic National Wildlife Refuge (ANWR)
Exclusive Economic Zone Limit
Alaska - U.S. Canada
Ivvavik National Park
Vuntut National Park
N


Map 2
Beaufort Sea Multiple-Sale Deferral Options
Legend
Submerged Lands Act Boundary
Bathymetry in Meters
Exclusive Economic Zone Limit
North Slope Rivers Greater Than 100 Km
ANWR and NPR-A
I (Proposal -- The Program Area)
II (No Lease Sale -- not shown)
III (Barrow Subsistence Whaling Deferral)
IV (Nuiqsut Subsistence Whaling Deferral)
V (Kaktovik Subsistence Whaling Deferral)
VI (Eastern Deferral)
30 0 30 60 Kilometers
20 0 20 40 Miles
Locator Map
Alaska
Arctic Ocean
Chukchi Sea
Beaufort Sea
N
Point Barrow
Barrow
Dease Inlet
McLeod Point
Cape Halkett
Atqasuk
Teshekpuk Lake
Teshekpuk Special Use Area
Harrison Bay
Oliktok Point
Prudhoe Bay
Cross Island
Colville Delta
Nuiqsut
Deadhorse
Brownlow Point
Barter Island
Kaktovik
Point Thomson
National Petroleum Reserve - Alaska (NPR-A)
Arctic Coastal Plain/1002 Area
Arctic National Wildlife Refuge (ANWR)
Exclusive Economic Zone Limit
Alaska - U.S.
Canada
Topagoruk River
Chipp River
Colville River
Kuparuk River
Sagavanirktok River
Canning River
Sadlerochit River
Hula Hula River
Okpilak River
Jago River
Aichilik River
Egaksrak River
Kongakut River
1000
500
200
100
50
40
157°
155°
153°
151°
149°
147°
145°
143°
141°
139°
72°
70°


Map 3
Cross Island
Stipulations 8a and 8b
Legend
Cross Island Deferral
Cross Island Stipulation 6a
Cross Island Stipulation 6b
Federal Offshore Leases
Current as of June 1, 2004
Lease Blocks
Submerged Lands Act Boundary
North Slope Rivers
Greater Than 100 Kilometers
4 0 4 8 Kilometers
3 0 3 6 Miles
N
Locator Map
Alaska
Prudhoe Bay
Cross Island

APPENDIX A

STANDARD AND OPTIONAL MITIGATING MEASURES FOR THE PROPOSED ACTION

A. Introduction

The following information summarizes lease stipulations and standard Information to Lessees.

A.1. Lease Stipulations for Oil and Gas Lease Sale 195

The stipulations for Sale 195 would be the same as for Sale 186. They are described fully in EIS Section II.H.1, in Appendix B of the Biological Evaluation for the endangered bowhead whale (which is part of EA Appendix C), and in a file entitled *Lease Stipulations for Oil and Gas Lease Sale 186* on the website: http://www.mms.gov/alaska/cproject/beaufortsale/FNOS%20186%20Package/FNIS186Package.htm.
The standard mitigating measures for the Proposed Action are:
Stipulation No. 1 Protection of Biological Resources
Stipulation No. 2 Orientation Program
Stipulation No. 3 Transportation of Hydrocarbons
Stipulation No. 4 Industry Site-Specific Bowhead Whale-Monitoring Program
Stipulation No. 5 Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvesting Activities
The following are optional mitigating measures for the Proposed Action:

Stipulation No. 6 Pre-Booming Requirements for Fuel Transfers. Fuel transfers (excluding gasoline transfers) of 100 barrels or more occurring 3 weeks prior to or during the bowhead whale migration will require Pre-Booming of the fuel barge(s). The fuel barge must be surrounded by an oil-spill-containment boom during the entire transfer operation to help reduce any adverse effects from a fuel spill. This stipulation is applicable to the blocks and migration times listed in the stipulation on Industry Site-Specific Bowhead Whale-Monitoring. The lessee's oil-spill-contingency plans must include procedures for the pre-transfer booming of the fuel barge(s).

Stipulation No. 7 Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders. To minimize the likelihood that migrating spectacled or Steller's eiders will strike lease structures associated with offshore drilling, all structures so identified by MMS must be lighted and/or marked in a manner that does not attract them and minimizes the likelihood they would collide with the structures. The MMS and the Fish and Wildlife Service will cooperatively develop lighting requirements and identify where, when, and on what type of structures the requirements should be applied. Specific lighting requirements will be developed by April 1, 2004, at which time MMS will issue these requirements.
The radiation of light outward from structures must be minimized 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. These requirements will not apply between October 31 and May 1 of each year, when eiders are not likely to be present.

Lessees are required to report spectacled and/or Steller's eiders injured or killed through collisions with lease structures, to the Fairbanks Fish and Wildlife Field Office, Endangered Species Branch, Fairbanks, Alaska at (907) 456-0499 for instruction on the handling and disposal of the injured.
The MMS letter to the NSB includes a statement about the Good Neighbor Policy (GNP), explaining on page 4 that "the MMS included a new ITL clause in the Sale 186 Final Notice of Sale (FNOS) entitled "Good Neighbor Policy" which acknowledges that the GNP is a viable mechanism for companies to assure timely, direct compensation to affected communities in the unlikely event of a major oil spill."

Stipulation No. 8a No Permanent Facility Siting in the Vicinity Seaward of Cross Island. Permanent OCS production facility siting within a defined 10-mile radius seaward of Cross Island will be prohibited unless the lessee demonstrates to the satisfaction of the Regional Director, in consultation with the NSB and the Alaska Eskimo Whaling Commission, that the development will not preclude reasonable subsistence access to whales. In making such a demonstration, the lessee shall follow the processes and requirements for consultation and mitigation of unreasonable conflicts as set out in Stipulation No. 5.

For purposes of analysis and for decision making, this stipulation is divided into two parts. Stipulation 8a will apply the 10-mile radius around Cross Island only outside the barrier islands. Stipulation 8b will apply the 10-mile radius only to those blocks within the barrier islands. The analysis considers the effects of the proposed action and its Alternatives taking into account these two subsets of Stipulation 8 and will discuss any difference in effects that these stipulations may cause. Stipulation 8a will apply to the following blocks: OPD; NR 06-03 Beechey Point; Blocks: 6415A; 6416A; 6417A; 6418A; 6419A; 6464B, D, F; 6465A, B; 6466A, B; 6467A, B; 6468A, B; 6469A, B; 6470A; 6514B, D, E, F, H; 6515B, C, D, E; 6516B, C, F; 6517B, D; 6518B; 6519A, B; 6520A; 6521A; 6565B; 6566B, E; 6568B; 6569A, B; 6570A, B; 6571A, C; 6618B, C, E; 6619A, B, C; 6620B, D; 6621B; 6670B.

Stipulation No. 8b - Permanent Facility Siting in the Vicinity Shoreward of Cross Island. Permanent OCS production facility siting within a defined 10-mile radius shoreward of Cross Island will be prohibited unless the lessee demonstrates to the satisfaction of the Regional Director, in consultation with the NSB and the Alaska Eskimo Whaling Commission, that the development will not preclude reasonable subsistence access to whales. In making such a demonstration, the lessee shall follow the processes and requirements for consultation and mitigation of unreasonable conflicts as set out in Stipulation 5.
Stipulation 8b will apply to the following blocks:
OPD; NR 06-03 Beechey Point; Blocks: 6616B, H, I; 6664C, H, I; 6665C, G, H, I, K; 6666D, G, H, J; 6667C, D, G; 6668B, C, E, F; 6669B, D, F; 6717B; 6718B, C, E, F, G; 6719B; 6768B; 6769I, J.

A.2. Standard Information to Lessees (ITL) Clauses

The following 16 standard ITL clauses apply to OCS activities in the Beaufort Sea area and are considered part of the proposed action and alternatives for the Beaufort Sea Sale 195. They are described fully in EIS Section 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

The following optional ITL is described also in EIS Section II.H.4..

No. 17 - Information to Lessees on Archaeological and Geological Hazards Reports and Surveys.

Lessees are referred to the regulations at 30 CFR 250.194, Archaeological Reports and Surveys, and 30 CFR 250.203(b)(1)(ix) for geologic hazard surveys and reports. Following is a list of specific blocks in the Beaufort Sea Planning Area on which an archaeological resource may exist and for which an archaeological report will be required.

> OPD: NR 05-01, Dease Inlet: Blocks: 6604-6606, 6654-6657, 6704-6709, 6754-6761, 6804-6812, 6856-6864, 6909-6915, 6960-6969, 7011-7023, 7062-7073, 7113-7123
>
> OPD: NR 05-02, Harrison Bay North; Blocks: 7001-7007, 7051-7059, 7101-7112
>
> OPD: NR 05-03, Teshekpuk: Blocks: 6015-6024, 6067-6072

OPD: NR 05-04, Harrison Bay: Blocks: 6001-6015, 6052-6066, 6106-6115, 6157-6168, 6208-6223, 6258-6274, 6309-6324, 6360-6374, 6410-6424, 6461-6471, 6513-6519, 6565-6566

OPD: NR 06-03, Beechey Point: Blocks: 6202-6207, 6251-6257, 6301-6308, 6351-6361, 6401-6417, 6456-6469, 6509-6520, 6561-6570, 6612-6614, 6616, 6618-6623, 6664-6674, 6717-6724, 6768-6771, 6819-6822, 6870-6871

OPD: NR 06-04, Flaxman Island: Blocks: 6651, 6701-6702, 6751-6754, 6802-6808, 6857-6860, 6910-6912, 6920-6924, 6961-6974, 7013-7022, 7066-7070, 7118-7119

OPD: NR 07-03, Barter Island: Blocks: 6853-6855, 6901-6909, 6958-6960, 7010-7011, 7061-7063, 7113-7114

OPD: NR 07-05, Demarcation Point: Blocks: 6016-6017, 6067-6069, 6118-6120, 6169-6170, 6222-6223, 6273-6275, 6324-6325

The regulations at 30 CFR 250.203(b)(1)(ix) require a shallow hazards report be included in all Exploration Plans (EP's) or Development and Production Plans (DPP's) at the time they are submitted to MMS for completeness review. In addition, for the blocks listed above, lessees must include a final archaeological resources report as required by 30 CFR 250.194 as part of any EP or DPP submitted to MMS for completeness review. Lessees are encouraged to combine surveys whenever feasible. The MMS will not consider a plan complete or initiate the regulatory review process without these documents.

Lessees may not set a drilling or production facility on location until MMS has approved an EP or DPP. Lessees are advised that seasonal constraints may prevent the following from occurring in the same year: collection of required data, obtaining of any necessary permits and coastal consistency certification, and the initiation of operations including mobilization and set down of the facility at location. Lessees are encouraged to plan accordingly.

Appendix B

Oil-Spill Analysis

B. Introduction

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 195. Information regarding the source, type, and sizes of oil spills, their behavior and the estimated path they follow, and the conditional and combined probabilities remain the same as discussed in the multiple-sale final EIS and is summarized in Section IV.A of this Environmental Assessment.

B.1. Large Oil-Spill-Analysis

The definition of a large spill is greater than or equal to 1,000 barrels. The following section elaborates on how the chance of one or more large oil spills occurring was derived for this Environmental Assessment. 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.

B.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 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 oil resource volume estimate remains 460 billion barrels for Alternative I, the Proposed Action, as discussed in Section II.B of the multiple-sale final EIS (USDOI, MMS, 2003a). Alternatives III, IV, V, and VI resource volumes are reduced by 1%, 5%, 3%, and 3%, respectively, from 460 million barrels. The following sections elaborate on how the spill rates were estimated and applied for Sale 195.

B.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. (2002). This study examined alternative oil-spill-occurrence estimators for the Beaufort and Chukchi seas 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., 2002). Using fault trees, oil-spill data from the offshore Gulf of Mexico and California were modified and incremented to represent expected Arctic performance.

B.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 B-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 B-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. In Figure B-2 these events included corrosion, third-party impact, operation impact, mechanical failure, and 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 B-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 included 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. (2002) 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. (2002) 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. 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.

Treatment of Uncertainties: The measures of uncertainty calculated were restricted to the Arctic effects in each fault-tree event. 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., 2002).

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 can 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 B-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 B-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%.

B.1.a(2)(a) Fault-Tree Input Data and Their Uncertainty Variations

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 which 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 B-1a 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 B-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 B-1b 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 cover, 0.2 meter 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 B-3 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. Table 4 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. (2002).

B.1.b. Results for Large Spill Rates for Sale 195

Based on the Bercha Group, Inc. (2002) fault-tree analysis for Sale 195, MMS estimates the mean spill rates for platforms, pipelines, and platforms and pipelines total over the life of the project as follows:

Platforms	0.15 spills per billion barrels produced	3.0 spills per thousand years
Pipelines	0.10 spills per billion barrels produced	1.9 spills per thousand years
Total	0.25 spills per billion barrels	4.9 spills per thousand years

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. Dr. Bercha (2004, pers. commun.) calculated confidence intervals on the total spill rate per billion barrels at the 95% confidence level as follows:

Type	Mean	95%
Total	0.25	0.21-0.30

These confidence limits include only variance in the arctic effects. The confidence limits do not consider the variance in the baseline data (Gulf of Mexico and Pacific OCS spill statistics). Inclusion of that variance would, in our opinion, increase the above variance. Bercha Group, Inc. (2002) clearly identified the lack of accounting for the variance of non-Arctic effects as a possible limitation in their final report. The MMS has a study for procurement this fiscal year 2004 National Studies List AK-04-02 titled *Improvements in the Fault Tree Approach to Oil Spill Occurrence Estimators for the Beaufort and Chukchi Seas*. The variability in the non-Arctic effects is to be addressed in this study.

B.1.c. Estimates for the Number of Large Spills Occurring for Sale 195

The spill rates discussed in this section are all based on spills per billion barrels. Using the above mean large spill rates, Table B-5a shows the estimated mean number of large oil spills for Alternative I, the Proposed Action and alternatives. For the Proposed Action and alternatives, we estimate 0.04-0.05 pipeline spills and 0.07 platform (and well) spills for a total over the life of Sale 195 production of 0.11-0.12 spills. Table B-5b 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 195 production range from 0.09-0.14 spills; that is, still only over a fraction of a spill. For purposes of analysis, one large spill was assumed to occur and was analyzed in the Beaufort multiple-sale EIS and this EA.

B.1.d. Method for Estimating the Chance of a Spill 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):

$$\text{P (n spils over future exposure t)} = \frac{(\lambda t)^n e^{-\lambda t}}{n!} \quad (1)$$

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) = $\frac{(n+v-1)!\,t^n \tau^v}{n!(v-1)!(t+\tau)^{n+v}}$ (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):

$\lambda = v / \tau$ (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)

B.1.e. Estimates for the Chance of One or More Large Spills Occurring

The frequency distribution of larger 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. Using the above mean spill rates, Table B-5c shows the chance of one or more large pipeline spills is 4-5%, and the chance of one or more large platform spills is 7% for the Proposed Action and alternatives. The total is the sum of the platform and pipeline spills. The chance of one or more large spills total ranges from 10-11 % for the Proposed Action and alternatives based on the mean spill rate (Figure B-5). Table 5d 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 total ranges from 9-13% (Figures B-6 and B-7).

B.1.f. 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.

B.2. Summary

The chance of one or more large pipeline spills is 4-5%, and the chance of one or more large platform spills is 7% for the Proposed Action and alternatives. The total is the sum of the platform and pipeline spills. The chance of one or more large spills total ranges from 10-11 % for the Proposed Action and alternatives based on the mean spill rate. 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 9-13%.

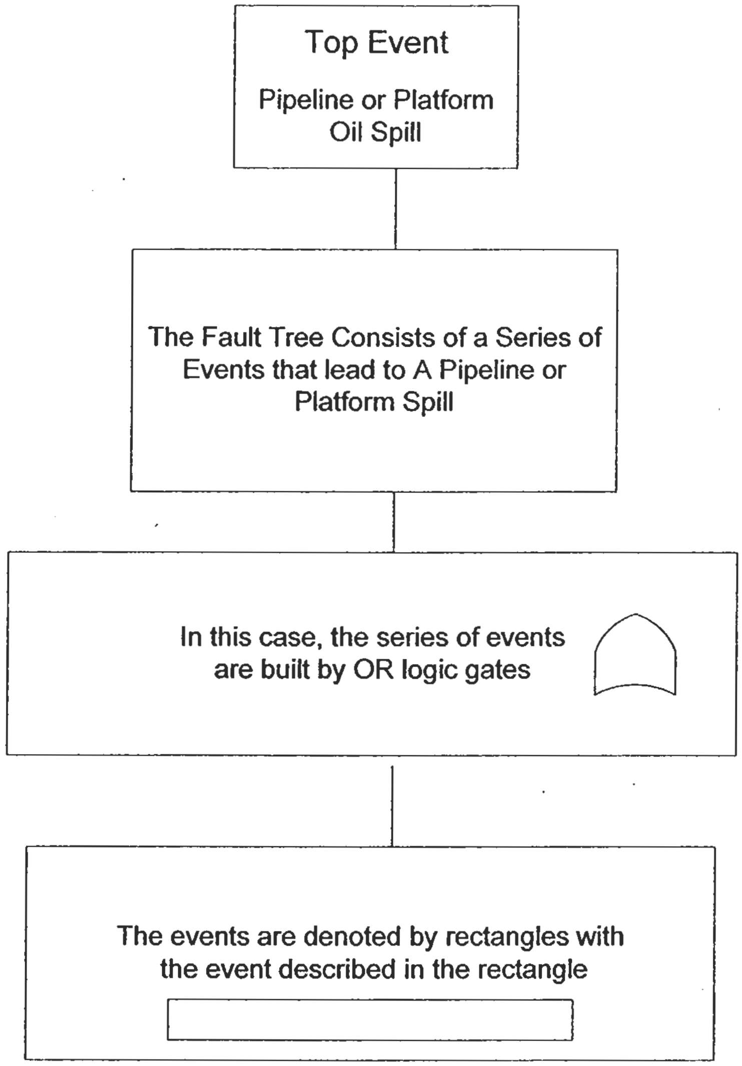


Figure B-1. Basic Parts of a Fault Tree

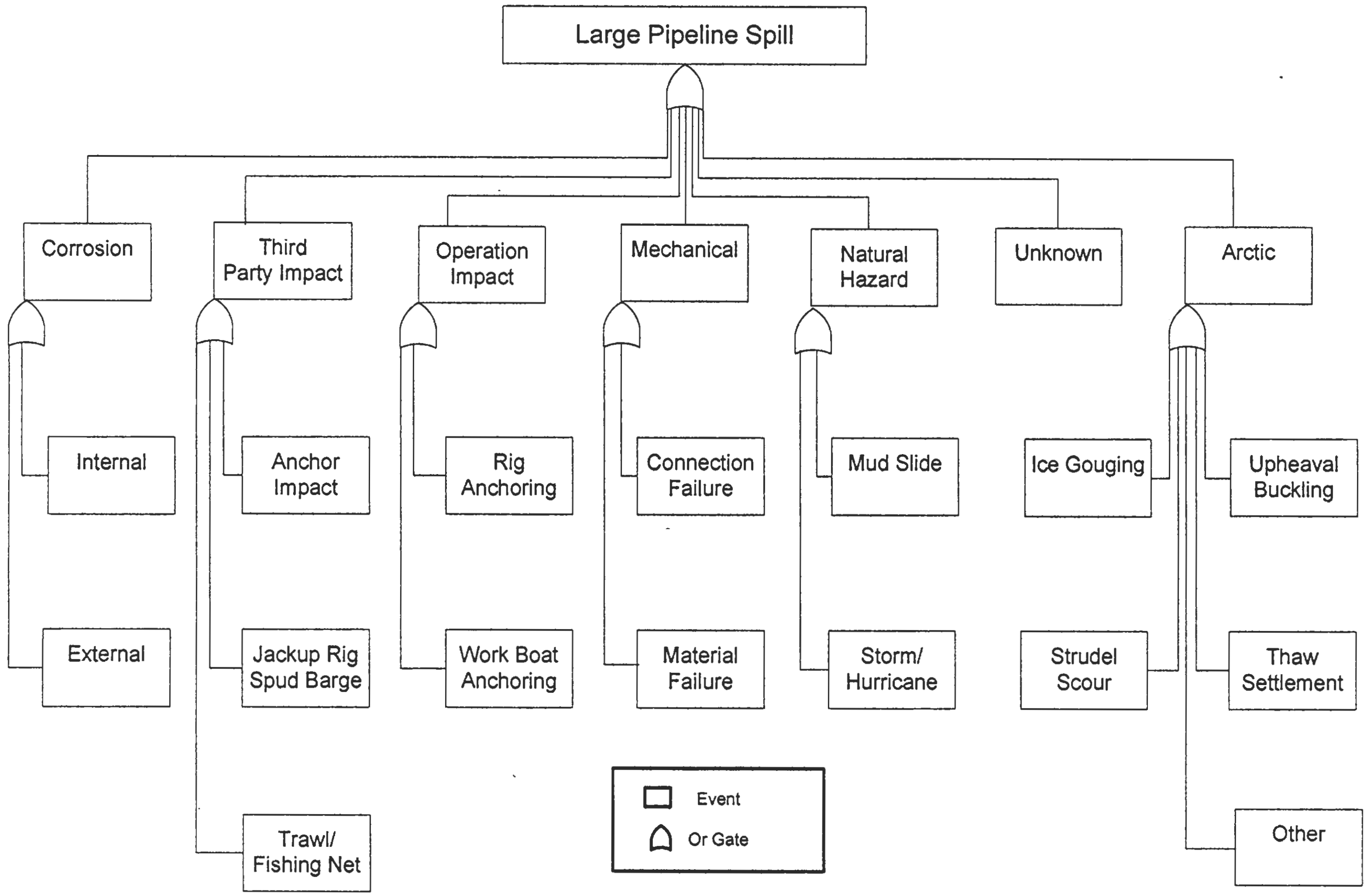


Figure B-2 Typical Fault Tree for A Pipeline Spill.

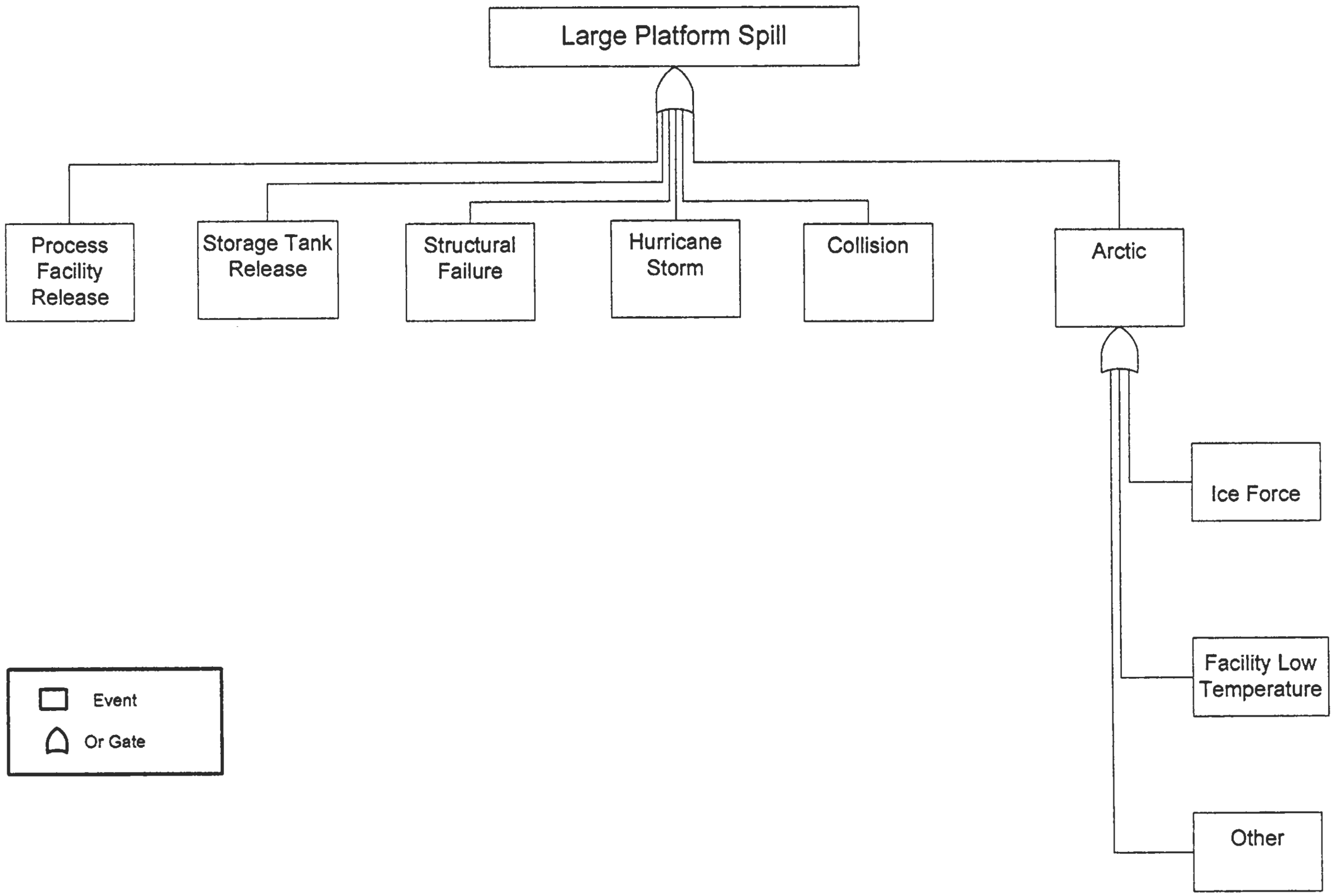


Figure B-3 Typical Fault Tree for a Platform Spill.

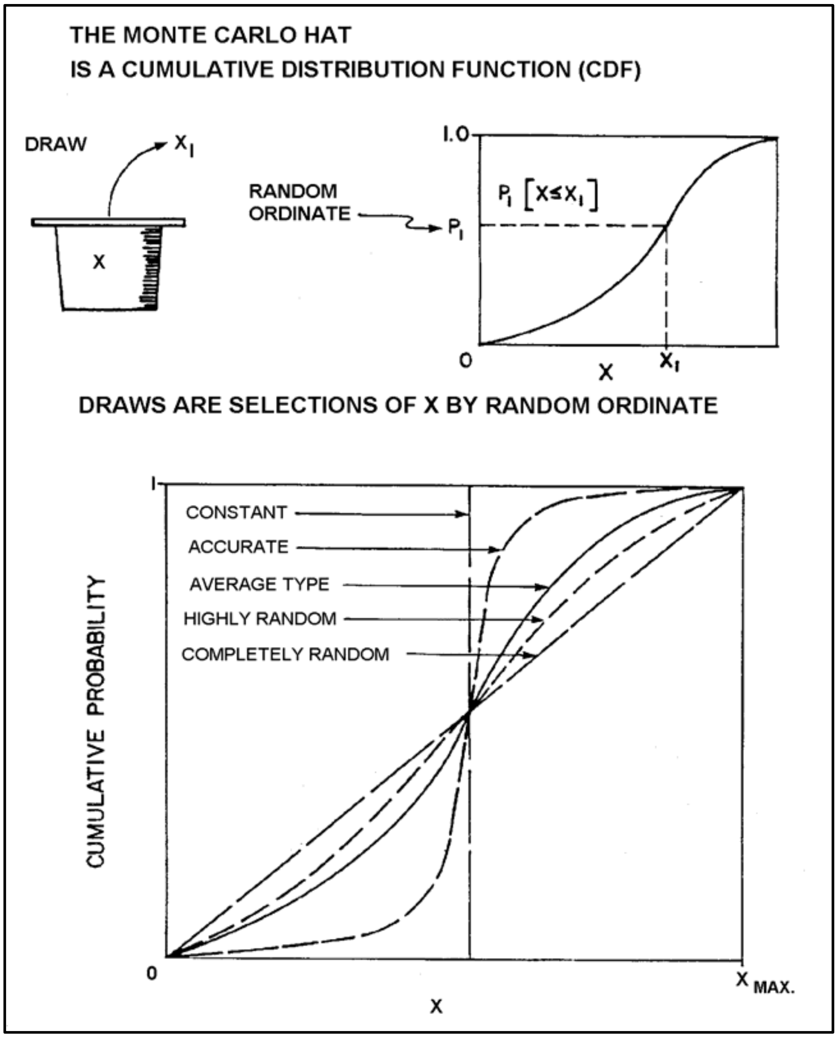


Figure B-4 Schematic of Monte Carlo Process as a Cumulative Distribution Function

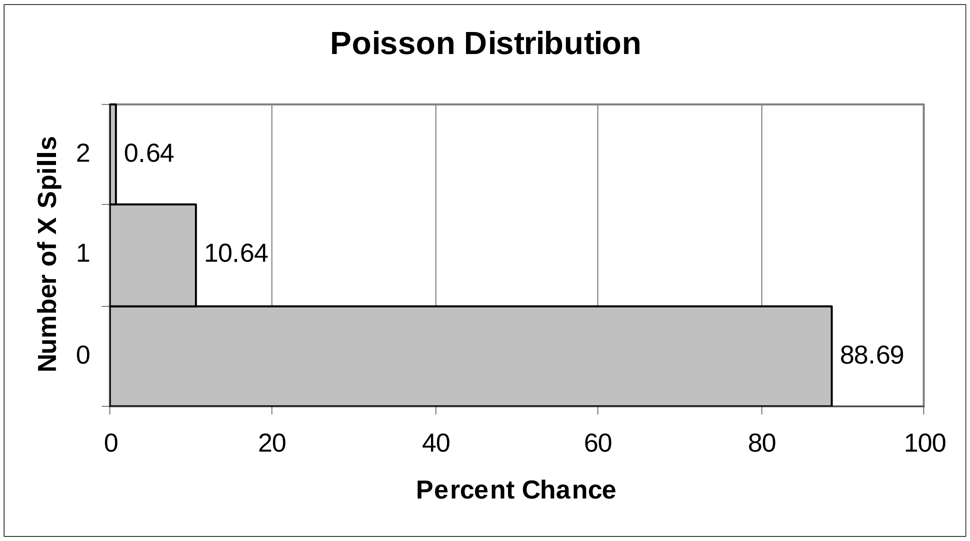


Figure B-5a. Alternative I Total (Pipeline and Platform)

Mean Number of Spills =0.12
Percent Chance of One or More = 11%
Percent Chance of No Spills = 89%

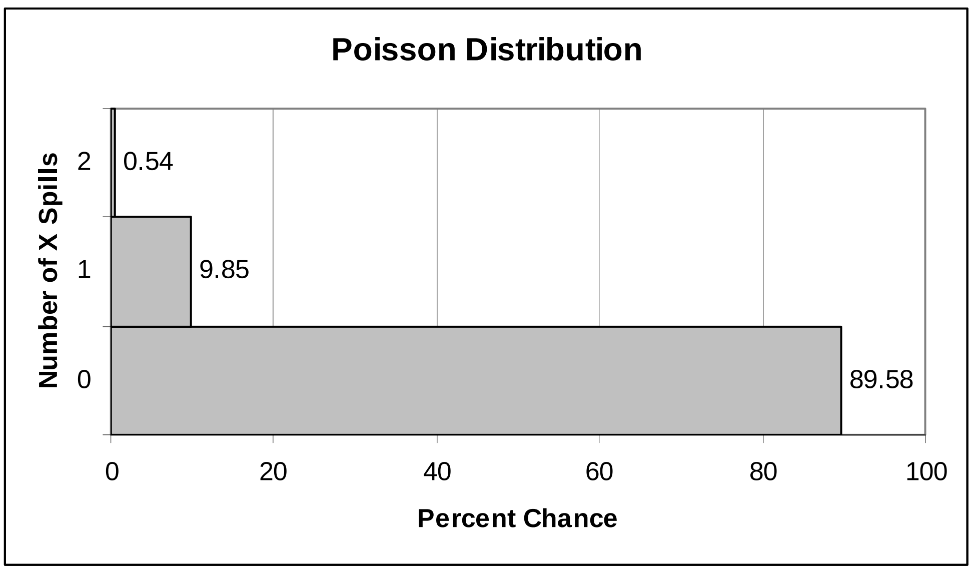


Figure B-5b. Alternatives III, IV, V and VI Total (Pipeline and Platform

Mean Number =0.11
Percent Chance of One or More = 10 %
Percent Chance of No Spills = 90%

Figure B-5 Poisson Distribution of Spill Occurrence Probabilities for Alternative I, the Proposed Action (Sale 195) and the Alternatives using the Mean Spill Rate.

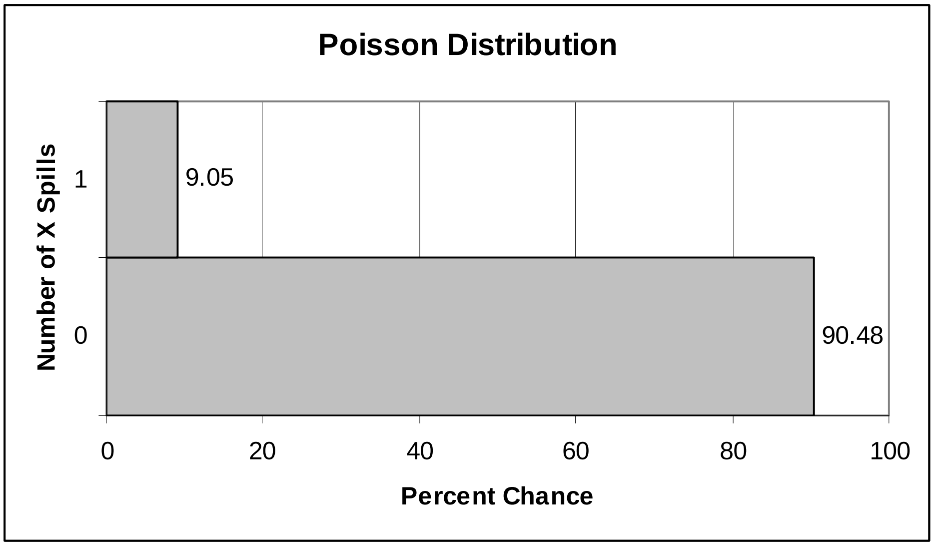


Figure B-6a. Alternative I and III Total (Pipeline and Platform)

Number of Spills =0.1
Percent Chance of One or More = 10%
Percent Chance of No Spills = 90%

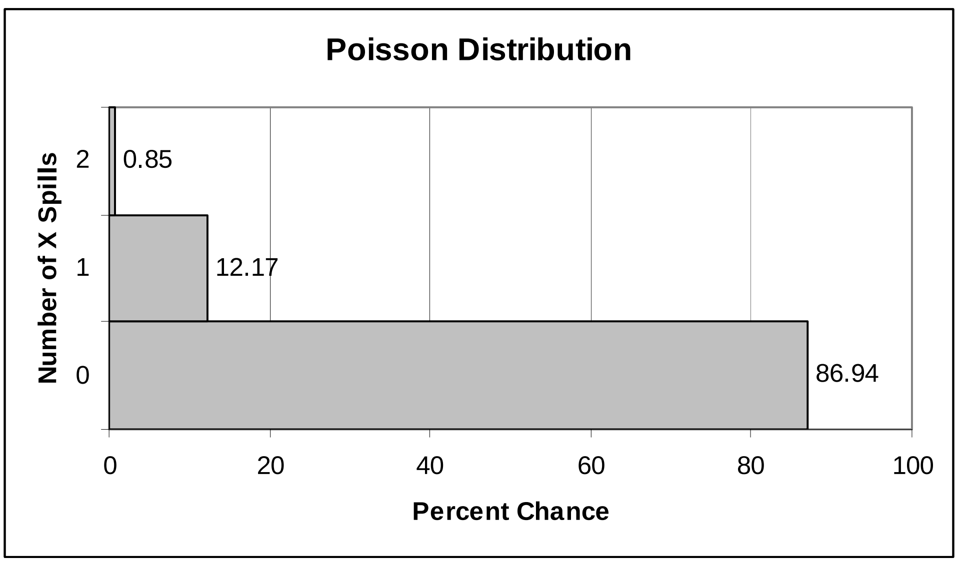


Figure B-6b. Alternative I and III Total (Pipeline and Platform)

Number of Spills =0.14
Percent Chance of One or More = 13%
Percent Chance of No Spills = 87%

Figure B-6 Poisson Distribution of Spill Occurrence Probabilities for Alternative I, the Proposed Action and Alternative III (Sale 195) using the Spill Rates at the 95% Confidence Interval.

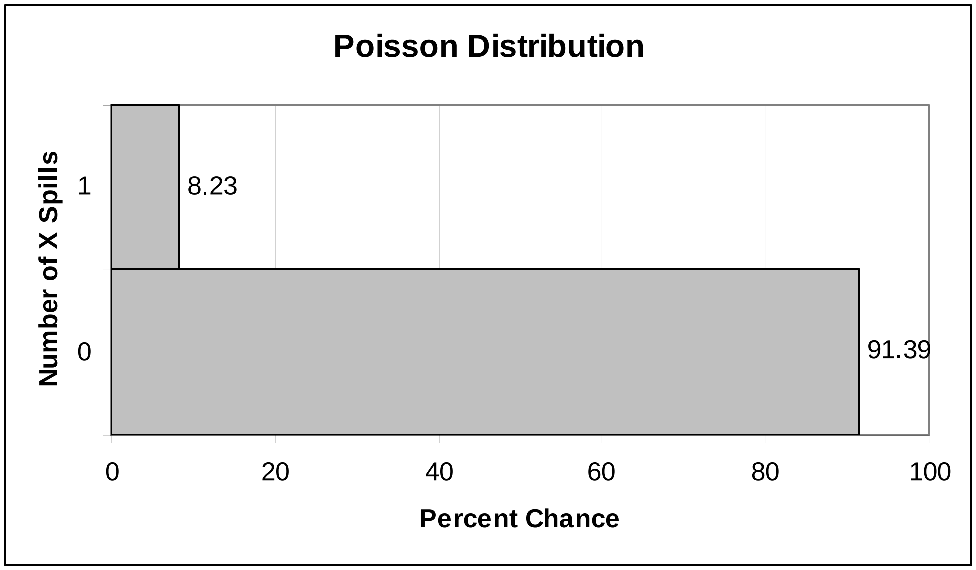


Figure B-7a. Alternative IV, V and VI Total (Pipeline and Platform)

Number of Spills =0.09
Percent Chance of One or More = 9%
Percent Chance of No Spills = 91%

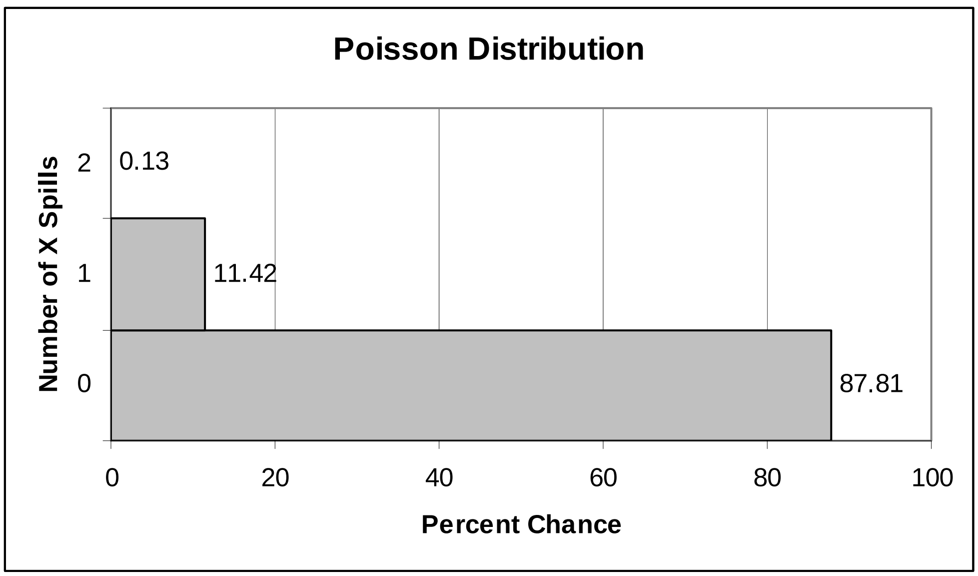


Figure B-7b. Alternative IV, V and VI Total (Pipeline and Platform)

Number of Spills =0.13
Percent Chance of One or More =12%
Percent Chance of No Spills = 88%

Figure B-7 Poisson Distribution of Spill Occurrence Probabilities for Alternatives IV, V and IV (Sale 195) using the Spill Rates at the 95% Confidence Interval.

Table B-1a
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**	(50)	(50)	(50)	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**	(90)	(90)	(90)	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**	(90)	(90)	(90)	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**	(80)	(60)	(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 B-1b
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	0.1747	–	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, 4 gouges per km-yr flux (Leidersdorf et al., 2001; Lanan & Ennis, 2001)..Frequency is distributed among different spill sizes.
	M	0.6178	0.3089	—	
	L	1.3438	0.6719	—	
	H	0.3762	0.1881	—	
Strudel Scour	**S**	0.0021	—	—	Only in shallow water. Average frequency of 4 scours/mile^2 and 100 ft of bridge length with 10% conditional P/L failure probability. The same spill size distribution as above.
	M	0.0038	—	—	
	L	0.0082	—	—	
	H	0.0023	—	—	
Upheaval Buckling	**S**	0.0004	0.0004	0.0004	All water depth. The failure frequency is 20% of that of Strudel Scour (Paulin et al., 2001).
	M	0.0008	0.0008	0.0008	
	L	0.0016	0.0016	0.0016	
	H	0.0005	0.0005	0.0005	
Thaw Settlement	**S**	0.0002	0.0002	0.0002	All water depth. The failure frequency is 10% of that of Strudel Scour (Paulin et al., 2001).
	M	0.0004	0.0004	0.0004	
	L	0.0008	0.0008	0.0008	
	H	0.0002	0.0002	0.0002	
Other	**S**	0.0881	0.0438	0.0002	To be assessed as 25% of above.
	M	0.1557	0.0775	0.0003	
	L	0.3386	0.1686	0.0006	
	H	0.0948	0.0472	0.0002	

Note:
S = Small (≥50and < 100 bbl)
M = Medium (≥100and < 1000 bbl)
L = Large (≥1000and < 10,000 bbl)
H = Huge (≥10,000)

Table B-2
Platform Fault Tree Input Rationalization

Event Classification	Spill Size	Frequency Change % Shallow	Medium	Deep	Reason
Arctic Modified					
Process Facility Rls.	All	(50)	(50)	(50)	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	(30)	(30)	(30)	High safety factor, Monitoring Programs
Hurricane/Storm	All	(80)	(80)	(80)	Less severe storms.
Collision	All	(90)	(90)	(90)	Very low traffic density.
–		**Freq. Increment per 10^4 well-year**			–
		Median	**Median**	***Median***	
		Expected	**Expected**	**Expected**	
Arctic Unique					
Ice Force	SM	0.1447	0.2170	0.3256	**Assumed 1/10000 years ice force causes spill. 85% of the spills are SM.**
		0.0340	0.0510	0.0765	
	HL	0.0255	0.0383	0.0575	
		0.0060	0.0090	0.0135	
Facility Low Temperature	SM	0.1000	0.1000	0.1000	**Assumed 10% of Historical Process Facilities release frequency and corresponding spill size distribution.**
		0.1000	0.1000	0.1000	
	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 B-3
Arctic Pipeline Effects Uncertainty Variations

Event Classification	Spill Size	Water Depth								
		Shallow			Medium			Deep		
		Frequency Change %								
		Low	Expected	High	Low	Expected	High	Low	Expected	High
Arctic Modified										
Corrosion										
External	**All**	(25)	(50)	(75)	(25)	(50)	(75)	(25)	(50)	(75)
Internal	**All**	(15)	(30)	(45)	(15)	(30)	(45)	(15)	(30)	(45)
Third Party Impact										
Anchor Impact	**All**	(60)	(90)	(95)	(60)	(90)	(95)	(60)	(90)	(95)
Jackup Rig Or Spud Barge	**All**	(25)	(50)	(75)	(25)	(50)	(75)	(25)	(50)	(75)
Trawl/Fishing Net	**All**	(60)	(90)	(95)	(60)	(90)	(95)	(60)	(90)	(95)
Operation Impact										
Rig Anchoring	**All**	(10)	(20)	(30)	(10)	(20)	(30)	(10)	(20)	(30)
Work Boat Anchoring	**All**	(10)	(20)	(30)	(10)	(20)	(30)	(10)	(20)	(30)
Mechanical										
Connection Failure	**All**	–	–	–	–	–	–	–	–	–
Material Failure	**All**	–	–	–	–	–	–	–	–	–
Natural Hazard										
Mud Slide	**All**	(50)	(80)	(90)	(30)	(60)	(90)	(20)	(40)	(60)
Storm/ Hurricane	**All**	(25)	(50)	(75)	(25)	(50)	(75)	(25)	(50)	(75)
Frequency Increment per 10^5 km-year										
Arctic Unique										
Ice Gouging	**S**	0.0060	0.0680	0.8290	0.0030	0.0340	0.4145	–	–	–
	M	0.0090	0.1210	1.4670	0.0045	0.0605	0.7335	–	–	–
	L	0.0210	0.2610	3.1900	0.0105	0.1305	1.5950	–	–	–
	H	0.0060	0.0730	0.8930	0.0030	0.0365	0.4465	–	–	–
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	0.00078	0.00859	0.10396	0.00003	0.00009	0.00033
	M	0.00246	0.03092	0.36929	0.00117	0.01528	0.18396	0.00005	0.00015	0.00059
	L	0.00571	0.06670	0.80303	0.00273	0.03296	0.40003	0.00011	0.00033	0.00128
	H	0.00163	0.01865	0.22480	0.00078	0.00922	0.11198	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 B-4
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**	(30)	(50)	(80)	(30)	(50)	(80)	(30)	(50)	(80)
Storage Tank Rls.	**All**	(20)	(30)	(40)	(20)	(30)	(40)	(20)	(30)	(40)
Structural Failure	**All**	(20)	(30)	(40)	(20)	(30)	(40)	(20)	(30)	(40)
Hurricane/Storm	**All**	(25)	(50)	(75)	(25)	(50)	(75)	(25)	(50)	(75)
Collision	**All**	(60)	(90)	(95)	(60)	(90)	(95)	(60)	(90)	(95)
		Frequency Increment per 10^4 well-year								
Arctic Unique										
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 B-5a
Estimated Mean Number of Large Platform, Pipeline and Total Spills for Alternative I, the Proposed Action (Sale 195) and its Alternatives

Alternative		Mean Number of Platform Spills	Mean Number of Pipeline Spills	Mean Number of Spills Total
I	Alternative I	0.07	0.05	0.12
II	No Sale	0	0	0
III	Barrow Subsistence Whale Deferral	0.07	0.05	0.11
IV	Nuiqsut Subsistence Whale Deferral	0.07	0.04	0.11
V	Kaktovik Subsistence Whale Deferral	0.07	0.05	0.11
VI	Eastern Deferral	0.07	0.05	0.11

Note:

Mean Number of Spills is rounded to two decimal places after multiplying the spill rate times the resource volume. Hence total may not equal platform plus pipeline.

Table B-5b
Estimated Number of Total Spills for Alternative I, the Proposed Action (Sale 195) and its Alternatives Using Spill Rates at the 95% Confidence Interval

Alternative		Number of Spills Total
I	Alternative I	0.10-0.14
II	No Sale	0
III	Barrow Subsistence Whale Deferral	0.10-0.14
IV	Nuiqsut Subsistence Whale Deferral	0.09-0.13
V	Kaktovik Subsistence Whale Deferral	0.09-0.13
VI	Eastern Deferral	0.09-0.13

Note:

Mean Number is rounded to the two decimal places after multiplying the spill rate times the resource volume.

Table B-5c
Estimated Percent Chance of One or More Large Platform, Pipeline and Total Spills for Alternative I, the Proposed Action (Sale 195) and its Alternatives

Alternative		Percent Chance of One or More Platform Spills	Percent Chance of One or More Pipeline Spills	Percent Chance of One or More Spills Total
I	Alternative I	7	5	11
II	No Sale	0	0	0
III	Barrow Subsistence Whale Deferral	7	5	10
IV	Nuiqsut Subsistence Whale Deferral	7	4	10
V	Kaktovik Subsistence Whale Deferral	7	5	10
VI	Eastern Deferral	7	5	10

Table B-5d
Estimated Percent Chance of One or More Total Spills for Alternative I, the Proposed Action (Sale 195) and its Alternatives Using the Spill Rates at the 95% Confidence Interval

Alternative		Percent Chance of One or More Spills Total
I	Alternative I	10-13
II	No Sale	0
III	Barrow Subsistence Whale Deferral	10-13
IV	Nuiqsut Subsistence Whale Deferral	9-12
V	Kaktovik Subsistence Whale Deferral	9-12
VI	Eastern Deferral	9-12

Appendix C

Threatened and Endangered Species Consultation

This color-coded appendix contains the following items:
MMS memorandum to USFWS, dated December 10, 2003
MMS letter to NOAA Fisheries, dated December 10, 2003
USFWS memorandum to MMS, dated January 1, 2004
NOAA Fisheries letter to MMS, dated March 8, 2004
NOAA Fisheries email to MMS, dated March 26, 2004
NOAA Fisheries letter to MMS dated June 28, 2004

Biological Evaluation for Reinitiation of Consultation with NOAA Fisheries, dated June 2004*

*Note that this Biological Evaluation includes the following three appendices:

Appendix A	ESA Section 7 Consultation Documents
Appendix B	Proposed Stipulations and Required Operating Procedures
Appendix C	Oil-Spill Information

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Washington, DC 20240

DEC 10 2003

Memorandum

To: Assistant Director for Endangered Species
U.S. Fish and Wildlife Service

From: Thomas A. Readinger *Thomas A. Readinger*
Associate Director for Offshore Minerals Management

Subject: Proposed Beaufort Sea Lease Sale 195: Endangered Species Act, Section 7 Consultation

The Minerals Management Service (MMS) is beginning the latest phase in the environmental assessment process for the proposed Beaufort Sea Oil and Gas Lease Sale 195 (scheduled for 2005). 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 195. 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 satisfies the information requirements specified in 50 CFR 402.12 and 402.14.

The Beaufort Sea Oil and Gas Lease Sale 186 took place on September 24, 2003. At this time, because available information indicates that conditions have not changed significantly nor is there significant new information that indicates impacts from the proposed action would differ from those identified and discussed in our final EIS, MMS plans to prepare an Environmental Assessment (EA) related to Sale 195. Based on information available to us at this time, it is likely that this EA will conclude with a Finding of No Significant Impact.

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 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."

The FWS's Biological Opinion (Page 27) specifies the circumstances under which re-initiation of formal consultation is required. No new information requiring re-initiation of formal consultation has been received by MMS since receipt of this Biological Opinion and, to our knowledge, none of the other circumstances that require re-initiation of formal consultation have occurred. The area proposed to be offered for lease in proposed Lease Sale 195 is the same as that offered in 186. As noted at the beginning of this memorandum, Beaufort Sea Oil and Gas Lease Sale 186 took place in the autumn 2003. While the MMS received bids on 33 tracts, no new offshore activity associated with the sale of any of the leases has occurred.

The MMS requests that FWS concur that the conclusions, incidental take statement, reasonable and prudent measures, conservation recommendations, and other sections contained in the October 22, 2002, Biological Opinion, which concluded formal consultation for Beaufort Sea Oil and Gas Lease Sale 186, apply to proposed Lease Sale 195 and are valid for inclusion in the EA for this lease sale.

If FWS does not concur, we ask that you specify why FWS believes the conclusions, incidental take statement, reasonable and prudent measures, and other portions of that Biological Opinion do not apply to proposed Lease Sale 195. If FWS believes that formal consultation should be reinitiated, we request that you specify which triggers for re-initiation the FWS believes have been met. Lastly, if FWS does not concur, we request that you specify what ESA listed, proposed, or candidate species, as well as designated critical habitat, may be in or near the proposed Lease Sale 195 area. At present, and based on your October 2002 Biological Opinion (Page 2), we are aware of two such species, for which FWS has management authority, that may be in or near the proposed lease sale area and that may be adversely affected by the proposed action:

Spectacled eiders (*Somateria fischeri*)
Steller's eiders (*Polysticta stelleri*)

Additionally, if FWS does not concur and is considering recommending additional measures to minimize impacts to threatened eiders, or if FWS believes a jeopardy situation may exist for all or any part of the proposed action, we request that you respond to this letter in as timely a manner possible, according to 50 CFR 402 14(g)(5), to allow MMS and FWS staffs 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 the FWS Biological Opinion can be included in the EA/EIS to be published in August 2004, and will ensure effective protection of listed eiders. These discussions also can ensure that any proposed alternatives are within our authority to control and implement, and are feasible, appropriate, and effective.

To facilitate consideration of our request for concurrence, we are sending copies of this letter to the FWS Region 7 Office in Anchorage and to the FWS Fairbanks Fish and Wildlife Field Office.

If you have any questions on the ESA consultation issues raised in this letter or if you require additional information, please contact Dr. Joel Hubbard, Minerals Management Service, Mail Stop 8303, 949 East 36th Avenue, Suite 300, Anchorage Alaska 99503-4363 (commercial and FTS telephone: 907-271-6670) or Ms. Judy Wilson, Minerals Management Service, Mail Stop 4042, 381 Elden Street, Herndon, Virginia 20170-4817 (commercial and FTS telephone: 703-787-1075).

cc: Mr. Rowan Gould
Regional Director
U.S. Fish and Wildlife Service
Region 7
1011 East Tudor Road
Anchorage, Alaska 99503

Mr. Steve Lewis
Field Office Supervisor
U.S. Fish and Wildlife Service
Fairbanks Fish and Wildlife Field Office
101 12th Avenue, Box 19
Fairbanks, Alaska 99701

United States Department of the Interior
MINERALS MANAGEMENT SERVICE
Washington, DC 20240

DEC 10 2003

Ms. Laurie Allen
Director
Office of Protected Resources
NOAA Fisheries
1315 East-West Highway
Silver Spring, Maryland 20910

Dear Ms. Allen:

The Minerals Management Service (MMS) is beginning the latest phase in environmental assessment related to proposed Beaufort Sea Oil and Gas Lease Sale 195 (scheduled for 2005). Our environmental assessment for this proposed sale is presented in the Final Environmental Impact Statement (FEIS) 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). This EIS contains information on the anticipated activities and potential effects of proposed Lease Sale 195.

The Beaufort Sea Oil and Gas Lease Sale 186 took place on September 24, 2003. While MMS received bids on 33 tracts, no offshore activity associated with the sale of any of the leases has occurred. Because available information indicates that conditions have not changed significantly and there is no significant new information indicating that potential impacts would differ from those already identified and discussed in the FEIS, MMS plans to prepare an Environmental Assessment (EA) related to Sale 195. Based on information available to us at this time, this EA likely will conclude with a Finding of No Significant Impact.

On May 9, 2002, under Section 7(a)(2) of the Endangered Species Act (ESA), MMS requested the National Oceanic and Atmospheric Administration (NOAA) Fisheries uphold their May 25, 2001, non-jeopardy Biological Opinion concerning Federal oil and gas leasing and exploration in the Alaskan Beaufort Sea Outer Continental Shelf Planning Area for proposed Oil and Gas Lease Sales 186, 195, and 202. By reply letter dated July 23, 2002, NOAA Fisheries stated:

> "We find the May 2001 opinion addresses these sales, in terms of the listed species and habitats present, the legal status of these species under the ESA having been unchanged, the anticipated actions associated with these sales being consistent with those actions considered in the opinion, and the sale area being consistent with that previously assessed."

In this same letter, NOAA Fisheries indicated that their opinion will be reconsidered prior to the subsequent sales, stating the following:

> "We have not applied this conclusion to Sales 195 and 202 at this time, however, as the logic which MMS has used in determining the need for supplemental analyses under NEPA for these sales would also extend to ESA consultation."

The MMS has determined for Lease Sale 195 that there is no significant new information revealing effects in a manner or to an extent not previously considered in the May 2001 Biological Opinion. The proposed activities associated with Lease Sale 195 have not been modified and the status of the bowhead whale remains unchanged.

The MMS requests that NOAA Fisheries concur that re-initiation of formal consultation under Section 7 of the ESA is not required for proposed Beaufort Sea Oil and Gas Lease Sale 195. We request your concurrence that the conclusions, conservation recommendations and all other sections of the May 25, 2001 Biological Opinion for oil and gas leasing in the Beaufort Sea apply to proposed Lease Sale 195 and are valid for inclusion in the EA for this lease sale.

If NOAA Fisheries does not concur, we ask that you specify what steps NOAA Fisheries believes the MMS should follow to meet its obligations under Section 7 of the ESA related to proposed Beaufort Sea Oil and Gas Lease Sale 195. Further, if NOAA Fisheries does not concur, we request that you specify what ESA listed, proposed or candidate species, as well as designated critical habitat, under NOAA Fisheries management authority, may be in or near the proposed Lease Sale 195 area. Based on previous correspondence with NOAA Fisheries on this issue, and based on NOAA Fisheries' May 25, 2001 Biological Opinion (Page 6), MMS is aware of only one such species, the endangered bowhead whale (*Balaena mysticetus*).

Additionally, if NOAA Fisheries does not concur and is considering recommending additional measures to minimize impacts to bowhead whales, or if you determine a jeopardy situation may exist for all or any part of the proposed action, we request that you respond to this letter in as timely a manner as possible, according to 50 CFR 402 14(g)(5), to allow the MMS and NOAA Fisheries staffs 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 the NOAA Fisheries Biological Opinion can be included in the EA/EIS to be published in August 2004, and will ensure effective protection of bowhead whales. These discussions also can ensure that any proposed alternatives are within our authority to control and implement, and are feasible, appropriate, and effective.

To facilitate consideration of our request for concurrence, we are sending copies of this letter to the NOAA Fisheries Alaska regional office in Juneau, Alaska and to the Anchorage field office.

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, 949 East 36th Avenue, Suite 300, Anchorage, Alaska 99503-4363 (commercial and FTS telephone: 907-271-6510) or Ms. Judy Wilson, Minerals Management Service, Mail Stop 4042, 381 Elden Street, Herndon, Virginia 20170-4817 (commercial and FTS telephone: 703-787-1075).

Sincerely,

Thomas A. Readinger

Thomas A. Readinger
Associate Director for
Offshore Minerals Management

cc: Mr. James Balsinger
Administrator
Alaska Region
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

Mr. Brad Smith
Anchorage Field Office
National Marine Fisheries Service
Federal Building
22 West 7th Avenue, Box 43
Anchorage Alaska 99513-7577

United States Department of the Interior
Fish and Wildlife Service
Fairbanks Fish and Wildlife Office
101 12th Ave., Box 19, Room 222
Fairbanks, AK 99701

January 1, 2004

Memorandum

To: Thomas A. Readinger
Associate Director for Offshore Minerals Management

From: Steven A. Lewis
Field Supervisor, Fairbanks Fish and Wildlife Field Office

Subject: Proposed Beaufort Sea Lease Sale 195: Endangered Species Act, Section 7 Consultation

The Fairbanks Fish and Wildlife Office (FFWFO) has reviewed Minerals Management Service's (MMS) December 10, 2003, request for concurrence.

The FFWFO is unaware of any new information or change in the status of the two listed species, spectacled eider (*Somateria fisheri*) and Steller's eider (*Polysticta stelleri*), that would require programmatic consultation under the October 23, 2002, Biological Opinion for MMS proposed Beaufort Sea Lease Sale 195. We base this statement on the understanding that proposed Beaufort Sea Lease Sale 195 is as described in the February 2003 OCS EIS/EA MMS 2003-001.

CC: Rowan Gould
LaVerne Smith
Ted Swem
Mike Roy
Joel Hubbard
Judy Wilson

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

March 8, 2004

Thomas A. Readinger
Associate Director for Offshore Minerals Management
Minerals Management Service
Washington, D.C. 20240

Dear Mr. Readinger:

Thank you for your letter concerning consultation under section 7 (a)(2) of the Endangered Species Act of 1973, as amended, for proposed oil and gas lease sale 195 in the Beaufort Sea, Alaska. In your letter, you request that we uphold the May 25, 2001 biological opinion for oil and gas leasing and exploration activities in the Beaufort Sea by determining that opinion remains in force and satisfies the consultation requirements of the ESA for Sale 195. In June, 2002, the Minerals Management Service prepared a draft Environmental Impact Statement (EIS) for proposed Beaufort Sea sales 186, 195, and 202. A supplemental EIS or Environmental Assessment was to be prepared for sales 195 and 202 in order to determine whether or not the information and analysis in the 2002 EIS remain valid at those future dates.

NOAA Fisheries has previously determined that the May 2001 opinion addresses Sale 186 (also in the Beaufort Sea), in terms of the listed species and habitats present, the legal status of affected species, the anticipated actions associated with the sale, and the proposed sale area. We did not apply that conclusion to Sale 195, as the need for supplemental analysis under NEPA for that sale would also extend to ESA consultation. Therefore, NMFS will provide further comment on the applicability of the May 2001 opinion, and the need for further consultation, pending our review of the NEPA documentation (i.e., the Environmental Assessment) prepared for Sale 195.

Please direct any questions to Mr. Brad Smith in our Anchorage, Alaska office at (907) 271-5006.

Sincerely,

James W. Balsiger
Administrator, Alaska Region

Rotterman, Lisa

From: Brad Smith [Brad.Smith@noaa.gov]
Sent: Friday, March 26, 2004 8:47 AM
To: Rotterman, Lisa; lisa-rotterman@mms.gov; lisa_rotterman@mms.gov
Subject: Sale 195 consultation

There have been no additions or changes to ESA-listed species or critical habitat for which the USDOC bears responsibility within the project area of Sale 195 since publication of the 2001 Regional Opinion. The bowhead whale remains the only such species likely to occur within the U.S. Beaufort Sea, and no critical habitat has been designated for this species.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

June 28, 2004

John Goll
Regional Director
Minerals Management Service
Alaska OCS Region
949 East 36th Avenue, Suite 300
Anchorage, Alaska 00598-4363

Dear Mr. Goll:

Than you for your letter concerning consultation under section 7 (a)(2) of the Endangered Species Act of 1973, as amended (ESA), for proposed oil and gas lease sale 195 in the Beaufort Sea. In your letter, you request that we uphold the May 25, 2001 biological opinion for oil and gas leasing and exploration activities in the Beaufort Sea (Arctic Opinion) by determining that opinion remains in force and satisfies the consultation requirements of the ESA for Sale 195.

NOAA Fisheries has reviewed the Biological Evaluation prepared by Minerals Management Service and other information relative to the effects of the proposed sales on ESA species and/or critical habitats under our jurisdiction. We have considered previous consultation in our review of Sale 195, and believe the conclusions and recommendations within the Arctic Opinion remain applicable and appropriate. The Arctic Opinion continues to reflect the best available scientific information and is not inconsistent with findings from applicable research which has occurred since 2001. Therefore, we find the requirements of section 7 of the ESA are satisfied by the inclusion of the Arctic Region Biological Opinion in the Sale 195 planning process. We also affirm that the May 2001 opinion supercedes all existing biological opinions for leasing and associated exploration activities in the Beaufort Sea Planning Area, and that re-initiation of formal section 7 consultation is not required for this sale. In view of this finding, NOAA Fisheries believes the section 7 consultation requirements of the ESA have now been met for Sale 195.

This finding assumes the MMS will continue to present mitigating measures and Information to Lessees which address such important issues as protection of biological resources, site-specific bowhead whale monitoring programs and methods to avoid or minimize disturbance.

Please direct any questions in this matter to Brad Smith, NMFS, 222 West 7th Avenue, Box 43, Anchorage, Alaska 99513; telephone (907) 271-3023.

Sincerely,

James W. Balsiger
Administrator, Alaska Region

Biological Evaluation for Threatened and Endangered Species Related to Consultation under Section 7 of the Endangered Species Act for Proposed Beaufort Sea OCS Oil and Gas Lease Sale 195

Prepared in Accordance with Section 7 of the Endangered Species Act of 1973, as Amended

Minerals Management Service
Alaska OCS Region
June 9, 2004

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Tables and Map Follow Appendix C

I. Introduction and Background

The endangered bowhead whale occurs seasonally in the Beaufort Sea Planning Area and may be exposed to OCS exploration and development/production activities associated with proposed Beaufort Sea Planning Area Oil and Gas Lease Sale 195. The OCS activities under Sale 195, and the development of any resources associated with that sale, may result in activities that could adversely affect bowhead whales occurring in or adjacent to the Beaufort Sea multiple-sale area, including: noise and disturbance; altered habitat; and spilled oil or other contaminants, such as discharges of drilling muds and cuttings. It is assumed that crude oil would not be released during exploration activities but could potentially occur during development/production activities.

Congress enacted the Endangered Species Act (ESA) "...to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved" and "to provide a program for the conservation of such...species."

To achieve this general goal, Congress specified the responsibilities of Federal Agencies prior to taking actions that might affect threatened or endangered species. Section 7(a)(2) of the ESA specifies:

> Each federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded or carried out by such agency is not likely to jeopardize the continued existence of any endangered species and threatened species or result in the destruction or adverse modification of habitat of such species which is determined...to be critical, unless such agency has been granted an exemption for such action...pursuant to subsection (h) of this chapter.

As part of such consultation, Federal Agencies proposing an action in an area are required to clarify whether and what listed, proposed, and candidate species or designated or proposed critical habitats may be in the action area. The action area is defined as "all areas to be affected directly or indirectly by Federal action and not merely the immediate area involved in the action [50 CFR §402.02]."

If it is determined that listed, proposed, and candidate species or designated or proposed critical habitat may be in the action area, the Federal Agency proposing the action is required to identify what endangered species or threatened species are likely to be affected by the Proposed Action and to help make the determination of whether or not the Proposed Action is "likely to adversely affect" listed species and/or critical habitat.

Pursuant to requirements under the Endangered Species Act of 1973, as amended, the Minerals Management Service (MMS) has consulted with the National Marine Fisheries Service (NMFS) on several previous lease sales in this region (most recently, Beaufort Sea Planning Area Oil and Gas Lease Sales 144 and 170, and Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, and 202). For Sales 144 and 170 Biological Opinions, the NMFS stated that the implications of these sales and previous sales in the Beaufort Sea were considered in the 1988 Arctic Regional Biological Opinion (ARBO). The NMFS stated that conclusions and recommendations contained in the 1988 ARBO were applicable to Sales 144 and 170, and they concluded that leasing and exploration activities were not likely to jeopardize the continued existence of endangered whales. Consultation on the ARBO was reinitiated because of new information on the effects of noise on bowhead whales from OCS activities and new technology for seismic operations. A revised Biological Opinion for Oil and Gas Leasing and Exploration Activities in the Beaufort Sea was issued in 2001. The 2001 Biological Opinion also concluded that oil and gas leasing and exploration in the Beaufort Sea is not likely to jeopardize the continued existence of bowhead whales.

In accordance with the ESA Section 7 regulations governing interagency cooperation, MMS notified NMFS by letter dated January 7, 2002, of the endangered and threatened species that would be included in a Biological Evaluation for Section 7 consultation for Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, and 202. The NMFS responded on February 11, 2002, confirming the bowhead whale as the species under their jurisdiction to be included in the evaluation. They also indicated that separate consultations were under way, or would be initiated, regarding the effects of the Trans-Alaska Pipeline System (TAPS) and the marine transport of oil from the terminal at Valdez. They confirmed that MMS did not need to consult on listed species and critical habitat along the pipeline or out of Valdez. The draft Environmental Impact Statement (EIS) for the Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, and 202 was completed and, in accordance with Section 7(a) of the ESA, formal consultation on the proposed Beaufort Sea multiple-sale program, including leasing and exploration activities associated with the sales, was initiated with NOAA Fisheries and the Fish and Wildlife Service by letter dated May 9, 2002. In this letter, MMS requested that NOAA Fisheries uphold the Biological Opinion issued in May 2001 concerning Beaufort Sea Oil and Gas leasing and exploration activities (the ARBO) for proposed Lease Sales 186, 195, and 202. To assist NOAA Fisheries in its consideration of this request, MMS submitted the draft EIS for Lease Sales 186, 195, and 202, which contained MMS's Biological Evaluation of the Proposed Action on bowhead whales, to NOAA Fisheries. The MMS indicated that it planned to prepare an Environmental Assessment (EA) for subsequent sales (Sales 195 and 202) under the multiple-sale program. In the EIS, MMS indicated that, based on information contained in the EA, the MMS would reinitiate consultation if there was new information that would trigger the need to reinitiate consultation.

NOAA Fisheries responded by letter dated July 23, 2002:

> NOAA Fisheries has reviewed the EIS and other information relative to the effects of the proposed sales on ESA species and/or critical habitats under our jurisdiction. We find the May 2001 opinion addresses these sales, in terms of the listed species and habitats present, the legal status of these species under the ESA having been unchanged, the anticipated actions associated with these sales being consistent with those actions considered in the opinion, and the sale area being consistent with that previously assessed. We also affirm that the May 2002 [sic] opinion supercedes all existing biological opinions for leasing and associated exploration activities in the Beaufort Sea Planning Area. In view of this finding, NOAA Fisheries believes the section 7 consultation requirements of the ESA have now been met for Sale 186. We have not applied this conclusion to Sales 195 and 202 at this time however, as the logic which MMS has used in determining the need for supplemental analysis under NEPA for these sales would also apply to ESA consultation. The applicability of the May 2002 [sic] opinion will be reconsidered prior to these subsequent sales.

In an email sent December 2, 2003 (Smith, 2003, pers. commun.), NMFS clarified that the May 2002 date in the July 2002 letter was an error, and that it should read 2001. In a letter dated December 10, 2003, MMS notified NOAA Fisheries that it had determined for Lease Sale 195 that there is no significant new information revealing effects in a manner or to an extent not previously considered in the NOAA Fisheries May 2001 Biological Opinion. The MMS noted that the proposed activities associated with Lease Sale 195 have not been modified, and that the status of the bowhead whale remains unchanged. The MMS requested that NOAA Fisheries concur that reinitiation of formal consultation under Section 7 of the ESA is not required for Lease Sale 195. The MMS requested that NOAA Fisheries concur that the conclusions, conservation recommendation, and all other sections of the May 25, 2001, Biological Opinion for oil and gas leasing in the Beaufort Sea apply to proposed Lease Sale 195 and are valid for inclusion in the EA for the sale. The MMS requested that, if the NMFS did not concur, they specify what steps they believed MMS should take to meet its ESA Section 7 obligations related to the proposed lease sale. In this same letter, MMS requested that NOAA Fisheries clarify what ESA listed, proposed, or candidate species, as well as proposed or designated critical habitat, may be in or near the proposed lease-sale area. The MMS stated that it was aware of only one species, the bowhead whale, under the jurisdiction of the NMFS that may be in the Proposed Action area of proposed Sale 195.

In a letter dated March 8, 2004, NOAA Fisheries stated that they previously had determined that the May 2001 opinion addresses Sale 186 in terms of the listed species and habitats present, the legal status of affected species, the anticipated actions associated with the sale, and proposed sale area. They reiterated that they did not apply this conclusion to Sale 195, as the need for supplemental analysis under the National Environmental Policy Act (NEPA) for that proposed sale would also extend to ESA consultation. NOAA Fisheries stated that they would provide further comment on the applicability of the May 2001 opinion and the need for further consultation, pending their review of the EA prepared for the sale. In an email dated March 26, 2004 (Smith, 2004, pers. commun.), NOAA Fisheries informed MMS that:

> There have been no additions or changes to ESA-listed species or critical habitat for which the USDOC bears responsibility within the project area of Sale 195 since publication of the 2001 Regional Opinion. The bowhead whale remains the only such species likely to occur within the U.S. Beaufort Sea, and no critical habitat has been designated for this species.

Based on the aforementioned correspondence, the MMS prepared this Biological Evaluation to aid NOAA Fisheries in their determination of whether or not the conclusions, conservation recommendation, and all other sections of the May 25, 2001, Biological Opinion for oil and gas leasing in the Beaufort Sea apply to proposed Lease Sale 195 and are valid for inclusion in the EA for the sale. This Biological Evaluation includes all information on bowhead whales, and the potential effects of the proposed action on this species, that is contained within our EA for proposed Sale 195. While the EA necessarily focuses on new information relating to potential effects on many resources, this evaluation focuses the analyses on bowheads. In this evaluation, MMS has summarized and updated relevant information about the Proposed Action, the bowhead whale, and potential effects and cumulative effects on this species. It brings together both the new information on bowhead biology and potential effects provided in the EA with much of that provided previously in the Beaufort Sea Multi-Sale FEIS. Thus, it provides a complete single source for evaluation of the potential effects of the proposed action on bowhead whales. MMS will send the final EA for proposed OCS Oil and Gas Lease Sale 195 to NOAA Fisheries as soon as it is printed this summer.

We incorporate by reference our previous Biological Evaluation of the Proposed Action on bowhead whales, which is contained within the Beaufort Sea multiple-sale final EIS.

Appendix A contains copies of the primary consultation communications.

The analysis contained in this Biological Evaluation is based on an exploration and development scenario presented in Section IV.A.1 and Appendices B and F of the final EIS, except where noted. The reader is referred to these sections for a discussion of resource-recovery rates and quantities, timing of infrastructure development, platform emplacement, wells drilled, resource production timeframes, and other information relevant to the development of the resources of Alternative I for Sale 195.

In the following sections, we provide the following information:

(a) a description of activities associated with the Proposed Action;
(b) available information on aspects of the biology, population ecology, history, regulatory history, etc. of the bowhead whale that facilitates assessing potential effects of the Proposed Action on this listed species;
(c) an analysis of the potential effects of the action on the bowhead whale based on biological studies, review of the literature, and the views of species and subject matter experts;
(d) environmental baseline;
(e) potential cumulative effects on the species; and
(f) effects of proposed stipulations and required operating procedures.

Guidance for the content of this section was taken from the Endangered Species Handbook (USDOI, Fish and Wildlife Service, and National Marine Fisheries Service, 1998).

II. Description of the Proposed Action

As required by the NEPA and the Council on Environmental Quality (CEQ) regulations, MMS identified a preferred alternative in the multiple-sale EIS. This option is included in the EA as the Proposed Action, offering for lease the entire area in EA Map 1 (which is identical to EIS Map 1) and provided in this Biological Evaluation as Map 1. The area encompasses 1,877 whole or partial blocks that cover 9,770,000 acres (about 3,954,000 hectares).

Since the multiple-sale EIS was issued in February 2003, the only oil and gas-related activities on the Beaufort Sea OCS have been the issuance of the Sale 186 leases, MMS approval of a permit application for on-ice winter geophysical (seismic) exploration, and the relinquishment of the McCovey leases after unsuccessful exploratory drilling. A series of wells have been drilled nearshore in State waters off Milne Point. We received no unanticipated information through the Request for Information, published in the *Federal Register* on December 16, 2003; therefore, we have no new oil and gas resource information. The description of the oil and gas resources and the estimated activities in the multiple-sale EIS reflect the best available information. Therefore, this assessment of proposed Sale 195 evaluates the same suite of resource estimates that were assessed in the multiple-sale EIS but in the context of new environmental information.

As we did in the multiple-sale EIS, we assume three different exploration and development scenarios for the three proposed OCS sales. Generally, we expect that leasing, exploration, and development activities will expand into more remote, deeper water during the course of the three-sale program. The scenarios indicate that resources for the Proposed Action would range from 340-570 million barrels (MMbbl) of oil, assuming a market price of oil between $18 and $30 per barrel (in 2000$). For purposes of analysis, we again use a single production estimate of 460 million barrels of oil.

II.A. Leasing Incentives

The analyses contained in the multiple-sale EIS are based on a hypothetical scenario of future industrial activities that could occur as a result of offshore leasing. The MMS used a petroleum-resource assessment of the Beaufort Sea completed during spring 2001 as the basis for our EIS assumptions. However, the resource assessment represents an optimistic view in that the model conducts a simulated discovery and development of all prospects in the database, many of which are not identified by mapping. In contrast, industry carefully selects the best prospects for leasing and exploration drilling based on economic, regulatory, and technological factors. Realistically, many small, remote, or difficult to identify prospects will not be leased or drilled by industry, because they will not meet the investment standards for leasing and exploration funding. Our resource assessment provides only one view of the economic potential of the area, which may not be shared by industry.

To increase the number of tracts leased and to encourage exploration and development, MMS implemented royalty reductions on oil production for Beaufort Sea Sale 186. The MMS expects to continue to offer leasing incentives for future sales in the area. The MMS also lowered the required minimum bid amount and rental rates for tracts leased in Sale 186 and plans to do the same for Sale 195.

The leasing incentives could provide a counterbalance to the delays and extra costs commonly associated with operations in this challenging frontier area. We believe that the hypothetical development scenario discussed in the multiple-sale EIS is more likely to occur with the new incentives than without them. Without the leasing incentives, the present situation of low industry interest in leasing and exploration likely would continue into the future.

II.B. Scenario

We acknowledge that the exploration and development scenario generated for purposes of environmental analysis is optimistic compared to historical trends in the Beaufort Sea. An optimistic development scenario ensures that the environmental analysis covers the potential effects at the reasonable high-end of possible petroleum-activity levels, including those that could occur as a result of any increase in activities due to incentives. For these reasons, the exploration and development scenario and environmental effects analysis presented in the multiple-sale EIS are a valid representation of the consequences of any Beaufort Sea sale as scheduled in the current 5-Year Offshore Oil and Gas Leasing Program.

As assumed in the final EIS, all hydrocarbon resources estimated to be produced as a result of proposed Lease Sale 195 should be crude oil. The anticipated 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 (USDOI, MMS, 2003a:Table II.A-1). The zones were delineated primarily on distance to existing infrastructure and secondarily on water depth. Although not a direct cause of impacts, leasing typically precedes future exploration and development activities.

As explained in Section II.B.2 of the multiple-sale 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. During Sale 186, the assumed pattern of leasing did not occur (nearly half of the total bids were received in the Far Zone). It remains to be seen if exploration activities (marine seismic and drilling) will occur on the remote leases. However, 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 expect 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 I provides similar information to that provided in the multiple-sale EIS (USDOI, MMS, 2003a:Table II.A-1). While it has been updated to include the leasing results from Sale 186, our estimates for the total sales-related activities remain unchanged.

Sale 195 would be held in 2005. We assume that timeframes for Sale 195 exploration and development would be similar to those projected prior to Sale 186. The total number of exploration and development wells drilled and the type of exploration and production platforms are assumed to be the same (see Table IV.A-2 in the final Beaufort Sea multiple-sale EIS [USDOI, MMS, 2003a]).

II.B.1. Exploration and Delineation

For purposes of analyses, we assume that a maximum of two drilling rigs would operate at any time, with a total of six exploration and six delineation wells expected to be drilled over the 8-year exploration period. The first commercial discovery is assumed to be made in 2008, 3 years after the sale date, and production from Sale195 would begin by 2013. Between 2012 and 2017, two production platforms are assumed to be installed. One platform would be in the Near Zone, and one would be in the Midrange Zone. Drilling of production and injection wells would begin in 2012 and finish in 2019, with a total of 102 wells drilled. Offshore pipeline construction would begin in 2012 and finish in 2016, with 40 miles of new offshore pipeline installed. The offshore pipeline would connect to existing onshore pipelines and, therefore, construction of new onshore pipelines would be minimal. Oil production from Sale 195 would end by 2036.

We assume that exploration activity (seismic surveys and drilling) would begin in 2007, 2 years after the proposed sale and continue until 2013, with delineation wells drilled through 2014. A commercial discovery is assumed to occur 3 years after the sale, and installation of a production platform is assumed to occur 4 years later. Following the next discovery, we assume delineation wells would employ the same drilling rig and continue over a 2-year period. Because of the short open-water drilling season in the Beaufort Sea, it is likely that a single drilling rig would drill a single well at any drilling site in any one year. However, in the event of a discovery, two delineation wells could be drilled by the same exploration rig in the same season. The type of units that might be used in exploration drilling would depend on water depth, sea-ice conditions, ice-resistance of the units, and availability of drilling units. Artificial ice islands grounded on the seabed are likely to be used as drilling platforms in shallow water (less than 10 meters), and nearshore operations would be supported by ice roads over the landfast ice. Gravel islands are not likely to be constructed for exploration-well drilling in OCS waters (generally deeper than 10 meters), although older artificial islands or natural shoals could be used as a base for temporary gravel or ice islands. However, should the lease operators consider that a gravel island is necessary, it likely would be constructed in water depths less than 40 feet (ft) (12 meters [m]); it could be built from barges in summer but likely would be built in winter. Gravel used to construct the island would be hauled over ice roads from onshore sources. Additional gravel is expected to be needed for a production island in similar water depths. Personnel and material would be carried to and from the various shallow-water platforms over ice roads (in winter) and by boats and barges (in summer). In water 33-66 ft (10-20 m) deep, movable platforms resting on the seafloor likely would be used for exploration. These platforms are designed to withstand winter ice forces, and drilling could be conducted year-round. Bottom-founded platforms (set on the seafloor) could be used to drill prospects in water depths of 10-20 m, and drillships or other types of floating platforms would be used in deeper water. These floating systems can operate only in open-water and broken-ice conditions and not in midwinter pack-ice conditions. Because mobile ice conditions in deeper water make ice roads unfeasible, deeper water (Far Zone) operations would take place during the summer open-water season and would be supported by icebreakers and supply boats. They would be stored in protected inshore areas when not in use.

Based on geologic studies, MMS assumes that exploration and delineation wells generally would test prospects from 3,000-15,000 ft (914-4,572 m), and we assume a representative exploration-well depth of 7,000 ft (2,133 m). At this depth, each exploratory or delineation well would require 425 short tons of drilling muds (dry weight) and produce approximately 525 short tons of dry rock cuttings. We assume that 80% of the drilling muds would be recycled, leaving 85 tons of "spent mud" to be discharged along with all the drill cuttings at the exploration site or disposed of onshore. We estimate that 935-1,040 short tons (dry weight) of drilling muds and 5,775-6,300 short tons (dry weight) of bore cuttings would need to be disposed of for the exploration and delineation activities for each sale. The higher figures are the estimates for Sale 195 (and applied also to Sale 186). These materials would be disposed of primarily at the drill site under conditions prescribed by the Environmental Protection Agency's National Pollution Discharge Elimination System (NPDES) (Clean Water Act of 1977, as amended [33 U.S.C. 1251 et seq.).

On completion of the exploration-drilling program the operator, depending on the type of platform used, may do the following: allow the ice island to melt, remove the protective berm from the gravel island and allow it to disperse from wave action, or mine the gravel island for other construction projects. Should economically recoverable oil resources be discovered, the gravel island could be enhanced for production activities. At the end of the exploration phase, a deepwater steel and/or concrete exploration platform either would be floated out and used in another field or would be reinforced and used as a production platform, should that be required.

II.B.1.a. Seismic-Survey Activity

Before exploration and production activities, the MMS requires the lessee/operator to conduct surveys to define any shallow hazards or archaeological resources that may be present. If geological/geophysical evidence shows that specific lease blocks might have the potential for archaeological resources, either prehistoric or historic, a site clearance is required. These surveys usually incorporate seismic profiling. The projected level of seismic activity varies by the number of wells that may be drilled. Site-specific surveys of the exploration and delineation well sites would be conducted during the ice-free seasons of the years of the exploratory phase. We estimate each survey would cover roughly six OCS blocks (9 square miles (mi^2 or 23 square kilometers [km^2]) for each exploration well. For Sales 186, 195, and 202, the total area covered by these surveys would equal 54 mi^2 (approximately 138 km^2). 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. Other factors affecting seismic surveys are climate, oceanography, and geology.

II.B.1.b. Support and Logistic Activities

Offshore exploration-drilling operations in the Beaufort Sea multiple-sale area would require onshore support facilities. Where possible, existing facilities within the Prudhoe Bay or Kuparuk unit areas would be used or upgraded. These onshore facilities would have to provide the following:

- a staging area for construction equipment, drilling equipment, and supplies;
- a transfer point for drilling and construction personnel;
- a harbor to serve as a base for vessels required to support offshore operations; and
- an airfield for fixed-wing aircraft and helicopters.

Existing systems would be used to transport equipment, material, supplies, and personnel. The descriptions of North Slope transportation systems, as contained in Section III.C of the Northeast National Petroleum Reserve-Alaska final EIS (USDOI, Bureau of Land Management and MMS, 1998); Sections 3.2 and 3.3 of the Beaufort Sea Oil and Gas Development/Northstar Project, final EIS (U.S. Army Corps of Engineers, 1999).

Existing surface-transportation routes, including both pipelines and roads, traverse about a quarter of the North Slope. They extend from the Endicott field facilities located on the Beaufort Sea coast to just west of the Kuparuk field. Gravel roads, which parallel existing pipelines, connect existing oil-production facilities between the Kuparuk and Endicott fields. One gravel road, east of the Colville River, connects the main Alpine pad with its airstrip. Most exploration activities are supported by ice roads that must be reconstructed each year. The Prudhoe-Kuparuk region is linked to interior Alaska by the Dalton Highway. The majority of the vehicles traveling the Dalton Highway are commercial-freight vehicles associated with oil-field activities, although privately owned vehicles and commercial tour operators also travel the Dalton Highway. Summer-traffic levels for the Dalton (June-August) are substantially higher than traffic levels for the rest of the year.

Air transportation is the primary means of passenger travel to the North Slope Borough and Prudhoe Bay/Kuparuk area. All public airstrips, except those at Barrow and Deadhorse, are gravel. The North Slope Borough continually upgrades local roads and airports. A private airfield capable of handling jet aircraft also is located at the Kuparuk Unit base camp.

Barges transport most heavy and bulky cargo to the North Slope Borough. Prudhoe Bay has barge-docking facilities at both the East Dock and the West Dock; however, the West Dock facility is larger and more active. Crowley Maritime operates several heavy-lift cranes, barges, and barge docks in addition to support vessels from the West Dock. Oliktok Dock was constructed in 1982 to expedite shipping to the Kuparuk Field. Barge traffic in support of continued development on the North Slope of Alaska typically, over time, has ranged from 10-15 barges per year. During the initial development of the Prudhoe Bay Unit in 1970, 48 barges were used; however, newer barges are larger and more efficient and would sharply reduce that number. Barges supporting exploration activities would travel directly to the drill site to offload any cargo. Typically, a mobile drilling platform used for exploration drilling would enter its area of operation fully supplied for the drilling season.

The number of required support vessels for each bottom-founded drilling unit would depend, at least in part, on the type and characteristics of the unit and the sea-ice conditions. If drilling operations occur during the open-water season, MMS requires an emergency-standby vessel within the immediate vicinity (5 mi or a 20-minute steaming distance, whichever is less) of the drilling unit to ensure emergency evacuation of personnel. This vessel also could assist in deploying the oil boom in the event of an oil spill. If operations are planned during broken-ice conditions, two or more icebreaking vessels may be required to perform ice-management tasks for the floating units. One to two potential drilling units might be operating during the open-water period.

During the open-water season (again, assuming a 45-day season), a supply boat would make one trip per rig per week. We estimate the total number of supply boat trips per open-water season could be as high as 14 for Sales 186 and 195 and 7 for Sale 202. The level of support-boat traffic would vary by distance from shore and/or support base and whether or not the facility can be supported by vehicles using ice roads in the winter.

The estimated numbers of vessel, helicopter, or vehicle trips are calculated as round trips. Estimates of vehicle trips do not include operations that may be necessary for rig demobilization or for emergencies.

Ice roads are assumed to be the principal route for transporting routine supplies and materials to ice islands and/or nearshore gravel islands. For drilling platforms farther offshore in the broken-ice zone, material and supplies would be transported by support/supply boats (with icebreaking capacity, if necessary) during the open-water season and by helicopter at all other times. For both types of drilling structures, it is probable that most personnel would be transported by helicopters. The number of helicopter trips flown in support of exploration and delineation well drilling is assumed to range from about 90-270 each year, depending on the number of wells (1-3) that are drilled. For each drilling operation, we assume there would be one flight per day of drilling. The time required to drill and test a well is about 90 days. For Sales 186, 195, and 202, the annual number of helicopter trips to the drill sites should average between 140 and 155.

II.B.2. Development and Production

II.B.2.a. Development- and Production-Related Seismic-Survey Activity

A three-dimensional, multichannel, prospect-defining, seismic-reflection survey would be conducted for each of the production platforms. The survey would cover approximately 35 mi^2 (92 km^2) for each production platform. The platform sites might be surveyed several years before the installation of the platform; surveys would be conducted during open-water, ice-free periods. High-resolution seismic-reflection data for shallow hazards would be collected before laying the offshore pipeline. The total trackline distance, estimated to be four times the length of the offshore trunk pipelines assumed for each sales scenario, would equal approximately 160 mi each for Sales 186 and 195, and 140 mi for Sale 202. Seismic activities and assumptions for development are similar to those described for exploration activities (see Section IV.A.2.b(1)(a) of the multiple-sale final EIS).

II.B.2.b. Production Platforms and Production Drilling

Assumed hydrocarbon production and development information is given in Tables IV.A-1, IV.A-2, and IV.A-3 of the multiple-sale final EIS, should commercial discoveries result from the above exploration activities. For Sales 186 and 195, we assume 69 production wells and 33 injection wells would be drilled from three production platforms. For Sale 202, 68 production wells and 34 injection wells would be drilled from two platforms. Drilling of each production and service well would require 650 short tons (dry weight) of drilling mud per well and 825 tons of rock cuttings. We assume that 80% of the mud is recycled and 130 tons per well is disposed of in the subsurface by service/injection wells on the production platform. The disposal of muds and cuttings and any produced water would be in accordance with approved NPDES permits for development-well drilling. The amount of disposed drilling muds would be about 13,300 tons for all wells drilled for each sale. The total amount of disposed cuttings for each sale would amount to 84,000 short tons (dry weight). These calculations are based on a production well with a representative depth of 10,000 feet (3,050 m).

Depending on the water depth, seafloor conditions, ice conditions, and size of the reservoir, several types of platforms could be used. In water depths less than or equal to 30 ft (10 m), artificial (gravel) and or caisson-retained islands may be used as production platforms. For water depths between 30 and 100 ft (10 and 30 m), bottom-founded structures designed with ice-management systems are likely. Icebreaking support ships may be required onsite. For waters deeper than 100 ft (30 m), a combination of extended-reach wells and/or subsea well tied back to the main production platform in shallower water is most likely.

A variety of steel and concrete structures of various designs can be built and used for a production platform that resists seawater, ice, and freeze-thaw cycles and operates safely in low-temperature, offshore environments such as the Beaufort Sea. Bottom-founded production platforms would be constructed and outfitted in ice-free harbors and moved to the production site. Modular units would be transported during the open-water season and assembled and installed in less than 45 days. In addition to the vessels (8-10 tugboats) used to tow the platform components to the site, installation also might require a large-capacity derrick barge and a vessel to accommodate the workers. Each platform could use two rigs to maximize development drilling and shorten startup times.

Gravel needs and transportation requirements for island construction would vary according to water depths. The BPXA proposal for the Liberty Project, estimated 800,000 cubic yards (yd^3) of gravel would be needed to construct a production Island in 22 ft (7 m) of water (USDOI, MMS, 2002). For Northstar Island, an estimated 700,000-800,000 yd^3 of gravel was hauled to the site of a relic exploration island. At the former exploration island site, about 400-500,000 yd^3 of gravel remained. Consequently, Northstar Island, which lies in 39 ft (12 m) of water, required approximately 1.2 million yd^3 of gravel. For both islands, construction material was carried on ice roads, with needed additional gravel excavated from onshore sites (U.S. Army Corps of Engineers, 1999).

At the end of production and the abandonment of the production platform, the following might occur. The gravel island's protective concrete or sandbag berm would be removed and allowed to disperse from wave action. The island's gravel resources may be removed and used for other construction projects. A far-offshore steel-production platform could be floated out and scrapped, or the structure could be sunk and allowed to become an artificial reef. This last option has proved effective in enhancing fish and benthic habitat offshore in the Gulf of Mexico. In all cases, the pipelines would be flushed and any remaining oil removed.

II.B.3. Support and Logistics Activities

For this scenario, it is assumed that the infrastructure at Prudhoe Bay would provide the major support for construction and operation activities associated with the development, production, and transportation of crude oil. However, as the development of the proposed sale area progresses into tracts farther from Prudhoe Bay and/or into deeper waters, new shore-base locations may be required. One new shore base is assumed for the development of Sale 202 resources (see Table IV.A-3 of the multiple-sale EIS) and is assumed to be located at Point Thomson in the west or Smith Bay in the east. It could be located anywhere in the eastern or western Beaufort Sea.

Support and logistics operations after discovery can be divided broadly into three phases: construction, development drilling, and production. Transportation needs for each project are initially and briefly intense and then decline over time. For the now-deferred Liberty Project, forecast construction-phase transport requirements for helicopter round trips ranged from 10-20 flights per day during the construction phase to 3-7 trips per week during the operation/production phase. Marine-support trips to the Northstar structures during the construction phase were estimated at 125-150 trips during the open-water season. This figure also includes sealift barges. Marine transport estimates declined to 4-6 trips per season during the operations/production phase. For surface transport during the construction phase, estimates for Northstar and Liberty were roughly 36,000 round trips (400 per day), assuming a 90-day season. Surface transport estimates are expected to decline to 100-200 per season during the operations/production phase.

As construction/development operations move farther from existing infrastructure and into deeper water, beyond the landfast-ice zone, the burden of transport would shift increasingly to helicopter and, more importantly, marine transport. Personnel, perishable goods, and emergency material would be transported by helicopter during all but the open-water season. During the construction phase, dredges would prepare the seafloor for bottom-founded structures; any fill or gravel required would be barged to site from shore or dredged from offshore sites. The open-water season would be the focus of activity as barges from outside the sale area and local support vessels fulfill the platforms' yearly construction and operating requirements. Icebreaking vessels would be on standby to extend the open-water season and to support ships in case of emergency activities.

Marine transport requirements during construction for facilities in the Far Zone most likely would range between 150 and 250 vessel trips during the open-water season. This number would include barges carrying construction supplies from outside ports, dredges, survey vessels, pipelaying barges, and local support vessels. Should subsea completions be used to produce deepwater finds, gathering lines would transport production to platforms that could be located in shallower waters. In this event, air and marine transport requirements would be reduced. During the period of developmental drilling (8 years for Sale 186, 7 years for Sale 195, and 5 years for Sale 202), helicopter trips for far/deepwater platforms would range from 7-14 per week per platform. During the production phase, average weekly helicopter operations could range between 3 and 7 trips per platform.

Table IV.A-4 in the multiple-sale EIS summarizes the exploration, development, production, and transportation assumptions for all Alternatives for each of the three sales. Transportation information presented in this table is based on the assumption that all three production platforms constructed as a result of Sale 186 would be in the shallow-water landfast-ice zone; that one of the three production platforms assumed for Sale 195 would be in the shallow-water zone and the other two would be in the Midrange or Far Zone; and that both production platforms for Sale 202 would be beyond the landfast-ice zone and located in the Midrange or Far Zone.

We assume that two new fields would be discovered, ranging in production potential for each field from 120-340 million barrels of oil. The MMS assumes that the fields discovered and developed would be this size and could be produced by one production platform, perhaps as a satellite with minimal onsite processing facilities. Each platform would contain one rig for development-well drilling and well-workover operations. Gravel islands would be the favored design for production facilities in water depths approximately 15 m or less, and bottom-founded platforms would be employed for production facilities in water depths to 35 m. Some oil may be produced by wells using extended-reach drilling technology, which would enable the operators to reach oil pools located in strata that lie beneath deeper OCS waters. However, the volume of oil developed by extended-reach drilling likely would represent a minor proportion of the total production from the new fields.

II.B.4. Activities Associated with Oil Transportation

II.B.4.a. Pipelines

As for Sale 186 development activities, we assume that the route selection and installation of offshore pipelines would take 1-2 years and could occur either in the summer open-water season, during mid- to late winter when landfast ice has stabilized, or both. Pipeline-landfall sites for this sale are assumed to be the same as for Sale 186. For Sale 186, we assumed that, because of their relatively small size, new offshore projects would use the existing infrastructure (processing facilities and pipeline-gathering systems) wherever possible. Produced oil would be gathered by existing pipeline systems within the Prudhoe Bay/Kuparuk field areas and transported to Pump Station 1 of the TAPS. We assume that Oliktok Point (using the Kuparuk or Milne Point field infrastructure), the Northstar pipeline landfall, West Dock (using the Prudhoe Bay field infrastructure), and the Badami field would be the primary landfalls.

However, because new fields leased in Sale 195 could be farther from existing infrastructure, a new onshore support facility could be needed in either the National Petroleum Reserve-Alaska (NPR-A) or the eastern North Slope. Plans are proposed for an expansion of development surrounding the Alpine field, and these facilities could gather oil production from the Beaufort OCS. A new onshore pipeline would be required to reach the existing North Slope gathering system connecting to Pump Station No. 1 of the TAPS. Depending on the location of the field, a new landfall would be constructed in Smith Bay (discovery in the western Beaufort) and traverse south of Teshekpuk Lake through the NPR-A to the Kuparuk field infrastructure, a distance of approximately 50 mi (80 km). Although a recent development plan (Exxon Corporation) has been postponed for the Point Thomson field, this area remains a likely area for industrial expansion on the eastern North Slope. Future onshore projects in the Point Thomson area are likely to be used by OCS operations in the eastern Beaufort Sea. The pipeline would pass along the coast and join the Badami pipeline, a distance of approximately 12 mi (19 km).

Installation of offshore pipelines between production platforms and onshore facilities would take 1-2 years. New onshore-pipeline sections would take 1-2 years to complete, with construction activities taking place simultaneously with the offshore-pipeline installation. We assume that offshore pipelines would be trenched as a protective measure against damage by ice in all water depths less than 50 m (164 ft). Trenching and pipeline laying would take place during the relatively short open-water season or during mid- to late winter, when the landfast ice has stabilized. At coastal landfalls, pipelines would be elevated on short gravel causeways to protect them against shoreline erosion. Booster stations at the landfalls would be required to maintain pressure in the long pipeline segments. Onshore pipelines would be elevated 5 ft above ground level on vertical support members. The onshore pipeline corridor, and shore-facility construction would be concurrent with the offshore platforms' installation.

The first production platform would be online in 2013. Production from Sale 195 leases is projected to continue until 2036, about 3 years beyond the projected end of Sale 186 production.

Production rates would quickly ramp up to peak production rates for 3 years before declining. A typical field cycle from discovery to abandonment lasts 21 years, or approximately 5 years from discovery to startup, a 15-year production life, and an abandonment phase. Considering the staggered discovery times of the fields, activities resulting from Sale 186 could last until 2033 (see Table IV.A-1 and Appendix B in the Beaufort Sea Multiple-Sale EIS).

II.B.4.b. Tankers

Crude oil produced from Sale 195 leases would be transported by pipeline to the oil terminal at Valdez, where it would be commingled with crude produced from other North Slope sources. Once at Valdez, the oil would be loaded into tankers for transport primarily to the U.S. west coast, with smaller quantities traveling to the Kenai Peninsula, Hawaii, the Gulf of Mexico, the Far East, or refineries in the Virgin Islands. Tankers loaded with oil produced from Sale 186 are expected to depart Valdez during 2010. Sale 195 tanker departure should begin sometime in 2013, and Sale 202 departures should begin at some point during 2019. Valdez tanker-transport traffic generated by the Proposal is approximated in Table IV.A-4 of the multiple-sale EIS. Assuming the use of 100,000 deadweight-ton tankers, we estimate that at the peak of production, Sales 186, 195, and 202 would generate 63 tanker loadings and departures in 2016, 56 in 2018, and 55 in 2020-2024, respectively.

II.B.5. Abandonment

Abandonment operations generally include removal of all equipment and the plugging of all wells. Overall, abandonment operations could take one or more years. A series of permitting and inspection activities are associated with abandonment procedures.

III. Information About Listed Bowhead Whales that May be Affected by the Proposed Action in the Alaskan Beaufort Sea

Information provided in this section summarizes information from the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003a) 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 ESA. 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 all three lease sales and related activities on this stock of whales, and an evaluation of cumulative effects on this population stock.

Since the preparation of our multiple-sale EIS, other documents that provide and synthesize information on this population have become available. The NMFS issued their *Biological Opinion on Issuance of Annual Quotas Authorizing the Harvest of Bowhead Whales to the Alaska Eskimo Whaling Commission for the Period 2003 through 2007* (NMFS, 2003a). Relatedly, in February 2003 the NMFS published the *Final Environmental Assessment for Issuing Subsistence Quotas to the Alaska Eskimo Whaling Commission for a Subsistence Hunt on Bowhead Whales for the Years 2003 through 2007* (NMFS, 2003b). The International Whaling Commission (IWC) reviewed and critically evaluated new information available on the bowhead whale at their 2003 meeting. This information and the associated discussions are summarized in the *Report of the Subcommittee on Bowhead, Right and Gray Whales* (IWC, 2003a). The Final 2002 Alaska Marine Mammal Stock Assessment (Angliss and Lodge, 2002) for this stock remains the most recent stock assessment available. We refer interested readers to these documents for details on topics that might lie outside the scope of the material provided in our multiple-sale EIS, updated in our EA for proposed Lease Sale 195, or provided here.

The IWC will be conducting an in-depth status assessment of this population in 2004 (IWC, 2003a) at their annual meeting.

III.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.

The IWC currently recognizes five stocks for management purposes (IWC, 1992). DeMaster et al. (2000, as cited in IWC, 2003a) summarized the IWC scientific committee discussions that led to the conclusion that the BCB bowheads comprise a single stock (IWC, 2003a). Studies to date have not provided evidence of substock structure, but available samples to test for a putative Chukchi Peninsula substock have been limited. The IWC Subcommittee on Bowhead, Right and Gray Whales agreed that it was important for the 2004 in-depth assessment to examine data acquired since the DeMaster (2000, as cited in IWC, 2003a) review to determine whether they agree with the single stock assumption (IWC, 2003a).

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. Regarding the listing status of bowhead whales, 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 [Bering-Chukchi-Beaufort Seas) bowhead [BCBB]) 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.

In a recent response to this paper, Taylor (2003) criticized Shelden et al. (2001) for underestimating the extinction risk of this population. Shelden et al. (2003) responded to the criticisms. Because of the importance of this topic for evaluating the present status of the bowhead, we discuss the arguments presented in some detail in the following.

Points raised by Taylor included that the model assumptions of Dennis et al. (1991) that were used by Shelden et al. (2001) to generate the population viability analysis in both of their models were not met, that the timeframes used by Gerber and DeMaster (1999) were not adequate, and that downward trends in bowhead abundance are expected based on "available evidence" about climate change. Shelden et al. (2003) replied to Taylor (2003 that while the model of Dennis et al. (1991) does make assumptions that are not met in the bowhead abundance estimates (for example, the abundance estimates do contain sampling error) the result is this model will overestimate the environmental stochasticity that the bowhead population experiences and, thus, will overestimate, not underestimate, the extinction risk of this population.

In Shelden et al.'s (2003) response to Taylor's statements regarding the expectation of future downward trends in abundance, based on what he termed "available evidence" regarding global warming, they point out that Taylor did not provide citations supporting this claim. Shelden et al. (2003:918-919) state that:

> Although available data do indicate that the Bering Sea environment is changing (e.g., Angel & Smith 2002), we are aware of no evidence that environmental changes will be detrimental to the population in the foreseeable future. In fact, our review...on this issue suggests that climate change may actually result in more favorable conditions for BCB bowheads.

Relatedly, Taylor argued that there will be downward trends in basic life-history parameters as a function of global warming. Shelden et al. (2003) responded that Taylor did not list which life-history parameters to which he was referring and did not provide the factor that he believed would result in the change of each parameter. They pointed out that members of the IWC's Scientific Committee had "tested extensively" the robustness of BCB bowheads, including changes in key population parameters.

With regards to Taylor's criticism of the timeframes used by Shelden et al. (2001) in their analyses, and his suggestion that they "could more reasonably have used a time frame of 100 years," they pointed out that one of the models used a 35-year timeframe based on time periods deemed appropriate for planning by agency scientists. The World Conservation Union-based model used an extinction probability of 20% in 20 years and an extinction probability of 10% in 100 years.

Regarding Taylor's (2003) conclusion that potential future threats should prohibit delisting, Shelden et al. (2003) disagreed, pointing out that there are many potential threats to any recovering population. They stated that: "If the BCBB classification is changed, management will focus on mitigating human-related sources of disturbance and mortality...so that the...population will continue to recover after delisting." They pointed out that if delisted, the population would be monitored for 5 years and would be relisted promptly, if appropriate. Shelden et al. (2003) completed their response to Taylor's criticism of their conclusion that the bowhead population should be delisted by iterating many of the protective measures in place that would protect the bowhead population, even if it were delisted.

After review of Taylor's scenarios by the IWC's Scientific Committee, many members questioned the methods and interpretations given in the paper (IWC, 2003a).

III.B. Past and Current Population Distribution and Abundance

Woody and Botkin (1993) estimated that the historic population abundance of bowheads was between 10,400-23,000 whales in 1848, before the advent of commercial whaling. Commercial whaling severely depleted bowhead whales. Woody and Botkin (1993) estimated that between 1,000-3,000 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, the estimate recognized by the IWC, and the estimate used by the NMFS in their stock assessments (Hill and DeMaster, 1999; Ferrero et al., 2000; Angliss, DeMaster, and Lopez, 2001). An alternative method produced an estimate of 7,800 individuals, with a 95% confidence interval of 6,800-8,900 individuals. Zeh, Raftery, and Schaffner (1995) estimated that the Western Arctic stock increased at a rate of 3.2% per year from 1978-1993. The 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.

In the 2003 *Report of the Subcommittee on Bowhead, Right and Gray Whales* for the IWC, the completed analysis of the 2001 ice-based census of bowhead whales in Barrow using the N_4/P_4 methodology was presented and critically evaluated (N_4 = the number of whales within 4 kilometers of the lead edge and P_4 = proportion of acoustic locations within 4 kilometers of the lead edge) (IWC, 2003a). Zeh provided a revised abundance estimate for 2001 of 10,020 (SE of 1,290, 95% confidence interval of 7,800-12,900). This revised abundance estimate was based on a revised (from data presented in the preliminary estimate in 2002) estimate from the acoustic location data, which incorporated acoustic data from the entire season, and the original (presented to the International Whaling Commission in 2002) estimate from the visual data. The standard error of this 2001 abundance estimate was more than twice that of the 1993 estimated. Such a high standard error was expected due to poor viewing conditions in 2001 (IWC, 2003a). Zeh also reported an annual rate of increase of 3.4% (95% CI 2.1% to 4.8%), an estimate nearly identical to the rate of increase of 3.3% based on data from the 1978-1993 time period.

The number of calves counted in 2001 (121) is nearly twice the number counted in 1993 (66), and it is the highest ever recorded.

The most recent population census shows a substantial increase over the previous population count of 8,200 whales, and suggests that population abundance is approaching the lower limits of the historical population

Zeh is recorded (in IWC, 2003a) as noting that modifications to this 2001N_4/P_4 abundance estimate for the Bering-Chukchi-Beaufort (BCB or B-C-B) seas stock of bowhead whales are not anticipated in the coming year prior to the in-depth status assessment by the IWC.

Distribution and Movements. Bowhead whales have an affinity for ice and are associated with relatively heavy ice cover and shallow continental shelf waters for much of the year. Throughout the winter, bowheads frequent the marginal ice zone, regardless of where the zone is, and polynyas (irregular areas of open water). Polynyas in the Bering Sea along the northern Gulf of Anadyr, south of St. Matthew Island, and near St. Lawrence Island, are important wintering areas for bowheads. Bowheads also congregate in these polynyas before starting their spring migration (Moore and Reeves, 1993).

Some, or nearly all, of the Western Arctic stock (Bering Sea stock) of bowhead whales migrate through the Alaskan Beaufort Sea semiannually between wintering areas in the Bering Sea and summer feeding grounds in the Canadian Beaufort Sea. 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. Other scientists maintain that a few bowheads swim northwest along the Chukotka coast in late spring and summer in the Chukchi Sea. Incidental sightings suggest that bowhead whales may occupy the northeastern Chukchi Sea in late summer more regularly than commonly believed (Moore, 1992). Records of bowhead sightings from 1975-1991 suggest that bowheads may occur regularly along Alaska's northwestern coast in late summer; however, no one has yet established if these are "early-autumn" migrants or whales that have summered nearby (Moore et al., 1995). Harry Brower, Jr., stated that he has seen whales in the Barrow area in the middle of the summer while the hunters are out 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. 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).

The bowheads' northward spring migration appears to coincide with ice breakup. 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. The migration takes place in pulses, or aggregations of whales swimming together, with the first pulse passing Point Barrow in late April or early May, the second pulse in mid-May, and a less-well-defined pulse in late May to mid-June (Moore and Reeves, 1993). 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 (5.5-7 inches) 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 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. Bowheads arrive on their summer feeding grounds near Banks Island from mid-May through June and remain in the Canadian Beaufort Sea and Amundsen Gulf until late August or early September (Moore and Reeves, 1993).

After summer feeding in the Canadian Beaufort Sea, bowheads begin moving westward into Alaskan waters in August and September. Generally, few bowheads are seen in Alaskan waters until the major portion of the migration takes place, typically between mid-September and mid-October. However, in some years bowheads are present in substantial numbers in early September. Greene and McLennan (2001) reported detecting substantial rates of bowhead whale calls on September 2-3 while conducting acoustic monitoring studies around the Northstar Project. 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 it 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). Braham et al. (1984, as reported in Moore and Reeves, 1993) reiterated the contention of Eskimo whalers that bowheads are segregated roughly by age class, with smaller whales preceding large adults and cow-calf pairs on the fall migration. 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).

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 per hour in ice-free waters. It traveled at an average speed of 3.7 km per hour in relative ice-free waters and at an average speed of 2.7 km per hour 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 per hour (Wartzog et al., 1990). Mate, Krutzikowsky, and Winsor (2000) tagged 12 juvenile bowhead whales with satellite-monitored radio tags in the Canadian Beaufort Sea. Individual movements and average speeds (1.1-5.8 km per hour) varied widely. 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 per hour. 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 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; Treacy, 2000). Over a 19-year period (1982-2000), there were 15 years with some level of offshore seismic exploration and/or drilling activity and three blank 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 Map 7 in the Beaufort Sea Multiple-Sale FEIS). 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 (1420 W to 1550 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 is also 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 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 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 Liberty 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 yd from the beach shoreline near Point Barrow during the fall migration (Rexford, as cited in USDOI, MMS, 1996b). 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, but no source for the reference was provided nor was any specific information 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 Chukotsk Peninsula. However, scattered sightings north of 72° N. latitude suggest that at least some whales migrate across the Chukchi Sea farther to the north. After moving south through the Chukchi Sea, bowheads pass through the Bering Strait in late October through early November on their way to overwintering areas in the Bering Sea.

III.C. Reproduction and Survival

Information regarding age at sexual maturity or mating behavior and timing for bowhead whales is not known with certainty. Most bowheads mate and calve from April through mid-June, coinciding with the spring migration. Mating may start as early as January and February, when most of the population is in the Bering Sea, but mating also has been reported as late as September and early October (Koski et al., 1993). Calving occurs from March to early August, with the peak probably occurring during the spring migration between early April and the end of May (Koski et al., 1993). Females give birth to a single calf probably every 3-4 years.

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. By comparison, the length of gestation for bowhead whales was estimated to be between 13 and 14 months by Nerini et al. (1984, as reported in Reese et al., 2001) and between 12 and 16 months by 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 parturition is likely to occur in mid-May to mid-June, when most whales are between the Bering Strait and Point Barrow. 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) females with term pregnancies appeared close to parturition; and (e) most of the herd believed to have migrated past Barrow by late May.

Several researchers have explored techniques for aging bowheads, including tympanic bullae lamina, carbon isotopes in baleen, photographic recapture, and aspartic-acid racemization of the eye lens. The various approaches at aging bowhead whales and estimating survival rates all suggest slow growth, great longevity, and high survival rates. 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. Zeh et al. (1993), while looking at population structure and dynamics, also concluded that the bowhead is a late-maturing, long-lived animal with fairly low mortality. Photographic recaptures by Koski et al. (1993) also suggested advanced age at sexual maturity of late teens to mid-twenties. Most female bowheads become sexually mature when they are 12.5-14.0 m long, probably at an age exceeding 15 years. The discovery of traditional whaling tools recovered from five bowheads landed since 1981 also suggest advanced longevity (George et al., 1995), in some instances exceeding 100 years. George et al. (1999), using the aspartic-acid racemization techniques, estimated the age of 42 whales. The results indicated that four animals exceeded 100 years of age.

There is little information regarding natural mortality for bowhead whales in the Bering, Chukchi, and Beaufort seas. Bowhead whales have no known predators except, perhaps, killer whales and subsistence whalers. Attacks by killer whales have occurred, but the frequency probably is low. George et al. (1994) concluded that the relatively low frequency of bite marks likely reflects a relatively low frequency of killer whale attacks and predation pressure. Likewise, the scarcity of observations of vessel-inflicted injuries suggests that the incidence of ship collisions with bowhead whales also is quite low. There also are some reports of bowheads becoming entangled in ropes from crab pots, harpoon lines, or fishing nets; however, the frequency of occurrence is not known. Some whales likely die as a result of entrapment in ice, but the number is thought to be relatively small (Philo et al., 1993). Little is known about the effects of microbial or viral agents on natural mortality.

Survival Estimation. Using aerial photographs of naturally marked bowheads collected between 1981 and 1998, Zeh et al. (2002) updated their previous work on estimating annual survival probabilities of BCB bowheads using both Bayesian and maximum likelihood implementations of Cormack and Jolly-Seber (JS) models for capture-recapture estimation in open populations and reduced-parameter generalizations of these models. The initial "capture" was made when a marked whale was first photographed and then "released." The "recaptures" came if the whales were photographed again in subsequent years. Zeh et al. (2003) employed a Bayesian Markov chain Monte Carlo implementation of the model to produce a posterior distribution for annual survival. Zeh et al. concluded that because the Cormack model "ignores much of the information on capture probabilities provided by the data, its results are less precise and more sensitive to the prior distributions used than results from the JS model." Thus, with "priors for annual survival and capture probabilities uniform from 0 to 1", Zeh et al. (2002:832) estimated "the posterior mean for bowhead survival rate from the JS model 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.

III.D. Bowhead Feeding

Bowheads are filter feeders, filtering prey from the water through baleen fibers in their mouth. Bowheads apparently feed throughout the water column, including bottom or nearbottom feeding as well as surface feeding. Food items most commonly found in the stomachs of harvested bowheads are zooplankton, including euphausiids, copepods, mysids, and amphipods. Euphausiids and copepods are the primary prey species.

The importance of the Alaskan Beaufort Sea as a feeding area for bowheads is an issue of concern to Inupiat whalers. It is likely that bowheads continue to feed opportunistically where food is available as they migrate across the Alaskan Beaufort Sea, similar to what they are thought to do during the spring migration. It also is likely that the extent of use of at least some areas as bowhead feeding habitat varies among years, in some cases perhaps considerably.

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 Alaska Beaufort Sea in late summer and autumn. It is known that bowhead whales feed in the Canadian Beaufort in the summer and early fall, and in the Alaskan Beaufort during their westward migration in late summer/early fall (Richardson and Thomson, 2002). In mid to late fall, at least some bowheads feed in the southwest Chukchi in mid to late fall. Detailed feeding studies have not been conducted in the Bering Sea in the winter. Richardson and Thomson (2002) concluded that some, probably limited, feeding occurs in the spring.

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 (for example, Napageak, 1996, as reported in NMFS, 2001). Bowheads have been observed feeding not more than 1,500 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). 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.

Carroll et al. (1987) and Shelden and Rugh (1995, 2002) reported that stomach contents collected from bowheads harvested between St. Lawrence Island and Point Barrow during April into June indicated some whales feed opportunistically during the spring migration. 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. Shelden and Rugh also suggested the lead system near Point Barrow may serve as an important feeding area in the spring in years when oceanographic conditions are favorable. 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. The extent or importance of the area to bowheads for feeding is not known, because no estimate of total stomach volume for the whales was provided.

Over the years, bowheads have been reported feeding in the eastern Beaufort Sea and Amundsen Gulf region in Canada and have been observed feeding in various places in the Alaskan Beaufort Sea. Some bowheads appear to feed east of Barter Island as they migrate westward (Thomson and Richardson, 1987). Lowry (1993) reports that stomachs of 13 out of 15 whales harvested off Kaktovik during 1979-1988 contained food, suggesting that nearly all bowheads taken at Kaktovik had been feeding before capture. Lowry estimated total volumes of contents in stomachs ranged from 3-48 L, with an average of 25.9 L in eight specimens. One whale was noted as having a full stomach, but no stomach volume was reported. The report did not distinguish between feeding whales with a full stomach and whales with as little as 3 L of material in the stomach. Stomachs of five out of six whales taken at Point Barrow during 1976-1988 contained food (Lowry, 1993). The total volume of contents of the stomach of one whale was estimated at 109 L, and three others were estimated at 8 L. No estimate of total stomach volume for the whales was provided. All whales with food materials in the stomach, regardless of volume, apparently were considered feeding whales.

Lowry and Sheffield (2002) analyzed stomach contents of whales taken at Kaktovik, Cross Island, and Barrow during the fall migration. The standard for a whale being designated as a feeding whale for this study was as little as 10 or more prey items in the stomach. In many instances no information was available about the volume of the stomach contents, but collected samples were available for laboratory analysis.

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. Of these 24 known feeding whales, there were estimates of stomach contents for 18 whales. Eleven of the 18 whales had less than 20 L of material in their stomach, and 7 whales had more than 20 L of material in their stomach. Several feeding whales had as little as 2-3 L in the stomach. Two whales had estimated stomach volumes of 136 and 150 L. Copepods were the dominant prey species by volume.

Four out of five whales taken during the fall at Cross Island from 1976-2000 were considered to have been feeding. Copepods were the main prey in three of the stomachs sampled. The report provided little or no information on volume or stomach content of these whales other than types of prey species.

Lowry and Sheffield (2002) concluded that the coastal waters of the Alaskan Beaufort Sea should be considered part of the bowhead's normal summer-fall feeding range (Richardson and Thomson, 2002).

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 known feeding whales, there were estimates of stomach contents for 16 whales. Seven of the 16 whales had less than 20 L of material in their stomach, and nine whales had more than 20 L of material in their stomach. Estimated stomach volumes ranging from 1-189 L were reported for the 16 whales with stomach contents, with five whales having stomach volumes greater than 100 L. Euphausiids were the dominant prey species by volume. The extent or importance of the area to bowheads for feeding is not clear from the Lowry and Sheffield 2002 report, because the standard for determining a feeding whale was set so low. As pointed out by Thomson, Koski, and Richardson (2002), there is a large difference between a stomach with that small amount of prey (10 prey items) and one that is full.

Bowheads occasionally have been observed feeding north of Flaxman Island and, in some years, fairly large groups of them have been seen feeding east of Point Barrow between Smith Bay and Point Barrow. 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.

Treacy (2002) used a Geographic Information System to identify temporal or spatial patterns in feeding or milling behavior of bowhead whales in a given year or multiple years. 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) observed a greater relative occurrence of feeding and/or milling behavior of whales on transect in six of the 20 years (1984, 1989, 1997, 1998, 1999, and 2000) near the mouth of Dease Inlet. Greater relative occurrence of feeding and/or milling behavior of bowheads was observed on transect in 4 of those years (1989, 1997, 1998, and 1999) near Cape Halkett. There were 9 other years when feeding and/or milling behaviors were noted on transect at locations other than near Dease Inlet or Cape Halkett (1982, 1983, 1985, 1986, 1988, 1990, 1993, 1995, and 1996). Feeding/milling behaviors during these 9 years were typically spottier, less recurrent between years, and/or involved fewer whales per unit effort. In 5 other years (1987, 1991, 1992, 1994, and 2001), neither feeding nor milling behaviors were observed on transect anywhere in the study area. Interannual and geographic variation in prey availability likely accounts for opportunistic feeding aggregations in particular years and locations (Treacy, 2002).

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 conclusion was controversial. The North Slope Borough's Science Advisory Committee (1987) believed there were problems in the study's design and length. The main concerns expressed by the Committee were the short duration of the study (two field seasons, one of which was limited by ice cover), suboptimal sampling designs, and difficulties in estimating food availability and consumption. Two years is too short a period in which to fully characterize the use of an area by bowheads. The Committee also said the overall conclusion of nonimportance seems marginally reasonable only for the whale stock as a whole and only in the context of the sampling period within the 1985-1986 feeding seasons. The Committee did not accept the conclusion that the study area is unimportant as a feeding area for bowhead whales. To respond to these concerns and to better understand the importance of the eastern Alaska Beaufort Sea to bowhead whales, the MMS funded a second study on bowhead whale feeding, entitled *Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information* (Richardson and Thomson, 1997). The study emphasized cooperation among local government, subsistence-whale hunters, scientists, and MMS in its planning and execution. This bowhead whale-feeding study was an extension of the feeding study conducted in the same area of the eastern Beaufort Sea during 1985 and 1986. The purpose of the project was to compile and integrate existing traditional and scientific knowledge about the importance of the eastern Alaskan Beaufort Sea for feeding by bowhead whales. The study area for this 1985-1986 study extended from eastern Camden Bay to the Alaska/Canada border (Richardson and Thomson (2002). Flaxman Island to the Alaska/Canada border and from shore to the 200-m depth contour for the intensive study area, and beyond this contour only for aerial survey data.

A later study by 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.

Following the first year of fieldwork on this study, 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 lowest biomass in any of the plankton tows conducted at 17 whale-feeding stations was 545 milligrams per cubic meter (mg/m^3). For 4 of the 17 stations the highest biomass measured was 771-807 mg/m^3 and, for 12 of 17 stations, the highest value was greater than or equal to 1,000 mg/m^3. Mean wet-weight biomass in the water column near actively feeding whales was 529 mg/m^3, a value considerably higher than the mean biomass in the water column elsewhere in the eastern Alaskan and Canadian parts of the Beaufort Sea (230 mg/m^3). The distribution of biomass values at locations with feeding bowheads indicates that the feeding threshold for bowheads may be a wet biomass of ~800 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).

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, some individual whales stopped to feed in the study area for periods of at least several days. 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.

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.

Although various types of evidence (with the exception of isotope ratios) 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). 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. Koski, et al. (2002) used six calculation methods to estimate residence time for whales in the eastern Alaska 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. Richardson and Thomson (2002) estimated that an average bowhead spends ~3.8 days in the area from Flaxman Island to the Alaska/Canada border during late summer/early autumn, or ~1.4 days longer than expected for a whale that swims steadily across that area. Of the individual bowheads that travel through this portion of the eastern Alaskan Beaufort Sea, some spend at least 7 days.

Residence time in different parts of the Alaskan Beaufort Sea (of which the eastern Beaufort is only a portion) may vary among years. 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. If the same individuals are staying in the areas, and feeding, for these lengths of time, then, in those years, they could be deriving a higher than typical percentage of their yearly energetic requirements from the Alaskan Beaufort Sea. Since large numbers of marked individuals have not been studied, we do not speculate further about this possibility.

Carbon-isotope analysis of bowhead baleen has indicated that a significant amount of feeding may occur in wintering areas (Schell, Saupe, and Haubenstock, 1987). 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. 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). 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. 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, 1993).

The isotopic data also 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. 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.

A study by 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.

Estimated food consumption by bowheads in the eastern Alaskan study area (Flaxman Island to 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. Based on this approach, in an average year the population of bowhead whales is estimated to consume about 2.4% of its annual energetic requirements in the study area. In 1 of the 5 years (1999), the population of bowheads may have derived about 7.5% of annual energetic requirements in the study area. In all other years, estimated consumption in the study area was less than 2%.

Thomson, Koski, and Richardson (2002) tried to reconcile the low estimates of summer feeding, as evident from 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. Perhaps, more feeding and energy accumulation occurs there in fall than in the Beaufort Sea in summer. If so, the observations of feeding in the Beaufort Sea might not be inconsistent with the strong Bering/Chukchi isotope signature in bowhead tissues.

In October 2002, Richardson and Thomson (2002) finalized the report from the study *Bowhead Whale Feeding in the Eastern Alaskan Beaufort Sea: Update of Scientific and Traditional Information*, funded by and conducted for MMS. The primary study area for this study extended the westward boundary about 1 degree longitude from that of the 1985-1986 study. Thus the boundary for the latter study was near the middle of Camden Bay (145 degree 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.

As summarized by Richardson and Thomson (2002:xvi): "This report is an integrated account of traditional knowledge, previous scientific knowledge, and results from recent scientific studies concerning the use of the study area for feeding" by bowheads. The project was an extension, with additional fieldwork (mainly in September of 1998, 1999, and 2000), of a previous study conducted in 1985 and 1986. This study was planned and undertaken with extensive local input into design, objectives, and implementation. Richardson and Thomson (2002) summarized that:

> Local cooperation and participation was considered critical to the success of the study. Including the July 1998 scientific review Board (SRB) Meeting, we met with representatives of the Kaktovik Whaling Captains Association...Alaska Eskimo Whaling commission (AEWC, and North Slope Borough (NSB) on six occasions during Year 1.

They met with the KWCA, AEWC and NSB during a Scientific Review Board meeting in June 1999. Project participants also met with Kaktovik whaling captains and other residents in June and September 1999 and August 2000. "One key objective of ...these meetings was to develop and refine a field plan that whalers would accept as non-interfering and likely to be effective in assessing the importance of the area" for feeding by bowhead whales.

Richardson and Thomson (2002:xliii) summarized that: "In an average year, the population of bowhead whales derives an estimated 2.4% of annual energetic requirements" in the eastern Alaskan Beaufort Sea.

> 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."

They concluded that an average bowhead spends approximately 3.8 days in the area from Flaxman Island to the Alaska/Canada border during the late summer/autumn period, or ~1.4 days longer than expected for a whale that swims steadily across that area. Averages in various years ranged from ~2.5-6.3 days. Although the average was less than 7 days in all years studied, it might exceed 7 days in a small minority of the years, based on the calculated upper 95% confidence bounds. Of the individual bowheads that travel through the eastern Alaskan Beaufort Sea, some spend at least 7 days between the Alaska/Canada border and Flaxman Island during late summer and autumn. 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 the factors are that influence residency times.

Regarding the importance of feeding in the eastern Beaufort Sea, isotopic evidence seems to indicate that especially adult bowhead whales feed primarily on prey from the Bering and/or Chukchi Sea. However, as noted by the Richardson and Thomson (2002:xxxviii):

> ...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.

Based on stomach content data supplemented by behavioral evidence, far more than 10% of the bowheads that pass through the eastern Alaskan Beaufort Sea during late summer and autumn feed there. Of the whales harvested at Kaktovik, 24 out of 32 whales had been feeding. The status of three other whales was uncertain. Of the 24 feeding whales, there were estimates of stomach contents for 18 whales. Eleven of these 18 whales had less than 20 L of stomach contents and 7 whales out of the 18 had 20 L or more of stomach contents.

Thomson, Koski, and Richardson (2002) offered a feeding scenario 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. Several aspects of this scenario are speculative.

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.

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).

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. 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. Both MMS and the NSB also 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).

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. 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.

III.E. Summary

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 bowhead whale population since the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003a). All recent available information indicates that the population continues to increase in abundance. The estimated current annual rate of increase is similar to the estimate for the 1978-1993 time series. There is discussion in the scientific and regulatory communities regarding the potential delisting of this population. Available new information also does not indicate there has been any significant change in the distribution of this population since the multiple-sale EIS. Thus, there is no new information suggesting that the basic assumptions about the status, characteristics, or distribution of this population that underlie our analyses in the multiple-sale EIS should be modified. We have taken all available information into account in the update of our analyses of potential effects on this population.

IV. Potential Effects of the Proposed Action

In the following section, we discuss potential effects of the proposed action on the western Arctic stock (also referred to as the Bering-Chukchi-Beaufort Seas [BCB or B-C-B] population or stock) of bowhead whales.

Summary of Effects on Endangered Bowhead Whales. 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.

The threshold for significance by which we evaluate threatened and endangered species is 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.

Bowhead whales exposed to spilled crude oil likely would 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 Requirements for Fuel Transfers should ensure rapid spill responses, decreasing the likelihood that large fuel spills would affect bowhead whales during their migration. Any effects from the discharge of muds and cuttings or suspension of sediment in the water column would be localized primarily around the drill rig because of the rapid dilution/deposition of these materials. Effects on the bowhead's prey species likely would be negligible. 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, although the maximum exact length of time of such persistence is difficult to gauge. Available evidence does not indicate that avoidance would be long term. Most avoidance would be on the order of hours, not days, following cessation of the sound. The Industry Site-Specific Bowhead Whale-Monitoring Program should effectively detect a delay or blockage of the migration, thereby alerting regulatory agencies to the effects. This should enable actions to be taken to avoid further delay or blockage. 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.

The multiple-sale EIS assessed potential effects of Sales 186, 195, and 202 on endangered bowhead whales in Section IV.C.5.a. Therein, we concluded that no significant impacts to this endangered species are expected. In the multiple-sale final EIS, we provided considerable detail about potential effects from specific types of effectors (for example, seismic surveys) on this population. We incorporate this information by reference.

In the following, we provide key findings from material provided in the EIS, provide new information, and summarize key findings.

IV.A. Effects of Noise and Disturbance on Bowhead Whales

Noise-producing oil and gas activities can occur during both exploration and the development/production stages. Such activities include geophysical seismic surveys, drilling, aircraft traffic, icebreaking or other vessel traffic, and construction. These are the activities most likely to affect bowhead whales.

Because of their reliance on hearing, there is an increasing concern about the impacts of proliferation of human-caused, or anthropogenic, sounds on marine mammals, especially on cetaceans (for example, see Richardson et al., 1995a; Hoffman, 2002; Tasker et al., 1998; National Resources Defense Council, 1999 and references cited therein). The NMFS (Carretta et al., 2001) summarized that a habitat concern for all whales, and especially for baleen whales, is the increasing level of human-caused noise in the world's oceans. Clapham and Brownell (1999) summarized that "...effects of ship noise on whale behavior and ultimately on reproductive success are largely unknown."

There is concern that manmade noise affects bowheads by raising background noise levels. Increased noise levels could interfere with communication among bowheads, mask important natural sound, cause physiological damage, or alter normal behavior, such as causing avoidance behavior that keeps animals from an important area or displace a migration route farther from shore. In the Beaufort Sea multiple-sale final EIS and in the Cook Inlet multiple-sale final EIS, we discuss factors that affect sound propagation, marine mammal hearing and, other information provided as background relevant to understanding the potential effects that human-generated sound can have on marine mammals. We incorporate this information by reference, but do not repeat that detail here.

Marine mammals use calls to communicate and probably listen to natural sounds to obtain information important for detecting open water, navigating, and avoiding predators. Baleen whale hearing has not been studied directly. There are no specific data on sensitivity, frequency or intensity discrimination, or localization (Richardson et al., 1995a). For each species, the frequency range of reasonably acute hearing in baleen whales likely includes the frequency range of their calls. Most baleen whale sounds are concentrated at frequencies less than 1 kilohertz (kHz), but the frequency range in bowhead songs can approach 4,000 Hertz (Hz) (Richardson et al., 1995a). Most calls emitted by bowheads are in the frequency range of 50-400 Hz, with a few extending to 1,200 Hz. Based on indirect evidence, at least some baleen whales are quite sensitive to frequencies below 1 kHz but can hear sounds up to a considerably higher but unknown frequency. Most of the manmade sounds that elicited reactions by baleen whales were at frequencies below 1 kHz (Richardson et al., 1995a). Some or all baleen whales may hear infrasounds, sounds at frequencies well below those detectable by humans. Even if the range of sensitive hearing does not extend below 20-50 Hz, whales may hear strong infrasounds at considerably lower frequencies. Based on work with other marine mammals, if hearing sensitivity is good at 50 Hz, strong infrasounds at 5 Hz might be detected (Richardson et al., 1995a).

Ketten (1998) reported that hearing loss can be caused by exposure to sound that exceeds an ear's tolerance (i.e., exhaustion or overextension of one or more ear components). Hearing loss to a marine mammal could result in an inability to communicate effectively with other members of its species, detect approaching predators or vessels, or echolocate (in the case of the toothed whales). Hearing loss resulting from exposure to sound often is referred to as a threshold shift. This occurs when such exposure results in hearing loss causing decreased sensitivity. This type of hearing loss is called a temporary threshold shift if the individual recovers its previous sensitivity of hearing, or permanent threshold shift if it does not.

Ketten (1998) reported that whether or not a temporary threshold shift or a permanent threshold shift occurs will be determined primarily based on the extent of inner ear damage the received sound and the received sound level causes. In general, whether a given species will tend to be damaged by a given sound depends on the frequency sensitivity of the species. Loss of sensitivity is centered around the peak spectra of the sound causing the damage.

Permanent threshold shifts are less species dependent and more dependent on the length of time the peak pressure lasts and the signal rise time. Usually if exposure time is short, hearing sensitivity is recoverable. If exposure to the sound is long, or if the sound is broadband in higher frequencies and has intense sudden onset, loss might be permanent. Repeated long exposures to intense sound or sudden onset of intense sounds generally characterize sounds that cause permanent threshold shift in humans.

Ketten (1998) stated that age-related hearing loss in humans is related to the accumulation of permanent-threshold-shift and temporary-threshold-shift damage to the ear. Whether similar age-related damage occurs in cetaceans is unknown.

Available evidence also indicates that reaction to sound, even within a species, may depend on the listener's sex and reproductive status, possibly age and/or accumulated hearing damage, type of activity engaged in at the time or, in some cases, on group size. For example, reaction to sound may vary depending on whether females have calves accompanying them, whether individuals are feeding or migrating (for example, see discussion of impacts of noise on humpback whales in McCauley et al., 2000 and Section IV.B.1.f(3)(d)2) of the Cook Inlet multiple-sale EIS) (DOI, MMS, 2003b). Response may be influenced by whether, how often, and in what context, the individual animal has heard the sound before. All of this specificity greatly complicates our ability, in a given situation, to predict the impacts of sound on a species, or on classes of individuals within a species. Because of this, and following recommendations in McCauley et al. (2000), we attempt to take a conservative approach in our analyses and base conclusions about potential impacts on potential effects on the most sensitive members of a population. In addition, we evaluate the potential for effects on bowheads making the implicit assumptions that sound may travel the maximums observed, rather than minimums and that whales engaged in a particular activity may respond at the maximum, not the minimum, distances observed in studies to date. However, this assumption may overestimate potential effect in many cases.

IV.A.1 Effects from Seismic Operations

Sound from seismic exploration is a potential source of noise disturbance to bowhead whales. Marine seismic exploration uses underwater sounds with source levels exceeding those of other activities discussed here. Marine seismic operations use high-energy airguns to produce a burst of underwater sound from the release of compressed air, which forms a bubble that rapidly expands and then contracts. Although the output of airgun arrays usually is tuned to concentrate low-frequency energy, the impulsive nature of the bubble collapse inevitably results in a broadband sound characteristic, and high-frequency energy also is produced. This means animals sensitive to either low-frequency or high-frequency sounds may be affected. Airgun arrays are designed to focus the sound energy downward. Despite this, sound pulses also are projected horizontally. Airgun arrays produce short-duration (transient) noise pulses with very high peak levels. The high peak level and impulsive nature of airguns have caused concern in the environmental community.

Marine seismic programs can be either 2- or 3-dimensional seismic surveys. A 2-dimensional seismic survey typically is more regional in nature and seismic lines tend to be much further apart (rarely closer than 1 kilometer) than in 3-dimensional surveys. Seismic programs generally use 2-dimensional seismic to explore large areas relatively inexpensively with the intent of identifying areas that warrant further exploration, such as drilling an exploration well or acquiring a 3-dimensional seismic survey. Seismic lines often are laid out in a number of different directions. Information that can be extracted from 2-dimensional seismic data is much more limited than information from 3-dimensional seismic data. Marine surveys in the Beaufort Sea OCS waters in the 1980's and most of the 1990's were 2-dimensional seismic. Ocean-bottom cable surveys in recent years have been 3-dimensional seismic. A 3-dimensional seismic survey is conducted on a closer grid and provides more detailed information about the subsurface. The more detailed data allow geoscientists to make realistic estimates of the amount and distribution of hydrocarbons within a reservoir.

Seismic surveys are of two types, high-resolution, shallow-seismic survey and low-resolution, deep-seismic survey. The next few paragraphs provide a brief discussion of a number of studies on the effects of noise from seismic operations on bowhead whales.

IV.A.1.a. High-Resolution Seismic Surveys

These surveys, which are of much lower energy, generally are conducted on leases following a lease sale to evaluate potential shallow hazards to drilling. Equipment used to conduct high-resolution seismic surveys/shallow-hazard seismic surveys include side-scan sonar, sub-bottom profiler, boomers, sparkers, gas exploders, waterguns, airguns, etc. The energy level of many of these is from one to three orders of magnitude less than for some of the equipment used in deep-seismic surveys. For example, a 2,000-cubic-inch (2,000 in^3) airgun array used in deep-seismic surveys has approximately $2x10^6$ foot-pounds of energy compared to an 80 in^3 airgun that likely would be the largest used in high-resolution seismic surveys and has approximately $9x10^4$ foot-pounds of energy. Airguns used in high-resolution seismic surveys generally would be no larger than 40 in^3, although an 80 in^3 airgun rarely might be used in some circumstances. Boomers, sparkers, and gas exploders range from about $8x10^2$-$9x10^4$ foot-pounds of energy. The majority of equipment used in these surveys has less than $5x10^3$ foot-pounds of energy. For additional comparison, the 2,000 in^3 airgun has an energy equivalent of slightly more than 1 pound of 60% dynamite at the 30 foot depth, while the 80 in^3 airgun has an energy equivalent of .06 pound of 60% dynamite at the 30 foot depth (Telford et al., 1978).

Some high-resolution seismic surveys, such as those using airguns, emit loud sounds; but the sounds would not be as loud as sounds from deep-seismic surveys. The sound also would not be likely to propagate as great a distance as sounds from deep-seismic surveys. Shallow-hazard seismic surveys for exploration- or delineation-well sites most likely would be conducted during the ice-free season. Because high-resolution seismic surveys are of lower energy and sound would be less likely to travel as far as sound from deep-seismic surveys, these activities are less likely to have significant effects on endangered whales. Bowheads appear to continue normal behavior at closer distances to high-resolution seismic surveys than to low-resolution seismic surveys. In the study by Richardson, Wells, and Wursig (1985), four controlled tests were conducted by firing a single 40 in^3 (0.66-L) airgun at a distance of 2-5 km (1.2-3.1 mi) from the whales. Bowheads sometimes continued normal activities (skim feeding, surfacing, diving, and travel) when the airgun began firing 3-5 km (1.86-3.1 mi) away (received noise levels at least 118-133 decibels re 1 microPascal [dB re 1 μPa]). Some bowheads oriented away during an experiment at a range of 2-4.5 km (1.2-2.8 mi) and another experiment at a range of 0.2-1.2 km (0.12-0.75 mi) (received noise levels at least 124-131 and 124-134 dB, respectively). Frequencies of turns, predive flexes, and fluke-out dives were similar with and without airgun noise; and surfacing and respiration variables and call rates did not change significantly during the experiments.

IV.A.1.b Deep-Seismic Surveys

These surveys emit loud sounds, which are pulsed rather than continuous, and can propagate long distances from their source. Overall source levels of noise pulses from airgun arrays are very high, with peak levels of 240-250 dB re 1 μPa at 1 meter. However, most energy is directed downward, and the short duration of each pulse limits the total energy. Received levels within a few kilometers typically exceed 160 dB re 1 μPa (Richardson et al., 1995a), depending on water depth, bottom type, ice cover, etc.

Numerous studies have been conducted on the effects of noise from seismic surveys on bowhead whales. The results from these studies have varied, in some cases considerably. Among some of these studies important variables were different. These included the type of seismic survey (2-dimensional versus 3-dimensional), the location of the study, and the year in which the study was conducted. Ice (and other weather-related factors) also varies among years as does the use of total available habitat by bowhead whales. Some of the studies employed different methodologies, some of which have been criticized by peer reviewers and others of which are more widely adopted. Because of the importance of the issue of potential noise disturbance of bowhead whales, we provide considerable detail on these studies below. However, we preface this section with the following observation: In numerous reports regarding whale response to sound, it has been shown that multiple factors may be important in the whale's response (e.g., McCauley et al., 2000). In some studies, these factors have been shown to include (but may not be limited to): the physical characteristics of the location into which the sound is released and the physical characteristics of the location where the whale is located at the time the sound is released; the whale's sex and reproductive condition (e.g., groups with or without calves); the behavior of the whale (e.g., migrating or feeding); specific characteristics of the sound (e.g., frequency, duration, whether impulsive or not, etc.), and prior exposure to the sound. Thus, the fact that results from different studies of bowhead response to oil and gas-related sound have varied is not surprising. The studies involving the response of bowheads to 3-dimensional seismic are most relevant to evaluating the potential effects of the proposed action.

During the 1980's, the behavior of bowhead whales exposed to noise pulses from seismic surveys was observed during the summer in the Canadian Beaufort Sea and during the fall migration across the Alaskan Beaufort Sea. In general, many of the seismic surveys conducted during the 1980's were 2-dimensional seismic surveys that covered fairly large areas in deeper waters. Additional studies on seismic surveys were conducted in the central Alaskan Beaufort Sea during the fall migration in 1996-1998. These surveys were 3-dimensional seismic surveys that covered fairly small areas in relatively shallow water fairly close to shore.

Reeves, Ljungblad, and Clarke (1983) conducted aerial surveys to observe bowhead whale behavior in the presence of active seismic vessels. Whales were observed as close as 3 km (1.86 mi) and as far away as 135 km (83.9 mi) from active seismic vessels. A pair of whales observed at a distance of 3 km (1.83 mi) were not moving while at the surface although the two whales' heads were in contact. This pair of whales was closer to a shooting seismic vessel than any other whales observed during the study. No obvious response was apparent, but the observation time was brief. (The received level of low-frequency underwater sound from an underwater source, generally is lower by 1-7 dB near the surface (depth of 3 m) than at deeper (greater than 9 m) depths (Richardson et al., 1995a). It is possible these whales may have been at the surface to avoid the louder noise in deeper water. For the group of 20 whales at a distance of approximately 135 km (83.9 mi), the blow frequency per surfacing and time at the surface were greater during the period immediately after the seismic vessel began shooting than before it began shooting. The authors stated that no major changes in whale behavior (such as flight reactions) were observed that could unequivocally be interpreted as responses to seismic noise. They noted a possible exception of "huddling" behavior, which they thought may have been caused by the onset of seismic sounds. The authors concluded that although their results suggest some changes in behavior related to seismic sounds, the possibility that unquantified factors could be correlative dictates caution in attempting to establish causative explanations from the preliminary findings.

There is disagreement about the confidence one should put on some of the earlier bowhead noise studies. For example, Ljungblad et al. (1985) conducted a set of four experiments where bowhead whales were approached by an operating seismic vessel. Sonobuoys were dropped near the whales to record received sound levels from the airguns and to record bowhead sounds. In Experiment 1, the *Western Beaufort* was actively shooting approximately 12 km (7.5 mi) from the whales' position. A sonobuoy dropped near the whales indicated a received level of seismic sound near the whales of 131.1 dB re 1 μPa at 12 km (7.5 mi). Additional seismic sounds from an unknown source also were received at the sonobuoy with a received level of 133.0 dB re 1 μPa. The *Western Beaufort* approached to within 1.3 km (0.81 mi) with received sound level of 152.4 dB re 1 μPa. At 3.5 km (2.18 mi), milling and social behavior ceased. Surfacing, respiration, and dive characteristics changed significantly and were accompanied with avoidance behaviors as the vessel approached to within 1.3 km (0.81 mi). Because the vessel had been shooting prior to the beginning of the experiment, predisturbance observations were not obtained and postdisturbance observations were confounded by other geophysical vessels that had become active in the area. Experiment 2 involved a sudden seismic startup by the *Western Aleutian* at a range of 7.2 km (4.47 mi) with a received sound level of 165 dB. The sound level of this array at 1 m was estimated at between 230 and 240 dB. The *Western Aleutian* was about 12.4 km (7.7 mi) from the whales and had been inactive. A sonobuoy revealed some low level seismic sound (less than 120 dB re 1 μPa) from an unknown source. The whales responded to the sudden startup of the *Western Aleutian* (165 dB) by changing their surfacing behavior and, as the vessel approached 3.5 km (2.18 mi) (170 dB), the surfacing, respiration, and dive characteristics changed significantly. In Experiment 3, the seismic vessel *Arctic Star* was approximately 15.5 km (9.6 mi) from the whales and was actively shooting before the experiment. A sonobuoy dropped near the whales measured received sound levels of 148.4 dB re 1 μPa. After completing the survey line, the vessel's airguns were shut down and the vessel changed course to begin approaching the whales. The vessel activated 18 of the 24 airguns at 11.6 km (7.2 mi) from the whales with an estimated sound source level of 246 dB re 1 μPa and a received level at the sonobuoy of 154.9 dB re 1 μPa. Surfacing, respiration, and dive characteristics changed significantly as the *Arctic Star* approached from 12-5 km (7.5-3.1 mi) with received sound levels ranging between 154.9 and 171.2 dB, respectively. Two whales remained until the vessel approached to within 3.5 km (2.18 mi). In Experiment 4, seismic sounds from the *Western Polaris* were initiated at a distance of 11.7 km (7.3 mi) with received levels of 154 dB re 1 μPa. The *Western Polaris* had been inactive before the experiment, although the *Mariner* was actively shooting at a distance of 28 km (17.4 mi) from the whales with received sound levels at the whales of 120 dB re 1 μPa. Surfacing, respiration, and dive characteristics began to change at a range of 7 km (4.35 mi) with a received sound level of 158.1 dB; partial avoidance behavior began at 3.5 km (2.18 mi) with a received sound level of 163.1 dB; and complete avoidance reactions were exhibited at 1.8 km (1.12 mi) when the estimated received sound level was 169 dB. This study concluded that whales responded to seismic sounds at ranges less than 10 km (6.2 mi), with the strongest responses occurring when whales were within 5 km (3.1 mi) of the sound source, and that a period of 30-60 minutes is required before whales recover from the effects of close seismic disturbance. No discernable behavioral changes occurred during exposure to seismic sound at ranges greater than 10 km (6.2 mi). It also concluded that the findings in this study were consistent with the findings of several earlier studies.

However, a subcommittee of the Scientific Committee of the IWC reviewed these data and some members were critical of the methodology and analysis of the results.

> Comments included reference to: the small sample size; inconsistencies between the data and the conclusions; lack of documentation of calibration of sound monitoring; and possible interference from other active seismic vessels in the vicinity. The sub-committee acknowledged the difficulty of performing experiments of this kind, particularly in the absence of a 'control' environment free of industrial noise. The sub-committee recommended that additional research taking into account the concerns expressed above be undertaken, and that the 1984 experimental results be subjected to rigorous reanalysis, before it can draw any conclusions on the effects of seismic activity on this species (IWC, 1987).

In their May 25, 2001 Biological Opinion for Federal Oil and Gas Leasing and Exploration by the Minerals Management Service within the Alaskan Beaufort Sea and its Effects on the Endangered Bowhead Whale, NOAA Fisheries (2001:20) wrote the following about the aforementioned study by Ljungblad et al (1985):

> These tests were not conducted under controlled conditions (i.e., other noise sources were operating at the time), and approaches at greater ranges were not conducted, so results cannot be used to determine the range at which the whales first begin to respond to seismic activity.

In Fraker et al. (1985), an active seismic vessel traveled toward a group of bowheads from a distance of 19 km (11.8 mi) to a distance of 13 km (8.18 mi). The whales did not appear to alter their general activities. Most whales surfaced and dove repeatedly and appeared to be feeding in the water column. During their repeated surfacing and dives, they moved slowly to the southeast (in the same direction as seismic-vessel travel) and then to the northwest (in the opposite direction of seismic-vessel travel). The study first stated that a weak avoidance reaction may have occurred but then stated there is no proof that the whales were avoiding the vessel. The net movement was about 3 km (1.86 mi). The study found no evidence of differences in behavior in the presence and absence of seismic noise, but noted that observations were limited.

In another study (Richardson, Wells, and Wursig, 1985) involving a full-scale seismic vessel with a 47-L airgun array (estimated source level 245-252 dB re 1 μPa), bowheads began to orient away from the approaching ship when its airguns began to fire from 7.5 km (4.7 mi) away. This airgun array had about 30 airguns, each with a volume of 80-125 in^3. The *Mariner* had been shooting seismic about 10 km to the west of a group of six whales. Prior to the start of the experimental seismic period, the whales were surfacing and diving and moving at slow to medium speed while at the surface. The vessel ceased shooting and moved within 7.5 km of the whales and began firing the airgun array while approaching the whales. The study reported no conspicuous change in behavior when the *Mariner* resumed shooting at 7.5 km away. The bowheads continued to surface and dive, moving at slow to medium speeds. The received level was estimated at 134-138 dB at 7 km (4.35 mi). Some near-bottom feeding (evidenced by mud being brought to the surface) continued until the vessel was 3 km (1.86 mi) away. The closest point of approach to any whale was approximately 1.5 km (0.93 mi), with the received level probably well over 160 dB. When the seismic vessel was within 1.5 km of whales at the original location, at least two of the whales were observed to have moved about 2 km to the south of the original location. The movements of the whales, at least while they were at the surface, were at the usual slow to moderate speeds. The study reported no conspicuous changes in behavior when the *Mariner* ceased shooting at 6 km beyond the whales. The bowheads were still surfacing and diving and moving at slow to medium speed. The most notable change in behavior apparently involved the cessation of feeding when the vessel was 3 km away. The whales began feeding again about 40 minutes after the seismic noise ceased.

While conducting a monitoring program around a drilling operation, Koski and Johnson (1987) noted that the call rate of a single observed bowhead whale increased after a seismic operation had ceased. During the 6.8 hours of observation, the whale was within 23-27 km (14.3-16.8 mi) from the drillship. A seismic vessel was reported to be from 120-135 km (74.58-83.9 mi) from the sonobuoy; the two loudest calls received were determined to be approximately 7 km (4.35 mi) and 9 km (5.6 mi) from the sonobuoy, with received levels of 119 and 118 dB, respectively. Approximate signal-to-noise ratios were 24 and 22 dB, respectively. No information is provided regarding the exact distance the whale was from the operating seismic vessel. The increase in call rate was noted within 25 minutes after seismic noise ceased. It also needs to be noted that there were few, if any, calls heard during the 2 hours prior to the start of seismic operations, so it is unclear whether the increase in call rate relates to cessation of seismic noise, the presence of the operating drillship, the combination of both activities, or some other factor that occurred in the late afternoon. During this same study a subgroup of four to seven whales within a larger group (15-20 whales) was noted moving rapidly away from an approaching seismic vessel at a distance of 22-24 km (13.7-14.9 mi). The received level of seismic pulses was 137 dB at 19 km (11.8 mi) from the sonobuoy and 22 km from the whales. The surfacing and diving were unusually brief, and there were unusually few blows per surfacing. No information was available regarding the time required for these whales to return to normal behavior. Richardson and Malme (1993) noted that this apparent avoidance response was the longest distance avoidance of a seismic vessel documented in the studies they reviewed.

Richardson and Malme (1993), while synthesizing data on the effects of noise on bowheads, concluded that collectively, scientific studies have shown that most bowheads usually show strong avoidance response when an operating seismic vessel approaches within 6-8 km (3.8-5.0 mi). Strong avoidance occurs when received levels of seismic noise are 150-180 dB re 1 μPa (Richardson and Malme, 1993). Strong pulses of seismic noise often are detectable 25-50 km (15.5-31 mi) from seismic vessels, but most bowheads exposed to seismic sounds from vessels more than about 7.5 km (4.7 mi) away rarely showed avoidance. Seismic pulses can be detectable 100 km (62.2 mi) or more away. Bowheads also may show specific behavioral changes, such as reduced surfacing; reduced dive durations; changes in respiration rates, including fewer blows per surfacing, and longer intervals between successive blows; and they may temporarily change their individual swimming paths. The authors noted that surfacing, respiration, and dive cycles may be altered in the same manner as those of whales closer to the vessels. Bowheads' surface-respiration-dive characteristics appeared to recover to pre-exposure levels within 30-60 minutes following the cessation of the seismic activity. These short-term responses are not likely to preclude a successful migration or to significantly disrupt feeding activities.

The North Slope Borough believes that many studies were different from the real-world situation, and various limitations have been pointed out. Most studies did not involve actively migrating whales; and those whales were being approached by the seismic ships whereas in the real world, the fall migrating whales are actively moving to the west and they are approaching a distant seismic boat that is firing. It is likely that some migrating bowheads show avoidance at distances exceeding those observed in studies conducted during the 1980's. Subtle shifts in direction could be occurring that cause the bowheads to be farther from shore as they gradually migrate toward the west. The MMS notes that many studies were observational and involved opportunistic sightings of whales in the vicinity of seismic operations. The studies were not designed to show whether more subtle reactions are occurring that can displace the migration corridor, so no definitive conclusions can be drawn from them on whether or not the overall fall migration is displaced by seismic activity.

Inupiat whalers suggest that the fall bowhead migration has tended to be farther offshore since seismic work began off northern Alaska. Aerial surveys have been conducted since 1979 to determine the distribution and abundance of bowhead whales in the Beaufort Sea during their fall migration. These surveys have been used for comparing the axis of the bowhead whale migration between years. Survey data from 1982-1987 were examined to determine whether industrial activity was resulting in displacement of bowhead whales farther offshore (Ljungblad et al., 1988). It was determined that a good indicator of annual shifts in bowhead distribution could be obtained by analyzing the distance of random bowhead sightings from shore (Zeh, as cited in Ljungblad et al., 1988). An analysis of the distance of random bowhead sightings from shore (a total of 60 bowhead sightings) was conducted, but no significant differences were detected in the bowhead migratory route between years. The axis of the bowhead migratory route near Barrow was found to fall between 18 and 30 km (7.76 and 18.6 mi) from shore. Although the analysis involved a relatively small sample size, these observations provide some insight into migration patterns during these years. The North Slope Borough, in a letter dated July 25, 1997, questioned the sample size and the precision of the Ljungblad et al. (1988) report to determine whether or not a displacement of fall migrating whales had occurred and how big a displacement would have to be before it could be detected.

Using larger sample sizes (for which confidence intervals were calculated) obtained over a larger study area, the aerial survey project found many between-year (1982-1996) differences in the median water depth at whale sightings that were highly significant (probability less than 0.05) (Treacy, 1997). Median depths ranged between 18 m (59 ft) in 1989 and 347 m (1,138 ft) in 1983, with an overall cumulative depth of 37 m (121 ft, confidence interval = 37-38 m). The aerial survey project has reported a potential association between water depth of the bowhead migration and general ice severity, especially in 1983, when severe ice cover may have forced the axis of the migration into waters 347 m (1,138 ft) deep. To address short-term bowhead whale displacement within a given year from site-specific industrial noise, MMS and NMFS require industry to conduct site-specific monitoring programs when industrial activity occurs during fall bowhead migrations.

Since 1996, seismic surveys in State of Alaska waters and adjacent nearshore Federal waters of the central Alaskan Beaufort Sea have been ocean-bottom cable surveys. These surveys have been 3-dimensional seismic programs. The area to be surveyed is divided into patches, each patch being approximately 5.9 by 4.0 km in size. Within each patch, several receiving cables are laid parallel to each other on the seafloor. Seismic data are acquired by towing the airguns along a series of source lines oriented perpendicular to the receiving cables. While seismic-data acquisition is ongoing on one patch, vessels are deploying cable on the next patch to be surveyed and/or retrieving cables from a patch where seismic surveys have been completed. Airgun arrays have varied in size each year from 1996-1998 with the smallest, a 560 in^3 array with 8 airguns, and the largest, a 1,500 in^3 array with 16 airguns. A marine mammal and acoustical monitoring program was conducted in conjunction with the seismic program each year in accordance with provisions of the NMFS Incidental Harassment Authorization. One of the dominant considerations during the design of the marine mammal monitoring program was the need to determine whether any displacement of the bowhead whale migration corridor occurred during seismic surveys. The monitoring program each year was designed to take into account both the results of previous scientific studies and the experience of subsistence whalers.

Based on 1996-1998 data, there was little or no evidence that bowhead headings, general activities, or swimming speeds were affected by seismic exploration. Bowheads approaching from the northeast and east showed similar headings at times with and without seismic operations. Miller et al. (1999) stated that the lack of any statistically significant differences in headings should be interpreted cautiously. Changes in headings must have occurred given the avoidance by most bowheads of the area within 20 or even 30 km of active seismic operations. Miller et al. (1999) noted that the distance at which deflection began cannot be determined precisely, but they stated that considering times with operations on offshore patches, deflection may have begun about 35 km to the east. However, some bowheads approached within 19-21 km of the airguns when they were operating on the offshore patches. It appears that in 1998, the offshore deflection might have persisted for at least 40-50 km west of the area of seismic operations. In contrast, during 1996-1997 there were several sightings in areas 25-40 km west of the most recent shotpoint, indicating the deflection in 1996-1997 may not have persisted as far to the west.

LGL Ltd.; Environmental Research Assocs., Inc. and Greeneridge Sciences Inc. conducted a marine mammal monitoring program for a seismic survey near the Northstar Development Project in 1996 (Miller et al., 1997). The marine mammal monitoring program was continued for subsequent seismic surveys in nearshore waters of the Beaufort Sea in 1997 and 1998 (Miller, Elliot, and Richardson, 1998; Miller et al., 1999). Details of these studies are provided in the Beaufort Sea multiple-sale final EIS.

These studies indicated that the bowhead whale-migration corridor in the central Alaskan Beaufort Sea during 1998 was similar to the corridor in many prior years, although not 1997. In 1997, nearly all bowheads sighted were in relatively nearshore waters. The results of the 1996-1998 studies indicated a tendency for the general bowhead whale-migration corridor to be farther offshore on days with seismic airguns operating compared to days without seismic airguns operating, although the distances of bowheads from shore during airgun operations overlapped with those in the absence of airgun operations. However, aerial-survey results indicated that bowheads tended to avoid the area around the operating source, perhaps to a radius of about 20-30 km.

Sighting rates within a radius of 20 km of seismic operations were significantly lower during seismic operations than when no seismic operations were happening. Within 12-24 hours after seismic operations ended, the sighting rate within 20 km was similar to the sighting rate beyond 20 km. There was little or no evidence of differences in headings, general activities, and swimming speeds of bowheads with and without seismic operations. Overall, the 1996-1998 results show that most bowheads avoided the area within about 20 km of the operating airguns. Within 12-24 hours after seismic operations ended, the sighting rate within 20 km was similar to the sighting rate beyond 20 km.

The observed 20-30 km area of avoidance is a larger avoidance radius than documented by previous scientific studies in the 1980's and smaller than the 30 mi suggested by subsistence whalers, based on their experience with the types of seismic operations that occurred in the Beaufort Sea before 1996 (Richardson, 2000).

Based on recordings of bowhead whale calls made during these same studies, Greene et al. (1999), summarized that results for the 3 years of study indicated that: (1) bowhead whales call frequently during the autumn migration through the study area; (2) calling continued at times when whales were exposed to airgun pulses; and (3) call-detection rates at some locations differed significantly when airguns were detectable versus not detectable. However, there was no significant tendency for the call-detection rate to change in a consistent way at times when airguns started or stopped.

During the 1996-1998 bowhead hunting seasons, seismic operations were moved to locations well west of Cross Island, the area where Nuiqsut-based whalers hunt for bowheads (Miller et al., 1999). As a result of mitigating measures implemented under the 1996-1998 Conflict Avoidance Agreements, the 1996-1998 seismic surveys did not adversely affect the accessibility of bowheads to subsistence whalers (Miller et al., 1999).

Richardson provided a brief comparison between observations from seismic studies conducted in the 1980's and the 1996 seismic survey at the Arctic Seismic Synthesis Workshop in Barrow (USDOI, MMS, 1997). Observations from earlier seismic studies during the summer and early autumn show that most bowhead whales interrupt their previous activities and swim strongly away when a seismic ship approaches within about 7.5-8 km. At the distances where this strong avoidance occurs, received levels of seismic pulses typically are high, about 150-180 dB re 1 μPa. The surfacing, respiration, and dive cycles of bowheads engaged in strong avoidance also change in a consistent pattern involving unusually short surfacing and diving and unusually few blows per surfacing. These avoidance and behavioral effects among bowheads close to seismic vessels are strong, reasonably consistent, and relatively easy to document. Less consistent and weaker disturbance effects probably extend to longer distances and lower received sound levels at least some of the time. Bowheads often tolerate much seismic noise and, at least in summer, continue to use areas where seismic exploration is common. However, the same pattern of change in surfacing, respiration, and diving cycles has been seen sometimes in bowheads as much as 73 km from seismic ships. Most of these whales were engaged in seemingly normal activities and were not swimming away from the seismic boat. However, at least one case of strong avoidance has been reported as far as 24 km from an approaching seismic boat (Koski and Johnson, 1987) and, as noted above, the aerial survey data (Miller et al., 1999) indicated that bowheads tended to avoid the area around the operating source, perhaps to a radius of about 20-30 km.

Richardson noted that many of the observations involved bowheads that were not actively migrating. Actively migrating bowheads may react somewhat differently than bowheads engaged in feeding or socializing. Migrating bowheads, for instance, may react by deflecting their migration corridor away from the seismic vessel. Monitoring of the bowhead migration past a nearshore seismic operation in September 1996 provided evidence consistent with the possibility that the closest whales may have been displaced several miles seaward during periods with seismic activity.

With respect to these studies conducted in the Beaufort Sea from 1996-1998, the peer-review group at the Arctic Open-Water Noise Peer Review Workshop in Seattle from June 5-6, 2001, prepared a summary statement supporting the methods and results reported in Richardson (1999) concerning avoidance of seismic sounds by bowhead whales:

> Monitoring studies of 3-D seismic exploration (8-16 airguns totaling 560-1500 in^3) in the nearshore Beaufort Sea during 1996-1998 have demonstrated that nearly all bowhead whales will avoid an area within 20 km of an active seismic source, while deflection may begin at distances up to 35 km. Sound levels received by bowhead whales at 20 km ranged from 117-135 dB re 1μPa rms and 107-126 dB re 1μPa rms at 30 km. The received sound levels at 20-30 km are considerably lower levels than have previously been shown to elicit avoidance in bowhead or other baleen whales exposed to seismic pulses.

A recent study in Canada provides information on the behavioral response of bowhead whales in feeding areas to seismic surveys (Miller and Davis, 2002). During the late summer and autumn of 2001, Anderson Resources Ltd. conducted an open-water seismic exploration program offshore of the Mackenzie Delta in the Canadian Beaufort Sea. The program consisted of streamer seismic surveys and associated bathymetric surveys conducted off the Mackenzie Delta. The bathymetric surveys were conducted by two medium-sized vessels equipped with side-scan sonar and single-beam echosounders. The seismic vessel was the *Geco Snapper*. The acoustic sources used in the seismic operations were two 2,250 in^3 arrays of 24 sleeve-type airguns. Each 2,250 in^3 airgun array was comprised of 24 airguns with volumes ranging from 40-150 in^3. The two airgun arrays fired alternately every 8 seconds along the survey lines. The airgun arrays were operated at a depth of 5 m below the water surface. Water depths within the surveyed areas ranged from 6-31 m and averaged 13 m (Miller, 2002).

Because marine seismic projects using airgun arrays emit strong sounds into the water and have the potential to affect marine mammals, there was concern about the acoustic disturbance of marine mammals and the potential effects on the accessibility of marine mammals to subsistence hunters. Although there are no prescribed marine mammal and acoustic monitoring requirements for marine seismic programs in the Canadian Beaufort Sea, it was decided that monitoring and mitigation measures in the Canadian Beaufort Sea should be as rigorous as those designed and implemented for marine seismic programs conducted in the Alaskan Beaufort Sea in recent years. The monitoring program consisted of three primary components: acoustic measurements, vessel-based observations, and aerial surveys. The NMFS recommended criterion that exposure of whales to impulse sound not exceed 180 dB re 1μPa rms (65 *FR* 16374) was adopted as a mitigation standard for this monitoring program. Estimates of sound-propagation loss from the airgun array were used to determine the designated 1,000-m safety radius for whales (the estimated zone within which received levels of seismic noise were 180 dB re 1μPa rms or higher).

Aerial and vessel-based surveys confirmed the presence of substantial numbers of bowheads offshore of the Mackenzie Delta from late August until mid-September. The distribution of bowheads in the study area was typical of patterns observed in other years and suggests that there were good feeding opportunities for bowheads in these waters during that period.

A total of 262 bowheads were observed from the seismic vessel *Geco Snapper* (Moulton, Miller, and Serrano, 2002). Sighting rates during daylight hours were higher when no airguns were operating than during periods with airguns operating. During the period when bowheads were most abundant in the study area (August 23-September 19), the bowhead sighting rate during periods with no seismic (0.85 bowheads/hour) was about twice as high as that recorded during periods with seismic (0.40 bowheads/hour) or all seismic operations combined (0.44 bowheads/hour). Average sighting distances from the vessel were significantly (probability less than 0.001) lower during no airguns (a mean radial distance of 1,368 m) versus line-seismic periods (a mean radial distance of 1,957 m). The observed difference in sighting rates and the significant difference in sighting distances suggest that bowheads did avoid close approach to the area of seismic operations. However, the substantial number of sightings during seismic periods and the relatively short (600 m) but significant difference in sighting distances suggests that the avoidance may have been localized and relatively small in nature. At a minimum, the distance by which bowheads avoided seismic operations was on the order of 600 m greater than the average distance by which they avoided general vessel operations. The lower sighting rates recorded during seismic operations suggest that some bowheads avoided the seismic operations by larger distances and, thereby, stayed out of visual range of the marine mammal observers on the *Geco Snapper*.

In this study, a total of 275 bowhead whale sightings were recorded during aerial transects with good lighting conditions (Holst et al., 2002). Bowheads were sighted at similar rates with and without seismic, although the no feeding-seismic sample was too small for meaningful comparisons. Bowheads were seen regularly within 20 km of the operations area at times influenced by airgun pulses. Of 169 transect sightings in good conditions, 30 sightings were seen within 20 km of the airgun operations at distances of 5.3-19.9 km. The aerial surveys were unable to document bowhead avoidance of the seismic operations area. The area of avoidance around the seismic operations area was apparently too small to be evident from the broadscale aerial surveys that were flown, especially considering the small amount of surveying done when seismic was not being conducted. General activities of bowheads during times when seismic operations were conducted were similar to times without seismic.

The bowheads that surfaced closest to the vessel (323-614 m) would have been exposed to sound levels of about 180 dB re 1 μPa rms before the immediate shutdown of the array (Miller et al., 2002). There were seven shutdowns of the airgun array in response to sightings of bowheads within 1 km of the seismic vessel. Bowheads at the average vessel-based sighting distance (1,957 m) during line seismic would have been exposed to sound levels of about 170 dB re 1 μPa rms. The many aerial sightings of bowheads at distances from the vessel ranging from 5.3-19.9 km would have been exposed to sound levels ranging from approximately 150-130 dB re 1 μPa rms, respectively.

The results from the study in summer 2001 are markedly different from those obtained during similar studies during the autumn migration of bowheads through the Alaskan Beaufort Sea (Miller et al., 2002). For example, during the Alaskan studies only 1 bowhead whale was observed from the seismic vessel(s) during six seasons (1996-2001) of vessel-based observations compared with 262 seen from the *Geco Snapper* in 2001. The zone of avoidance for bowhead whales around the airgun operations in 2001 was clearly much smaller (~2 km) than that observed for migrating bowhead whales in recent autumn studies in Alaskan waters (up to 20-30 km). Davis (1987) concluded that migrating bowheads during the fall migration may be more sensitive to industrial disturbance than bowheads on their summering grounds, where they may be engaged in feeding activities.

Inupiat subsistence whalers have stated that industrial noise, especially noise due to seismic exploration, has displaced the fall bowhead migration seaward and, thereby, is interfering with the subsistence hunt at Barrow (Ahmaogak, 1989). Whalers have reported reaction distances, where whales begin to divert from their migratory path, on the order of 10 (T. Albert cited in USDOI, MMS, 1995) to 35 mi (F. Kanayurak in USDOI, MMS, 1997). Kanayurak stated that the bowheads "are displaced from their normal migratory path by as much as 30 miles." Also at the March 1997 workshop, Mr. Roxy Oyagak, Jr., a Nuiqsut whaling captain, stated in written testimony:

> Based on the industrial activity, there is an unmitigable adverse impact on the village of Nuiqsut on subsistence whaling. i.e., 1) by causing the whales to abandon the hunting area...and 3) placing physical barriers between the subsistence whalers and marine mammals, including altering the normal bowhead whale migration route.

In conclusion, based on information from the scientific studies and traditional knowledge presented above, bowhead response to seismic surveys varies, sometimes considerably. It is not entirely clear which factor(s) explain the difference in response.

Seismic activity should have little effect on zooplankton. Bowheads feed on concentrations of zooplankton. Zooplankton that are very close to the seismic source may react to the shock wave, but little or no mortality is expected (LGL Ltd., 2001). A reaction by zooplankton to a seismic impulse would be relevant only if it caused a concentration of zooplankton to scatter. Pressure changes of sufficient magnitude to cause zooplankton to scatter probably would occur only if they were very close to the source. Impacts on zooplankton behavior are predicted to be negligible and would have negligible effects on feeding bowheads (LGL Ltd., 2001).

A substantial amount of seismic work, especially low-resolution, deep-seismic, already has been conducted in the proposed Lease Sale area. Geophysical surveys conducted in conjunction with proposed Lease Sale 195 are likely to cover much smaller areas to fill in gaps from earlier seismic surveys. Also, some of the seismic work that may be needed may be conducted when whales are not present in the area.

There is concern about industrial activities in the spring lead system. The general location of the spring lead system in the Beaufort Sea is based on relatively limited survey data and is not well defined. Noise-producing activities, such as seismic surveys, in the spring lead system during the spring bowhead migration have a fairly high potential of affecting the whales. Seismic surveys are not expected to be conducted in or near the spring lead system through which bowheads migrate because (1) degraded ice conditions would not allow on-ice surveys, and (2) insufficient open water is present for open-water seismic surveys.

Within the proposed Lease Sale 195 area, there have not been seismic surveys conducted during the open water season since the preparation of the Beaufort Sea Multiple-Sale FEIS in January of 2002.

IV.A.2. Potential Effects from Drilling Operations

Exploration units and other drilling units are other sources of noise. Exploration drilling in the Beaufort Sea can be conducted from manmade gravel islands, ice islands, caisson-retained islands, bottom-founded drilling platforms such as the concrete island drilling system or single steel drilling caisson, or from drillships in deeper water supported by icebreakers. The type of drilling platform used depends on water depth, oceanography, ice cover, and other factors. Stationary sources of offshore noise (such as drilling units) appear less disruptive to bowhead whales than moving sound sources (such as vessels). Drilling operations from most of these structures except drillships are likely to be conducted during the winter months. Drilling from ice islands would occur only during the winter when bowheads are not present, and noise from these activities would not affect bowhead whales. Therefore, this type of drilling activity is not discussed here.

As stated previously, the general location of the spring lead system in the Beaufort Sea is based on relatively limited survey data and is not well defined. Noise-producing activities such as drilling operations in the spring lead system during the spring bowhead migration have a fairly high potential of affecting the whales. The MMS believes that exploratory drilling operations using floating platforms within the spring lead system during the spring bowhead migration are unlikely, because the ice at this time of year would be too thick for floating drilling platforms to get to the location and conduct drilling operations, even with icebreaker support. Thus, in the Multiple-Sale FEIS, we concluded that spring-migrating bowheads are not likely to be exposed to drilling noise from activities on leases from Sales 186, 195, or 202. Areas in or near the spring lead system could be leased during these sales, but any exploratory drilling operations likely would be conducted during the open-water season (August-October) using floating drilling platforms.

Some bowheads in the vicinity of drilling operations would be expected to respond to noise from drilling units by slightly changing their migration speed and swimming direction to avoid closely approaching these noise sources. Based on findings by Miles, Malme, and Richardson (1987) and unpublished data, Malme et al. (1989) stated that the results of drillship and dredge playback tests indicated that most bowheads do not exhibit overt reactions unless received noise levels are about 110-120 dB, or 20-30 dB above ambient levels in the corresponding band and 20-30 dB above the assumed hearing sensitivity threshold. .

Richardson et al. (1995:285) summarized findings from studies of bowheads migrating west past active drillships and support vessels and reported avoidance at greater distances:

> In 1986 and 1993, most bowheads apparently avoided the area within 10 km of the drillship...some bowheads apparently began to divert around the drillsite when still 20+ km

away…This suggests that autumn-migrating bowheads may be slightly more responsive than summering bowheads.

Although underwater sounds from drilling on some artificial islands and caissons have been measured, little information is available about reactions of bowheads to drilling from these structures. Underwater noise levels from drilling operations on natural barrier islands or artificial islands are low and are not audible beyond a few kilometers (Richardson et al., 1995a). Noise is transmitted very poorly from the drill-rig machinery through land into the water. Even under open-water conditions, drilling sounds are not detectable very far from the structure. Drilling noise from caisson-retained islands is much stronger. At least during open-water conditions, noise is conducted more directly into the water than from island drill sites. Noise associated with drilling activities at both sites varies considerably with ongoing operations. The highest documented levels were transient pulses from hammering to install conductor pipe.

NOAA Fisheries (NMFS, 2001:27) concluded that

> "bowhead whale responses to noise from drilling and exploration activities are expected to depend on the type of activity and its location relative to the whales' normal migration corridors…Thus, a drill ship operating offshore and closer to the center of the migration is expected to have a greater biological impact than a drilling operation from an artificial island situated in very shallow water along the nearshore edge of the migration."

IV.A.2.a. Potential Effects of Drilling Operations from Artificial Gravel Islands

The following is a brief discussion of several studies on the measurement of underwater noise and the effects of noise from drilling operations on gravel islands on bowhead whales.

Seal Island: Noise measurements were made during the open-water season near Seal Island, a manmade gravel island off Prudhoe Bay in water 12 m deep. Davis, Greene, and McLaren (1985) measured underwater noise from Seal Island during the open-water season while well logging was occurring but not drilling operations. Underwater sound levels recorded from bottom hydrophones 1.65-2.4 km from Seal Island were strongly affected by wind speed and active barge or tug traffic at the island. The strongest tone measured was 486 Hz from turbochargers on the generators used for well-logging operations. This tone was measured by a hydrophone on a boat at distances of up to 5 km from Seal Island. Noise associated with barge or tug movement at the island readily could be detected at 2.4 km from the island, even during high winds. Noise levels in the 20-1,000-Hz band from barge traffic were about 118 dB re 1 μPa at 1.6 km and had decreased to 108-110 dB re 1 μPa at 2.4 km. At that rate of sound attenuation, the noise level from barges was estimated to be about 92 dB at 6 km. Underwater sounds from Seal Island were not detectable 2.3 km away while people were on the island and power generators were operating, but no logging or drilling operations were ongoing.

Aerial surveys for bowhead whales near Seal Island in 1982 (during island construction) and 1984 found that most whales were in water deeper than 18 m, which is consistent with data from previous studies (Davis, Greene, and McLaren, 1985). In 1982, one whale was sighted in 12 m of water about 11 km northwest of Seal Island. In 1984, there were two sightings of single whales in 12-15 m of water. Whales migrating in water deeper than 18 m would have been too far away to detect noise from Seal Island, because industrial noise was not audible in the water more than a few kilometers away. Acoustic data collected in 1982 and 1984 suggest that some bowheads were closer to Seal Island in 1984 than in 1982. Localizations made by the hydrophone array on three occasions indicated the whales were present between 2.5 and 6 km from Seal Island. Bowhead calls recorded on hydrophones were thought to be from whales that were in water at least 18 m deep. The study concluded that there was no evidence to suggest that bowheads avoided Seal Island in 1984 compared to 1982.

Sandpiper Island: Johnson et al. (1986) measured underwater noise from Sandpiper Island, a manmade gravel island in water 15 m deep. Sound was measured using a bottom-hydrophone system at 0.5 km from the island and sonobuoys at greater distances from the island. The median sound levels observed at a fixed location 0.5 km from Sandpiper Island were relatively low. Median noise levels in the 20-1,000-Hz band were 93 and 95 dB re 1 μPa during two periods without drilling and 100 dB re 1 μPa during one period with drilling. In the absence of shipping or other industrial sounds, the expected level of noise in the 20-1,000-Hz band is about 100 dB re 1 μPa for Beaufort Sea State 2 conditions (wind speeds at 7-10 knots [kn] and wave heights up to 0.5 m). The most obvious components were tones at 20 and 40 Hz, which were attributed to power generation on the island.

The low-frequency industrial sounds from Sandpiper Island attenuated rapidly with increasing range, at least partially due to the shallow water. The low-frequency sounds were evident when ambient noise levels were low but were largely masked during periods when ambient noise was above average. Sound levels received at a sonobuoy 3.7 km from Sandpiper Island (76 dB re 1 μPa in both the 20- and 40-Hz bands) were 24-30 dB lower than the levels received at the bottom hydrophone 0.5 km from the island. The bottom hydrophone measured drilling sounds of 100 dB re 1 μPa in the 20-Hz frequency band at 0.5 km from Sandpiper Island. The sounds were severely attenuated at 3.7 km and not detectable at 9.3 km. The effective source level of the 40-Hz tone was estimated at 145 dB re 1 μPa at 1 m.

Impulsive hammering sounds associated with installation of a conductor pipe were as high as 131-135 dB re 1 μPa at 1 km, when pipe depth was about 20 m below the island. In contrast, broadband drilling noise at this distance was about 100-106 dB. During hammering, the transient signals had the strongest components at 30-40 Hz and about 100 Hz. Moore et al. (1984, as cited in Richardson, et al., 1995b) reported that received levels for transient piledriving sounds recorded at 1 km from a manmade island near Prudhoe Bay were 25-35 dB above ambient levels in the 50- to 200-Hz band. They estimated that the sounds might be received underwater as far as 10-15 km from the source, farther than drilling sounds.

Aerial surveys for bowhead whales in 1985 indicated that no bowheads were seen closer than 30 km from Sandpiper Island (Johnson et al., 1986). Almost all of the migrating bowheads traveled in water deeper than 18 m, as was found in the surveys for Seal Island. Sandpiper and Northstar islands are both about 6 km south of the 18-m-depth contour. Industrial noise from Sandpiper Island, with or without drilling, was not audible in the water more than a few kilometers away. Because the migration route of almost all bowheads is north of the 18-m contour, few individual whales moved into the zone where industrial noise potentially was detectable.

The authors concluded that the number of whales that passed along the southern edge of the migration route and approached the artificial islands, both Seal and Sandpiper, must have been a very low fraction of the total population given the absence of sightings close to the islands.

Tern Island: Studies at Tern Island were conducted to determine sound levels that could be expected from the proposed Liberty development project. The studies provide information on distances that sound travels as a result of activities on gravel islands.

Greene (1997) measured underwater sounds under the ice at the proposed Liberty Island location from drilling operations on Tern Island in Foggy Island Bay in February 1997. Sounds from the drill rig generally were masked by ambient noise at distances near 2 km. The strongest tones were at frequencies below 170 Hz, but the received levels diminished rapidly with increasing distance and dropped below the ambient noise level at ranges of about 2 km. Drilling sounds were not detected at frequencies above 400 Hz, even at 200 m from the drill rig.

Greene noted that if production proceeded at Liberty, the types and frequency characteristics of some of the resulting sounds would be similar to those from the drilling equipment in this study. Electric power generation, pumps, and auxiliary machinery again would be involved, as would a drill rig during the early stages of production. However, the production island also would include additional processing and pumping facilities. If this equipment requires significantly more electric power, generators may produce sounds that are detectable at greater distances. However, these sounds would diminish rapidly with increasing distances due to high spreading losses (35 dB/tenfold change in range) plus the linear attenuation rates of 2-9 dB per km (0.002-0.009 dB/m). Sound transmission within the lagoon for activities at Liberty would be similar to the sound transmission measured for activities at Tern Island, but the barrier islands to the north and the lagoon's very shallow water near those islands should make underwater sound transmission very poor beyond the islands and into the Beaufort Sea.

Greene (1998) measured ambient noise and acoustic-transmission loss underwater at the proposed Liberty Island site in Foggy Island Bay during the open-water season of 1997 to complement transmission loss and ambient-noise measurements made under the ice at Liberty in February 1997. For wind speeds of zero, 10, 20, and 30 km, typical overall ambient noise levels in the 20-5000-Hz band were 85, 94, 104, and 114 dB re 1 μPa, respectively. For the data from both recorders taken together, the median 20-5,000-Hz band level for the 44 days was 97 dB re 1 μPa, or 9 dB above the corresponding level for Knudsen's standard for Sea State 0 (Greene, 1998). The levels were consistent with other ambient noise measurements made in similar locations at similar times of the year. The measured ambient levels in winter generally were lower than those measured in summer, which means that industrial sounds would be expected to be detectable at greater distances during the winter. Bowheads are not present in the winter.

Acoustic-transmission loss was measured using a four-element sleeve-gun array and a minisparker as sources. The sleeve-gun array is a relatively low-frequency source (63-800 Hz) compared to the minisparker (315-3,150 Hz). Received sounds were recorded quantitatively at distances up to 8.1 km southeast and 10.1 km north of Liberty. At greater distances (up to 10 km), the sounds from the sleeve-gun array diminished generally according to -25 log(R), while the minisparker sound diminished at approximately -10 log(R), corresponding to cylindrical spreading. This difference is attributed to the sleeve-gun array being a low-frequency source compared to the minisparker. Propagation-loss rates varied with frequency. The minisparker had a higher linear loss rate, which corresponds to higher absorption and scattering losses at higher frequencies.

Richardson et al. (1995a) summarized that noise from drilling activities varies considerably with operations. The highest documented levels were transient pulses from hammering to install conductor pipe. Underwater noise associated with drilling from natural barrier or artificial islands usually is weak and is inaudible beyond a few kilometers. Richardson et al. (1995a) estimated that drilling noise generally would be confined to low frequencies and would be audible at a range of 10 km only during unusually quiet periods, while the audible range under more typical conditions would be approximately 2 km.

IV.A.2.b. Potential Effects of Drilling Operations from Bottom-Founded Structures

Two types of caissons have been used for offshore drilling in the Alaska Beaufort Sea: the concrete island drilling system, which is a floating concrete rig that is floated into place, ballasted with seawater, and sits on the seafloor; and the single steel drilling caisson, which is a section of a ship with a drill rig mounted on it and also is floated into place, ballasted with seawater, and sits on the seafloor. Drilling from these platforms generally begins after the bowhead whale migration is done and continues through the winter season.

In the absence of drilling operations, radiated levels of underwater sound from the concrete island drilling system were low, at least at frequencies above 30 Hz. The overall received level was 109 dB re 1 μPa at 278 m, excluding any infrasonic components. When the concrete island drilling system was drilling in early winter, radiated sound levels above 30 Hz again were relatively low (89 dB at 1.4 km). However, when infrasonic components were included, the received level was 112 dB at 1.4 km. More than 99% of the sound energy received was below 20 Hz. Received levels of sound at 222-259 m ranged from 121-124 dB. The maximum detection distance for infrasonic sounds was not determined. Such tones likely would attenuate rapidly in water shallow enough for a bottom-founded structure. Overall, the estimated source levels were low for the concrete island drilling system, even when the infrasonic tones were included (Richardson et al., 1995a).

Sounds from the steel drilling caisson were measured during drilling operations in water 15 m deep with 100% ice cover. The strongest underwater tone was at 5 Hz (119 dB re μPa) at a distance of 115 m. The 5-Hz tone apparently was not detectable at 715 m, but weak tones were present at 150-600 Hz. The broadband (20-1,000 Hz) received level at 215-315 m was 116-117 dB re μPa, higher than the 109 dB reported for the concrete island drilling system at 278 m.

Inupiat whalers believe that noise from drilling activities displace whales farther offshore away from their traditional hunting areas. These concerns were expressed primarily for drilling activities from drillships with icebreaker support that were operating offshore in the main migration corridor. Concerns also have been expressed about noise generated from the single steel drilling caisson, the drilling platform used to drill two wells on the Cabot Prospect east of Barrow in October 1990 and November 1991. Mr. Jacob Adams, Mr. Burton Rexford, Mr. Fred Kanayurak, and Mr. Van Edwardson, all with the Barrow Whaling Captain's Association, stated in written testimony at the Arctic Seismic Synthesis and Mitigating Measures Workshop on March 5-6, 1997, in Barrow: "We are firmly convinced that noise from the Cabot drilling platform displaced whales from our traditional hunting area. This resulted in us having to go further offshore to find whales" (USDOI, MMS, 1997b). The two wells drilled for the Cabot Prospect were spudded on October 19, 1990, and November 1, 1991, respectively.

IV.A.2.c Potential Effects of Drilling Operations from Drillships and other Floating Platforms

Bowhead reaction to drillships is variable. Bowhead whales whose behavior appeared normal have been observed on several occasions within 10-20 km (6.2-12.4 mi) of drillships in the eastern Beaufort Sea, and there have been a number of reports of sightings within 0.2-5 km (0.12-3 mi) from drillships (Richardson et al., 1985; Richardson and Malme, 1993). On several occasions, whales were well within the zone where drillship noise should be clearly detectable by them. However, bowheads may avoid drillships and their support vessels at 20-30 km (see below and NMFS, 2003a). The factors associated with the variability are not fully identified or understood.

Richardson and Malme (1993) point out that the data, although limited, suggest that stationary industrial activities producing continuous noise, such as stationary drillships, result in less dramatic reactions by bowheads than do moving sources, particularly ships. It also appears that bowhead avoidance is less around an unattended structure than one attended by support vessels. Most observations of bowheads tolerating noise from stationary operations are based on opportunistic sightings of whales near ongoing oil-industry operations, and it is not known whether more whales would have been present in the absence of those operations. Because other cetaceans seem to habituate somewhat to continuous or repeated noise exposure when the noise is not associated with a harmful event, this suggests that bowheads will habituate to certain noises that they learn are nonthreatening. However, in Canada, bowhead use of the main area of oil-industry operations within the bowhead range was low after the first few years of intensive offshore oil exploration in 1976 (Richardson, Wells, and Wursig, 1985), suggesting perhaps cumulative effects from repeated disturbance may have caused the whales to leave the area. In the absence of systematic data on bowhead summer distribution until several years after intensive industry operations began, it is arguable whether the changes in distribution in the early 1980's were greater than natural annual variations in distribution, such as responding to changes in the location of food sources. Ward and Pessah (1988) concluded that the available information from 1976-1985 and the historical whaling information do not support the suggestion of a trend for decreasing use of the industrial zone by bowheads as a result of oil and gas exploration activities. They concluded that the exclusion hypothesis is likely invalid.

The distance at which bowheads may react to drillships is difficult to gauge, because some bowheads would be expected to respond to noise from drilling units by changing their migration speed and swimming direction to avoid closely approaching these noise sources. For example, in the study by Koski and Johnson (1987), one whale appeared to adjust its course to maintain a distance of 23-27 km (14.3-16.8 mi) from the center of the drilling operation. Migrating whales apparently avoided the area within 10 km (6.2 mi) of the drillship, passing both to the north and to the south of the drillship. The study detected no bowheads within 9.5 km (5.9 mi) of the drillship, and few were observed within 15 km (9.3 mi). The principal finding of this study was that migrating bowheads appeared to avoid the offshore drilling operation in fall 1986.

In other studies, Richardson, Wells, and Wursig (1985) observed three bowheads 4 km (2.48 mi) from operating drillships, well within the zones ensonified by drillship noise. The whales were not heading away from the drillship but were socializing, even though exposed to strong drillship noise. Eleven additional whales on three other occasions were observed at distances of 10-20 km (6.2-12.4 mi) from operating drillships. On two of the occasions, drillship noise was not detectable by researchers at distances from 10-12 km (6.2-7.4 mi) and 18-19 km (11.2-11.8 mi), respectively. In none of the occasions were whales heading away from the drillship. Ward and Pessah (1988, as cited in Richardson and Malme, 1993) reported observations of bowheads within 0.2-5 km (0.12-3 mi) from drillships.

The ice-strengthened Kulluk, a specialized floating platform designed for arctic waters, was used for drilling operations at the Kuvlum drilling site in western Camden Bay in 1992 and 1993. Data from the Kulluk indicated broadband source levels (10-10,000 Hz) during drilling and tripping were estimated to be 191 and 179 dB re μPa at 1 m, respectively, based on measurements at a water depth of 20 m in water about 30 m deep (Richardson et al., 1995a).

Hall et al. (1994) conducted a site-specific monitoring program around the Kuvlum drilling site in the western portion of Camden Bay during the 1993 fall bowhead whale migration. Results of their analysis indicated that bowheads were moving through Camden Bay in a significantly nonrandom pattern but became more randomly distributed as they left Camden Bay and moved to the west. The results also indicated that whales were distributed farther offshore in the proximal survey grid (near the drill site) than in the distant survey grid (an area east of the drill site), which is similar to results from previous studies in this general area. The authors noted that information from previous studies indicated that bowheads routinely were present nearshore to the east of Barter Island and were less evident close to shore from Camden Bay to Harrison Bay (Moore and Reeves, as cited in Hall et al., 1994). The authors believed that industrial variables such as received level were insufficient as a single predictor variable to explain the 1993 offshore distribution of bowhead whales, and they suggested that water depth was the only variable that accounted for a significant portion of the variance in the model. They concluded that for 1993, water depth, received level, and longitude accounted for 85% of the variance in the offshore distribution of the whales. Based on their analyses, the authors concluded that the 1993 bowhead whale distribution fell within the parameters of previously recorded fall-migration distributions.

Davies (1997) used the data from the Hall et al. study in a Geographic Information System model to analyze the distribution of fall-migrating bowheads in relation to an active drilling operation. He also concluded that the whales were not randomly distributed in the study area, and that they avoided the region surrounding the drill site at a range of approximately 20 km (12.4 mi). He also noted that the whales were located significantly farther offshore and in significantly deeper water in the area of the drilling rig. As noted by Hall et al. (1994), the distribution of whales observed in the Camden Bay area is consistent with previous studies (Moore and Reeves, 1993), where whales were observed farther offshore in this portion of the Beaufort Sea than they were to the east of Barter Island. Davies concluded, as did Hall et al., that it was difficult to separate the effect of the drilling operation from other independent variables. The model identified distance from the drill rig and water depth as the two environmental factors that were most strongly associated with the observed distribution of bowheads in the study area. The Davies analysis, however, did not note that surface observers (Hall et al., 1994) observed whales much closer to the drilling unit and support vessels than did aerial observers. In one instance, a whale was observed approximately 400 m (436 yd) from the drill rig. Hall et al. suggest that bowheads, on several occasions, were closer to industrial activity than would be suggested by an examination of only aerial-survey data.

Schick and Urban (2000) also analyzed data from the Hall et al. study and tested the correlation between bowhead whale distribution and variables such as water depth, distance to shore, and distance to the drilling rig. The distribution of bowhead whales around the active drilling rig in 1993 was analyzed and the results indicated that whales were distributed farther from the drilling rig than they would be under a random scenario. The area of avoidance was localized and temporary (Schick and Urban, 2000); Schick and Urban stated they could not conclude that noise from the drilling rig caused the low density near the rig, because they had no data on actual noise levels. They also noted that ice, an important variable, is missing from their model and that 1992 was a particularly heavy ice year. Because ice may be an important patterning variable for bowheads, Schick and Urban said they were precluded from drawing strong inference from the 1992 results with reference to the interaction between whales and the drilling rig. Moore and DeMaster (1998, as cited in Schick and Urban, 2002) proposed that migrating bowheads are often found farther offshore in heavy ice years because of an apparent lack of feeding opportunities. Schick and Urban (2002) stated that ultimately, the pattern in the 1992 data may be explained by the presence of ice rather than by the presence of the drilling rig.

In playback experiments, some bowheads showed a weak tendency to move away from the sound source at a level of drillship noise comparable to what would be present several kilometers from an actual drillship (Richardson and Malme, 1993). In one study, sounds recorded 130 m (426 ft) from the actual Karluk drill rig were used as the stimulus during disturbance test playbacks (Richardson et al., 1991). For the overall 20- to 1,000-Hz band, the average source level was 166 dB re 1 μPa in 1990 and 165 dB re 1 μPa in 1989.

Bowheads continued to pass the projector while normal Karluk drilling sounds were projected. During the playback tests, the source level of sound was 166 dB re 1 μPa. One whale came within 110 m (360 ft) of the projector. Many whales came within 160-195 m (525-640 ft), where the received broadband (20-1,000 Hz) sound levels were about 135 dB re 1 μPa. That level was about 46 dB above the background ambient level in the 20- to 1,000-Hz band on that day. Bowhead movement patterns were strongly affected when they approached the operating projector. When bowheads still were several hundred meters away, most began to move to the far side of the lead from the projector, which did not happen during control periods while the projector was silent.

In a subsequent phase of this continuing study, Richardson et al. (1995b) concluded:

> ...migrating bowheads tolerated exposure to high levels of continuous drilling noise if it was necessary to continue their migration. Bowhead migration was not blocked by projected drilling sounds, and there was no evidence that bowheads avoided the projector by distances exceeding 1 kilometer (0.54 nautical mile). However, local movement patterns and various aspects of the behavior of these whales were affected by the noise exposure, sometimes at distances considerably exceeding the closest points of approach of bowheads to the operating projector.

Some migrating bowheads diverted their course enough to remain a few hundred meters to the side of the projector. Surfacing and respiration behavior, and the occurrence of turns during surfacings, were strongly affected out to 1 km (0.62 mi). Turns were unusually frequent out to 2 km (1.25 mi), and there was evidence of subtle behavioral effects at distances up to 2-4 km (1.25-2.5 mi). The study concluded that the demonstrated effects were localized and temporary and that playback effects of drilling noise on distribution, movements, and behavior were not biologically significant.

The authors stated that one of the main limitations of this study (during all 4 years) was the inability of a practical sound projector to reproduce the low-frequency components of recorded industrial sounds. Both the Karluk rig and the icebreaker *Robert Lemeur* emitted strong sounds down to ~10-20 Hz, and quite likely at even lower frequencies. It is not known whether the under-representation of low-frequency components (less than 45 Hz) during icebreaker playbacks had significant effects on the responses by bowheads. Bowheads presumably can hear sounds extending well below 45 Hz. It is suspected but not confirmed that their hearing extends into the infrasonic range below 20 Hz. The authors believed the projector adequately reproduced the overall 20- to 1,000-Hz level at distances beyond 100 m (109 yd), even though components below 80 Hz were under-represented. If bowheads are no more responsive to sound components at 20-80 Hz than to those above 80 Hz, then the playbacks provided a reasonable test of the responsiveness to components of Karluk sound above 20 Hz.

The authors also stated that the study was not designed to test the potential reactions of whales to nonacoustic stimuli detected via sight, olfaction, etc. At least in summer/autumn, responses of bowheads to actual dredges and drillships seem consistent with reactions to playbacks of recorded sounds from those same sites. Additional limitations of the playbacks identified by the authors included low sample sizes and the fact that responses were only evident if they could be seen or inferred based on surface observations. The numbers of bowhead whales observed during both playback and control conditions were low percentages of the total Beaufort Sea population. Also, differences between whale activities and behavior during playback versus control periods represent the incremental reactions when playbacks are added to a background of other activities associated with the research. Thus, playback results may somewhat understate the differences between truly undisturbed whales versus those exposed to playbacks.

If drillships are attended by icebreakers, as typically is the case during the fall in the U.S. Beaufort Sea, the drillship noise frequently may be masked by icebreaker noise, which often is louder. There are no observations of bowhead reactions to icebreakers breaking ice. Response distances would vary, depending on icebreaker activities and sound-propagation conditions. Based on models, bowhead whales likely would respond to the sound of the attending icebreakers at distances of 2-25 km (1.24-15.53 mi) from the icebreakers (Miles, Malme, and Richardson, 1987). Zones of responsiveness for intermittent sounds, such as an icebreaker pushing ice have not been studied. This study predicts that roughly half of the bowhead whales show avoidance response to an icebreaker underway in open water at a range of 2-12 km (1.25-7.46 mi) when the sound-to-noise ratio is 30 dB. The study also predicts that roughly half of the bowhead whales would show avoidance response to an icebreaker pushing ice at a range of 4.6-20 km (2.86-12.4 mi) when the sound-to-noise ratio is 30 dB.

Richardson et al. (1995b) found that bowheads migrating in the nearshore lead often tolerated exposure to projected icebreaker sounds at received levels up to 20 dB or more above the natural ambient noise levels at corresponding frequencies. The source level of an actual icebreaker is much higher than that of the projectors (projecting recorded sound) used in this study (median difference 34 dB over the frequency range 40-6,300 Hz). Over the two-season period (1991 and 1994) when icebreaker playbacks were attempted, an estimated 93 bowheads (80 groups) were seen near the ice camp when the projectors were transmitting icebreaker sounds into the water, and approximately 158 bowheads (116 groups) were seen near there during quiet periods. Some bowheads diverted from their course when exposed to levels of projected icebreaker sound greater than 20 dB above the natural ambient noise level in the one-third octave band of the strongest icebreaker noise. However, not all bowheads diverted at that sound-to-noise ratio, and a minority of whales apparently diverted at a lower sound-to-noise ratio. The study concluded that exposure to a single playback of variable icebreaker sounds can cause statistically but probably not biologically significant effects on movements and behavior of migrating whales in the lead system during the spring migration east of Point Barrow. The study indicated the predicted response distances for bowheads around an actual icebreaker would be highly variable; however, for typical traveling bowheads, detectable effects on movements and behavior are predicted to extend commonly out to radii of 10-30 km (6.2-18.6 mi) and sometimes to 50+ km (31.1 mi). Effects of an actual icebreaker on migrating bowheads, especially mothers and calves, could be biologically significant. It should be noted that these predictions were based on reactions of whales to playbacks of icebreaker sounds in a lead system during the spring migration and are subject to a number of qualifications. (The predicted "typical" radius of responsiveness around an icebreaker like *Robert Lemeur* is quite variable, because propagation conditions and ambient noise vary with time and with location. In addition, icebreakers vary widely in engine power and thus, in noise output, with *Robert Lemeur* being a relatively low-powered icebreaker. Furthermore, the reaction thresholds of individual whales vary by at least 10 dB around the "typical" threshold, with commensurate variability in predicted reaction radius.)

While conducting aerial surveys over the Kuvlum drilling location, Brewer et al. (1993) showed that bowhead whales were observed within about 30 km (18.6 mi) north of the drilling location. The closest observed position for a bowhead whale detected during the aerial surveys was approximately 23 km (14.3 mi) from the project icebreakers. The drilling rig was not operating on that day, but all three icebreakers had been actively managing ice periodically during the day. The study did not indicate what the whale's behavior was, but it did not appear to be avoiding the icebreakers. Three whales were sighted that day, and all three appeared to be moving to the northwest along the normal migration route at speeds of 2.4-3.4 km/hour (1.5-2.1 mi/hour). Bowhead whale call rates peaked when whales were about 32 km (19.9 mi) from the industrial activity. There was moderate to heavy ice conditions throughout the monitoring area, with heavy, grounded icefloes to the west, north, and east of the drilling site. Generally, whales tend to be located in deeper water during years of moderately heavy ice cover (Treacy, 1993). Brewer et al. (1993) were unable to determine if either ice or industrial activity by themselves caused the whales to migrate to the north of the drilling location, but they concluded that ice alone probably did not determine the observed distribution of whales.

Concerns have been raised regarding the effects of noise from OCS exploration and production operations in the spring lead system and the potential for this noise to delay or block the bowhead spring migration. Spring-migrating bowheads are not likely to be exposed to drilling noise. To date, no drilling or production operations have taken place in the vicinity of the spring lead system during the bowhead migration.

IV.A.3. Effects from Vessel Traffic

Bowheads react to the approach of vessels at greater distances than they react to most other industrial activities. According to Richardson and Malme (1993), most bowheads begin to swim rapidly away when vessels approach rapidly and directly. Avoidance usually begins when a rapidly approaching vessel is 1-4 km (0.62-2.5 mi) away. A few whales may react at distances from 5-7 km (3-4 mi), and a few whales may not react until the vessel is less than 1 km (less than 0.62 mi) away. Received noise levels as low as 84 dB re 1 μPa) or 6 dB above ambient may elicit strong avoidance of an approaching vessel at a distance of 4 km (2.5 mi) (Richardson and Malme, 1993).

In the Canadian Beaufort Sea, bowheads observed in vessel-disturbance experiments began to orient away from an oncoming vessel at a range of 2-4 km (1.2-2.5 mi) and to move away at increased speeds when approached closer than 2 km (1.2 mi) (Richardson and Malme, 1993). Vessel disturbance during these experimental conditions temporarily disrupted activities and sometimes disrupted social groups, when groups of whales scattered as a vessel approached. Reactions to slow-moving vessels, especially if they do not approach directly, are much less dramatic. Bowheads often are more tolerant of vessels moving slowly or in directions other than toward the whales. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. After some disturbance incidents, at least some bowheads returned to their original locations (Richardson and Malme, 1993). Some whales may exhibit subtle changes in their surfacing and blow cycles, while others appear to be unaffected. Bowheads actively engaged in social interactions or mating may be less responsive to vessels.

Bowhead whales probably would encounter relatively few vessels associated with exploration activities during their fall migration through the Alaskan Beaufort Sea. Vessel traffic generally would be limited to routes between the exploratory-drilling units and the shore base. Each floating drilling unit probably would have one vessel remaining nearby for emergency use. Depending on ice conditions, floating drilling units may have two or more icebreaking vessels standing by to perform ice-management tasks. It is likely that vessels actively involved in ice management or moving from one site to another would be more disturbing to whales than vessels idling or maintaining their position. In either case, bowheads probably would adjust their individual swimming paths to avoid approaching within several kilometers of vessels attending a drilling unit and probably would move away from vessels that approached within a few kilometers. Vessel activities associated with exploration are not expected to disrupt the bowhead migration, and small deflections in individual bowhead-swimming paths and a reduction in use of possible bowhead-feeding areas near exploration units should not result in significant adverse effects on the species. During their spring migration (April through June), bowheads likely would encounter few, if any, vessels along their migration route, because ice at this time of year typically would be too thick for seismic-survey ships, drillships, and supply vessels to operate in.

In 2003 there was concern by Alaskan Native whalers that barge traffic associated with oil and gas activities might have caused bowhead whales to move farther offshore and, thus, to be less accessible to subsistence hunters. Because of the concern over this issue, we provide a summary of the information available to MMS on this issue, with focus on information related to evaluation of potential effects of the whales (for example, their movement patterns). The following is based on information provided by ConocoPhillips to MMS (Majors, 2004, pers. commun.; Greene, 2003).

Drilling rigs and equipment associated with the Puviaq exploration well west of Teshekpuk Lake were moved to Camp Lonely for barge out to Deadhorse in the summer of 2003, prior to the autumn whaling season. Camp Lonely is about 85 miles east of Barrow. While barge activities originally were scheduled to be completed prior to September 1, 2003, stormy weather and eroded beach conditions prevented their completion until October 10, 2003. Barrow whalers landed their first whale of the autumn migration on October 8, 2003. The hunters located whales more than 20 mi offshore of Barrow. Some whalers were concerned that ConocoPhillips' barging activities caused deflection of the whales farther offshore. ConocoPhillips contracted with Greeneridge Sciences to determine noise propagation distances associated with the barging activities. Greene (2003:2) concluded that a broadband source level of 171 dB re 1µP at 1 m is a reasonable and potentially a conservative (higher than the likely actual source level) estimate to use as a source level for the "relatively small tug and barge used by ConocoPhillips in its demobilization activities." After evaluating alternative models for estimating transmission loss, and considering likely ambient noise levels (based on data collected in 1996 offshore of Northstar), Greene (2003) applied the estimated source level to what he viewed as the most reasonable sound propagation loss model to estimate the received level of sound at four distances (0.1-63 km) from the tug and barge. The estimated hearing distances are based on the assumption that the whales do not hear sounds below the background noise level. Greene acknowledged that this assumption oversimplifies the hearing process but believes it is reasonable, given the approximations made for source level and for propagation loss. Greene (2003) estimated the following received sound levels at specific distances: 131 dB re 1 µPA at 0.1 km; 111 dB re 1 µPA at 1.0 km; 102 dB re 1 µPA at 2.8 km; and 75 dB re 1 µPA at 63 km. Given the assumptions that were required about hearing and the approximations regarding sound transmission loss, Greene (2003:4) stated it would be best to consider the estimates of received sound levels as "guidelines." ConocoPhillips also evaluated traditional knowledge information available from a 1997 workshop held in Barrow (Major, 2004, pers. commun.). Based on this information, they concluded that whales would have returned to their original headings about 45 mi before reaching Barrow if they had encountered noise from the barging operation at Camp Lonely. We cannot critically evaluate this conclusion, because it is unclear exactly which information it is based upon. ConocoPhillips and the NSB both researched the timing of vessel activities in the region. ConcoPhillips reported that this research revealed that another barge, unrelated to oil industry activities, departed Barrow for Deadhorse on October 8, 2003, which was the first day a whale was landed in Barrow (Major, 2004, pers. commun.). They also reported that an elder Barrow whaling captain reported that migration patterns of many species were different in 2003. For example, he reported that bowhead whales were spotted on the west side of Barrow in August, 2003. On the NSB map reporting the locations of landed whales offshore of Barrow, the waters nearshore to about 20 mi offshore were recorded to be muddy. ConcocoPhillips concluded that their barging operations were not the cause of deflected whales offshore of Barrow in the fall of 2003 (Major, 2004, pers. commun.). There are no other data available to MMS regarding potential effects of the barge operations. Thus, we cannot critically evaluate the potential influence of the barging operations on whale movements near Barrow in 2003.

Considerable information regarding vessel traffic in 2001 the Beaufort Sea near BP's Northstar facility is provided by Williams and Rodrigues (2003). Much of this information was for vessel traffic during the 2002 whaling season was collected by AEWC's whaling communication center. We refer reader to pages 2-20 to 2-28 of William and Rodrigues (2003) for this detailed information.

In addition to acting as a source of noise and disturbance, marine vessels could potentially result strike bowhead whales, causing injury or death. As noted in the baseline section of this evaluation, available information indicates that current rates of vessel strikes of bowheads are low. At present, available data do not indicate that strikes of bowheads by oil and gas-related vessels will become an important source of injury or mortality in the Beaufort Sea Planning Area. Risk of strikes would increase as vessel traffic in bowhead habitat increases. We assume travel corridors would be established to minimize the amount of bowhead habitat that would be affected by oil and gas-related vessel traffic. If oil and gas-related vessel traffic increases substantially in areas commonly frequented by bowhead whales during periods when the bowheads are present, vessel strike rates should be carefully monitored.

IV.A.4. Effects from Aircraft Traffic

Most offshore aircraft traffic in support of the oil industry involves turbine helicopters flying along straight lines. Underwater sounds from aircraft are transient. According to Richardson et al. (1995a), the angle at which a line from the aircraft to the receiver intersects the water's surface is important. At angles greater than 13 degrees from the vertical, much of the incident sound is reflected and does not penetrate into the water. Therefore, strong underwater sounds are detectable while the aircraft is within a 26-degree cone above the receiver. An aircraft usually can be heard in the air well before and after the brief period while it passes overhead and is heard underwater.

Data on reactions of bowheads to helicopters are limited. Most bowheads are unlikely to react significantly to occasional single passes by low-flying helicopters ferrying personnel and equipment to offshore operations. Observations of bowhead whales exposed to helicopter overflights indicate that most bowheads exhibited no obvious response to helicopter overflights at altitudes above 150 m (500 ft). At altitudes below 150 m (500 ft), some bowheads probably would dive quickly in response to the aircraft noise (Richardson and Malme, 1993). However, bowhead reactions to a single helicopter flying overhead probably are temporary (Richardson et al., 1995a). This noise generally is audible for only a brief time (tens of seconds) if the aircraft remains on a direct course, and the whales should resume their normal activities within minutes. Patenaude et al. (1997) found that most reactions by bowheads to a Bell 212 helicopter occurred when the helicopter was at altitudes of 150 m or less and lateral distances of 250 m or less. The most common reactions were abrupt dives and shortened surface time and most, if not all, reactions seemed brief. However, the majority of bowheads showed no obvious reaction to single passes, even at those distances. The helicopter sounds measured underwater at depths of 3 and 18 m showed that sound consisted mainly of main-rotor tones ahead of the aircraft and tail-rotor sounds behind the aircraft; more sound pressure was received at 3 m than at 18 m; and peak sound levels received underwater diminished with increasing aircraft altitude. Sound levels received underwater at 3 m from a Bell 212 flying overhead at 150 m ranged from 117-120 dB re 1 μPa in the 10- to 500-Hz band. Underwater sound levels at 18 m from a Bell 212 flying overhead at 150 m ranged from 112-116 dB re 1 μPa in the 10- to 500-Hz band.

Fixed-wing aircraft flying at low altitude often cause hasty dives. Reactions to circling aircraft are sometimes conspicuous if the aircraft is below 300 m (1,000 ft), uncommon at 460 m (1,500 ft), and generally undetectable at 600 m (2,000 ft). Repeated low-altitude overflights at 150 m (500 ft) during aerial photogrammetry studies of feeding bowheads sometimes caused abrupt turns and hasty dives (Richardson and Malme, 1993). Aircraft on a direct course usually produce audible noise for only tens of seconds, and the whales are likely to resume their normal activities within minutes (Richardson and Malme, 1993). Patenaude et al. (1997) found that few bowheads (2.2%) during the spring migration were observed to react to Twin Otter overflights at altitudes of 60-460 m. Reaction frequency diminished with increasing lateral distance and with increasing altitude. Most observed reactions by bowheads occurred when the Twin Otter was at altitudes of 182 m or less and lateral distances of 250 m or less. There was little, if any, reaction by bowheads when the aircraft circled at an altitude of 460 m and a radius of 1 km. The effects from an encounter with aircraft are brief, and the whales should resume their normal activities within minutes.

IV.A.5. Effects from Other Oil- and Gas-Related Activities

Island-construction activities could cause noise and disturbance to bowhead whales. Placement of fill material for island construction generally occurs during the winter, when bowhead whales are not present. Completion of island construction and placement of slope-protection materials may take place during the open-water season, but these activities generally are completed before the bowhead whale fall migration. Placement of sheetpile, if used, would generate noise during the open-water period for one construction season but also should be completed in early to mid-August, before the whales migrate. Noise is not likely to propagate far due to the shallow water and the presence of barrier islands that, in many cases, may lie between the drilling location and the migration corridor used by bowhead whales, depending on the island location. Even during the migration, noise from these activities would be minor and would not affect bowhead whales. If such construction were to occur in an area where large numbers of whales were attempting to feed (such as has been observed in a few years, but not in many other years) in the Dease Inlet/Smith Bay area, the whales might be displaced from a small portion of the feeding range for that year.

Preliminary analysis of noise measurements during the open-water construction season at Northstar Island by Blackwell and Greene (2001) indicated that the presence of self-propelled barges had the largest impact on the level of sound coming from Northstar Island. Self-propelled barges remained at Northstar for days or weeks and always had their engines running, because they maintained their position by "pushing" against the island. Sound measurements on a day when there were no self-propelled barges showed that sounds were inaudible to the field acoustician listening to the hydrophone signal beyond 1.85 km, even on a relatively calm day. By comparison, the sounds produced by self-propelled barges, while limited in their frequency range, were detectable underwater as far as 28 km north of the island. Other vessels, such as the crew boat and tugs, produced qualitatively the same types of sounds, but they were present intermittently, and their effect on the sound environment was lower.

IV.A.6. New Information Regarding Potential Impacts of Noise from Production Facilities

As noted in the multiple-sale final EIS (USDOI, MMS, 2003a), it has been documented that bowhead and other whales avoid various industrial activities if the received sound levels associated with the activity are sufficiently strong (see summaries and references in Richardson et al., 1995a and National Research Council, 2003). The monitoring of sound associated with the construction and production activities at the BP Exploration (Alaska) Inc. (BP) Northstar facility and the monitoring of marine mammals in nearby areas has recently provided additional information relative to assessing potential impacts of oil and gas production-related noise on bowhead whales. Williams and Rodrigues (2003) reported that BP began construction of the Northstar gravel island in early 2000. Northstar is built on an artificial gravel island, and was constructed on the remnants of the submerged artificial gravel island called Seal Island. This facility if about 54 miles (87 km) northeast of Nuiqsut. To date, it is the only offshore oil production facility north of the barrier islands in the Beaufort Sea. However, the facility is situated in State of Alaska waters, and thus, is still relatively nearshore relative to leasing blocks offered in the proposed lease sale. Two pipelines connect this island to the existing infrastructure at Prudhoe Bay. Richardson and Williams (2003) reported that transportation to the island from the mainland is primarily via vessels in the summer and helicopters during seasonal transitional periods. Oil production began on 31 October 2001 (Richardson and Williams, 2003).

North Slope residents have expressed concern that the bowhead whale autumn migration corridor might be deflected offshore in the Northstar area due to whales responding to underwater sounds from construction, operation, and vessel and aircraft traffic associated with Northstar. Richardson and Thompson (2003) and other researchers working with LGL and Greeneridge Sciences, Inc. for BPXA undertook studies during the open-water period to determine both the underwater noise levels at various distances north of Northstar and potential impacts on bowhead whales north of the island, as assessed by locations determined by vocalization locations. The final report confirms the basic findings previously referred to. Additional details from the final report are provided below.

During three days in September 2001, Greeneridge Sciences collected measurements of underwater and airborne sounds at seven distances north of the island (0.25 km – 37 km). The lowest levels recorded were 87-90 dB re 1 μPa underwater and 37-40 dBA re 20 μPa in air at the most distant locations. Maximum levels were 116 dB re 1 μPa underwater and 56 dBA re 20 μPa in air. Richardson and Williams (2003) and Blackwell (2003) summarized that when both oil production and drilling was occurring, underwater and airborne sound reached background levels at about 3.5 km (2.2 mi.) from Northstar. The authors report that these values are comparable to those found in previous studies of sounds from gravel islands. Sound levels were higher (up to 128 dB re 1 μPa underwater at 3.7 km) when operating vessels, including crew boats were present. At Northstar in 2001, two 61.5 ft. (18.7 m) crew vessels operated between West Dock and Northstar between 23 July 2001 and 7 October 2001 for a total of 824 round trips (Williams and Rodrigues, 2003).

Sound levels were also recorded from cabled hydrophones located about 0.25 n.mi. (420 m) north of Northstar continuously for 31 days from 31 August to 1 October 2002 (Richardson and Williams, 2003). Broadband (10-1000 Hz) levels recorded in 2002 by the cabled hydrophones spanned a narrower range than in 2001. In 2001 the 95th percentile was higher (122.8 dB re 1 μPa) than in 2002 (117.2 db re 1 μPa) but the 5th percentile was higher in 2002 (94.8 dB) than in 2001 (87.8 dB). Median values were comparable in both years (2001:102. dB vs. 2002:103.0 dB). Many spikes in broadband levels could be attributed to crew boats and barge traffic.

During the normal "open water period" in 2001 (16 June to 31 October) there were approximately 989 roundtrip helicopter flights to Northstar. With regards to estimates of the numbers of whales displaced by Northstar noise, Moulton et al. (2003:11-20) (emphasis in original) noted that

> "...the 90% confidence bounds for the estimated displacement are fairly wide. The lower edge of the 90% confidence bound around the estimated displacement is often ≤0 km, and the upper edge often about twice the best estimate of displacement. **Confidence bounds on the estimated number of whales displaced by x km have not been estimated, but it is clear that they also would be fairly wide.** To a first approximation, one can say that there is roughly a 50% chance that the true value was higher than the best estimate, and a 50% chance that it was lower."

Moulton et al. (2003) concluded that:

> "...during the late summer and early autumn of 2001 and 2002, a small number of bowhead whales in the southern part of the migration corridor (closest to Northstar) were affected by vessel or Northstar operations. This occurred during 4-5% of the time when levels of underwater sound from these activities were highest. At these time, most "Northstar sound" was from maneuvering vessels, not the island itself. The best **(though quite imprecise)"** (emphasis added) "estimates of

the number of bowhead that were apparently deflected offshore by ≥2 km (1.2 mi) were 13 bowheads in 2001 and 19 bowheads in 2002.... Confidence bounds on the estimated numbers of whales displaced by x km have not been estimated, but it is clear that they would also be fairly wide."

This study was discussed in detail at the Open Water Peer Review Meeting in Seattle in 2003 and it is important to note that the NSB and the AEWC did not agree with the estimates of the numbers of whales that were affected by Northstar noise. NSB and AEWC representatives noted that whales farther offshore than those that were evaluated by the acoustic localization methodology could have been affected by noise from Northstar and may have deflected farther offshore. As shown above, the authors also acknowledged that the estimates of the numbers of whales that were apparently deflected are "quite imprecise". It is also important to note that this study did not have a Northstar-absent control, a point noted by the authors of the report (see Greene et al., 2003:7-5). That is, there are no locations of whales based on vocalizations absent any sound from Northstar to be compared with localizations given Northstar sound. Limitations of the study are well discussed by the authors in the report. However, the available data on bowhead locations, coupled with data on noise propagation, indicate that if noise from Northstar is having an impact on whale movements, the effect, if it exists, is not dramatic.

IV.A.7. Summary of Noise and Disturbance Effects

Available data suggest that bowheads are not conspicuously affected by any aircraft overflights at altitudes above 300 m (984 ft). Below this altitude, some changes in whale behavior may occur, depending on the type of aircraft and the responsiveness of the whales present in the vicinity of the aircraft. The effects from such an encounter with either fixed-wing aircraft or helicopters generally are brief, and the whales should resume their normal activities within minutes. Bowheads may exhibit temporary avoidance behavior if approached by vessels at a distance of 1-4 km (0.62-2.5 mi). Marine-vessel traffic also may include seagoing barges transporting equipment and supplies from Southcentral Alaska to drilling locations, most likely between mid-August and mid- to late September. If the barge traffic continues into September, some bowheads may be disturbed. Fleeing behavior from vessel traffic generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. In some instances, at least some bowheads returned to their original locations. In many cases, vessel activities are likely to be in shallow, nearshore waters outside the main bowhead-migration route.

The observed response of bowhead whales to seismic noise has varied among studies. The factors associated with variability are not entirely clear. Some of the variability in study results may be due to differences in study methodology, whereas other variability may reflect differences in whale response, possibly due to one or more factors such as location, options available to the whales, types of seismic activity, age or sex of the whales exposed, or other context-related differences. Some early, but highly criticized, studies indicated that most bowheads exhibit avoidance behavior when exposed to sounds from seismic activity at a distance of a few kilometers but rarely show avoidance behavior at distances of more than 7.5 km (4.7 mi). In these early studies, bowheads exhibited tendencies for reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows.

Recent, more widely accepted, studies of the effects of seismic activity (1996-1998) and traditional knowledge indicate that during the fall migration, most bowhead whales avoid an area around a seismic vessel operating in nearshore waters by a radius of about 20 km and may begin avoidance at greater distances. The sighting rates of whales at a radius of 20 and 30 km was higher than the sighting rate within the 20-km radius, but it varied annually from no evidence of a reduced sighting rate in 1996 to a reduced sighting rate in 1998. This is a larger avoidance radius than was observed from scientific studies conducted in the 1980's. Avoidance did not persist beyond 12 hours after the end of seismic operations. Thus, available data indicate that behavioral changes are temporary. However, there is concern within the subsistence whaling communities that whales exposed to this source of noise (and other sources) may become more sensitive, at least over the short term, to other noise sources.

NMFS (2001:69) concluded that:

> Seismic actions, and the possible use of icebreakers to support OCS activities present the highest probability for avoidance of any of the activities associated with oil exploration.

Exploratory drilling from gravel islands generally is conducted during the winter. Should these activities occur during the migration, noise produced from the activities is not expected to have major effects on bowhead whales because gravel islands are constructed in fairly shallow water shoreward of the main migration route, and broadband noise from operations on gravel islands generally is not audible beyond a few kilometers. Exploratory drilling from bottom-founded structures also generally is conducted during the winter. Bowheads have been sighted within 0.2-5 km (0.12-3 mi) from drillships, although some bowheads probably change their migration speed and swimming direction to avoid close approach to noise-producing activities. In their 2001 Biological Opinion, NMFS (2001:69) stated that:

> Davies (1997) concludes bowhead whales avoided an active drilling rig at a distance of 20 km.

If icebreakers attended drillships, as typically is the case during the fall in the U.S. Beaufort Sea, the drillship noise frequently may be masked by icebreaker noise, which often is louder. 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 (2.86-12.4 mi) when the sound-to-noise ratio is 30 dB. Whales appear to exhibit less avoidance behavior with stationary sources of relatively constant noise than with moving sound sources.

Island-construction activities likely will be conducted during the winter and generally are in nearshore shallow waters shoreward of the main bowhead whale migration route. These activities are generally not expected to have major effects on bowhead whales. Some whales may be displaced seaward, if cleanup activities occurred outside the barrier islands or in the channels between the barrier islands during the whale migration.

Bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident and behavioral changes are temporary, lasting from minutes (in the case of vessels and aircraft) up to 30-60 minutes (in the case of seismic activity in earlier seismic studies). In recent studies, avoidance of the area within 20 km of seismic operations did not persist beyond 12 hours after the end of seismic operations. Occasional brief interruption of feeding by a passing vessel or aircraft probably is not of major significance. Similarly, the energetic cost of traveling a few additional kilometers to avoid closely approaching a noise source is small in comparison with the cost of migration between the central Bering and eastern Beaufort seas.

We do not believe these disturbances or avoidance factors will be significant, because the anticipated level of industrial activity is not sufficiently intense to cause repeated displacement of specific individuals. Reactions are less obvious in the case of industrial activities that continue for hours or days, such as distant seismic exploration and drilling. Behavioral studies have suggested that bowheads habituate to noise from distant, ongoing drilling or seismic operations (Richardson et al., 1985), but there still is some apparent localized avoidance (Davies, 1987).

There is insufficient evidence to indicate whether or not industrial activity in an area for a number of years would adversely impact bowhead use of that area (Richardson et al., 1985), but there has been no documented evidence that noise from OCS operations would serve as a barrier to migration.

Overall, bowhead whales exposed to noise-producing activities such as vessel and aircraft traffic, drilling operations, seismic surveys, and construction activities most likely would experience temporary, nonlethal effects. There is variability in their response to certain noise sources. Some of the variability appears to be context specific (e.g., feeding versus migrating whales) but the factors associated with the variability are not fully understood.

In their 2001 Biological Opinion, NMFS (2001:69) concluded that:

> While...deflections during migration may not injure individual animals, concern is warranted for cumulative noise and multiple disturbance; the consequences of which might include long-term shifts in migrational paths or displacement from nearshore feeding habitats. However, it appears unlikely that these impacts would prevent the survival and recovery of this species...Nonetheless, concern is warranted over the distribution in time and space of several noise-producing activities.

IV.B Discharge and Construction Habitat Effects

There could be a number of minor alterations in bowhead habitat as a result of exploration. Discharge of drilling muds and cuttings during exploration activities are not expected to cause significant effects, either directly through contact or indirectly by affecting prey species. Any effects would be localized primarily around the drill rig because of the rapid dilution/deposition of these materials. Bottom-founded drilling units and/or gravel islands may cover small areas of benthic habitat, and drilling muds and cuttings may cover portions of the seafloor that support epibenthic invertebrates used for food by bowhead whales. However, the effects likely would be negligible, because bowheads feed primarily on pelagic zooplankton and the areas of sea bottom that are impacted would be inconsequential in relation to the available habitat.

Gravel-island-construction activities, including placement of fill material, or installation of sheetpile or gravel bags for slope protection would cause sediment suspension or turbidity in the water. It is likely that most of these construction activities would occur during the winter when bowheads are not present in the area. Activities occurring during the open-water season likely would be completed before the bowhead whales begin their fall migration. Bowheads should not be affected by these activities.

IV.C. Potential Effects of Large and Very Large Spills on Bowhead Whales

As noted, we previously concluded that whales exposed to spilled oil likely would experience temporary, nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. We believe this conclusion is supported by the best available information. There are no data available to MMS that definitely link a large oil spill with a significant population-level effect on a species of large cetacean.

That said, there is uncertainty regarding the potential impacts of especially a very large spill on bowhead whales (and other large cetaceans), especially in instances where whales are aggregated and/or constrained in their movements (for example, due to ice conditions). We are not, and we cannot be, certain of the exact effects on bowheads should the unlikely large or very large spill occur. Existing information is inconclusive, there is a lack of agreement over the interpretation of post-*Exxon Valdez* oil-spill studies, and it is not possible to experiment with large numbers of live large cetaceans. We feel that it is important to acknowledge this uncertainty about potential effects on the Western Arctic stock of bowhead whales, because it is endangered and because of its importance to Alaskan Native peoples of the Arctic. The National Research Council (2003a:161), citing Ahmaogak (1985, 1986, 1989) and Albert (1990) states that: "...the potential for an oil spill and its likely effects on bowhead whales are viewed by bowhead-dependent hunters as the greatest threat to the whale population and to their cultural relationship with the animal."

In the Biological Opinion for Federal Oil and Gas Leasing and Exploration by the MMS within the Alaskan Beaufort Sea, and its Effects on the Endangered Bowhead Whale, NMFS (2001:51) stated that:

> It is difficult to accurately predict the effects of oil on bowhead whales (or any cetacean) because of a lack of data on the metabolism of this species and because of inconclusive results of examinations of baleen whales found dead after major oil releases....

Large cetaceans are difficult animals on which to obtain detailed data on health, growth, reproduction, and/or the survival of individuals. It is very difficult, if not impossible, to obtain many of the kinds of data that have been gathered on some other marine mammals to assess acute or chronic adverse effects from an oil spill (or other effecters). Postspill studies on cetaceans specifically are inconclusive and, thus, it is not possible to confidently estimate the likelihood that serious injury to individuals of bowhead whales could or would occur with oil exposure.

For the reasons discussed in the previous paragraphs, it is difficult to predict the impact of a large spill on bowhead whales. The greatest threat to large cetaceans probably is from inhalation of volatile compounds present in fresh crude oil. It is documented that, with respect to mammals in general, ingestion of petroleum hydrocarbons can lead to subtle and progressive organ damage or to rapid death. Ingestion, surface contact with, and especially inhalation of fresh crude oil has been shown to cause serious damage and even death in many species of mammals. However, available evidence suggests that mammalian species vary in their vulnerability to short-term damage from surface contact with oil (summarized in Geraci and St. Aubin, 1988) and ingestion. Additionally, while differences in acute vulnerability to oil contamination do exist due to ecological (for example, nearshore versus offshore habitat) and physiological reasons (for example, dependence on fur rather than on blubber for thermal protection), species also vary greatly in the amount of information that has been collected about them and about their potential oil vulnerability. These facts are linked, because the most vulnerable species have received the most focused studies. However, it also is the case that it is more difficult to obtain detailed information on the health, development, reproduction and survival of large cetaceans than on some other marine mammals. Data are not available that would permit evaluation of the potential for long-term sublethal effects on large cetaceans.

It is well documented that exposure of at least some mammals to petroleum hydrocarbons through surface contact, ingestion, and especially inhalation can be harmful.

Many polycyclic aromatic hydrocarbons are teratogenic and embryotoxic in at least some mammals (Khan et al., 1987). Maternal exposure to crude oil during pregnancy may negatively impact the birth weight of young. Fetuses of rats whose mothers were given repeated small doses of Prudhoe Bay crude oil during pregnancy had significantly lower weights and crown-rump lengths than control rats (Khan et al., 1987). All fetuses of rats exposed to polycyclic 7,12-dimethylbenz(a)anthracene during key periods of pregnancy were stunted and oedematous in the deep portions of the dermis and underlying subcutaneous layers (Currie et al., 1970). Aromatic components of crude oil have been associated with a variety of hemorrhagic abnormalities in humans (Haley, 1977). After seals were experimentally dosed with crude oil, increased gastrointestinal motility and vocalization and decreased sleep were observed (Geraci and Smith, 1976; Engelhardt, 1985, 1987).

If mortality of bowheads were to occur after exposure to fresh crude oil after a large spill, it would be not be consistent with many, perhaps most, published findings of expected impacts of oil on cetaceans. The potential for there to be long-term sublethal (for example, reduced body condition, poorer health, or longer dependency periods), or lethal effects from large oil spill on cetaceans essentially is unknown. There are no data on cetaceans adequate to evaluate the probability of such effects.

Despite the fact that there is no documented mortality of a large cetacean due to an oil spill, we assume, based on the fact that certain components of crude oil are highly toxic to other mammals, that such mortality could occur. This does not mean that such effect would occur. However, for the basis of our assessment, we assume it could. Such an assumption, if it provides an overestimate of potential effects, is more protective of the population than erring on the side of assuming that such impacts could not occur because they previously have not been documented.

Bowhead whales may be particularly vulnerable to oil-spill effects due to their use of ice edges and leads where spilled oil may accumulate (Engelhardt, 1987:104). In the unlikely event of a large oil spill in the bowhead whale's habitat while they were present, some whales could experience the following (Geraci, 1990):

- oiling of skin
- inhaling of hydrocarbon vapors (from a fresh spill)
- ingesting contaminated prey
- fouling of their baleen
- reduced food source
- displacement from feeding areas
- death
- other effects

The number of whales contacting spilled oil would depend on the size, timing, and duration of the spill; how many whales were near the spill; and the whales' ability or inclination to avoid contact.

The potential for there to be adverse effects from a large oil spill would also likely be greater (than in more typical circumstances) if a very large spill of fresh oil (with high concentrations of aromatics) contacted one or more large aggregation of bowheads. Such aggregations occasionally have been documented in MMS aerial bowhead whale surveys. For example, Treacy (1998) observed large feeding aggregations, including relatively large numbers of calves (for example, groups of 77[6], 62[5], 57[7], and 51[0], where the numbers given in brackets are the numbers of calves) of feeding bowheads in waters off of Dease Inlet/Smith Bay in 1997 and in 1998. However, in some years no large aggregations of bowheads were seen anywhere within the study area. When seen, the aggregations were in open water. The likelihood of a very large spill occurring and contacting such a group is low but not outside the range of possibilities. The factors associated with the presence of such groups are not yet clear. It is not known if they would leave the area heavily contaminated with crude oil.

There are few postspill studies with sufficient details to reach firm conclusions about the long-term effects, of an oil spill on free-ranging populations of marine mammals.

IV.C.1. Information from Previous Spills

Available information indicates it is unlikely that bowhead whales would be likely to suffer significant population adverse affects from a large spill originating in the proposed lease sale area. However, individuals or small groups could be injured or potentially even killed in a large spill. Oil spill response activities (including active attempts to move whales away from oiled areas) could cause short-term changes in local distribution and abundance.

These conclusions are based on data collected after the *Exxon Valdez* oil spill and other spills. However, as we pointed out in the recent final EIS for the Cook Inlet Planning Area OCS Oil and Gas Lease Sales (USDOI, MMS, 2003b) information about environmental impacts on whales is rudimentary and full of speculation and uncertainty. While animals such as sea otters, seals, and many birds can be examined closely, impacts on whales from oil spills (and many other perturbations) are difficult to assess because large numbers of most of the species cannot be easily captured, examined, weighed, sampled, or monitored closely for extended periods of time. Thus, impacts such as the sublethal impacts observed on sea otters (for example, reduced body condition, abnormal health, etc.) (see Rotterman and Monnett, 2002 and references cited therein) after the *Exxon Valdez* oil spill are unlikely to be documented in cetaceans because the data needed to determine whether or not such impacts exist cannot be collected. On the other hand, it may be that ecological and physiological characteristics specific to large cetaceans serve to buffer them from many of those same types of impacts. Unless impacts are large and whales die and are necropsied, most effects must be measurable primarily using tools of observation. Unless baseline data are exceptionally good, determination of an effect is only possible if the effect is dramatic. With whales, even when unusual changes in abundance occur following an event such as the *Exxon Valdez* oil spill (as with the disappearance of relatively large numbers of killer whales from the AB pod in Prince William Sound) (see Dahlheim and Matkin, 1994 and the following discussion), interpretation of the data is uncertain or is often controversial due to the lack of supporting data, such as oiled bodies or observations of individuals in distress (and, in that case, the existence of a viable alternative explanation of the probable mortality).

Individual or small groups of bowhead whales could be adversely affected or even killed due to if they came into contact with fresh oil from a large spill. Larger groups could be impacted if a large spill occurred when large aggregations of bowheads were feeding. Cetaceans that inhabit areas that are in the path of a major oil spill can be impacted in several different ways. First, individuals potentially could be directly affected by contact with the oil or its toxic constituents through inhalation of aromatic fractions of unweathered oil (probably the most serious threat to cetaceans), ingestion (of the oil itself or of contaminated prey), fouling of their baleen, and surface contact. Second, they could be indirectly impacted if the quality or quantity of their prey were reduced. Third, individuals could be directly or indirectly affected due to maternal effects (for example, changes in food assimilation during pregnancy, or reduced maternal health) or in utero exposure to toxic components of oil. Fourth, they could be affected by disturbance of spill response and cleanup activities. Although there is evidence for all of the aforementioned types of effects in other types of mammals from experiments and/or postspill studies, there is very little evidence regarding the probability for any of the aforementioned in cetaceans due to limitations discussed above.

After the *Exxon Valdez* oil spill, von Ziegesar, Miller, and Dahlheim (1994) stated that <u>potential</u> (but not documented) impacts to another baleen whale, the humpback whale, from the *Exxon Valdez* oil spill included displacement from normal feeding areas, reduction in prey, or possible physiological impacts resulting in mortality or reproductive failure. In all 3 years of von Zeigesar's study, humpback whales were observed primarily in Knight Island Passage and areas in the southwestern portions of the sound (see Figures 10-6 and 10-7 in von Zeigesar, Miller, and Dahlheim, 1994). von Zeigesar, Miller, and Dahlheim (1994) reported that no humpbacks were observed feeding in water with floating oil but were seen in areas that comprised the primary path of the spill. However, most of the still floating oil had exited the sound prior to peak humpback abundance. However, considerable oil remained and oil continued to wash off of beaches due to wave action and oil-spill-cleanup activities. Whales also were exposed to increased noise and other disturbance due to oil-spill cleanup. von Zeigesar, Miller, and Dahlheim (1994) report that no humpbacks were observed swimming in oil and no humpback deaths or strandings were reported during 1988-1990 in Prince William Sound. They concluded that the results of their study do not indicate a change in calving rate, seasonal residence time, mortality, or abundance. They concluded also that long-term impacts to the whales or their environment could not have been detected in the short period of their study, and that because of the wide distribution of humpback whales in the North Pacific and unequal surveying effort in their study, the effects, if any, of the *Exxon Valdez* oil spill on humpbacks may never be known.

After the *Exxon Valdez* oil spill, Loughlin (1994) observed gray whales swimming in oil from the *Exxon Valdez* oil spill in March 1989, but no gross abnormalities were reported. J. Lentfer (as reported in Harvey and Dahlheim, 1994) reported seeing three gray whales at the southwest entrance to Prince William Sound swimming northwest through a moderate amount of oil. Six other whales were observed near the southwest entrance to Prince William Sound. Based on 10 minutes of observation, Lentfer reported that the whales continually swam at the surface and appeared lethargic. Fumes from the oil were apparent in the airplane at 100-200 m elevation (J. Lentfer, cited in Harvey and Dahlheim, 1994). Loughlin (1994) reported that 26 gray whales were found in 1989 on Alaska beaches from Kayak Island to King Salmon. Most of the whales were along the outside of the Kodiak Archipelago near Sitkinak and Tugidak Islands. During 1990, 9 gray whales were stranded at Sitkinak Island and 17 were stranded at Tugidak. Thirty-six gray whale carcasses were counted at these islands in 2 years (Loughlin, 1994). Six gray whales were reported between Kayak Island and Sarichef during 1975-1987. Loughlin (1994) concludes that the reason for the greater number of whales found in 1989 is unexplained but may be attributable to the fact that the search after the *Exxon Valdez* oil spill coincided with the northern migration of gray whales and to the greater activity in remote areas after the spill. One of three of these whales that were tested had elevated levels of polycyclic aromatic hydrocarbons in its blubber. However, again there is no other link between the observations, and Loughlin (1994) concluded it was unclear what caused the death of the gray whales.

Large numbers of gray whale carcasses have been discovered previously in other parts of the range (see examples in Loughlin, 1994). Brownell (1971) concluded that reports were incorrect that gray whales and other cetaceans died after the Santa Barbara Channel oil spill.

Other dead cetaceans found in 1989 after the *Exxon Valdez* oil spill included one fin whale and one minke whale, both in upper Cook Inlet, one minke whale on Montague Island, and four harbor porpoise (two in the Kodiak areas). Samples from three gray whales, two minke whales, and five harbor porpoise were analyzed for hydrocarbon contaminants. Blubber from one gray whale showed a polycyclic aromatic hydrocarbon level of 467 nanograms per gram (ng/g) wet weight, with a polycyclic aromatic hydrocarbon profile consistent with a petrogenic source (Loughlin, 1994). Polycyclic aromatic hydrocarbon levels in the blubber of one of five harbor porpoises examined were similar (446 ng/g wet weight) but Loughlin did not discuss the polycyclic aromatic hydrocarbon profile of this animal. Loughlin (1994), reported that histological examination of all tissues were unremarkable and provided no information about the cause of death of any of the cetaceans.

Based on evidence of observation of individuals from the AB pod of killer whales in heavy oil, and large disappearances of whales from the AB pod in the 2 years following that exposure (Dahlheim and Matkin, 1994; Harvey and Dahlheim, 1994), one could conclude that whales are vulnerable if they are present within a very large spill, probably due to inhalation. This link is circumstantial, and there is not agreement in the scientific community as to whether or not there likely was an oil-spill impact on killer whales after the *Exxon Valdez* oil spill.

Matkin et al (1994) reported that all seven regularly encountered resident killer whale pods inhabited oiled areas of Prince William Sound after the *Exxon Valdez* oil spill. They also reported that killer whales had the potential to contact or consume oil, because they did not avoid oil or avoid surfacing in slicks. Only in the 2 years following the *Exxon Valdez* oil spill did significant numbers (13) of individual whales, primarily reproductive females and juveniles, disappear from AB pod. These authors reported that this mortality was significantly higher than in any other period except when killer whales where being shot by fishers during sablefish fishery interactions. Dahlheim and Matkin (1994:170) concluded that "There is a spatial and temporal correlation between the loss of the 14 whales and the *Exxon Valdez* oil spill, but there is no clear cause-and-effect relationship." Harvey and Dahlheim (1994) observed 18 killer whales, including 3 calves, and saw the pod surface in a patch of oil. Dahlheim and Matkin (1994) also reported seeing AB pod swim through heavy slicks of oil. The link between the *Exxon Valdez* oil spill and the disappearance of the orcas is circumstantial, and there is not agreement in the scientific community as to whether or not there likely was an oil-spill impact on killer whales after the *Exxon Valdez* oil spill.

During the oil spill off Santa Barbara in 1969, an estimated 3 million gallons of oil may have entered the marine environment. Gray whales were beginning their annual migration north during the spill. Whales were observed migrating northward through the slick. Several dead whales were observed and carcasses recovered, including six gray whales, one sperm whale, one pilot whale, five common dolphins, one Pacific white-sided dolphin, and two unidentified dolphins. Brownell (1971, as reported by Geraci, 1990) acknowledged that these whales totaled more than the usual number of gray whales and dolphins stranding annually on California shores, and concluded that increased survey efforts had led to the higher counts. Several of the whales examined were thought to have died from natural causes, and one may have been harpooned. No evidence of oil contamination was found on any of the whales examined. The Batelle Memorial Institute concluded the whales were either able to avoid the oil, or were unaffected when in contact with it.

Neither mysticete nor odontocete whales seem to avoid oil, although they can detect it (Geraci, 1990). However, in captivity, bottlenose dolphins avoided an oiled area (Geraci, St. Aubin, and Reisman, 1983). Geraci (1990) reported that fin whales, humpbacks, dolphins and other cetaceans have been observed entering oiled areas and behaving normally. After the *Exxon Valdez* oil spill, Dall's porpoises were observed 21 times in light sheen, and 7 times in areas with moderate to heavy surface oil (Harvey and Dahlheim, 1994). Of those porpoises for which oiling status could be determined, only one was observed with oil on its skin. Harvey and Dahlheim (1994) report that the dorsal surface of the porpoise's body, from the blowhole to the dorsal fin, was covered in oil. They report that this individual appeared stressed because of its labored breathing pattern. Lung problems were common in oiled otters brought into treatment centers after the *Exxon Valdez* oil spill and are frequent in mammals following inhalation of petroleum hydrocarbons.

Geraci (1990) summarized available information about the physiological and toxic impacts of oil on cetaceans (see Table 6-1 in Geraci, 1990). He concluded that although there have been numerous observations of cetaceans in oil after oil spills, there were no certain deleterious impacts. While petroleum can damage mammalian skin, Geraci and St. Aubin (1985) reported little effects with exposures of 75 minutes. Lipid composition was not modified, and epidermal cell proliferation was not significantly reduced. However, as pointed out by Harvey and Dahlheim (1994), the significance of these results is uncertain because of small sample sizes and the uncertainty of their applicability to natural situations. It is not clear why some cetaceans that are observed in oil do not become oiled while at least a few apparently do. It is not clear how long crude oil would remain on a free-ranging cetacean's skin once it was oiled.

We know of no bowhead whale deaths resulting from an oil spill. For the reasons discussed in the previous paragraph, it is difficult to predict the impact of a large spill on either bowhead whales. Based on literature on other mammals indicating severe adverse effects of inhalation of the toxic aromatic components of fresh oil, mortality of cetaceans could occur if they surfaced in large quantities of fresh oil. Although there is no conclusive evidence that bowhead whales would be killed as a result of contact with spilled oil, a few whales could die from prolonged exposure to oil. However, if such mortality occurred, it would be not be consistent with many, perhaps most, published findings of expected impacts of oil on cetaceans. The potential for there to be long-term sublethal (for example, reduced body condition, poorer health, or longer dependency periods), or lethal effects from large oil spill on cetaceans essentially is unknown. There are no data on cetaceans adequate to evaluate the probability of such effects.

However, for reasons discussed above, if individual, small groups or, less likely, large groups of whales were exposed to large amounts of fresh oil, especially through inhalation of highly toxic aromatic fractions, they might be seriously injured or die from such exposure. Although there is very little definitive evidence linking cetacean death or serious injury to oil exposure, disappearances (and probable deaths) of killer whales and the deaths of large number of gray whales both coincided with the *Exxon Valdez* oil spill and with observations of members of both species in oil. However, in these two cases, even if one assumed the disappearances of the killer whales and the high number of gray whale carcasses both were the result of the coinciding oil spill, and one assumed impacts on bowhead whales of the same magnitude, it is unlikely that there would be a significant population-level adverse effect in the event of a large oil spill.

IV.C.2. Surface Contact

Surface contact with petroleum hydrocarbons, particularly the low-molecular-weight fractions, can cause temporary or permanent damage of the mucous membranes and eyes (Davis, Schafer, and Bell, 1960) or epidermis (Hansbrough et al., 1985; St. Aubin, 1988; Walsh et al., 1974). Contact with crude oil can damage eyes (Davis, Schafer, and Bell, 1960). Corneal ulcers and abrasions, conjunctivitis, and swollen nictitating membranes were observed in captive ringed seals placed in crude oil-covered water (Geraci and Smith, 1976), and in seals in the Antarctic after an oil spill (Lillie, 1954). Corneal ulcers and scarring were observed in oiled otters brought into oil-spill treatment centers (Wilson et al., 1990) after the *Exxon Valdez* oil spill. There is speculation that bowhead whale eyes may be vulnerable to damage from oil on the water due to their unusual anatomical structure.

Oil first would contact a whale's skin as it surfaces to breathe. The effects of oil contacting skin are largely speculative. We do not know how long spilled oil will adhere to the skin of a free-ranging whale. Oil might wash off the skin and body surface shortly after bowheads vacated oiled areas, if they left shortly after being oiled. However, oil might adhere to the skin and other surface features (such as sensory hairs) longer, if bowheads remained in these areas.

In a study on nonbaleen whales and other cetaceans, Harvey and Dahlheim (1994) observed 80 Dall's porpoises, 18 killer whales, and 2 harbor porpoises in oil on the water's surface from the *Exxon Valdez* spill. They observed groups of Dall's porpoises on 21 occasions in areas with light sheen, several occasions in areas with moderate-to-heavy surface oil, once in no oil, and once when they did not record the amount of oil. Thirteen of the animals were close enough to determine if oil was present on their skin. They confirmed that 12 animals in light sheen or moderate-to-heavy oil did not have oil on their skin. One Dall's porpoise had oil on the dorsal half of its body. It appeared stressed because of its labored breathing pattern. The authors gave no other information on effects. The 18 killer whales and 2 harbor porpoises were in oil but had none on their skin. None of the cetaceans appeared to alter their behaviors when in areas where oil was present. The authors concluded their observations were consistent with other reports of cetaceans behaving normally when oil is present. It is probable that bowhead whales would respond in a similar manner (U.S. Army Corps of Engineers, 1998:Appendix B).

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

Although oil is unlikely to adhere to smooth skin, it may stick to rough areas on the surface (Henk and Mullan, 1997). Haldiman et al. (1985) found the epidermal layer to be as much as seven to eight times thicker than that found on most whales. They also found that little or no crude oil adhered to preserved bowhead skin that was dipped into oil up to three times, as long as a water film stayed on the skin's surface. Oil adhered in small patches to the surface and vibrissae (stiff, hairlike structures), once it made enough contact with the skin. The amount of oil sticking to the surrounding skin and epidermal depression appeared to be in proportion to the number of exposures and the roughness of the skin's surface.

Albert (1981) suggested that oil would adhere to the skin's rough surfaces (eroded areas on the skin's surface, tactile hairs, and depressions around the tactile hairs). He theorizes that oil could irritate the skin, especially the eroded areas, and interfere with information the animal receives through the tactile hairs. Because we do not know how these hairs work, we cannot assess how any damage to them might affect bowheads. Albert (1981) is concerned that the eroded skin may provide a point of entry into the bloodstream for pathogenic bacteria, if the skin becomes more damaged. Evidence from Shotts et al. (1990) suggests that the lesions are active sites of necrosis. The authors noted that 38% of the microorganisms in lesions contained enzymes necessary for hemolytic activity of blood cells (breaking down of red blood cells and the release of hemoglobin) compared to 28% of the microorganisms on normal skin. Many of these species of bacteria and yeast were determined to be potential pathogens of mammalian hosts. Hansen (1985) speculates that much of the oil is washed off the whale's skin as it moves through the water.

Geraci and St. Aubin also investigated how oil might affect healing of superficial wounds in a bottlenose dolphin's skin. They found that following a cut, newly exposed epidermal cells degenerate to form a zone of dead tissue that shields the underlying cells from seawater during healing. They massaged the superficial wounds with crude oil or tar for 30 minutes, but the substances did not affect healing. Lead-free gasoline applied in the same manner caused strong inflammation, but it subsided within 24 hours and was indistinguishable from control cuts. The authors concluded that the dead tissue had protected underlying tissues from gasoline in the same way it repels osmotic attack by seawater. The authors further concluded that in real life, contact with oil would be less harmful to cetaceans than they and others had proposed.

Bratton et al. (1993) synthesized studies on the potential effects of contaminants on bowhead whales. They say no published data prove oil fouling of the skin of any free-living whales, and conclude that bowhead whales contacting fresh or weathered petroleum are unlikely to suffer harm. Cetacean skin is a strong barrier to the toxic effects of petroleum.

IV.C.3. Effects of Inhalation of Components of Crude Oil

The greatest threat to large cetaceans probably is from inhalation of volatile compounds present in fresh crude oil. Based on literature on other mammals indicating severe adverse effects of inhalation of the toxic aromatic components of fresh oil, mortality of cetaceans could occur if they surfaced in large quantities of fresh oil. Inhalation of volatile hydrocarbon fractions of fresh crude oil can damage the respiratory system (Hansen, 1985; Neff, 1990); cause neurological disorders or liver damage (Geraci and St. Aubin, 1982); have anesthetic effects (Neff, 1990); and, if accompanied by excessive adrenalin release, cause sudden death (Geraci, 1988).

Geraci and St. Aubin (1982) calculated the concentrations of hydrocarbons associated with a theoretical spill of a typical light crude oil. They calculated the concentrations of the more volatile fractions of crude oil in air. The results showed that vapor concentrations could reach critical levels for the first few hours after a spill. If a whale or dolphin were unable to leave the immediate area of a spill during that time, it would inhale some vapors, perhaps enough to cause some damage. Fraker (1984), while reviewing the effects of oil on cetaceans, stated that a whale surfacing in an oil spill will inhale vapors of the lighter petroleum fractions, and many of these can be harmful in high concentrations. Animals that are away from the immediate area or that are exposed to weathered oils would not be expected to suffer serious consequences from inhalation, regardless of their condition. The most serious situation would occur if oil spilled into a lead that bowheads could not escape. In this case, Bratton et al. (1993) theorized the whales could inhale oil vapor that would irritate their mucous membranes or respiratory tract. They also could absorb volatile hydrocarbons into the bloodstream. However, they rapidly would excrete these volatile hydrocarbons, and vapor concentrations that harm whales would dissipate within several hours after a spill.

Within hours after the spill, toxic vapors from oil in a lead could harm the whales' lungs and even kill them. Only a few whales likely would occupy the affected lead at any given time.

IV.C.4. Effects of Ingestion of Spilled Oil

Bowheads sometimes skim the water surface while feeding, filtering a lot of water for extended periods. If oil were present, they could swallow it. Albert (1981) suggested that whales could take in tarballs or large "blobs" of oil with prey. He also said that swallowed baleen "hairs" mix with the oil and mat together into small balls. These balls could block the stomach at the connecting channel, which is a very narrow tube connecting the stomach's fundic and pyloric chambers (the second and fourth chambers of the stomach) (Tarpley et al., 1987). Hansen (1985; 1992) suggests that cetaceans can metabolize ingested oil, because they have cytochrome p-450 in their livers (Hansen, 1992). The presence of cytochrome p-450 (a protein involved in the enzyme system associated with the metabolism and detoxification of a wide variety of foreign compounds, including components of crude oil) suggests that cetaceans should be able to detoxify oil (Geraci and St. Aubin, 1982, as cited in Hansen, 1992). He also suggests that digestion may break down any oil that adheres to baleen filaments and causes clumping (Hansen, 1985). Observations and stranding records do not reveal whether cetaceans would feed around a fresh oil spill long enough to accumulate a critical dose of oil. There is great uncertainty about the potential effects of ingestion of spilled oil on bowheads, especially on bowhead calves. In some mammals, ingestion of some petroleum hydrocarbons can lead to subtle and progressive organ damage or to rapid death.

Bowheads may swallow some oil-contaminated prey, but it likely would be only a small part of their food. It is not known if bowheads would leave a feeding area where prey was abundant following a spill. Some zooplankton eaten by bowheads consume oil particles but apparently can excrete hydrocarbons quickly from their system. Tissue studies by Geraci and St. Aubin (1990) revealed low levels of naphthalene in the livers and blubber of baleen whales. This result suggests that prey have low concentrations in their tissues, or that baleen whales may be able to metabolize and excrete petroleum hydrocarbons.

In fish (Rice, 1985) and in birds (Leighton, Butler, and Peakall, 1985) environmental stress, such as fluctuation in food abundance and temperature, may increase the vulnerability to petroleum hydrocarbon exposure. In birds, oil ingestion may contribute significantly to morbidity or mortality even when other factors may be the immediate causative agent (Leighton, Butler, and Peakall, 1985) and increases susceptibility to lethal bacterial disease (Rocke, Yuill, and Hinsdill, 1984). Because oil ingestion can decrease food assimilation of prey eaten (for example, St. Aubin, 1988), the resulting effect on an affected individual bird or mammal might be much like that seen if prey quality or quantity was reduced.

IV.C.5. Effects of Baleen Fouling

Baleen hairs might be fouled, which would reduce a whale's filtration efficiency. Braithwaite (1983, as cited in Bratton et al., 1993) used a simple system to show a 5-10% decrease in filtration efficiency of bowhead baleen after fouling, which lasted for up to 30 days. Fraker (1984) noted that there was a reduction in filtering efficiency in all cases, but only when the baleen was fouled with 10 millimeters of oil was the change statistically different. We do not know how such a reduction in food caught in the baleen would affect the overall health or feeding efficiency of these whales. Geraci and St. Aubin (1985) found that 70% of the oil adhering to baleen plates was lost within 30 minutes. In 8 of 11 trials, more than 95% of the oil was cleared after 24 hours. The study could not detect any change in resistance to water flowing through baleen after 24 hours. This study tested baleen from fin, sei, humpback, and gray whales. The baleen from these whales is shorter and coarser than that of bowhead whales, whose longer baleen has many hairlike filaments. Information from these two studies suggest that a spill of heavy oil, such as Bunker C, or residual patches of weathered oil, could interfere with feeding efficiency of the fouled plates for several days at least (Geraci and St. Aubin, 1985). Lighter oil should result in less interference with feeding efficiency. Bowheads most likely would occupy oiled waters for only a short time, and filtration efficiency could return to normal in a matter of hours as oil flushes from the baleen. Repeated baleen fouling over a long time, however, might reduce food intake and blubber deposition, which could harm the bowheads.

IV.C.6. Effects of Reduced Food Source

An oil spill probably would not permanently affect zooplankton, the bowhead's major food source, and any effects are most likely to occur nearshore (Richardson et al., 1987, as cited in Bratton et al., 1993). The amount of zooplankton lost, even in a large oil spill, would be very small compared to what is available on the whales' summer-feeding grounds (Bratton et al., 1993).

IV.C.7. Effects of Displacement from Feeding Areas

We have no observations through western science whether bowheads may be temporarily displaced from an area because of an oil spill or cleanup operations. However, Thomas Brower, Sr. (1980) described the effects on bowhead whales of a 25,000-gallon oil spill at Elson Lagoon (Plover Islands) in 1944. It took approximately 4 years for the oil to disappear. For 4 years after the oil spill, Brower observed that bowhead whales made a wide detour out to sea when passing near Elson Lagoon/Plover Islands during fall migration. Bowhead whales normally moved close to these islands during the fall migration. These observations indicate that some displacement of whales may occur in the unlikely event of a large oil spill, and that the displacement may last for several years. Based on these observations, it also appears that bowhead whales may have some ability to detect an oil spill and avoid surfacing in the oil by detouring around the area of the spill. Potential displacement because of disturbance is discussed in Section III.C.3.

Several investigators have observed various cetaceans in spilled oil, including fin whales, humpback whales, gray whales, dolphins, and pilot whales. They did not avoid slicks but swam through them, apparently showing no reaction to the oil. During the spill of Bunker C and No. 2 fuel oil from the *Regal Sword*, researchers saw humpback and fin whales, and a whale tentatively identified as a right whale, surfacing and even feeding in or near an oil slick off Cape Cod, Massachusetts (Geraci and St. Aubin, 1990). Whales and a large number of white-sided dolphins swam, played, and fed in and near the slicks. The study reported no difference in behavior between cetaceans within the slick and those beyond it. None of the observations prove whether cetaceans can detect oil and avoid it. Some researchers have concluded that baleen whales have such good surface vision that they rely on visual clues for orientation in various activities. In particular, bowhead whales have been seen "playing" with floating logs and sheens of fluorescent dye on the sea surface of the sea (Wursig et al., 1985, as cited in Bratton et al., 1993). These observations suggest that if oil is present on the sea surface and is of such quality or in such quantity that it is readily optically recognizable, bowhead whales may be able to recognize and avoid it (Bratton et al., 1993).

After the *Exxon Valdez* oil spill, researchers studied the potential effects of an oil spill on cetaceans. Dahlheim and Loughlin (1990) documented no effects on the humpback whale. von Ziegesar, Miller, and Dahlheim (1994) found no indication of a change in abundance, calving rates, seasonal residency time of female-calf pairs, or mortality in humpback whales as a result of that spill, although they did see temporary displacement from some areas of Prince William Sound. It was difficult to determine whether the spill changed the number of humpback whales occurring in Prince William Sound. This study could not have detected long-term physiological effects to whales or to the humpback's prey.

IV.C.8. Summary of Oil-Spill Effects

The effects of a large oil spill and subsequent exposure of the bowhead whale population to fresh crude oil are uncertain, speculative, and controversial. The effects would depend on how many whales contacted oil, the duration of contact, and the age/degree of weathering of the spilled oil. The number of whales contacting spilled oil would depend on the size, timing, and duration of the spill; how many whales were near the spill; and the whales' ability or inclination to avoid contact. If oil got into leads or ice-free areas frequented by migrating bowheads, a large portion of the population could be exposed to spilled oil. If a very large slick of fresh oil contacted a large aggregation or aggregations of feeding bowheads, especially with a high percent of calves, the effect might be expected to be greater than under more typical circumstances. There is great uncertainty about the effects of fresh crude oil on cetacean calves. Prolonged exposure to freshly spilled oil could kill some whales, but, based on available information, the number likely would be small. In the unlikely event of a large oil spill, the probability of oil contacting whales is likely to be considerably less than the probability of oil contacting bowhead habitat. If a spill occurred and contacted bowhead habitat during the fall migration, it is likely that some whales would be contacted by oil. It is unknown what effects an oil spill would have on bowhead whales, but some conclusions can be drawn from studies that have looked at the effects of oil on other cetaceans. Engelhardt (1987) theorized that bowhead whales would be particularly vulnerable to effects from oil spills during their spring migration into arctic waters because of their use of ice edges and leads, where spilled oil tends to accumulate. Several other researchers (Geraci and St. Aubin, 1982; St. Aubin, Stinson, and Geraci, 1984) concluded that exposure to spilled oil is unlikely to have serious direct effects on baleen whales. There is some uncertainty and disagreement within the scientific community on the results of studies on the impacts of the *Exxon Valdez* oil spill on large cetaceans (for example, Loughlin, 1994, Dahlheim and Matkin, 1994, Dahlheim and Loughlin, 1990). Geraci (1990) reviewed a number of studies on the physiologic and toxic effects of oil on whales and concluded there was no evidence that oil contamination had been responsible for the death of a cetacean.

It is likely that some whales would experience temporary, nonlethal effects, including one or more of the following symptoms:

- oiling their skin, causing irritation
- inhaling hydrocarbon vapors
- ingesting oil-contaminated prey
- fouling of their baleen and reduced foraging efficiency
- losing their food source
- temporary displacement from some feeding areas

Some whales could die as a result of contact with spilled oil, particularly if there is prolonged exposure to freshly spilled oil, such as in a lead. The extent of the effects would depend on how many whales contacted oil, the duration of contact, and the age/degree of weathering of the spilled oil. The number of whales contacting spilled oil would depend on the location, size, timing, and duration of the spill and the whales' ability or inclination to avoid contact. If oil got into leads or ice-free areas frequented by migrating bowheads, a large portion of the population could be exposed to spilled oil. Under some circumstances, some whales could die as a result of contact with spilled oil. Prolonged exposure to freshly spilled oil could kill some whales, but the number likely would be small.

We conclude that there is uncertainty about effects on bowheads (or any large cetacean) in the unlikely event of a very large spill. There are, in some years and in some locations, relatively large aggregations of feeding bowhead whales within the proposed lease-sale area. If a large amount of fresh oil contacted a significant portion of such an aggregation, effects potentially could be greater than typically would be assumed. However, based on available information about the effects of oil on large cetaceans, we see no evidence that any potential impact on this population would be likely to result in significant effect on the population. All available information indicates that the Bering-Chukchi-Beaufort seas bowhead population is robust, resilient, and continuing to increase. Thus, 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.

NMFS (2001:57) concluded that:

> There is still considerable disagreement as to the probable effects of oil on bowhead whales in the Alaskan Beaufort Sea. This disagreement probably reflects the migratory habit of these animals in the region, as well as a lack of definitive studies. Data on the anatomy and migratory behavior of bowhead whales suggest that a large oil spill would be expected to adversely affect bowhead whales, especially if substantial amounts of oil were in the lead system during the spring

migration...Exposure of bowhead whales to an oil spill could result in lethal effects to an unknown number of individuals.

IV.D. Probabilities of Contacting an Oil Spill

Neff (1990) reports that several studies have tried to model the probability that bowhead whales would contact spilled oil in the Navarin Basin, Chukchi Sea, and Beaufort Sea in the unlikely event of a large oil spill. The models suggest that only a small number of the Beaufort Sea bowhead population would be affected by a large spill. The model by Reed et al. (1987) predicted the greatest number of contacts would occur in the Beaufort Sea, but that no encounter involved more than 1.9% of the population. According to the diving-behavior study, most of the encounters involved fewer than 100 surfacings in oil-covered waters. Bratton et al. (1993), describing an oil-spill model and bowhead whale/oil-spill linkages, indicated one model calculated a total probability of 51.8% that at least one whale would encounter oil spilled in the Beaufort Sea Planning Area, should a spill occur or, alternatively, a 48.2% probability of no whales surfacings in oil. These models used oil-spill probabilities from MMS's 5-year oil and gas lease schedule for 1987-1991 for spills greater than 1,000 bbl. Whether bowhead whales would come into contact with oil would depend on the location, timing, and magnitude of the spill; the presence and extent of shorefast and broken ice; and the effectiveness of cleanup activities.

Geraci and St. Aubin (1990) stated that the notable weakness in modeling is that there is no information on the type and duration of oil exposure required to produce an effect. They further stated that for all but the sea otter, the premise that contact is fatal is indefensible. Models commonly overestimate the impact of a spill. They further stated that few, if any, cetaceans have been claimed by spilled oil.

IV.D.1. Oil-Spill-Risk Analysis

Based on the oil spill risk analysis that will be provided in our EA, the definition of a large spill is one greater than or equal to 1,000 barrels. Below, we summarizes information on the oil-spill data and assumptions we use in the analysis of large spills in this Biological Evaluation and in our 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 Multiple-Sale EIS in February 2003.

Information regarding the source, type, and sizes of oil spills; their behavior; the estimated path they follow; and the conditional and combined probabilities remain the same as discussed in the multiple-sale EIS in Section IV.A and Appendix A. Thus, the conditional and the combined probabilities that oil spilled in the Beaufort Sea would contact specific environmental resource areas that are important to bowhead whales remain the same as analyzed and discussed in the multiple-sale EIS (USDOI, MMS, 2003a: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.

A recent laboratory study on the biodegradation of weathered Alaska North Slope crude indicates that low-dose oil locations are bioremediated more effectively than high-dose locations (Lepo et al., 2003). Prince et al. (2003) discuss three northern spills and demonstrate that photo-oxidation and biodegradation play an important role in the long-term weathering of crude oils. Photo-oxidation and biodegradation would continue to weather the 28-65% of the oil remaining.

After 30 days under landfast ice:

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

Oil spreading and floe motion were studied to determine how floe motion, ice concentration, slush concentration, and oil types affect spreading in ice. Spreading rates were lowered as ice concentrations increased; but for ice concentrations less than 20-30%, there was very little effect. Slush ice rapidly decreased spreading. If the ice-cover motion increased, then spreading rates increased, especially with slush ice present (Gjosteen and Loset, 2004). The new information helps to determine the specific behavior of oil under ice but does not change the above assumptions.

The chance of one or more large spills occurring is derived from two components: (1) the spill rate and (2) the resource volume estimates. The oil resource volume estimate remains 460 billion barrels (Bbbl), as discussed in the Beaufort multiple-sale EIS (USDOI, 2003a:Section II.B). 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., 2002). 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.

Considering only the variance in the 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 0.25 oil spills (95% confidence interval 0.21-0.30 oil spills) per billion barrels produced. Considering only the variance in the Arctic effects, we are 95% confident that the spill rate for large spills from platforms and pipelines will be no more than 0.30 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 4-5%, and the chance of one or more large platform spills would be 7% for Alternative I, the Proposed Action and its alternatives. The chance of one or more large spills from platforms and pipelines combined ranges from 10-11% for Alternative I, the Proposed Action and its alternatives based on the spill rate. Using the spill rate at the 95% confidence interval, the chance of one or more large spills from platforms and pipelines combined for Alternative I, the Proposed Action, and its alternatives ranges from 9-13%. Appendix B discusses how these spill rates were derived, and the reader is directed to Appendix B for more detail. Regardless of the chance of spill occurrence, for purposes of analysis we analyzed the consequences of one large or very large oil spill.

Since the conditional and the combined probabilities that oil spilled in the Beaufort Sea would contact specific environmental resource areas that are important to bowhead whales remain the same as analyzed and discussed in the multiple-sale EIS (USDOI, MMS, 2003a:Appendix A) we simply reiterate our summary here for the convenience of our readers.

The following paragraphs present conditional and combined probabilities estimated by the Oil-Spill-Risk Analysis model (expressed as a percent chance) of a spill contacting bowhead whale habitat within 180 days. Conditional probabilities are based on the assumption that a spill has occurred. Combined probabilities, on the other hand, factor in the chance of the spill occurring.

Summer Spill. For conditional probabilities, the Oil-Spill-Risk Analysis model estimates a less than 0.5-37% chance that an oil spill starting at LA1-LA18 will contact ERA's 19-37 within 180 days during the summer, assuming a spill occurs, and a less than 0.5-46% chance, assuming a spill starts at Pipeline Segment (P) P1-P13 (Table A.2-23 in the multiple-sale FEIS). The ERA's 19 through 28 are resource areas in the spring lead system in the Beaufort and Chukchi seas; ERA's 29 through 37 are resource areas along the bowhead whale fall-migration route in the Beaufort Sea, as defined by data from the MMS Bowhead Whale Aerial Survey Program. The greatest percent chance of contact from a launch area occurs at ERA 32, which has a 37% chance of contact from a spill occurring at LA10. The chance of contact in this environmental resource area is highest, because the Oil-Spill-Risk Analysis model's launch area and the environmental resource area are in close proximity to or overlap each other (Maps A-2a and 2b in the multiple-sale FEIS). Similarly, the highest chance of contact in other environmental resource areas occurs when the spill-launch area and the environmental resource area are in close proximity to or overlap each other. The greatest percent chance of contact from a pipeline segment occurs at ERA 32, which has a 46% chance of contact from a spill occurring at P4 (Table A.2-23 in the multiple-sale EIS). The chance of contact in this environmental resource area is highest, because the model's pipeline segment and the resource area are in close proximity to or overlap each other (Maps A-2a and 2b in the multiple-sale FEIS). Similarly, the highest chance of contact in other environmental resource areas occurs when the pipeline segment and the resource area are in close proximity to or overlap each other.

Winter Spill. The Oil-Spill-Risk Analysis model estimates a less than 0.5-27% chance that an oil spill starting at LA1-LA18 will contact ERA's 19-37 within 180 days during the winter, assuming a spill occurs, and a less than 0.5-32% chance, assuming a spill starts at P1-P13 (Table A.2-41). The greatest percent chance of contact from a launch area occurs at ERA's 25 and 28, which have a 27% chance of contact from a spill occurring at LA2 and LA7, respectively. The chance of contact in these environmental resource areas is highest, because the model's launch areas and the resource areas are in close proximity to or overlap each other (Maps A-2a and 2b). Similarly, the highest chance of contact in other environmental resource areas occurs when the launch area and the resource area are in close proximity to or overlap each other. The greatest percent chance of contact from a pipeline segment occurs at ERA 25, which has a 32% chance of contact from a spill occurring at P1 (Table A.2-23). The chance of contact in this environmental resource area is highest, because the model's pipeline segment and the resource area are in close proximity to or overlap each other (Maps A-2a and 2b). Similarly, the highest chance of contact in other environmental resource areas occurs when the pipeline segment and the resource area are in close proximity to or overlap each other.

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 oil spills would occur and contact ERA 28 (Beaufort Spring Lead 10), the resource area with the highest chance of contact.

We refer the reader to Appendix A of the multiple Sale FEIS for previously provided details supporting the OSRA analysis.

IV.E. Conclusion on Effects

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, although there is concern and some uncertainty about the potential for longer-term effects from cumulative effects of multiple noise sources within an area. At present levels of activity, the geographic scale of any potential noise effects is probably relatively small compared to the total habitat used by bowhead whales in the Alaskan Beaufort Sea. The Industry Site-Specific Bowhead Whale-Monitoring Program should be effective in detecting a delay or blockage of the migration. Any effects from the discharge of muds and cuttings or suspension of sediment in the water column would be primarily localized around the drill rig because of the rapid dilution/deposition of these materials. Effects on the bowheads prey species likely would be negligible. The stipulation on Pre-booming Requirements for Fuel Transfers should reduce the likelihood that fuel spills would affect bowhead whales during their migration. We conclude that there is uncertainty about effects on bowheads (or any large cetacean) in the unlikely event of a very large spill. Available data indicate that whales exposed to spilled oil likely would experience temporary or permanent nonlethal effects, although prolonged exposure to freshly spilled oil could kill some whales. There are, in some years and in some locations, relatively large aggregations of feeding bowhead whales within the proposed lease-sale area. If a large amount of fresh oil contacted a significant portion of such an aggregation, effects potentially could be greater than typically would be assumed. However, based on available information about the effects of oil on large cetaceans, we do not have information that indicates that any potential impact on this population would be likely to result in significant effect on the population. All available information indicates that the Bering-Chukchi-Beaufort seas bowhead population is robust, resilient, and continuing to increase. Thus, while there is uncertainty about the exact nature and level of effect of a very large spill under highly specific distribution patterns, and adverse effects could occur, 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.

V. Environmental Baseline

For the purposes of interagency consultations under Section 7 of the ESA, the environmental baseline is defined as the past and present impacts of all Federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed Federal projects in an action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process [50 CFR §402.02].

In this case, the relevant action area includes the range of the BCB bowhead whale with emphasis on the Beaufort Sea. Human activities that we identified that meet the aforementioned definition include, but may not be limited to the following: historic commercial whaling; past subsistence hunting; previous oil- and gas-related activity; proposed Federal and State oil and gas activities that have recently been consulted on and/or that are essentially contemporaneous with the proposed project; past research activities; past incidental take in commercial-fishing activities; and past shipping activities.

V.A. Historical Commercial Whaling

It is clear that commercial whaling between 1848 and 1915 was the primary human impact on this population. Commercial whaling severely depleted bowhead whales. Woody and Botkin (1993) estimated that the historic abundance of bowheads in this population was between 10,400 and 23,000 whales in 1848, before the advent of commercial whaling. Woody and Botkin (1993) estimated between 1,000 and 3,000 animals remained in 1914, near the end of the commercial-whaling period. Commercial whaling also may have caused the extinction of some subpopulations and some temporary (but lasting several years) changes in distribution.

Following protection from whaling, this population (but not some other bowhead populations) has shown marked progress toward recovery. As noted in the affected environment section, the current population estimate is 10,020 (SE of 1,290, 95% CI of 7,800-12,900) (Zeh, as cited in International Whaling Commission, 2003) and, thus, estimated population size is within the lower bounds of estimates of the historic population size. Recently, Shelden et al. (2001, 2003) concluded that this population should be removed from the list of species designated as endangered under the ESA.

V.B. Subsistence Hunting

Alaskan Native people have been hunting bowhead whales for at least 2,000 years. Thus, subsistence hunting is not a new contributor to cumulative effects on this population. There is no indication that, prior to commercial whaling, subsistence whaling caused significant adverse effects on the population. However, modern technology has changed the potential for any lethal take of this whale to cause population-level adverse effects if unregulated. Under the authority of the IWC, the subsistence take from this population has been regulated by a quota system since 1977. Federal authority for cooperative management of the Eskimo subsistence hunt is shared with the Alaska Eskimo Whaling Commission (AEWC) through a cooperative agreement between the AEWC and the United States Department of Commerce, National Oceanic and Atmospheric Administration (NOAA) (see Appendix 9.5 of NOAA Fisheries, 2003b).

We expand our discussion of subsistence take here because of the significance of this take to our conclusions about the potential effects and cumulative effects of other effectors. The sustainable take of bowhead whales by subsistence hunters represents the largest single-known, human-related cause of mortality at the present time. Available information suggests that it is likely to remain so for the foreseeable future. While other potential effectors primarily have the potential to cause or be related to behavioral or sublethal adverse effects to this population, there is little or no evidence for other common human-related causes of mortality.

Thus, the subsistence take, which all available evidence indicates is sustainable, monitored, managed, and regulated, helps to put potential cumulative impacts (as well as potential direct and indirect impacts associated with the proposed action) into perspective. We are aware of no information that indicates that the effect of any other of the past human activities (other than commercial whaling), or reasonably foreseeable other human activities, would be likely to have the effect on this population that the subsistence harvest does. We are not aware of information that indicates the combined effect of any other reasonably foreseeable human activity would have such an effect.

That said, we emphasize that the subsistence take of bowhead whales does indeed appear to be sustainable, and all evidence indicates that the affected population is robust and continues to increase. The hunt puts the other potential impacts into perspective:

- Unlike most or all of the other potential impactors, the take of bowhead whales for subsistence has been occurring for at least 2,000 years.
- The take is of extremely high cultural significance to the whaling communities.
- The subsistence take is small compared to the estimated size of the population. The NMFS concluded that Alaskan Native hunters from 10 communities take less than 1% of the total population (NMFS, 2003a). Russian Chukotkan Native peoples also are allowed to hunt bowhead whales under the IWC quota. The distribution of the quota is determined annually through an agreement between the United States and Russia, who make a joint request for an aboriginal subsistence quota to the IWC.
- The take is less than that which would be consistent with the requirements of the IWC "Schedule," a set of principles and guidelines that govern Scientific Committee recommendations on setting catch limits for commercial and aboriginal subsistence whaling. In 2002, the IWC's Scientific Committee agreed "...that it is very likely a catch limit of 102 whales or less annually would be consistent with the requirements of the Schedule" (IWC, 2002:36).
- The Alaska Eskimo Whaling Commission and NOAA Fisheries cooperate to conduct research on this population, to monitor the hunt and to undertake other measures to ensure the long-term health and viability of this population.

In Table II, we reproduce information provided by NOAA Fisheries (NMFS, 2003b) regarding the numbers of bowhead whales from the western Arctic (BCB) stock taken by subsistence hunters from 1978-2002. The sustained growth of this bowhead population indicates that this level of take has been sustainable. Because the quota for the hunt is tied to the population size and population parameters (IWC, 2003a; NOAA Fisheries, 2003b), this source of mortality likely will not contribute to a significant adverse effect on this population.

During a special meeting in October 2002, the IWC renewed the catch limits for the BCB Seas bowhead population by consensus, allowing for a combined total of up to 280 bowhead whales to be landed in the years 2003-2007 (IWC, 2002). The number of bowhead whales that can be struck in any given year shall not exceed 67 except that any unused portion of a strike quota from any year, including from the 1998-2002 quota block, shall be carried forward and added to the strike quota of any subsequent year, provided no more than 15 strikes shall be added to the quota for any one year. The IWC further specified that "It is forbidden to strike, take or kill calves or any bowhead whale accompanied by a calf (IWC, 2002). NOAA Fisheries (NMFS, 2003b:4) points out that the "Quota of 56 landed whales per year continues to be shared between Alaskan and Russian Natives, the quota does not meet the documented need for landed whales by Alaska Natives."

The level of subsistence take of bowheads could increase over the life of the proposed project as the human populations within bowhead hunting communities are increasing (IWC, 2002), and the current quota is well below what the IWC considers consistent with its guidelines (IWC, 2002; IWC, 2003b). The IWC considers population size and related nutritional needs in its quotas for aboriginal harvest.

There are adverse impacts associated with subsistence hunting, in addition to the death of animals that are successfully hunted and the serious injury of animals that are struck but not immediately killed. Available evidence indicates that subsistence hunting causes disturbance to the other whales, changes in their behavior and that it sometimes causes temporary effects on habitat use, including migration paths. Thus, subsistence hunting represents a source of noise and disturbance to the whales. According to Native hunters, behavioral changes observed in whales that are in the vicinity of hunting include temporary alteration of behavior including changes in the direction in which they were traveling, going further offshore, and turning back into leads (see references and further discussion under cumulative effects). Available data are insufficient to determine whether there are longer-term (longer than when the hunting is occurring) changes in habitat use due to hunting. While some such changes were reported by commercial whalers (see cumulative section), the pattern and intensity of such whaling is not comparable to modern subsistence hunting. Because evidence indicates that bowhead whales are long-lived, some bowhead whales may have been in the vicinity where subsistence hunting occurred on multiple, perhaps dozens or more, occasions. Thus, some whales may have cumulative exposure to hunting activities. This source of noise and disturbance adds to noise and disturbance from other sources, such as that from shipping and oil and gas-related activities. To the extent such activities occur in the same habitats during the period of whale migration, even if the activities (for example, hunting and shipping) themselves do not occur simultaneously, cumulative effects from all noise and disturbance could affect whale habitat use. However, we are not aware of information indicating long-term habitat avoidance has occurred with present levels of activity.

When a subsistence hunt is successful, it results in the death of a bowhead. The NMFS (2003a) pointed out that whales that are not struck or killed may be disturbed by noise associated with the approaching hunters, their vessels, and the sound of one or more bombs detonating: "...the sound of one or more bombs detonations during a strike is audible for some distance. Acousticians, listening to bowhead whale calls as part of the census, report that calling rates drop after such a strike ..." (NMFS, 2003a:35). We are not aware of data indicating how far hunting-related sounds (for example, the sounds of vessels and/or bombs) can propagate in areas where hunting typically occurs, but this is likely to vary with environmental conditions. We do not know if whales issue an "alarm call" or a "distress call" after they, or another whale, are struck prior to reducing call rates.

The National Marine Fisheries Service (2003a) reported that:

> ...whales may act "skittish" and wary after a bomb detonates, or may be displaced further offshore (E. Brower, pers. com.). However, disturbances to migration as a result of a strike are temporary (J. George, 1996), as evidenced when several whales may be landed at Barrow in a single day. There is some potential that migrating whales, particularly calves, could be forced into thicker offshore ice as they avoid these noise sources. The experience of Native hunters suggests that the whales would be more likely to temporarily halt their migrations, turn 180 degrees away...(i.e., move back through the lead systems), or become highly sensitized as they continue moving (E. Brower, pers. com.).

Bockstoce and Burns (1993) reported that during commercial whaling, which we <u>emphasize</u> differed greatly from the current subsistence take in terms of its magnitude and intensity, whalemen found that:

> the whales, in the opinion of the whalers, began to adapt to the threat. In particular they vanished for several years in an area where a large number of kills had been made. Furthermore, the bowheads apparently quickly learned to distinguish the sound of a whaleboat approaching them, and when a whale was struck, all nearby bowheads would dive and flee. Such responses are similar to those reported by contemporary subsistence hunters.... Similarly, when a boat did approach close to bowheads, the animals were often noticed dodging or slumping in the water to avoid the harpoon.

Because evidence indicates that bowhead whales are long-lived, some bowhead whales may have been in the vicinity where hunting was occurring on multiple, perhaps dozens or more, occasions. Thus, some whales may have cumulative exposure to hunting activities. This form of noise and disturbance adds to noise and disturbance from other sources, such as shipping and oil and gas-related activities. To the extent such activities occur in the same habitats during the period of whale migration, even if the activities (e.g., hunting and shipping) themselves do not occur simultaneously, cumulative effects from all noise and disturbance could affect whale habitat use. However, we are not aware of information indicating long-term habitat avoidance has occurred with present levels of activity. Additionally, if, as reported above, whales become more "skittish" and more highly sensitized following a hunt, it may be that their subsequent reactions, over the short-term, to other forms of noise and disturbance are heightened by such activity. Data are not available that permit evaluation of this possible, speculative interaction.

In summary, up to 82 (67 + 15) whales could be struck (with the presumption that they could die, even if not retrieved) in a given year from 2004 through 2007 as long as a total of 280 is not exceeded over the 5-year period. The basis of the quota was a joint request by the Russian Federation and the United States for an annual average of 56 landed whales (or a total of 255 for the Alaska Eskimos and 25 for the Chukotka Natives over the 5-year period) (NMFS, 2003b). If the population of whales continues to increase in abundance, this quota could be increased for the next 5-year period (2008-2012). However, the quota likely will continue to be a small percentage of the estimated population size and will not have significant adverse impacts on the population. The fact that this well-documented take exists and the population is still increasing and apparently robust puts other potential effects, most of which are expected to be nonlethal and temporary, into perspective. The subsistence take, while additive, actually is small as compared to the capacity of the population to absorb it and to thrive. We are aware of no other known potential human-related effects that approach, or could reasonable be predicted to approach, the level of this known removal. This activity also results in noise and disturbance that may have temporary effects on habitat use. However, we are not aware of information suggesting there have been any long-term modifications of habitat use due to this form of noise and disturbance.

V.C. Commercial-Fishing and Marine Vessel-Traffic Baseline

We discuss potential future incidental take and marine vessel-traffic effects on bowhead whales in the cumulative effects section of this document.

Based on available data, previous incidental take of bowhead whales apparently has occurred only rarely. The bowhead's association with sea ice limits the amount of fisheries activity occurring in bowhead habitat. However, as noted in the section on climate change, the frequency of such interactions in the future would be expected to increase if commercial-fishing activities expand northward, with resultant increases in temporal and, especially, spatial overlap between commercial-fishing operations and bowhead habitat use. There is some uncertainty about whether such expansion will occur. Increases in spatial overlap alone could result in increased interactions between bowheads and derelict fishing gear.

Potential effects on bowhead whales from commercial-fishing activities include incidental take in the fisheries and/or entanglement in derelict fishing gear resulting in death, injury, or effects on the behavior of individual whales; disturbance resulting in temporary avoidance of areas; and whales being struck and injured or killed by vessels.

A young bowhead was reported to have died after being entrapped in a fishing net in Japan (Shelden and Rugh, 1995) and another in northwest Greenland in a net used to capture beluga whales. Several cases of rope or net entanglement, at least 10 incidents from 1978-1999, have been reported from whales taken in the subsistence hunt (Angliss, DeMaster, and Lopez, 2001). The number of entanglements or scarring attributed to ropes may include more than 20 cases (Craig George, as cited in Angliss and Lodge, 2002). Table 29 in Angliss and Lodge (2002:173) details reports of scarring of bowhead whales attributed to entanglement in ropes. Between 1989-94 logbook data on incidental take of bowheads are available, but after that time the requirement is for fishers to self report. Angliss and Lodge (2002:173) reported that "the records are considered incomplete and estimates of mortality based on them represent minimums". There are no observer program records of bowhead whale mortality incidental to commercial fisheries in Alaska. New information on entanglements of bowhead whales indicates that bowheads do have interactions with crab-pot gear. There have been two confirmed occurrences of entanglement in crab-pot gear, one in 1993 and one in 1999 (Angliss and Lodge, 2002). Angliss and Lodge (2002) reported that the average rate of bowhead entanglement in crab pot gear for 1996-2000 is 0.2. Based on currently available data, the estimated annual mortality rate incidental to commercial fisheries also is 0.2 (see Appendix 2 in Angliss and Lodge, 2002:179). Marine vessel traffic, in general, can pose a threat to bowheads because of the risk of ship strikes. Additionally, noise associated with ships or other boats potentially could cause bowheads to alter their movement patterns or make other changes in habitat use. Pollution from marine vessel traffic, especially from large vessels such as large cruise ships, also could cause degradation of the marine environment and increase the risk of the whales' exposure to contaminants and disease vectors.

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 observations of ship-strike injuries suggests that bowheads either do not often encounter vessels or they avoid interactions with vessels, or that interactions usually result in the animals' death. The NMFS (2003b), citing a pers. commun. with C. George of the North Slope Borough) states that since the 1994 publication by George et al. (1994), ship-strike injuries have been observed on 6 additional whales out of about 180 whales examined between 1995 and 2002. Thus, we believe our aforementioned general conclusion about ship strikes is likely to be valid.

There has been speculation recently that commercial shipping through the Northwest Passage is likely to substantially increase in the coming decades. For example, an article in 2000 in the *Christian Science Monitor* (Walker, 2000) quotes the director of the Canadian Project at the Center for Strategic and International Studies in Washington, C. Sands, as saying he believes that "there's a reasonable chance" Arctic commercial shipping is going to occur across the Northwest Passage. Burns (2000:4) concludes that "...proposed reduction in sea ice area could also open up the Northwest Passage. This could expose cetaceans to increased ship traffic and mineral exploitation."

V.D. Research Activities

The Western Arctic bowhead has been the focus of research activities that could, in some instances, cause minor temporary disturbance of the whales. During research on the whales themselves, the reactions of the whales generally are closely monitored to minimize potential adverse effects. Additionally, research conducted primarily for reasons other than the study of the bowhead has also occurred within the range of the bowhead. In some cases, such research has the potential to adversely affect the whales through the introduction of additional noise, disturbance, and low levels of pollution into their environment.

Information about known future projects is presented in the cumulative section. Some of the research projects discussed here are continuing in the future, but are considered in this section because they already have been initiated. Previous research on bowheads has included aerial surveys, ship-based observations, acoustic studies, shore-based censuses, studies involving samples and examination of carcasses of animals killed in the subsistence hunt, and satellite tracking. The NMFS recently initiated photo-identification studies. The primary result of ship-based activities could be temporary disturbance of individual whales from a highly localized area. Whales might slightly and temporarily alter their habitat use to avoid large vessels. Whales also could be temporarily harassed or disturbed by low-flying airplanes during photo-identification work. These effects would be as described for low-flying aircraft in our effects section. All such effects are expected to be of short duration. Aerial surveys generally are flown at a height such that they do not cause harassment.

The NMFS (2003b) concluded that the greatest potential impact to bowhead whales from research in the Arctic was from underwater noise generated by icebreakers. They cite the Western Arctic Shelf Basin Interactions (SBI) project, which has and plans to operate from the U.S. Coast Guard *Healy* and *Polar Star* icebreakers. This is a multiyear, interdisciplinary program aimed at investigating the impacts of climate change on biological, physical, and geochemical processes in the Chukchi and Beaufort Shelf Basin in the Western Arctic Ocean. The SBI's cruise track in 2002 departed from Nome in early May, traveled through the Bering Strait and into the Chukchi Sea north to approximately 75° N. longitude, west and then gradually south to a nearshore region on June 5 and about 150° W. latitude. The ship then generally followed the coast to Pt. Lisburne. From that point, it returned directly to Nome on June 15. In 2002, the *Healy* also traveled into the Bering Sea to research the land bridge that once linked Russia and Alaska. According to a U.S. Coast Guard Pacific Area webpage on the project (http://www.uscg.mil/pacarea/healy/deploymets/aws02/science/aws02science.htm), this mission will use towed sonar arrays, bottom coring, and CTD profiling.

Richardson et al. (1995a:Table 6.5) reported estimated source levels for similarly sized icebreakers to range from 177-191 dB re 1 μPa-m. During icebreaking, extremely variable increases in broad-band (10-10,000 Hz) noise levels of 5-10 dB are caused by propeller cavitation. Based on previous studies of bowhead response to noise, such sound could result in temporary avoidance of animals from the areas where the icebreakers were operating and potentially cause temporary deflection of the migration corridor, depending of the location of the icebreakers.

More generally, Morrison et al. (2001) (citing Brigham, 1998, 2000) point out that from 1977-1998, there have been 27 icebreaker trips to the North Pole (presumably not all in the range of this stock of bowhead) for science and tourism.

Research vessels also sometimes introduce noise intentionally, not just incidentally, into the environment as part of the ship's operating systems or to enable the collection of specific types of data (e.g., geologic data). For example, in 1994, the R/V *Maurice Ewing* conducted deep-seismic investigation of the continental crust in the Bering and Chukchi seas in Alaska between August 6, 1994-September 1, 1994. Details of this cruise are available (Galloway and Shipboard Scientific Party, EW94-10, 1994). According to this report, two north-south transects were profiled.

> The eastern transect extended from 58° 50´N, 169°32´W, well within the continental shelf of the Bering Sea, north of the Pribilof Islands, to just south of the shelf edge north of Barrow at 71°49´N, 154°33´W. The western transect extended from the central Chukchi Sea, well within the shelf at 71°23´N, 163°00´W into the Aleutian Basin at 58°00´N, 178°30´W, near Navarinsky Canyon (Galloway and Shipboard Scientific Party, EW94-10, 1994:3).
>
> The hardware for the cruise…consisted of a digital 180-channel streamer…4 km in length, with 25-meter hydrophone spacing…. The source was a[n] 8355 in^3 (137.7 liters), 20-chamber airgun array…. (Galloway and Shipboard Scientific Party, EW94-10, 1994:7)

In a more recent permit application for an Incidental Harassment Authorization, Lamont-Doherty (2003), the entity that controls the R/V *Maurice Ewing*, summarized that airgun noise could cause "…tolerance, masking of natural sounds, behavioral disturbance, and perhaps permanent or temporary hearing impairment." In September 2002, two beaked whales were discovered beached on the Gulf of California (Mexico) coast by NMFS biologists vacationing in the region when the *Maurice Ewing* was conducting a seismic survey in the general area (Lamont-Doherty, 2003).

Bowhead whales from the Western Arctic stock that remained in the Chukchi Sea during the summer of 1994 could have been exposed to noise from this vessel. Because of the source level of this airgun array, it is not unlikely that the distance at which bowheads could be affected by this noise source would be greater than that observed in oil- and gas-related noise research. However, we do not speculate further about whether such exposure occurred or if it did occur, what potential effects it may have had, because observations of marine mammal reactions during this cruise are not available.

In recent years, there also have been scientific field operations in the Arctic Ocean that have used U.S. Navy submarines as platforms. The Scientific Ice Expeditions (SCICEX) program used a Sturgeon-class nuclear-powered attack submarine for unclassified scientific cruises to the Arctic Ocean. A composite of SCICEX tracks in 1993, 1995, 1996, and 1997 can be found at http:/www.ideo.columbia.edu/res/pi/SCICEX and includes travel into bowhead habitat. The program was scheduled to operate at least through 1999. The SCICEX-98 deployment apparently was the fifth of such field operations. The primary objectives of this scientific program, which began on August 1, 1998, were to continue to document physical, chemical, and biological changes in the Arctic Ocean and to characterize the topography and sediment characteristics of the Arctic Ocean floor. The U.S. Navy submarine *Hawkbill* was used in the 1998 field operation. This research cruise entered north of the Bering Strait and traveled along a transect that "roughly paralleled the shelf break north of the Chukchi Sea and terminated just west of Barrow Canyon." A cross-Arctic transect followed and extended to the eastern extreme of the "data release area" (see Figure 1 in the Cruise Report at the following Web-site address).

According to information provided in the Cruise Report (http:www.ideo.columbia.edu/res/pi/SCICEX/Pages/Cruise_Report.html), the SCICEX-98 cruise was a successful first deployment of the Seafloor Characterization and Mapping Mods (SCAMP), which is described in detail in Chayes et al. (1997). However, it is not clear if all elements of SCAMP were used in research activities within the range of the Western Arctic bowhead stock, or if some of the technology used in the 2001 cruise is modified from that described by Chayes et al. (1997). The aforementioned Cruise Report states that geophysical instrumentation used on the cruise included two active sonars. One of these is the Sidescan Swath bathymetric sonar (SSBS), a bilateral swath mapping sonar that operates at 12 kHz at ping intervals out to 20 seconds. Table 1 of Chayes et al. (1997) provides the major "design goal" specifications for the SSBS as follows: Frequency: 12 kHz; pulse length: 8μS to 10 mS; modulation: "CW or" (something is missing in the original source); repetition rate: 2-20 seconds; source level: 233dB re 1 μPascal at 1 m; power: 115 VAC; backscatter swath width: ~160°; bathymetry swath width: ~140°. Additionally, SCAMP employs a subbottom profiling system intended to profile structures down to about 100 meters below the seafloor. Based on information in Table 2 of Chayes et al. (1997), the major "design goal" specifications for the SCAMP High Resolution Subbottom Profiler are as follows: Frequency: 2-8 kHz; pulse length: 1-100 mS; modulation: CW or FM; repetition rate: 1-10 seconds; source level: 230 dB re 1 μPascal at 1 m; penetration: ~100 meters. It is not clear if the subbottom profiler detailed in the 1997 paper is that used in 2001. The cruise report for 2001 states that the SCAMP subbottom profiler is an ODEC Bathy-2000P that has been modified for integration with the data system used and for submarine operations. In 2001, the geophysical survey included about 8,900 nautical miles of trackline miles over 30 days between August 1 and September 1, 2001, and included habitat documented to be within the range of the bowhead whale during that time.

Richardson et al. (1995a:301) concluded that: "Ships and larger boats routinely use fathometers, and powerful side-looking sonars are common on many military, fishing, and bottom-survey vessels.... Sounds from these sources must often be audible to marine mammals and apparently cause disturbances in some situations."

Active sonars were used in commercial whaling after World War II, and whaling boats sometimes tracked whales underwater using active sonar. Ash (1962, cited in Richardson et al., 1995a) reported that this often caused strong avoidance by baleen whales. Reeves (1992) reported that ultrasonic pulses were used to scare baleen whales to the surface. Maybaum (1990, 1993) reported that humpback whales on the wintering grounds moved away from 3.3 kHz sonar pulses and increased their swimming speed and swim-track linearity in response to 3.1- to 3.6-kHz sonar sweeps. Richardson et al. (1995a) also concluded that Smith, 1985 reported that the energy emitted by high-power sonars was sufficient energy to cause concerns about possible nonauditory physical effects and hearing damage in human divers.

The National Research Council summarized that:

> Recent reports and retrospectively analyzed data show an association between the use of multiple high-energy mid-range sonars and mass strandings of beaked whales (*Ziphius cavirostris*). Recent mass strandings...have occurred in a temporal and spatial association with ongoing military exercises employing multiple high-energy, mid-frequency (1-10) kHz) sonars. (National Research Council, 2003b:89)

Submarines are highly valued platforms for a variety of oceanic research in part because they are relatively quiet, enabling the use of active and passive acoustic technologies for a variety of studies. Information about the response of bowheads to resting or transiting submarines is not available to MMS.

Other ships have made numerous research trips into the range of the bowhead. For example, in 1995, the National Research Council reported that the *Alpha Helix* had performed numerous research cruises in the North Pacific, Bering Sea, Chukchi Sea and Alaskan coastal waters over the past 15 years (National Research Council, 1995). Operation of this vessel is primarily limited to open water. The R/V *Alpha Helix* has modest ice-strengthening characteristics but no icebreaking capability.

We conclude that some past and present research-related noise and disturbance could potentially have caused, and cause, harassment and, possibly, temporary displacement of individual whales. Such noise and disturbance adds to cumulative levels of noise in the whales' environment. At present, available information does not indicate that such noise is having behavioral or physiological adverse effects on the bowheads in this stock. However, available information is not sufficient to form any conclusions about such potential effects. We are not aware of any information that suggests long-term displacement from important habitats has occurred, that indicates the population is suffering any significant population-level effect from any single effector, or that indicates that the cumulative effects, including those from research activities, would have such an effect.

The MMS is continuing to evaluate information about past and current research activities as it becomes available.

V.E. Pollution and Contaminants

Initial studies of bowhead tissues collected from whales landed at Barrow in 1992 (Becker et al., 1995) indicate that bowhead whales have very low levels of mercury, PCB's, and chlorinated hydrocarbons, but they have fairly high concentrations of cadmium in their liver and kidneys. The study concluded that the high concentration of cadmium in the liver and kidney tissues of bowheads warrants further investigation. Becker (2000) noted that concentration levels of chlorinated hydrocarbons in bowhead whale blubber generally are an order of magnitude less than what has been reported for beluga whales in the Arctic. This probably reflects the difference in the trophic levels of these two species; the bowhead being a baleen whale feeding on copepods and euphausiids, while the beluga whale is a toothed whale feeding at a level higher in the food web. The concentration of total mercury in the liver also is much higher in beluga whales than in bowhead whales.

Bratton et al. (1993) measured organic arsenic in the liver tissue of one bowhead whale and found that about 98% of the total arsenic was arsenobetaine. Bratton et al. (1997) looked at eight metals (arsenic, cadmium, copper, iron, mercury, lead, selenium, and zinc) in the kidneys, liver, muscle, blubber, and visceral fat from bowheads harvested from 1983-1990. They observed considerable variation in tissue metal concentration among the whales tested. Metal concentrations evaluated did not appear to increase over time between 1983 and 1990. Based on metal levels reported in the literature for other baleen whales, the metal levels observed in all tissues of the bowhead are similar to levels in other baleen whales. The bowhead whale has little metal contamination as compared to other arctic marine mammals, except for cadmium, which requires further investigation as to its role in human and bowhead whale health. The study recommended limiting the consumption of kidney from large bowhead whales pending further evaluation.

Cooper et al. (2000) analyzed anthropogenic radioisotopes in the epidermis, blubber, muscle, kidney, and liver of marine mammals harvested for subsistence food in northern Alaska and in the Resolute, Canada region. The majority of samples analyzed had detectable levels of ^{137}Cs. Among tissues of all species of marine mammals analyzed, ^{137}Cs was almost always undetectable in the blubber and significantly higher in epidermis and muscle tissue than in the liver and kidney tissue. The levels of anthropogenic radioisotopes measured were orders of magnitude below levels that would merit public health concern. The study noted there were no obvious geographical differences in ^{137}Cs levels between marine mammals harvested in Resolute, Canada and those from Alaska. However, the ^{137}Cs levels in marine mammals were two to three orders of magnitude lower than the levels reported in caribou in northern Canada and Alaska.

Based on the use of autometallography (AMG) to localize inorganic mercury in kidney and liver tissues for five bowhead whales, Woshner et al. (2002:209) reported that "AMG granules were not evident in bowhead tissues, confirming nominal mercury (Hg) concentrations." Detected concentrations ranged from 0.011-0.038 micrograms per gram (μg/g) wet weight for total mercury. Mössner and Ballschmiter (1997) reported that total levels of 310 nanograms per gram (ng/g) polychlorinated biphenyls and chlorinated pesticides in bowhead blubber from the North Pacific/Arctic Ocean, an overall level many times lower than that of other species from the North Pacific or Arctic Ocean (beluga whales [2,226 ng/g]; northern fur seals [4,730 ng/g]) and than that of species from the North Atlantic (pilot whale [6,997 ng/g]; common dolphin [39,131 ng/g]; and harbor seal [70,380 ng/g]). However, while total levels were low, the combined level of 3 isomers of the hexachlorocyclohexanes was higher in the bowhead blubber (160 ng/g) tested than in either the pilot whale (47 ng/g), the common dolphin (130 ng/g), and the harbor seal (140 ng/g). These results confirmed results expected due to the lower trophic level of the bowhead relative to the other marine mammals tested.

In the Beaufort Sea multiple-sale final EIS, we concluded that the levels of metals and other contaminants measured in bowhead whales appear to be relatively low, with the exception of cadmium. Since the finalization of the multiple-sale EIS, additional information (included in the review presented above) on contaminants in BCB bowheads has become available. This information supports this same general conclusion.

V.F. Offshore Exploration and Development

To date, offshore petroleum extraction activities conducted in State waters or on the OCS in the Beaufort Sea as a result of previous Federal lease sales since 1979 apparently have not had long-term detectable adverse effects on the bowhead whale population. Although numerous exploration wells have been drilled in the Beaufort Sea from a variety of platforms, including gravel islands, ice islands, bottom-founded drilling platforms, submersibles, and drillships and extensive seismic surveys have been conducted, no related bowhead whale mortality has been reported. The bowhead whale population has continued to increase over that timeframe. Artificial gravel islands have been constructed. Vessel and aircraft traffic has occurred related to exploration and development with no long-term adverse cumulative effects detectable in information from western scientific studies. However, Inupiat whalers have stated that noise from these activities at least temporarily displaces whales farther offshore, especially if the operations are conducted in the main migration corridor. As noted in the section on effects, whales may avoid areas where seismic surveys or drilling operations are being conducted. Recent monitoring studies (Miller et al., 1997, 1999; Miller, Elliot, and Richardson, 1998) indicate that most whales migrating in the fall avoid an area with a radius about 20-30 km around a seismic vessel operating in nearshore waters. We are not aware of data that indicate that such avoidance was long-lasting. We are not aware of data that indicate that the cumulative effects of all noise and disturbance-causing factors combined (e.g., oil and gas activities, shipping, subsistence hunting, and research activities) and/or habitat alteration activities (e.g., gravel island construction) has had any long-lasting behavioral physiological adverse effect(s) on individual bowhead whales or on the population.

The Trans-Alaska Pipeline System, the construction of a Trans-Alaska Gas System, the Alaska Natural Gas Transportation System, the converting of natural gas to liquefied natural gas, and the tankering of crude oil from Valdez are projects that would not be likely to have important cumulative effects on bowhead whales.

The Bureau of Land Management (BLM) reported that marine docking facilities for NPRA-W potentially could be located in Peard Bay, Barrow, or Dease Inlet, although initial development projects could be staged out of Prudhoe Bay and materials transported by vehicle in winter or barge in summer (USDOI, BLM and MMS, 2003). This could increase vessel traffic through the Dease Inlet/Smith Bay areas, areas used in some years (e.g., 1997) by large numbers of bowheads, including relatively high percentages of females with calves. The response of female and calf groups to such vessel traffic is unknown. The BLM noted that the vessel trip frequency would depend on the number of concurrent projects and the stage of development (USDOI, BLM and MMS, 2003). Because numbers of vessel roundtrips from equipment source area to NPR-A staging area (13/summer) are forecast for a project during the construction period, and supply vessels are likely to follow established routes, the actual area disturbed would be limited. The area and, potentially the numbers of individuals affected, would increase if concurrent projects at different locations were to be developed. Vessel traffic occurs during the open-water season and, although numbers of bowheads that could be exposed to such traffic could be substantial in some but probably not most years, the geographic scale of the effect compared to the area used by bowheads even off of Smith Bay and Dease Inlet is likely to be small and concentrated in the nearshore shipping corridor.

In conclusion, there is no clear indication that disturbance from oil and gas exploration and development activities since the mid-1970's has had an additive or synergistic adverse effect on the bowhead whale population. The bowhead whale population has been steadily increasing at the same time that oil and gas activities have been occurring in the Beaufort Sea and throughout the bowhead whale's range.

VI. Potential Cumulative Effects on Bowhead Whales

For purposes of interagency consultation requirements under the ESA, cumulative effects are defined in 50 CFR 402.02 (Interagency Cooperation on the Endangered Species Act of 1973, as amended):

> "...those effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation."

We note that this definition differs from that of cumulative effects as defined under NEPA. Thus, some effects that are discussed as cumulative effects in the Beaufort Sea multiple-sale EIS and in the EA for proposed Lease Sale 195 are discussed in the environmental baseline section in this biological evaluation. All actions that require Section 7 consultation under the ESA are included under baseline effects in this evaluation (for example, subsistence hunting, Federal oil and gas lease sales). Some of the sources of potential effects are discussed within this document as both part of the environmental baseline (those effects from the particular effector that have already occurred), and in the cumulative effects section (effects from that source that are reasonably certain to occur in the future).

An updated and expanded analysis and discussion of potential cumulative effects on bowhead whales is provided in Section IV.E of the multiple-sale EIS.

The potential for cumulative adverse effects on bowhead whales is of great concern because of their current endangered status, which resulted from past human activity (overexploitation by commercial whalers), and because of their importance as a subsistence species to Alaskan Native residents of coastal villages adjacent to their range. In our general conclusions about cumulative effects in the Beaufort Sea multiple-sale final EIS (USDOI, MMS, 2003a), we stated:

> Potential cumulative effects on the bowhead whale...[and other key resources]...would be of primary concern and warrant continued close attention and effective mitigation practices.
>
> The incremental contribution of Sale 186 to the cumulative effects likely would be quite small. Construction and operations related to the Beaufort Sea multiple sales primarily would be concentrated in the Near Zone, and oil output would be a small percentage (approximately 7%) of the total estimated North Slope/Beaufort Sea production.
>
> The incremental contribution of effects from Beaufort Sea Sale 186 to the overall effects under the cumulative case is not likely to cause an adverse effect on the bowhead whale population.

With respect to potential cumulative effects on bowhead whales specifically from Beaufort Sea, North Slope, and Transportation Activities, we also summarized and concluded (USDOI, MMS, 2002):

> Bowhead whales might experience cumulative effects from OCS activities, such as oil spills or noise from drilling, vessel and aircraft traffic, construction, seismic surveys, or oil-spill-cleanup activities, and from non-OCS activities. Bowhead whales temporarily may move to avoid noise-producing activities and may experience temporary, nonlethal effects, if oil spills occur during activities associated with any past, present, or reasonably foreseeable future development projects in the arctic region.
>
> We do not expect bowhead whales to die from noise produced while exploring, developing, and producing offshore oil and gas, but some whales could experience temporary, nonlethal effects. Some bowheads temporarily may move to avoid vessels and activities conducted for seismic surveys, drilling, and construction. Contact with spilled oil in the Beaufort Sea could cause some temporary, nonlethal effects to some bowhead whales, and a few could die from prolonged

exposure to freshly spilled oil. There is no clear indication that disturbance from oil and gas exploration and development activities since the mid-1970's has had an additive or synergistic effect on the bowhead whale population. The bowhead whale population has been steadily increasing at the same time that oil and gas activities have been occurring in the Beaufort Sea and throughout the bowhead whale's range. Bowhead whales should not be affected by oil spills or activities associated with the transport of oil through the Trans-Alaska Pipeline System or by marine transportation along the tanker routes to market.

> Activities that are not related to oil and gas also could have cumulative effects on bowhead whales. A small number of whales may be injured or killed as a result of entrapment in fishing nets or collisions with ships. Native whalers from Alaska harvest bowheads for subsistence and cultural purposes under a quota authorized by the International Whaling Commission. Native whalers from Russia also are authorized to harvest bowhead whales under a quota authorized by the International Whaling Commission. However, the status of the population is closely monitored these activities are closely regulated.

We summarized the contribution of Beaufort Sea Sale 186 to cumulative effects as follows:

> Noise contribution to cumulative effects from Alternative I for Sale 186 likely would be limited to temporary avoidance behavior by a few bowhead whales in response to aircraft and vessel traffic, drilling activities and possibly some seismic surveys.

We pointed out that the Alternative I for Sale 186 represents about 8% of past and present oil and gas development projects in the Beaufort Sea area and about 4% of past, present, and reasonably foreseeable future oil and gas development projects in the Beaufort Sea area (USDOI, MMS, 2003a:Table V-7b).

Regarding Alternative I, we stated:

> It is expected to contribute about 17% of the mean number of spills on the offshore area (Table V-13). The total estimated mean number of cumulative offshore spills is 0.65, and the estimated mean number of spills from the Beaufort Sea Sale 186 is 0.11. The most likely number of offshore spills for Alternative I for Sale 186 is zero (Table V-13). It is expected to contribute about 4% of mean number of spills for the Trans-Alaska Pipeline System tanker spills (Table V-13). Because more oil spills are likely to occur under the cumulative case than for Alternative I for Sale 186 alone, whales are more likely to contact spilled oil, and oil-spill effects may be greater. Some individuals exposed to spilled oil may inhale hydrocarbon vapors, experience some damage to skin or sensory organs, ingest spilled oil or oil-contaminated prey, feed less efficiently because of baleen fouling, and lose some prey killed by the spill. Prolonged exposure to freshly spilled oil could kill or injure a few whales.

In addition to the detailed coverage in the Beaufort Sea multiple-sale final EIS, several other documents have become available recently that are particularly useful as sources of information about potential cumulative effects on this population. These documents also provide information helpful in evaluating the potential significance of effects on the status and health of this population. These include: The National Marine Fisheries Service's *Biological Opinion on Issuance of Annual Quotas Authorizing the Harvest of Bowhead Whales to the Alaska Eskimo Whaling Commission for the Period 2003 through 2007* (NMFS, 2003a); their *Final Environmental Assessment for Issuing Subsistence Quotas to the Alaska Eskimo Whaling Commission for a Subsistence Hunt on Bowhead Whales for the Years 2003 through 2007* NMFS, 2003b); papers evaluating whether this population should be delisted (Shelden et al., 2001, 2003; Taylor, 2003); and the National Research Council's report *Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope* (National Research Council, 2003a). The International Whaling Commission (IWC) reviewed and critically evaluated new information available on the bowhead whale at their 2003 meeting. This information and the associated discussions are summarized in the *Report of the Subcommittee on Bowhead, Right and Gray Whales* (IWC, 2003a). The 2002 Alaska Marine Mammal Stock Assessment for this stock remains the most recent stock assessment available. We refer interested readers to these documents, to references cited in the multiple-sale final EIS, and to new references cited in the following text for details on potential cumulative effects that might lie outside the scope of the material provided in our final EIS and updated here. Lastly, we note that the IWC will be conducting an in-depth status assessment of this population in 2004 (IWC, 2003a) at their annual meeting.

Consideration of all the information available to us, including information available to us since finalization of the Beaufort Sea multiple-sale final EIS, indicates that the general conclusions quoted herein about potential cumulative effects on bowhead whales that were presented in the multiple-sale final EIS are still valid and apply to proposed Sale 195.

However, because of the endangered status of this stock and its importance to Alaskan Native residents of the Beaufort, Chukchi, and Bering seas bowhead-hunting communities, and because the NMFS indicated during informal ESA consultation with them related to this sale that we should expand our discussion of cumulative issues, we supplement but try not to repeat the detailed information provided in the multiple-sale EIS. Additionally, we expand our discussion of potential cumulative impacts on this population in an attempt to increase the transparency of the rationale underlying our conclusions about such effects and to clarify the uncertainty, where it exists, in evaluation of the potential impact(s) of specific effectors.

VI.A. Introductory Information Relevant to Evaluation and Interpretation of Potential Cumulative Effects on Bowheads

"Evidence is accumulating" that suggests at least some bowhead "whales live a very, very long time. If estimates are correct, some whales may be over 100 years old" (C. George, as cited in U.S. Dept. of Commerce, 2002). These data add to previous estimates that these whales may live to 50-75 years of age. The NOAA Fisheries (U.S. Dept. of Commerce, 2002) points out that "...some whales alive today may have been alive at the end of the commercial whaling period." Thus, evaluation of potential cumulative effects, both at the individual level and at the level of the population, needs to take a very long view both into the past and into the future.

That said, varying, sometimes considerable, amounts of uncertainty are associated with conclusions about the potential for particular effectors to have impacted bowheads, to be impacting them, and especially to cause impact in the future.

Some of the uncertainty is unavoidable and cannot be remedied. Bowhead whales are very large marine animals. They inhabit parts of the world where weather, day length, and remoteness make research on free-ranging animals difficult, extremely expensive, and sometimes dangerous. Many of the types of data that could reduce the level of uncertainty about potential impacts of some potential effectors, such as very large oil spills, cannot be acquired in any reasonable way. For example, many of the chronic impacts of oil pollution that have been documented in smaller mammals could not be detected in large cetaceans because of the limitations of studying them. They cannot be easily captured, weighed, examined, and then let go and then captured again. When they die, they typically die at sea, and evidence of the fact and cause of their death is lost. Bowheads cannot be brought into aquariums and subjected to oiling or noise experiments as some smaller marine mammals can. Thus, for these and other reasons, the range of potential physiological, especially long-term sublethal, effects on these (and other large) whales from such factors as large and very large oil spills, high energy noise, or contaminants are uncertain. Behavioral impacts of repeated exposure to noise and disturbance in the marine environment and whether that noise is from shipping, oil- and gas-related activities, or hunting are also uncertain. The uncertainty extends to potential effects of climate change because of uncertainty about what physical changes actually will occur, what the biological and development of consequences of such changes will be, and how bowheads will respond to such changes.

Because the potential effects of at least some specific factors are uncertain, an even greater level of uncertainty exists about the cumulative impact of all of the potential factors, especially over the long timeframes that must be considered for this species. In general, the uncertainty about potential cumulative effects becomes greater the further into the future we try to predict and the more likely the potential effector may affect bowheads in a manner that is difficult to directly monitor (for example, effects of contaminants).

While such uncertainty exists about the details of some but not all cumulative effects, the Western Arctic stock of bowheads is relatively very well studied and monitored. The current status of this population is not uncertain, despite the inherent uncertainty associated with some factors that might be having some adverse (or even positive) effects on it. Because some of the potential cumulative effects on this population are highly regulated (for example, subsistence hunting), we know clearly the level of at least some effects. These two points are important. We are able to view other potential effects against relatively detailed knowledge of population status and in light of rather detailed knowledge about the population level consequences of at least some known cumulative effectors (for example, subsistence hunting, past levels of offshore industrial activity).

VI.B Geographic and Temporal Scope of the Cumulative Analyses

As noted, cumulative effects are those effects that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what Federal or non-Federal agency or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

In our cumulative effects analyses, we have considered all factors that we believe potentially could contribute to cumulative effects on bowhead whales from the Western Arctic stock (also referred to as the Bering-Chukchi-Beaufort seas population) anywhere in their range. For this reason, the geographic area considered in our cumulative analyses corresponds to the entire range of the stock as shown in Figure 38 of the *Final Alaska Marine Mammal Stock Assessments* (Angliss and Lodge, 2002:171) and includes areas in the northern Bering Sea (winter and some summer use), through the Chukchi Sea (spring habitat and some use in the summer), much of the Alaskan Beaufort Sea, and western portions of the Canadian Beaufort Sea (summer feeding areas). Thus, we include potential effects on this stock along the bowhead migration route in the Beaufort and Chukchi seas; in the western Canadian Beaufort Sea, where they aggregate in large numbers and feed in the summer; and in the Chukchi and Bering seas, areas where they spend long periods of time in the late autumn, winter, and spring.

Our baseline date for cumulative analysis was the initiation of commercial whaling of this population in 1848, and our endpoint is the likely period of effect of reasonably foreseeable potential effectors that could be expected to occur over the expected life of the project, a period of approximately 30-40 years.

VI.C Factors Identified that Could Contribute to Cumulative Effects

We identified the following types of past, present, and reasonably foreseeable human-related actions and factors that potentially could contribute to cumulative effects on the Western Arctic stock of bowhead whales:

- Sustainable Subsistence Hunting
- Activities Related to Offshore Petroleum Extraction
- Commercial Fishing and Marine Vessel Traffic
- Climate Change (also referred to as Global Warming)
- Research Activities
- Pollution and Contaminants

The potential factors that we identified include those that were identified in the multiple-sale final EIS. However, because of the importance of this population, we have expanded our discussion of our analyses of cumulative effects, especially the potential for climate change, and associated changes in human activity during open water to impact this population. Following a suggestion from B. Smith of NOAA Fisheries, we also have included research activities in our cumulative analyses.

VI.C.1 Future Subsistence Hunting

Currently, Alaska Native hunters from 10 villages harvest bowheads for subsistence and cultural purposes under a quota authorized by the IWC. Chukotkan Native whalers from Russia also are authorized to harvest bowhead whales under the same authorized quota. The status of the population is closely monitored, and these activities are closely regulated. The issuance of the annual quota to the AEWC for the subsistence hunt is subject to Section 7 consultation under the ESA. Thus, our discussion of subsistence take is in our baseline section in this document. We note that, due to differences in the definition of cumulative effects under the NEPA and under the ESA, the discussion of subsistence take is in the cumulative effects analysis in our EA for this lease sale.

VI.C.2 Activities Related to Offshore Petroleum Extraction

In Section V.C.5.a(1)(a) of the multiple-sale EIS, we provided considerable detail on current and reasonably foreseeable oil- and gas-related projects that may affect bowhead whales. We do not repeat this detailed information here. The McCovey Prospect was one project for which an exploration plan had been approved northwest of Cross Island. This project was considered reasonably foreseeable at the time of the multiple-sale EIS. We concluded that: "if this results in submittal of a future development and production plan, coordination with Native groups will be necessary to maintain traditional hunting in the area." The exploration well drilled at this location has been capped and abandoned. Thus, the potential for incremental cumulative effects from oil and gas exploration projects in this region may be somewhat overstated in the multiple-sale EIS at least over the next decade.

Some effects on bowhead whales may occur because of activities from previous and proposed lease sales of State and Federal areas offshore. Generally, bowhead whales remain far enough offshore to be mainly in Federal waters, but they move into State waters in some areas, such as the Beaufort Sea southeast and north of Kaktovik and near Point Barrow.

The Liberty Project is a reasonably foreseeable future development project that is located shoreward of the barrier islands and well shoreward of the bowhead whale's normal fall-migration route. The Kuvlum and Hammerhead units, both reasonably foreseeable future development projects, are within the bowhead whale's normal fall-migration route. Some bowhead whales could be disturbed if development proceeds at the Kuvlum and Hammerhead units or other reasonably foreseeable future development projects, such as the Sandpiper or Flaxman Island units. In general, development projects such as Endicott or Northstar are not likely to harm bowhead whales. Endicott is inside the barrier islands in relatively shallow water. Support traffic travels over the causeway. Although Northstar is not inside the barrier islands, it is well shoreward of the bowhead's typical fall-migration route. Operations for both Endicott and Northstar projects are conducted from gravel structures, which limit how far noise would travel. The Sandpiper and Flaxman Island units, also reasonably foreseeable future development projects, are not within the bowhead whale's normal fall-migration route. Endicott, Northstar, and Flaxman Island are all or mostly on State lands. Other Federal and State sales in the Beaufort Sea that are scheduled through 2007 could lead to more noise and disturbance from exploratory activities. This would include activities within the marine environment associated with the BLM lease sales in the NPR-A.

The Liberty Project is located inside of the barrier islands, well shoreward of the bowhead's fall-migration route (USDOI, MMS, 2002). Operations for the Liberty Project, if developed, also likely would be conducted from gravel structures, limiting how far noise would travel. Studies discussed in Section IV.C.5 of the final EIS indicate that noise from oil and gas operations on gravel islands is substantially attenuated within 4 km and not detectable at 9.3 km.

Some bowhead whales could be disturbed if development proceeds at the Kuvlum and Hammerhead units or other reasonably foreseeable future development projects, such as the Sandpiper or Flaxman Island units. The Kuvlum and Hammerhead units are within the bowhead whale's normal fall-migration route. Development of these units likely would share infrastructure with the Badami group. Each unit likely would have its own production pads and wells and a pipeline connecting it to an existing or planned field associated with Badami. Installing production platforms and constructing pipelines could disturb some bowhead whales on their fall migration, if pipeline construction in deeper water took place during the latter part of the open-water season. If helicopters from Deadhorse pass low overhead, they could cause bowheads to dive. Whales would try to avoid close approach by vessels.

The Sandpiper and Flaxman Island units are not within the main bowhead whale fall migration route. Sandpiper is near Northstar, and the effects on bowheads from development at that location likely would be similar to those expected from Northstar. Flaxman Island is closer to the bowhead whale's main fall-migration route, but it is a barrier island. In general, noise from oil and gas activities on gravel islands does not travel more than a few kilometers. Development of the Sandpiper unit likely will share infrastructure with the Northstar group. The unit likely would have its own production pads and wells and a pipeline connecting it to Northstar. Development of the Flaxman Island unit likely would share infrastructure with the Badami group. The unit likely would have its own production pads and wells and a pipeline connecting it to a past or present development project associated with Badami.

Some effects on bowhead whales may occur because of activities from previous and proposed lease sales of State and Federal areas offshore. Generally, bowhead whales remain far enough offshore to be mainly in Federal waters, but they move into State waters in some areas, such as the Beaufort Sea southeast and north of Kaktovik and near Point Barrow. We detailed these potential effects in the Beaufort Sea Sale 170 final EIS (USDOI, MMS, 1998) and in the Beaufort Sea Multi-Sale Final EIS (USDOI, MMS, 2003a).

To date, activities conducted in State waters or on the OCS in the Beaufort Sea as a result of previous Federal lease sales since 1979 apparently have not had adverse effects on the bowhead whale population. Exploration wells have been drilled in the Beaufort Sea from a variety of platforms, including gravel islands, ice islands, bottom-founded drilling platforms, submersibles, and drillships and extensive seismic surveys have been conducted. To date, no bowhead whale mortality has been reported. The bowhead whale population has continued to increase over that timeframe. However, Inupiat whalers have stated that noise from these activities at least temporarily displaces whales farther offshore, especially if the operations are conducted in the main migration corridor. Whales may avoid areas where seismic surveys or drilling operations are being conducted. Recent monitoring studies (Miller et al., 1997, 1999; Miller, Elliot, and Richardson, 1998) indicate that most whales migrating in the fall avoid an area with a radius about 20-30 km around a seismic vessel operating in nearshore waters. These studies are discussed in detail in the final EIS. More abbreviated discussion is given in the section of this evaluation on effects of the Proposed Action.

Overall, cumulative effects to bowhead whales from oil and gas activities could include behavioral responses to seismic surveys; aircraft and vessel traffic; exploratory drilling; construction activities, including dredging/trenching and pipelaying; and development drilling, production operations, and oil-spill-cleanup operations that take place at varying distances from the whales. It also could include effects from discharges and from oil spills (if an oil spill were to occur). In general, bowheads may try to avoid vessels or seismic surveys if closely approached, but they do not respond much to aircraft flying overhead at 1,000 ft or more. Bowheads also try to avoid close approaches by motorized vessels. The response of individual bowheads to sound, such as drillship sounds, is variable (for example, Richardson et al., 1985; Richardson and Malme, 1993). However, some bowheads are likely to change their migration speed and swimming direction to avoid getting close to them. Whales appear less concerned with stationary sources of relatively constant noise than with moving sources. Bowheads do not seem to travel more than a few kilometers in response to a single disturbance, and behavioral changes are temporary, lasting from minutes (for vessels and aircraft) up to 30-60 minutes (for seismic activity). In some other species, responsiveness is linked to both context and to the sex and/or reproductive status of the animal. For example, in studies in Australia, humpback whale females with calves show greater avoidance of operating seismic boats than do males. Detailed discussions of how these various activities may affect bowheads can be found in the final EIS's for Beaufort Sea Lease Sales 144 and 170, the final EIS for Beaufort Sea Planning area oil and Gas Lease Sales 186, 195, 202; the final EIS for the Liberty Development and Production Plan, and the Section 7 consultation for the Beaufort Sea Region (USDOI, MMS, 1996a, 1998; 2002; National Marine Fisheries Service, 2001).

We are not aware of any information that suggests potential effects from other offshore projects will be qualitatively different or differ in general degree from those summarized in the Beaufort Sea multiple-sale EIS, which we incorporate by reference. Available information indicates that these conclusions are valid.

Overall, bowhead whales exposed to noise-producing activities associated with offshore petroleum extraction activities would be most likely to experience temporary, nonlethal behavioral effects such as avoidance behavior. There is some uncertainty about whether effects could be longer term, if sufficient oil and gas activity were to occur in a localized area. For example, there is some indication that long-term displacement has occurred in some cetaceans, albeit rarely, due to noise and/or disturbance associated with increased vessel traffic effects and noise associated with other (not oil- and gas-associated) sources. For example, shipping and dredging associated with an evaporative saltworks project in Guerrero Negro Lagoon in Baja California (National Research Council, 2003b) caused gray whales to abandon the lagoon through most of the 1960's. When boat traffic declined, the lagoon was reoccupied first by single whales, and later by cow-calf pairs (Bryant, Lafferty, and Lafferty, 1984). Morton and Symonds (2002) reported that killer whale use of Broughton Archipelago in British Columbia declined significantly when high-amplitude acoustic harassment devices were installed at salmon farms in an attempt to deter seal predation. Almost no whales were observed in the archipelago between 1993 and 1999, when the acoustic harassment devices were in use. Killer whales reoccupied the archipelago within 6 months of the removal of the devices in 1999 (Morton and Symonds, 2002; National Research Council, 2003b).

There is no indication that any of the activities proposed here, or the cumulative effects of all human activities (other than historic commercial whaling), has or is likely to cause such a long-term displacement. Over the timeframe of the proposed project (about 30 years), available information does not indicate that it is likely a level of noise and/or related disturbance would be reached that would have such an effect. Additionally, existing regulatory authority under both the Marine Mammal Protection Act and the ESA is sufficient to keep such a situation from occurring and to mitigate many of the potential impacts from noise and other disturbance.

Native hunters believe that there is potential for increased noise (for example, from shipping and/or oil and gas development) to drive whales farther from shore, decreasing their availability to subsistence hunters, and potentially reducing mortality from this source. If such an effect occurred, it could produce a countervailing effect to adverse effects on the whale population. As noted in the section on subsistence hunting, cumulative noise and disturbance associated with oil and gas activities, shipping and subsistence hunting could potentially have an additive or even synergistic effect on bowhead whale habitat use. However, at present, we are aware of no other information that suggests such an effect would be likely to occur or that such effects have occurred.

Effects of a large oil spill are most likely to result in nonlethal temporary or permanent effects. The most likely effects of oil on adult bowhead whales would be essentially as described in Section IV.C.5 of the Beaufort Sea multiple-sale EIS. As summarized in the multiple-sale EIS and in National Marine Fisheries Service (2003), individuals exposed to spilled oil may inhale hydrocarbon vapors, experience some damage to skin or sensory organs, ingest spilled oil or oil-contaminated prey, feed less efficiently because of baleen fouling, and lose some prey killed by the spill. Prolonged exposure to freshly spilled oil, or possibly exposure to high concentrations of freshly spilled oil, could kill or injure whales. Because of existing information available for other mammals regarding the toxic effects of fresh crude oil, and because of inconclusive results of studies on cetaceans after the *Exxon Valdez* oil spill, we are uncertain about the potential for mortality of more than a few individuals. Such potential probably is greatest if a large aggregation of feeding or milling whales, especially an aggregation containing relatively high numbers of calves, was contacted by a very large slick of fresh oil. Such aggregations occasionally have been observed in open-water conditions off Dease Inlet. Even in such a case, available evidence indicates most effects would be nonlethal. However, we reiterate that due to the limitations of available information and due to the limitations inherent in study baleen whales, there is uncertainty about the range of potential effects of a very large spill on bowhead whales, especially if a large aggregation of females with calves were to be contacted by a large or very large spill of fresh oil. The NOAA Fisheries also has concluded that, given the abundance of plankton resources in the Beaufort Sea (Bratton et al., 1993), it is unlikely that the availability of food resources for bowheads would be affected.

Available information suggests that the potential for oil-industry activities outside of the Beaufort Sea to contribute to cumulative effects on this stock of bowhead whales is still limited. In the multiple-sale EIS, we concluded that the potential for oil-industry activities outside of the Alaskan Beaufort Sea appears to be limited. This remains the case. Two Federal lease sales were conducted in the Chukchi Sea and exploration activities were conducted, but no development occurred. A Chukchi Sea/Hope Basin lease sale scheduled in the 1997-2002 5-Year Program was deferred. Although there are no plans for future oil and gas exploration activities in the Bering Sea south of St. Lawrence Island, a "special interest" offering in Norton Sound in the northern Bering Sea was completed on April 22, 2002. No nominations were received during that offering. Calls for information and nominations for both the Chukchi Sea/Hope Basin and for Norton Basin "special interest" offerings were held in March 2003. However, no nominations were received for either area. Thus, MMS did not proceed with lease sales in these areas—the sales were deferred for 1 year, and the calls will be reissued in 2004. This process will proceed throughout the 5-Year Program until there is sufficient interest to proceed with a sale. The 5-Year Program (2002-2007) allows for two lease sales in the Chukchi/Hope Basin and one sale in the Norton Basin. It is somewhat speculative whether industry interest in the area is sufficient that sales will be held in the future.

In the multiple-sale EIS, we concluded that in the Canadian Beaufort Sea, the main area of industry interest has been around the Mackenzie River Delta and offshore of the Tuktoyaktuk Peninsula. This remains the case. Oil was discovered in these areas, although industry showed little interest in the area during the 1990's. Interest in the area increased recently, and an open-water seismic-exploration program was conducted off the Mackenzie River Delta during late summer and autumn of 2001. This was the first major offshore seismic program in that area since the early 1990's. We are not aware of plans for any additional seismic surveys. The single steel drilling caisson, used to drill at the McCovey Prospect, was moved to the Canadian Beaufort in 2003. It remains the case that some drilling operations may be conducted over the next few years. Bowhead whales migrate to and feed offshore of the Mackenzie Delta region of the Canadian Beaufort Sea. Offshore development and production in this area likely would have greater potential to have adverse impacts on the whales than development elsewhere in the Beaufort Sea.

VI.C.3. Commercial Fishing and Marine Vessel Traffic

We report available data on previous incidental take and marine vessel traffic effects on bowhead whales in the section on "environmental baseline." In the multiple-sale EIS, we concluded that a small number of whales may be injured or killed as a result of entrapment in fishing nets or collisions with ships. Based on available data, incidental take of bowhead whales apparently has occurred only rarely. At present, the bowhead whales' association with sea ice limits the amount of fisheries activity occurring in bowhead habitat. However, as noted in the section on climate change, the frequency of such interactions in the future would be expected to increase if commercial-fishing activities expand northward, with resultant increases in temporal and, especially, spatial overlap between commercial fishing operations and bowhead habitat use. We note there is uncertainty about whether such expansion will occur. Increases in spatial overlap alone could result in increased interactions between bowheads and derelict fishing gear. Between 1989 and 1994, logbook data on incidental take of bowheads are available, but after that time, the requirement is for fishers to self report. Angliss and Lodge (2002:173) reported that "the records are considered incomplete and estimates of mortality based on them represent minimums". There are no observer program records of bowhead whale mortality incidental to commercial fisheries in Alaska (Angliss and Lodge, 2002). New information on entanglements of bowhead whales indicates that bowheads do have interactions with crab-pot gear. There have been two confirmed occurrences of entanglement in crab-pot gear, one in 1993 and one in 1999 (Angliss and Lodge, 2002). Table 29 in Angliss and Lodge (2002, page 173) details reports of scarring of bowhead whales attributed to entanglement in ropes. Citing a personal communication from Craig George of the North Slope Borough , Department of wildlife Management, Angliss and Lodge (2002) report a preliminary result from reexamination of bowhead harvest records suggests there may be more than 20 cases indicating entanglements or scarring attributable to ropes in the bowhead harvest records. Angliss and Lodge (2002) reported that the average rate of bowhead entanglement in crab pot gear for 1996-2000 is 0.2. As reported in Appendix 2 of Angliss and Lodge (2002:179), the estimated annual mortality rate incidental to commercial fisheries also is 0.2.

Potential effects on bowhead whales from commercial-fishing activities include incidental take in the fisheries and/or entanglement in derelict fishing gear resulting in death, injury, or effect on the behavior of individual whales; disturbance resulting in temporary avoidance of areas; and whales being struck and injured or killed by vessels.

Marine vessel traffic, in general, can pose a threat to bowheads because of the risk of ship strikes. Additionally, noise associated with ships or other boats could cause bowheads to change their behavior. Pollution from marine vessel traffic, especially from large vessels such as large cruise ships, also could cause degradation of the marine environment and increase the risk of the whales' exposure to contaminants.

As noted in the environmental baseline section, we previously concluded that available evidence indicates that bowheads either do not often encounter vessels or they avoid interactions with vessels, or that interactions usually result in the animals' death. We believe this general conclusion about ship strikes is likely to be valid. However, we agree with the conclusion by the NMFS (2003b) that the rate may have increased slightly in recent years.

The NMFS (2003b) concluded that the greatest potential impact to bowhead whales from research in the Arctic was from underwater noise generated by icebreakers. They cite the Western Arctic Shelf Basin Interactions (SBI) project, which plans to operate from the U.S. Coast Guard *Healy* and *Polar Star* icebreakers. This is a multiyear, interdisciplinary program aimed at investigating the impacts of climate change on biological, physical, and geochemical processes in the Chukchi and Beaufort Shelf Basin in the Western Arctic Ocean. The SBI's cruise track in 2002 departed from Nome in early May , traveled through the Bering Strait and into the Chukchi Sea north to approximately 75° N. longitude, west and then gradually south to a nearshore region on June 5 and about 150° W. latitude. The ship then generally followed the coast to Pt. Lisburne. From that point, it returned directly to Nome on June 15. In 2002, the *Healy* also traveled into the Bering Sea to research the land bridge that once linked Russia and Alaska. According to a U.S. Coast Guard Pacific Area webpage on the project (http://www.uscg.mil/pacarea/healy/deploymets/aws02/science/aws02science.htm), this mission will use towed sonar arrays, bottom coring, and CTD profiling.

Richardson et al. (1995a:Table 6.5) reported estimated source levels for similarly sized icebreakers to range from 177-191 db re 1 μPa-m. During icebreaking, extremely variable increases in broad-band (10-10,000 Hz) noise levels of 5-10 dB are caused by propeller cavitation. Based on previous studies of bowhead response to noise, such sound could result in temporary avoidance of animals from the areas where the icebreakers were operating and potentially cause temporary deflection of the migration corridor, depending of the location of the icebreakers.

As noted in the Baseline, in recent years there also have been scientific field operations in the Arctic Ocean that have used U.S. Navy submarines as platforms. We refer the reader to that section for information about those cruises. U.S. Navy submarines are likely to continue to be used as platforms in the future

Richardson et al. (1995a:301) concluded that: "Ships and larger boats routinely use fathometers, and powerful side-looking sonars are common on many military, fishing, and bottom-survey vessels.... Sounds from these sources must often be audible to marine mammals and apparently cause disturbances in some situations."

Active sonars were used in commercial whaling after World War II, and whaling boats sometimes tracked whales underwater using active sonar. Ash (1962, cited in Richardson et al., 1995a) reported that this often caused strong avoidance by baleen whales. Reeves, (1992) reported that ultrasonic pulses were used to scare baleen whales to the surface. Maybaum, 1990, 1993) reported that humpback whales on the wintering grounds moved away from 3.3 kHz sonar pulses and increased their swimming speed and swim-track linearity in response to 3.1- to 3.6-kHz sonar sweeps. Richardson et al. (1995a) also concluded that Smith, 1985 reported that the energy emitted by high-power sonars was sufficient energy to cause concerns about possible nonauditory physical effects and hearing damage in human divers.

The National Research Council summarized that:

> Recent reports and retrospectively analyzed data show an association between the use of multiple high-energy mid-range sonars and mass strandings of beaked whales (*Ziphius cavirostris*). Recent mass strandings...have occurred in a temporal and spatial association with ongoing military exercises employing multiple high-energy, mid-frequency (1-10) kHz) sonars. (National Research Council, 2003b:89)

Submarines are highly valued platforms for a variety of oceanic research in part because they are relatively quiet, enabling the use of active and passive acoustic technologies for a variety of studies. Information about the response of bowheads to resting or transiting submarines is not available to MMS.

In conclusion, some of the research ships that have previously made trips into the range of the bowhead are likely to do so again in the future and there may be additional research cruises that could impact the whales. We refer the reader to the baseline section for more discussion on past research activities involving ships. All large research ships that are active in the range of the bowheads during periods when they are present have the potential to cause noise and disturbance to the whales, potentially altering their movement patterns or other behavior. However, available evidence does not indicate such disturbance will have a significant effect on this population over the approximate life of the project, even when added to the effects of other effectors.

VI.C.4. Climate Change (also referred to as Global Warming and Climate Warming)

In the multiple-sale EIS, we concluded that:

> Climatic change in terms of global warming should not be measurable, as any trends in global warming are on a greater scale than 10-15 years and would not be measurable in this shorter timeframe. If ice roads were to experience a shorter season of supportive cold temperature, the operations would be suspended accordingly or supported by helicopter similar to the roadless development sites.

However, climate change is increasingly a subject of concern for residents of the Arctic. Investigation of climate change and potential biological and physical effects is rapidly increasing. Thus, in this section, we expand the timeframe of our climate change analyses to the life of the project (about 30 years) and consider recently available information regarding potential impacts of climate change that could impact bowhead whales.

The IUCN /Species Survival Commission (IUCN/SSC) (IUCN, 2003) concluded that a workshop by the IWC in 1996

> "placed the issue of climate change, including ozone depletion, firmly on the cetacean conservation agenda.... Effects of climate change are complex and interactive, making them analytically almost intractable. This workshop report acknowledges the difficulties in establishing direct links between climate change and the health of individual cetaceans, or indirect links between climate change and the availability of cetacean prey...."

We do not attempt to make direct links or to make predictions about whether continued warming will occur, and if it does, what the rate and pattern of change will be. In the following, we provide a short summary from a few highly credible summaries of available information on climate warming and on predictions related to potential climate-warming-related changes that could result in effects on this population of bowhead whales. These sources are the International Panel on Climate Change (IPCC, (2001a,b, the SEARCH SSC (2001), Tynan and DeMaster (1997) and the International Whaling Commission (1997).

In 2001, the IPCC published detailed, synthetic and summary reports on the topic of climate change. The IPCC (2001b:2) uses the term climate change to refer to "any change in climate over time, whether due to natural variability or as a result of human activity. This usage differs from that in the Framework Convention on Climate Change...."

In this document, our usage of the term is the same as that defined by the IPCC.

We excerpt some findings from two key documents produced by segments of this committee that may be especially relevant to understanding cumulative impacts on bowhead whales:

The IPCC produced a summary, entitled *Climate Change 2001: Synthesis Report Summary for Policymakers*, "approved in detail at IPCC Plenary XVIII," which "represents the formally agreed statement of the IPCC concerning key findings and uncertainties contained in the Working Group contributions to the third Assessment Report" (IPCC, 2001a). This international group has published (IPCC, 2001b) conclusions with regards to climate change, and we refer readers to this document for detail beyond that which we can cite here. In Table SPM-1 (IPCC, 2001b:5) they list 20th century changes in the atmosphere, climate, and biophysical system of Earth. In this summary and in at least some of the individual working group summaries, the IPCC (2001a,b) used the following terms, where they felt appropriate, to indicate judgmental estimates of confidence: "virtually certain (greater than a 99% chance that a result is true); very likely (90-99% chance); likely (66-90% chance); medium likelihood (33-66% chance); unlikely (10-33% chance); very unlikely (1-10% chance); and exceptionally unlikely (less that 1% chance). Individual IPCC working groups also published synthetic documents, some of which are cited here and in the EA for proposed sale 195.

The first issue to address is whether observed changes in climate should be discussed as a potential human impact that can affect bowhead whales, their habitat, and other components of the ecological and human systems that also can be impacted by the Proposed Action. In other words, does available evidence support the contentions that : (1) global climate is warming and (2) that human activities have had, and can be expected to continue to have (over the timeframe of the proposed project, about 30 years), an important role in this warming.

The IPCC (2001a) concluded that:

- "Human activities have increased the atmospheric concentrations of greenhouse gases and aerosols since the preindustrial era" (IPCC, 2001a:4).
- "An increasing body of observations gives a collective picture of a warming world and other changes in the climate system" (IPCC, 2001a:4).
- On a global basis, "it is very likely" that 1998 was the warmest year and the 1990's was the warmest decade in instrumented history (1861-2000) (IPCC, 2001a:4,b).
- "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities...The best agreement between model simulations and observations over the last 140 years has been found when all...anthropogenic and natural forcing factors are combined" (IPCC, 2001a:5). (see Figure SPM-2 of IPCC, 2001a).
- The IPCC (2001a:30-31) considers the statement that most of the observed warming over the past 50 years is likely due to increases in greenhouse gas concentrations due to human activities as a "robust finding." They define such findings as those that hold "...under a variety of approaches, methods, models, and assumptions and one that is expected to be relatively unaffected by uncertainties." However, they highlight that there is uncertainty that constrains relating regional trends to anthropogenic change.
- "Changes in sea level, snow cover, ice extent, and precipitation are consistent with a warming climate near the Earth's surface. Examples...include...increases in sea level and ocean-heat content, and decreases in snow cover and sea-ice extent and thickness" (IPCC, 2001a:6). The statement that "rise in sea level during the 21st century that will continue for further centuries" is also considered a "robust finding" (IPCC. 2001a:31). However, they highlight the uncertainty understanding the probability distribution associated with both temperature and sea-level projections.
- Projections using the SRES emissions scenarios in a range of climate models result in an increase in globally averaged surface temperature of 1.4 to 5.8° C over the period 1990 to 2100. This is about two to ten times larger than the central value of observed warming over the 20th century and the projected rate of warming is very likely to be without precedent during at least the last 10,000 years, based on paleoclimate data. For the periods 1990 to 2025 and 1990 to 2050, the projected increases are 0.4 to 1.1° C and 0.8 to 2.6° C, respectively (IPCC, 2001a:8).

The IPCC (2001a) also highlights uncertainty and inconsistencies in local and regional model projections and the ability to predict quantitative changes at these scales due to the capabilities of regional scale models (especially regarding precipitation).

In Table SPM-3, the IPCC (2001a:31-32) listed what they termed robust findings (a finding that holds under a variety of approaches, methods, models, and assumptions and one that is expected to be relatively unaffected by uncertainties) and key uncertainties (those that, if reduced, may lead to new and robust findings. They point out that many of the robust findings have to do with the existence of a climate response to human activity and the direction of the response. Many of the uncertainties are related to quantification of either the timing and/or magnitude of the response.

The report of the Working Group I of the IPCC (IPCC, 2001b) further concluded that:

- Since 1861, the global average surface temperature (which is the average of near surface air temperature and sea surface temperature) has increased. Over the 20th century, the increase has been 0.6+0.2° C.
- "It is likely that there has been about a 40% decline in Arctic sea-ice thickness during late summer to early autumn in recent decades and a considerably slower decline in winter sea-ice thickness" (IPCC (2001b:4).
- Average global sea level rose between 0.1-0.2 meters during the 20th century.
- In the 20th century, it is very likely that there was a 0.5-1% increase in precipitation per decade over most mid- and high latitudes of the Northern Hemisphere continents.
- It is likely that there has been an increase in cloud cover and an increase in the frequency of heavy precipitation events in the mid to high latitudes.
- Since the mid 1970's, warm episodes of the El Niño-Southern Oscillation (ENSO) phenomenon) have been more intense, persistent and frequent compared to the previous 1000 years.

At the request of the White House, the National Research Council (National Research Council, 2001:vii) identified "areas in the science of climate change where there are the greatest certainties and uncertainties". In answer to the question of whether climate change is occurring and, if so, how, the National Research Council (2001:3) wrote that:

> Weather station records and ship-based observations indicate that global mean surface air temperature warmed between about 0/4 and 0.8 C...during the 20th century...the warming trend is spatially widespread and is consistent with an array of other evidence...in this report. The ocean....has warmed by about 0.05 C...averaged over the layer extending from the surface down to 10,000 feet, since the 1950s.

They concluded that

> The IPCC's conclusion that most of the observed warming of the last 50 years is likely to have been due to the increase in greenhouse gas concentrations accurately reflects the current thinking of the scientific community on this issue. The stated degree of confidence in the IPCC assessment is higher today than it was 10, or even 5 years ago, but uncertainty remains....

The National Research Council (2001:3) concluded that: "The predicted warming is larger over higher latitudes than over low latitudes, especially during winter and spring, and larger over land than over sea."

Atmospheric temperature increases due to global warming may be more pronounced in the Arctic region than in geographic areas closer to the equator (Peters and Darling, 1985; Peters, 1991). Heavy precipitation events are projected to become more common in the Arctic with flooding events likely to increase in frequency, and sea-levels are expected to rise (Walsh, 2003; Gough, 1998).

The Study of Environmental Arctic Change (SEARCH) is a broad, multiscale, interdisciplinary program aimed at understanding the environment of the Arctic in the future. The SEARCH Science Steering Committee (SSC) (2001:30-31) concluded that

> The recent arctic ...changes, specifically changes in the area and thickness of sea ice, can also profoundly impact arctic marine transportation.... Greater access and longer navigation seasons may be possible in Hudson Bay, the Chukchi and Beaufort seas, and along the Russian Arctic coast in present sea ice trends continue...it is conceivable that surface ships in the future will not have to confine their operations to the arctic marginal seas.... If changes result in opening significant new navigation routes, the size of the shipping industry could be changed several fold. International ship traffic may become substantial if the Northern Sea Route and Northwest Passage are open for longer periods of time. The greatest economic impact of changes in ice conditions may not be in shipping per sea, but in making new areas economically feasible to develop....

We emphasize that there is uncertainty associated with many of the predictions about potential climate changes, especially at a regional level, and associated environmental changes that could occur. However, if this change occurs, it is likely that shipping will increase throughout the range of the bowhead, especially in the southern portions of the Beaufort Sea. If commercial fisheries were to expand into the Beaufort Sea, as discussed as a possible outcome of climate warming, bowhead whale death and or injury due to interactions with fishing gear, possibly injury and or death due to incidental take in commercial fisheries, and temporary effects on behavior potentially could occur. There are, however, no data that would permit us to quantitatively predict such types of effects.

With respect to observations and conclusions specifically pertinent to bowhead whales, the SEARCH SSC (2001:2) noted that:

> Available data point to long-term and recently augmented reductions in sea-ice cover (Maslanik et al., 1996; Bjorgo et al., 1997; Cavalieri et al., 1997; Zakharov, 1997; Rothrock et al., 1999).... Perhaps most alarming, there have...been significant reductions in sea ice extent (Parkinson et al., 1999) and a 43% reduction in average sea ice thickness (Rothrock et al., 1999) in recent decades.

The SEARCH SSC (2001) also noted that the results of several recent expeditions indicate that the presence of Atlantic-derived water in the Arctic has increased. Tynan and DeMaster (1997) pointed out that recent decreases in ice coverage have been more extensive in the Siberian Arctic than in the Beaufort Sea. While Tynan and DeMaster (1997:308) hypothesized that decreases in sea ice extent and warming could have profound effects on some marine mammals and their prey, they summarized that: "Present climate models, however, are insufficient to predict regional ice dynamics, winds and mesoscale features, and mechanisms of nutrient resupply, which must be known to predict productivity and trophic response." However, it is important to note that since their 1997 paper, there has been considerable research on climate changes in the Arctic and while the ability to predict change still has considerable uncertainty, the aforementioned "robust findings" have emerged.

Tynan and DeMaster (1997) note an earlier IPCC report that concluded that an increase in human activity is likely to accompany the opening of the Northwest Passage and the Russian Northern Sea Route. They identify a potential for increased environmental pollution, an increased incidence of epizootics, exploration, increased ship traffic, increased fisheries and increased industrial activities, and the synergistic effects of these factors with ecosystem changes due to climate change as potential concerns for marine mammals populations. Increased freshwater discharge from the Mackenzie River could promote regional ice formation and result in increased riverborne pollutants (Tynan and DeMaster, 1997) into important summering habitat for the bowheads.

The primary potential effects to bowhead whales related to climate change/climate warming that we have identified include:

- increased noise and disturbance related to increased shipping, and possibly related to increased development, within their range;
- increased interactions with commercial fisheries, including increased noise and disturbance, incidental take, and gear entanglement;
- decreases in ice cover with the potential for resultant changes in prey species concentrations and distribution; related changes in bowhead whale distributions; changes in subsistence-hunting practices that could result in smaller, younger whales being taken and, possibly, in fewer whales being taken; and
- more frequent climatic anomalies, such as El Niños and La Niñas, with potential resultant changes in prey concentrations.
- a northern expansion of other whales species, with the possibility of increased overlap in the northern Bering and/or the Chukchi Seas

Perhaps the greatest potential adverse effect associated with global warming could occur if predictions that the Northwest Passage may become ice free for significant lengths of time prove accurate, opening sea routes across the Beaufort Sea and increasing shipping in all parts of the range of the Western Arctic stock of the bowhead whale. SEARCH SSC (2001:30) concludes that

> ...greater access and longer navigation seasons may be possible in Hudson Bay, the Chukchi and Beaufort seas, and along the Russian Arctic coast if present sea ice trends continue. The

> significant reduction in the thickness of arctic sea ice...and...winter multiyear ice...suggest the possibility of shipping in the central Arctic Ocean sometime during the 21st century. It is significant to note that at the end of the 20th century nuclear and non-nuclear icebreakers (from Canada, Germany, Russia, Sweden, and the U.S.) have made summer transits to the North Pole and operated throughout the central Arctic Ocean.... Thus it is conceivable that surface ships in the future will not have to confine their operations solely to the arctic marginal seas.

Vincent, Gibson, and Jeffries (2001) reported a decrease in pack ice thickness by 27% from 1867-1999 in the Canadian high Arctic with the collapse of the Ellesmere Ice Shelf (90% reduction). The prediction that ice cover and ice thickness will continue to decrease in the Arctic is uncertain. Analysis of ice thickness from six submarine cruises from 1991-1997 showed no trend towards a thinning ice cover (Winsor, 2001).

There has been recent environmental change along the Northern Sea Route (across the north of Eurasia) that could alter shipping between northern Europe and Asia. Global interest in this route resulted in a comprehensive study, called the International Northern Sea Route Programme (INSROP) that confirmed that the European Union and Russia are collaborating on programs to better link their areas using Arctic shipping, and that technological and environmental challenges are no longer absolute obstacles to commercial shipping. SEARCH SSC (2001:30) states that: "Continued sea ice reductions will no doubt influence the initiation of transportation studies similar too INSROP for the Northwest Passage, the coasts of Greenland, the Alaskan Arctic coast and other regional seas."

Increased shipping could have substantial effects on development in the Arctic, making new areas economically feasible to develop (SEARCH SSC, 2001). SEARCH SSC (2001:31 states that:

> A substantial change in the open water season for the Beaufort Sea – from 60 to 150 days (Maxwell, 1997) – can potentially reduce the costs associated with offshore oil and gas exploration and production.... Shipping access to the large oil and gas reserves in the Barents and Kara seas will be substantially improved if regional warming of the Russian Arctic continues...."

Thus, potential effects include increased development in the Beaufort and Chukchi seas. However, it is important to note that all of the aforementioned potential changes in shipping are dependent on continued warming and reductions in sea ice.

The Office of Naval Research (2001) reported that climate warming in the Arctic is likely to result in the northward migration of subarctic species of marine mammals and an increase in commercial-fishing activities into the Chukchi and Beaufort seas, where operations have been minimal in the past.

Significant reductions in the thickness of arctic sea ice (Rothrock, Yu, and Maykut, 1999) and winter multiyear ice (Johannessen et al., 1999) have been reported. In 1998, record sea-ice retreat was observed for the Beaufort and Chukchi seas (Maslanik, 1999).

If substantial increases in shipping were to occur that placed more ships in waters inhabited by bowheads, increases in adverse effect to bowheads also might occur due to shipping-related noise and disturbance, vessel strikes, and pollution. Quantification of such potential changes are not possible at this time due to the level of uncertainty about changes that might occur over the course of the proposed project and the shipping industry's response to greater cross-Beaufort transiting opportunities, when they to occur.

We conclude that the potential effects of global warming on this population of bowhead whales are somewhat uncertain. We have identified some potential changes that, in turn, potentially could have adverse impacts on bowhead whales, were they to occur. However, we are aware of no information that indicates such change over the course of the next 30 years could have a significant adverse impact on bowheads. There is no evidence suggesting that many of the changes that could occur, such as changes in timing of migrations and shifts in distribution, would be associated with adverse effects on these whales. In Shelden et al.'s (2003) response to Taylor's statements regarding the expectation of future downward trends in abundance based on what he termed "available evidence" regarding global warming, they point out that Taylor did not provide citations supporting this claim. Shelden et al. (2003:918-919) state that:

> Although available data do indicate that the Bering Sea environment is changing (e.g., Angel & Smith 2002), we are aware of no evidence that environmental changes will be detrimental to the population in the foreseeable future. In fact, our review...on this issue suggests that climate change may actually result in more favorable conditions for BCB bowheads.

Relatedly, Taylor argued that there will be downward trends in basic life-history parameters as a function of global warming. Shelden et al. (2003) responded that Taylor did not list which life-history parameters he was referring to and did not provide the factor that he believed would result in the change of each parameter. They pointed out that members of the International Whaling Commission's Scientific Committee had "tested extensively" the robustness of BCB bowheads, including changes in key population parameters.

Angliss and Lodge (2002:174) stated that

> Ice-associated animals, such as the bowhead whale, may be sensitive to changes in Arctic weather, sea-surface temperatures, or ice extent, and the concomitant change on prey availability. There are insufficient data to make reliable predictions of the effects of Arctic climate change on bowhead whales.

Based on our review of the available information, we agree with this general conclusion.

VI.C.5 Research Activities

The Western Arctic bowhead has been, and is likely to continued to be, the focus of research activities that could, in some instances, cause minor temporary disturbance of the whales. During research on the whales themselves, the reactions of the whales generally are closely monitored to reduce any potential adverse effects. Additionally, there is other arctic research (conducted primarily for reasons other than the study of the bowhead) that could impact the whales through the introduction of additional noise, disturbance, and low levels of pollution in their environment.

Information about previous research is summarized in the baseline section. Some of the research projects are the same projects and are continuing into the future. Studies have included aerial and land-based surveys, ship-based observations, acoustic studies, shore-based censuses, studies involving samples and examination of carcasses of animals killed in the subsistence hunt, and satellite tracking. The NMFS recently initiated photo-identification studies. The primary result of ship-based activities could be temporary harassment and/or disturbance of individual whales from a highly localized area. Whales also could be temporarily harassed or disturbed by low-flying airplanes during photo-identification work. These effects would be as described for low-flying aircraft in our effects section. All such effects are expected to be of short duration. The aerial surveys generally are flown at a height such that they do not cause harassment.

The NMFS (2003b) concluded that the greatest potential impact to bowhead whales from research in the Arctic was from underwater noise generated by icebreakers. We discuss icebreakers more fully in the section on environmental baseline.

We conclude that research-related noise and disturbance could cause harassment and, possibly, temporary displacement of individual whales. It would add to cumulative levels of noise in the whales' environment. At present, available information does not indicate that such noise is having behavioral or physiological adverse effects on the bowheads in this stock. We are not aware of any information that suggests long-term displacement from important habitats or that would indicate the population is suffering any significant population-level effect from any single effector, or that the cumulative effects, including from this source, would have such an effect.

The MMS is continuing to evaluate information about cumulative effects from research activities as it becomes available.

VI.C.6 Pollution and Contaminants

As noted above in Section V.E., available data indicate that the current levels of metals and other contaminants measured in bowhead whales appear to be relatively low, with the exception of cadmium. However, there is still concern about the potential for there to be cumulative effects of contaminants on bowhead whale. We refer NOAA Fisheries to Section V.C.5.f(3)(a) of the Final EIS for the Cook Inlet Planning Area Oil and Gas Lease Sales 191 and 199 for our review of recent general literature on contaminants in cetaceans and other marine mammals, and in Arctic and nearby oceanic waters.

VI.D. Summary and Conclusions for Beaufort Sea, North Slope, and Transportation Cumulative Effects on the Bowhead Whale

Bowhead whales might experience cumulative effects from human activities in their habitat including subsistence hunting, vessel traffic (commercial, tourism and research-related), oil and gas related activities (spills, noise from drilling, vessel and aircraft traffic, construction, seismic surveys, or oil-spill-cleanup activities), increased fishery interactions, and possibly changes in prey distributions and abundance due to climate change. Potential cumulative effectors associated with potential future climate change are difficult to assess because of uncertainty about rates and patterns of change that may occur.

There is no clear indication that disturbance from oil and gas exploration and development activities since the mid-1970's has had an additive or synergistic effect on the bowhead. We do not expect bowhead whales to die from noise produced while exploring, developing, and producing offshore oil and gas, but some whales could experience temporary, nonlethal effects. Bowhead whales temporarily may move to avoid noise-producing activities. Contact with spilled oil in the Beaufort Sea or elsewhere in their range could cause some temporary or permanent, nonlethal effects to some bowhead whales, and could kill some whales. The bowhead whale population has been steadily increasing at the same time that oil and gas-related activities have been occurring in parts of the Beaufort Sea and throughout other parts of the bowhead whale's range. Bowhead whales should not be affected by oil spills or activities associated with the transport of oil through the Trans-Alaska Pipeline System or by marine transportation along the tanker routes to market.

Activities that are not related to oil and gas also could also contribute to cumulative effects on bowhead whales. Native whalers from Alaska harvest bowheads for subsistence and cultural purposes under a quota authorized by the IWC. Native whalers from Russia also are authorized to harvest bowhead whales under a quota authorized by the IWC. The size of this harvest is tied to the health and size of the population and is not likely to cause significant adverse effects to the population. Climate warming could result in increased shipping, increased development and disturbance throughout the bowhead's range, increased fisheries interactions, and increased pollution. However, there is uncertainty, particularly over the short term (e.g., within the potential life of the project) and at the regional level, about what changes in climate might occur and what human-related changes might follow such change. A small number of whales may be injured or killed as a result of entrapment in fishing nets or collisions with ships. At present, available evidence does not indicate that pollution is contributing to adverse cumulative effects on this population.

The best available information regarding potential effects of past, current, and reasonably foreseeable anthropogenic actions on the Western Arctic stock of bowhead whales supports the conclusion that it is unlikely that there would be significant cumulative impacts on these whales over the lifetime of the proposed project. The effects on bowhead whales of various cumulative factors likely would be substantially greater than for any single activity or activities associated with any individual oil and gas lease sale. The incremental contribution of Sale 195 to the cumulative effects likely would be small. While there is uncertainty about the exact level and nature of potential effects that presently may be associated with or that could result from particular activities or effectors, available data indicate that this population is robust and is increasing at a healthy rate. It is highly unlikely to become extinct over the next 100 years (Shelden et al., 2001). This population also is highly regulated and relatively well monitored. Whatever adverse effects it currently is suffering or historically has suffered from human activities, there is no indication such effectors currently have important adverse effects on this population. There are multiple regulatory tools available to adequately protect this population from many of the potential adverse human-related effects.

Most effects are not expected to be additive or synergistic, as many of the potential effects would be expected to occur in different areas and, by chance, affect different individuals. However, we acknowledge some uncertainty about this conclusion. If certain activities were clustered in their space (for example, shipping and offshore petroleum development both increase in the area of the Beaufort Sea offshore of the MacKenzie River where bowheads commonly aggregated to feed in the summer), there could be additive or synergistic effects on this population. This would be particularly true if there is a threshold level of noise/disturbance that causes bowheads, or some key component of the bowhead population, to avoid an area that otherwise would hold benefit to them.

We conclude that cumulative effects on this population are still of primary concern and, thus, warrant continued close attention and effective mitigation practices.

VII. Effectiveness of Proposed Mitigating Measures

Several mitigating measures will be considered for the Beaufort Sea sales that may offer some protection to bowhead whales. These include stipulations (see below) and Information to Lessees (ITL) clauses on Endangered Whales and MMS Monitoring Program.

The stipulations for Sale 195 would be the same as for Sale 186. These include two stipulations, a standard stipulation, Industry Site-Specific Bowhead Whale-Monitoring Program and a new proposed stipulation, Pre-booming Requirements for Fuel Transfers.

The stipulation on Industry Site-Specific Bowhead Whale-Monitoring Program should be effective in detecting a delay or blockage of the migration, thereby alerting regulatory agencies about an effect. It may also prevent such an effect. This stipulation mandates that lessees will conduct a site-specific monitoring program during exploratory-drilling activities, including seismic activities, to determine when bowhead whales are present in the vicinity of leases and the extent of behavioral effects of these activities on bowhead whales. The stipulation requires a peer review of monitoring plans and the draft report from the monitoring program. If the information obtained from this or other monitoring programs indicates that there is a threat of serious, irreparable, or immediate harm to the species, the lessee will be required to suspend operations causing such threat, which should help to minimize the likelihood of disrupting whale feeding, migration, or socialization. Some endangered whales may interact with the activities associated with exploratory drilling and some inadvertent conflicts or incidental "taking" situations could occur. This stipulation, in conjunction with the ITL clause on Information on Endangered Whales and MMS Monitoring Program, addresses Conservation Recommendations No. 3 and No. 4 in the May 25, 2001, National Marine Fisheries Service Biological Opinion for the Alaskan Beaufort Sea. This will help protect endangered bowhead whales during their migration from significant adverse effects due to exploratory activities, such as a blockage or delay of the migration.

Stipulation No.1 on Protection of Biological Resources states that if biological populations or habitats are identified that require additional protection, the RS/FO can require biological surveys and, based on such surveys or other information available to the RS/FO could require the lessees to modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected. This stipulation should be effective in ensuring that if new information becomes available that indicates specific components of bowhead populations require additional protection, such protections can be implemented.

The optional stipulation on Pre-Booming Requirements for Fuel Transfers should ensure rapid spill responses, decreasing the likelihood that large fuel spills would affect bowhead whales during their migration. It is designed to reduce the possibility that any fuel spilled would escape into the marine environment for 3 weeks prior to or during the bowhead whale migration. This stipulation also could preclude disturbance activities involved with cleanup operations of a fuel spill prior to the migration.

Several ITL clauses may confer protection to bowhead whales. The ITL on Endangered Whales and the MMS Monitoring Program will gather information on whale distribution and abundance and will provide assistance to determine the extent, if any, of any adverse effects to the species. Such monitoring and identification of any adverse effects can help ensure that such adverse effects are mitigated quickly and that steps are taken in the future to, if possible, avoid such effects. Other ITL clauses may offer protection of the bowhead whale: Bird and Marine Mammal Protection, which advises lessees of requirements under the Endangered Species Act and Marine Mammal Protection Act and provides guidelines regarding disturbance of marine mammals, and Sensitive Areas to be Considered in Oil-Spill-Contingency Plans, which identifies areas needing protection in the event of an oil spill.

While benefits are gained from these mitigating measures, the overall effects on bowhead whales with these mitigating measures in place is likely to be the same as if the measures were not in place. Overall, the mitigating measures may provide additional protection to whales but would not eliminate all potential effects. The Industry Site-Specific Bowhead Whale-Monitoring Program should be effective in detecting any impact on the migration and, thus, in minimizing any delay or blockage of the migration, but not in preventing incidental take by harassment. Fewer whales may be affected by activities due to these measures or affected to a lesser extent. However, even with the mitigating measures in place, whales still are expected to experience mostly temporary nonlethal effects as a result of exposure to oil and gas activities, with potential for some mortality if whales are exposed to freshly spilled oil over a prolonged period.

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APPENDIX A ESA Section 7 Consultation Documents

United States Department of the Interior
MINERALS MANAGEMENT SERVICE
Washington, DC 20240

DEC 10 2003

Ms. Laurie Allen
Director
Office of Protected Resources
NOAA Fisheries
1315 East-West Highway
Silver Spring, Maryland 20910

Dear Ms. Allen:

The Minerals Management Service (MMS) is beginning the latest phase in environmental assessment related to proposed Beaufort Sea Oil and Gas Lease Sale 195 (scheduled for 2005). Our environmental assessment for this proposed sale is presented in the Final Environmental Impact Statement (FEIS) 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). This EIS contains information on the anticipated activities and potential effects of proposed Lease Sale 195.

The Beaufort Sea Oil and Gas Lease Sale 186 took place on September 24, 2003. While MMS received bids on 33 tracts, no offshore activity associated with the sale of any of the leases has occurred. Because available information indicates that conditions have not changed significantly and there is no significant new information indicating that potential impacts would differ from those already identified and discussed in the FEIS, MMS plans to prepare an Environmental Assessment (EA) related to Sale 195. Based on information available to us at this time, this EA likely will conclude with a Finding of No Significant Impact.

On May 9, 2002, under Section 7(a)(2) of the Endangered Species Act (ESA), MMS requested the National Oceanic and Atmospheric Administration (NOAA) Fisheries uphold their May 25, 2001, non-jeopardy Biological Opinion concerning Federal oil and gas leasing and exploration in the Alaskan Beaufort Sea Outer Continental Shelf Planning Area for proposed Oil and Gas Lease Sales 186, 195, and 202. By reply letter dated July 23, 2002, NOAA Fisheries stated:

> "We find the May 2001 opinion addresses these sales, in terms of the listed species and habitats present, the legal status of these species under the ESA having been unchanged, the anticipated actions associated with these sales being consistent with those actions considered in the opinion, and the sale area being consistent with that previously assessed."

In this same letter, NOAA Fisheries indicated that their opinion will be reconsidered prior to the subsequent sales, stating the following:

> "We have not applied this conclusion to Sales 195 and 202 at this time, however, as the logic which MMS has used in determining the need for supplemental analyses under NEPA for these sales would also extend to ESA consultation."

The MMS has determined for Lease Sale 195 that there is no significant new information revealing effects in a manner or to an extent not previously considered in the May 2001 Biological Opinion. The proposed activities associated with Lease Sale 195 have not been modified and the status of the bowhead whale remains unchanged.

The MMS requests that NOAA Fisheries concur that re-initiation of formal consultation under Section 7 of the ESA is not required for proposed Beaufort Sea Oil and Gas Lease Sale 195. We request your concurrence that the conclusions, conservation recommendations and all other sections of the May 25, 2001 Biological Opinion for oil and gas leasing in the Beaufort Sea apply to proposed Lease Sale 195 and are valid for inclusion in the EA for this lease sale.

If NOAA Fisheries does not concur, we ask that you specify what steps NOAA Fisheries believes the MMS should follow to meet its obligations under Section 7 of the ESA related to proposed Beaufort Sea Oil and Gas Lease Sale 195. Further, if NOAA Fisheries does not concur, we request that you specify what ESA listed, proposed or candidate species, as well as designated critical habitat, under NOAA Fisheries management authority, may be in or near the proposed Lease Sale 195 area. Based on previous correspondence with NOAA Fisheries on this issue, and based on NOAA Fisheries' May 25, 2001 Biological Opinion (Page 6), MMS is aware of only one such species, the endangered bowhead whale (*Balaena mysticetus*).

Additionally, if NOAA Fisheries does not concur and is considering recommending additional measures to minimize impacts to bowhead whales, or if you determine a jeopardy situation may exist for all or any part of the proposed action, we request that you respond to this letter in as timely a manner as possible, according to 50 CFR 402 14(g)(5), to allow the MMS and NOAA Fisheries staffs 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 the NOAA Fisheries Biological Opinion can be included in the EA/EIS to be published in August 2004, and will ensure effective protection of bowhead whales. These discussions also can ensure that any proposed alternatives are within our authority to control and implement, and are feasible, appropriate, and effective.

To facilitate consideration of our request for concurrence, we are sending copies of this letter to the NOAA Fisheries Alaska regional office in Juneau, Alaska and to the Anchorage field office.

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, 949 East 36[th] Avenue, Suite 300, Anchorage, Alaska 99503-4363 (commercial and FTS telephone: 907-271-6510) or Ms. Judy Wilson, Minerals Management Service, Mail Stop 4042, 381 Elden Street, Herndon, Virginia 20170-4817 (commercial and FTS telephone: 703-787-1075).

Sincerely,

Thomas A. Readinger

Thomas A. Readinger
Associate Director for
Offshore Minerals Management

cc: Mr. James Balsinger
Administrator
Alaska Region
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

Mr. Brad Smith
Anchorage Field Office
National Marine Fisheries Service
Federal Building
22 West 7[th] Avenue, Box 43
Anchorage Alaska 99513-7577

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, Alaska 99802-1668

March 8, 2004

Thomas A. Readinger
Associate Director for Offshore Minerals Management
Minerals Management Service
Washington, D.C. 20240

Dear Mr. Readinger:

Thank you for your letter concerning consultation under section 7 (a)(2) of the Endangered Species Act of 1973, as amended, for proposed oil and gas lease sale 195 in the Beaufort Sea, Alaska. In your letter, you request that we uphold the May 25, 2001 biological opinion for oil and gas leasing and exploration activities in the Beaufort Sea by determining that opinion remains in force and satisfies the consultation requirements of the ESA for Sale 195. In June, 2002, the Minerals Management Service prepared a draft Environmental Impact Statement (EIS) for proposed Beaufort Sea sales 186, 195, and 202. A supplemental EIS or Environmental Assessment was to be prepared for sales 195 and 202 in order to determine whether or not the information and analysis in the 2002 EIS remain valid at those future dates.

NOAA Fisheries has previously determined that the May 2001 opinion addresses Sale 186 (also in the Beaufort Sea), in terms of the listed species and habitats present, the legal status of affected species, the anticipated actions associated with the sale, and the proposed sale area. We did not apply that conclusion to Sale 195, as the need for supplemental analysis under NEPA for that sale would also extend to ESA consultation. Therefore, NMFS will provide further comment on the applicability of the May 2001 opinion, and the need for further consultation, pending our review of the NEPA documentation (i.e., the Environmental Assessment) prepared for Sale 195.

Please direct any questions to Mr. Brad Smith in our Anchorage, Alaska office at (907) 271-5006.

Sincerely,

James W. Balsiger
Administrator, Alaska Region

Rotterman, Lisa

From: Brad Smith [Brad.Smith@noaa.gov]
Sent: Friday, March 26, 2004 8:47 AM
To: Rotterman, Lisa; lisa-rotterman@mms.gov; lisa_rotterman@mms.gov
Subject: Sale 195 consultation

There have been no additions or changes to ESA-listed species or critical habitat for which the USDOC bears responsibility within the project area of Sale 195 since publication of the 2001 Regional Opinion. The bowhead whale remains the only such species likely to occur within the U.S. Beaufort Sea, and no critical habitat has been designated for this species.

APPENDIX B Proposed Stipulations and Required Operating Procedures

The stipulations for Sale 195 would be the same as for Sale 186. We refer NOAA Fisheries to the following website for full descriptions of the Stipulations and Information to Lessees for Lease Sale 186:

http://www.mms.gov/alaska/cproject/beaufortsale/FNOS%20186%20Package/FNIS186Package.htm, click on "Lease Stipulations for Oil and Gas Lease Sale 186."

Below, we provide information on bowhead-relevant mitigations.

Stipulation No. 1. Protection of Biological Resources
Stipulation No. 2. Orientation Program
Stipulation No. 3. Transportation of Hydrocarbons
Stipulation No. 4. Industry Site-Specific Bowhead Whale-Monitoring Program
Stipulation No. 5. Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvesting Activities
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

Stipulation No. 1 Protection of Biological Resources. If biological populations or habitats that may require additional protection are identified in the lease area by the Regional Supervisor, Field Operations (RS/FO), the RS/FO may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats. The RS/FO shall give written notification to the lessee of the RS/FO's decision to require such surveys.

Based on any surveys that the RS/FO may require of the lessee or on other information available to the RS/FO on special biological resources, the RS/FO may require the lessee to:

1. Relocate the site of operations;
2. Establish to the satisfaction of the RS/FO, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist;
3. Operate during those periods of time, as established by the RS/FO, that do not adversely affect the biological resources; and/or
4. Modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee shall immediately report such findings to the RS/FO and make every reasonable effort to preserve and protect the biological resource from damage until the RS/FO has given the lessee direction with respect to its protection.

The lessee shall submit all data obtained in the course of biological surveys to the RS/FO with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RS/FO provides written directions to the lessee with regard to permissible actions.

Stipulation No. 2 Orientation Program. The lessee shall include in any exploration or development and production plans submitted under 30 CFR 250.203 and 250.204 a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) for review and approval by the RS/FO. The program shall be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the sale and adjacent areas. The program shall address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals and provide guidance on how to avoid disturbance. This guidance will include the production and distribution of information cards on endangered and/or threatened species in the sale area. The program shall be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas in which such personnel will be operating. The orientation program shall also include information concerning avoidance of conflicts with subsistence, commercial fishing activities, and pertinent mitigation.

The program shall be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

The lessee shall maintain a record of all personnel who attend the program onsite for so long as the site is active, not to exceed 5 years. This record shall include the name and date(s) of attendance of each attendee.

Stipulation No. 3 Transportation of Hydrocarbons. 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 lessor specifically reserves the right to require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to recommendations of any advisory groups and Federal, state, and local governments and industry.

Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessel from offshore production sites, except in the case of an emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the RS/FO.

Stipulation No. 4 Industry Site-Specific Bowhead Whale-Monitoring Program. Lessees proposing to conduct exploratory drilling operations, including seismic surveys, during the bowhead whale migration will be required to conduct a site-specific monitoring program approved by the RS/FO; unless, based on the size, timing, duration, and scope of the proposed operations, the RS/FO, in consultation with the North Slope Borough (NSB) and the Alaska Eskimo Whaling Commission (AEWC), determine that a monitoring program is not necessary. The RS/FO will provide the NSB, AEWC, and the State of Alaska a minimum of 30 but no longer than 60 calendar days to review and comment on a proposed monitoring program prior to approval. The monitoring program must be approved each year before exploratory drilling operations can be commenced.

The monitoring program will be designed to assess when bowhead whales are present in the vicinity of lease operations and the extent of behavioral effects on bowhead whales due to these operations. In designing the program, lessees must consider the potential scope and extent of effects that the type of operation could have on bowhead whales. Experiences relayed by subsistence hunters indicate that, depending on the type of operations, some whales demonstrate avoidance behavior at distances of up to 35 miles. The program must also provide for the following:

1. Recording and reporting information on sighting of other marine mammals and the extent of behavioral effects due to operations,

2. Inviting an AEWC or NSB representative to participate in the monitoring program as an observer,
3. Coordinating the monitoring logistics beforehand with the MMS Bowhead Whale Aerial Survey Project (BWASP),
4. Submitting daily monitoring results to the MMS BWASP,
5. Submitting a draft report on the results of the monitoring program to the RS/FO within 60 days following the completion of the operation. The RS/FO will distribute this draft report to the AEWC, the NSB, the State of Alaska, and the National Oceanic and Atmospheric Administration - Fisheries (NOAA).
6. Submitting a final report on the results of the monitoring program to the RS/FO. The final report will include a discussion of the results of the peer review of the draft report. The RS/FO will distribute this report to the AEWC, the NSB, the State of Alaska, and the NOAA-Fisheries.

Lessees will be required to fund an independent peer review of a proposed monitoring plan and the draft report on the results of the monitoring program. This peer review will consist of independent reviewers who have knowledge and experience in statistics, monitoring marine mammal behavior, the type and extent of the proposed operations, and an awareness of traditional knowledge. The peer reviewers will be selected by the RS/FO from experts recommended by the NSB, the AEWC, industry, NOAA - Fisheries, and MMS. The results of these peer reviews will be provided to the RS/FO for consideration in final approval of the monitoring program and the final report, with copies to the NSB, AEWC, and the State of Alaska.

In the event the lessee is seeking a Letter of Authorization (LOA) or Incidental Harassment Authorization (IHA) for incidental take from the NOAA - Fisheries, the monitoring program and review process required under the LOA or IHA may satisfy the requirements of this stipulation. Lessees must advise the RS/FO when it is seeking an LOA or IHA in lieu of meeting the requirements of this stipulation and provide the RS/FO with copies of all pertinent submittals and resulting correspondence. The RS/FO will coordinate with the NOAA - Fisheries and advise the lessee if the LOA or IHA will meet these requirements.

This stipulation applies to certain blocks and time periods that are listed in the Notice of Sale for Lease Sale 186.

Stipulation No. 5 Conflict Avoidance Mechanisms to Protect Subsistence Whaling and Other Subsistence-Harvesting Activities. Exploration and development and production operations shall be conducted in a manner that prevents unreasonable conflicts between the oil and gas industry and subsistence activities (including, but not limited to, bowhead whale subsistence hunting).

Prior to submitting an exploration plan or development and production plan (including associated oil-spill contingency plans) to MMS for activities proposed during the bowhead whale migration period, the lessee shall consult with the directly affected subsistence communities, Barrow, Kaktovik, or Nuiqsut, the North Slope Borough (NSB), and the Alaska Eskimo Whaling Commission (AEWC) to discuss potential conflicts with the siting, timing, and methods of proposed operations and safeguards or mitigating measures which could be implemented by the operator to prevent unreasonable conflicts. Through this consultation, the lessee shall make every reasonable effort, including such mechanisms as a conflict avoidance agreement, to assure that exploration, development, and production activities are compatible with whaling and other subsistence hunting activities and will not result in unreasonable interference with subsistence harvests.

A discussion of resolutions reached during this consultation process and plans for continued consultation shall be included in the exploration plan or the development and production plan. In particular, the lessee shall show in the plan how its activities, in combination with other activities in the area, will be scheduled and located to prevent unreasonable conflicts with subsistence activities. Lessees shall also include a discussion of multiple or simultaneous operations, such as ice management and seismic activities, that can be expected to occur during operations in order to more accurately assess the potential for any cumulative affects. Communities, individuals, and other entities who were involved in the consultation shall be identified in the plan. The RS/FO shall send a copy of the exploration plan or development and production plan (including associated oil-spill contingency plans) to the directly affected communities and the AEWC at the time they are submitted to the MMS to allow concurrent review and comment as part of the plan approval process.

In the event no agreement is reached between the parties, the lessee, the AEWC, the NSB, the National Oceanic and Atmospheric Administration-Fisheries (NOAA), or any of the subsistence communities that could be affected directly by the proposed activity may request that the RS/FO assemble a group consisting of representatives from the subsistence communities, AEWC, NSB, NOAA - Fisheries, and the lessee(s) to specifically address the conflict and attempt to resolve the issues before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests. Upon request, the RS/FO will assemble this group if the RS/FO determines such a meeting is warranted and relevant before making a final determination on the adequacy of the measures taken to prevent unreasonable conflicts with subsistence harvests.

The lessee shall notify the RS/FO of all concerns expressed by subsistence hunters during operations and of steps taken to address such concerns. Lease-related use will be restricted when the RS/FO determines it is necessary to prevent unreasonable conflicts with local subsistence hunting activities.

In enforcing this stipulation, the RS/FO will work with other agencies and the public to assure that potential conflicts are identified and efforts are taken to avoid these conflicts.

Subsistence whaling activities occur generally during the following periods:

August to October: Kaktovik whalers use the area circumscribed from Anderson Point in Camden Bay to a point 30 kilometers north of Barter Island to Humphrey Point east of Barter Island. Nuiqsut whalers use an area extending from a line northward of the Nechelik Channel of the Colville River to Flaxman Island, seaward of the Barrier Islands.

September to October: Barrow hunters use the area circumscribed by a western boundary extending approximately 15 kilometers west of Barrow, a northern boundary 50 kilometers north of Barrow, then southeastward to a point about 50 kilometers off Cooper Island, with an eastern boundary on the east side of Dease Inlet. Occasional use may extend eastward as far as Cape Halkett.

(An MMS letter to the NSB, dated 8/27/03, states on pages 2 and 3 that "(w)e are also committed to developing written guidance for implementing Stipulation 5." Has the guidance been written and can it be incorporated here?)

Stipulation No. 6 Pre-Booming Requirements for Fuel Transfers. Fuel transfers (excluding gasoline transfers) of 100 barrels or more occurring 3 weeks prior to or during the bowhead whale migration will require pre-booming of the fuel barge(s). The fuel barge must be surrounded by an oil-spill-containment boom during the entire transfer operation to help reduce any adverse effects from a fuel spill. This stipulation is applicable to the blocks and migration times listed in the stipulation on Industry Site-Specific Bowhead Whale-Monitoring. The lessee's oil-spill-contingency plans must include procedures for the pre-transfer booming of the fuel barge(s).

Standard Information to Lessees (ITL) Clauses. The following are a subset of the standard ITL clauses (1 through 16) that apply to OCS activities in the Beaufort Sea area and are considered part of the proposed action and alternatives for the Beaufort Sea Sale 195. We have not listed ITL clauses that are not relevant to evaluation of potential impacts of the proposed action on bowhead whales.

Stipulation No. 7 Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eider. This stipulation is not described her because it does provide protection to bowhead whales.

Information to Lessees
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. 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

These ITL clauses are described fully in the Beaufort Multi-Sale FEIS Section II.H.3.

APPENDIX C Oil-Spill Information

This section summarizes information on the oil-spill data and assumptions we use in the analysis of large spills in the EA as well as new information about oil spills relevant to the Proposal and alternatives since the publication of the Beaufort multiple-sale EIS. A large oil spill is defined as greater than or equal to 1,000 bbl. Before summarizing new resource information and updating the effects about a large oil spill, we briefly review the oil-spill analysis in the Beaufort multiple-sale EIS (USDOI, MMS, 2003) and provide new information on oil spills and oil-spill response.

Oil-Spill Analysis

Information regarding the source, type, and sizes of oil spills; their behavior; the estimated path they follow; and the conditional as well as combined probabilities 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 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 resource volume estimates. The oil resource volume estimate remains 460 billion barrels, as discussed in USDOI, MMS (2003:Section II.B). 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., 2002). 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.

Considering only the variance in the Arctic effects, our best estimate of the large spill rate for platforms and pipelines total is that there may be 0.25 oil spills (95% CI 0.21-0.30 oil spills) greater than or equal to 1,000 bbl per billion barrels produced. Considering only the variance in the arctic effects, we are 95% confident that there will be a large spill rate for platforms and pipelines of no more than 0.30 spills greater than or equal to 1,000 bbl per billion barrels produced.

Using the mean spill rates, the chance of one or more large pipeline spills would be 4-5%, and the chance of one or more large platform spills would be 7% for the Proposal and alternatives. The chance of one or more spills total ranges from 10-11% for the Proposal and alternatives based on the mean spill rate. Using the spill rate at the 95% confidence interval, the chance of one or more large spills total for the Proposal and alternatives ranges from 9-13%. Appendix B discusses how these spill rates were derived, and the reader is directed to Appendix B of the EA for more detail.

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

The multiple-sale EIS explains that the confidence estimate includes only the variability in the Arctic effects on the spill rate. The confidence estimate does not consider the variance in the baseline data (Gulf of Mexico and Pacific OCS spill statistics) or in the Sale 195 production estimate. Inclusion of these variances would, in our opinion, increase the range in the confidence interval.

During Fiscal Year 2004, the MMS is preparing for the procurement of 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 confidence intervals due to non-Arctic effects are to be addressed in this study. The study would be based on a fault-tree method that modifies the Gulf of Mexico oil-spill rates to expected Arctic oil. Results of this study will not be available for Sale 195 analysis but should be available for Sale 202 analysis.

New information. A recent laboratory study on the biodegradation of weathered Alaska North Slope crude indicates that low-dose oil locations are bioremediated more effectively than high-dose locations (Lepo et al., 2003). Prince et al. (2003) discuss three northern spills and demonstrate that photo-oxidation and biodegradation play an important role in the long-term weathering of crude oils. Oil spreading and floe motion were studied to look at how floe motion, ice concentration, slush concentration, and oil types affect spreading in ice. Spreading rates were lowered as ice concentrations increased, but for ice concentrations less than 20-30% there was very little effect. Slush ice rapidly decreased spreading. If the ice-cover motion increased then spreading rates increased, especially with slush ice present (Gjosteen and Loset, 2004).

Oil-spill Responses

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 area for all three operating seasons in the Arctic: solid ice, open water, and broken ice (USDOI, MMS, 2003:Section 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 multiple-sale EIS (in Section IV.A.6.d) explained that research was ongoing. 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 small pools of oil that tend to form around broken pieces of ice. For example, response demonstrations have been conducted on small test "spills" with skimmers on hydraulic booms that were mounted on ice-strengthened barge and with fireproof booms and in situ burning.

Table I.
Representative Development Schedule for Sale 195 (the same as USDOI, MMS, Alaska OCS Region, 2003a: Table IV.A-2)

Year	Exploration Wells	Delineation Wells	Exploration Drilling Rigs	Production Platforms	Production Wells	Injection Wells	Production Drilling Rigs	Offshore Pipelines (miles)	New Shore Bases	Field #1 Oil Production (MMbbl)	Field #2 Oil Production (MMbbl))	Combined Oil Production (MMbbl)	Cumulative Oil Production (MMbbl)
2003	—	—	—	—	—	—	—	—	—	—	—	—	—
2004	—	—	—	—	—	—	—	—	—	—	—	—	—
2005	—	—	—	—	—	—	—	—	—	—	—	—	—
2006	—	—	—	—	—	—	—	—	—	—	—	—	—
2007	1	—	1	—	—	—	—	—	—	`—	—	—	—
2008	1	—	1	—	—	—	—	—	—	—	—	—	—
2009	—	2	1	—	—	—	—	—	—	—	—	—	—
2010	1	—	1	—	—	—	—	—	—	—	—	—	—
2011	—	—		—	—	—	—	—	—	—	—	—	—
2012	2	—	2	1	3	3	1	10	—	—	—	—	—
2013	1	2	2	—	10	4	1	—	—	7.9	—	7.9	7.9
2014	—	2	1	—	10	4	1	—	—	15.7	—	15.7	23.6
2015	—	—	—	—	—	—	—	—	—	15.7	—	15.7	39.3
2016	—	—	—	1	3	3	1	30	—	15.7	—	15.7	55.1
2017	—	—	—	1	13	7	2	—	—	13.0	21.5	34.5	89.5
2018	—	—	—	—	20	8	2	—	—	10.7	28.6	39.4	128.9
2019	—	—	—	—	10	4	1	—	—	8.8	28.6	37.5	166.3
2020	—	—	—	—	—	—	—	—	—	7.3	28.6	35.9	202.3
2021	—	—	—	—	—	—	—	—	—	6.0	28.6	34.7	236.9
2022	—	—	—	—	—	—	—	—	—	5.0	28.6	33.6	270.5
2023	—	—	—	—	—	—	—	—	—	4.1	25.2	29.3	299.8
2024	—	—	—	—	—	—	—	—	—	3.4	22.2	25.6	325.4
2025	—	—	—	—	—	—	—	—	—	2.8	19.5	22.3	347.7
2026	—	—	—	—	—	—	—	—	—	2.3	17.2	19.5	367.2
2027	—	—	—	—	—	—	—	—	—	1.9	15.1	17.0	384.2
2028	—	—	—	—	—	—	—	—	—	—	13.3	13.3	397.5
2029	—	—	—	—	—	—	—	—	—	—	11.7	11.7	409.2
2030	—	—	—	—	—	—	—	—	—	—	10.3	10.3	419.5
2031	—	—	—	—	—	—	—	—	—	—	9.1	9.1	428.6
2032	—	—	—	—	—	—	—	—	—	—	8.0	8.0	436.5
2033	—	—	—	—	—	—	—	—	—	—	7.0	7.0	443.6
2034	—	—	—	—	—	—	—	—	—	—	6.2	6.2	449.7
2035	—	—	—	—	—	—	—	—	—	—	5.4	5.4	455.2
2036	—	—	—	—	—	—	—	—	—	—	4.8	4.8	460.0
2037	—	—	—	—	—	—	—	—	—	—	—	—	—
—	6	6	—	3	69	33	—	40	—	120	340	460	—

Source:
USDOI, MMS, Alaska OCS Region**.**
Notes:
Each oil-production column represents annual production from a single field. There are two fields assumed for this sale. A combined production stream and cumulative production stream are also provided. All other activities represent a sum of activities associated with these two fields.

Table II.
Bowhead Whale Takes By Alaska Natives, 1978-2002

Year	Harvested	Struck/Lost	Total Take
1978	12	6	18
1979	12	15	27
1980	16	18	34
1981	17	11	28
1982	8	11	19
1983	9	9	18
1984	12	13	25
1985	11	6	17
1986	20	8	28
1987	22	9	3
1988	23	6	29
1989	18	8	26
1990	30	14	44
1991	27	19	46
1992	38	12	50
1993	41	11	52
1994	34	12	46
1995	43	14	57
1996	39	5	44
1997	48	18	66
1998	41	13	54
1999	42	5	47
2000	35	12	47
2001	49	26	75
2002	39[6]	11	50

Note:
In addition, five landed Western Arctic bowhead whales are included in the annual quota for takes by Chukotka Natives in Russia under the IWC quota for the Western Arctic bowhead stock, (IWC, 1988).

Data from: NMFS (2003:15-16)

[6] This number includes two animals that were abandoned due to weather.

Appendix D

Fish Resources of the Alaskan Beaufort Sea Region

Additional Detailed Analysis for Fish and Essential Fish Habitat

D. Introduction

The description and analysis provided in this section supplement the information in the multiple-sale EIS (USDOI, MMS, 2003a). This additional information is useful and informative, but it does not change the conclusions reached in the EIS of no significant impacts to fish or essential fish habitat as a result of the activities associated with proposed OCS Lease Sale 195.

In general, the Arctic is noted for its low species diversity of fish, with many species occurring at the northern limits of their ranges. Mecklenburg, Mecklenburg, and Thorsteinson (2002) documented 13 orders, 22 families, and 77 species of fish as occurring in freshwater, nearshore brackish, or marine waters of the Alaskan-Beaufort Sea region (Table D-1). Representative taxa include: lampreys, sleeper sharks, herrings, suckers, pikes, mudminnows, smelts, whitefishes, graylings, trout and salmon, lanternfishes, cods, sticklebacks, greenlings, sculpins, fathead sculpins, poachers, lumpsuckers, snailfishes, eelpouts, pricklebacks, wolffishes, sand lances, and righteye flounders. Table D-2 lists an additional 27 species that are documented as occurring in waters immediately adjacent to the Alaskan Beaufort Sea (Alaskan Chukchi Sea and/or Canadian Beaufort Sea) (Mecklenburg, Mecklenburg, and Thorsteinson 2002); these species may occur in the Alaskan-Beaufort Sea region; however, they have yet to be documented as such. By comparison, more than 100 species have been collected in the Canadian Arctic (McAllister, 1975). Additional species are likely to be found in the Alaskan Beaufort Sea when marine waters are more thoroughly surveyed. For example, the shulupaoluk (*Lycodes jugoricus*) was collected by N.J. Wilimovsky in the Chukchi Sea (Walters, 1955); and McAllister (1962) collected two specimens in brackish waters of the Beaufort Sea at Herschel Island, Yukon Territory, Canada. Shulupaoluk is a name applied by Ungava Eskimos to an eelpout (Dunbar and Hildebrand, 1952 as cited in McAllister, 1962); to date, a shulupaoluk has yet to be documented as occurring in the Alaskan Beaufort Sea, although based on the noted collections, the species is likely to occur there.

The diverse fishes of the Alaskan Beaufort Sea region use a range of waters and substrates for spawning, breeding, feeding, or growing to maturity. The range of waters and substrates are hierarchically organized in Table D-3 for suitable analysis of fishes relative to their environment. Table D-3 also shows each species' occurrence by hierarchical category.

Biologists studying arctic fishes of Alaska have classified them into primary assemblages by occurrence in basic aquatic systems and by life-history strategies that allow the fishes to survive the frigid polar conditions (for example, Craig, 1984; Craig, 1989; Moulton and George, 2000; Gallaway and Fechhelm, 2000). A life-history strategy is a set of co-adapted traits designed by natural selection to solve particular ecological problems (Craig, 1989 citing Stearns, 1976). Each species' strategy is a combination of unique variables such as age at maturity, fecundity (for example, clutch size), or juvenile survivorship. Such variables and strategies determine, in part, species abundance within a geographic region; they are useful to study organisms with similar and dissimilar patterns. Table D-4 is a compilation of life-history characteristics that was assembled primarily from FishBase (Froese and Pauly, 2003). Additionally, Table D-4 includes regional abundance data by species that was brought together from such references as Frost and Lowry (1983); Schmidt, McMillan, and Gallaway (1983); Craig and Halderson (1986); Thorsteinson, Jarvela, and Hale (1990); Griffiths et al. (1998); Jarvela and Thorsteinson (1999); Gallaway and Fechhelm (2000); Moulton and George (2000); and Fechhelm and Griffiths (2001).

Extensive information on these fishes, and the probable effects on them due to Proposed Sale 195, is located in a publicly-available administrative file. The conclusion in the administrative file is that the probability of a spill of at least 1,000 bbl occurring and contacting land in the open-water season within 30 days during the production life of the Sale 195 area is 5%. The probability of a spill occurring and contacting individual land segments adjoining areas of particular interest to fishes (river deltas, lagoon systems) is considerably less: for individual land segments from Point Hope to the Mackenzie River Delta, the probability of contact within 30 days is less than or equal to 2% for spills in the open-water season or less than or equal to 4% for spills over the entire winter. The probability of a 1,000 bbl or greater spill occurring and contacting the deltas of the Colville, Kuparuk, Ikpikpuk, Sagavanirktok, Canning, and Mackenzie rivers in the open-water season within 30 days is less than 0.5%. Thus, the probability of important river deltas being contacted is very low. The combination of factors suggests that effects to fishes in nearshore waters are expected to be moderate. High effects are possible for some diadromous species and capelin if spawning-year individuals, aggregated multi-age assemblages, or a year-class of young were affected. However, since delta areas are unlikely to be contacted, these high effects are not expected to occur. For pelagic species or those in offshore water, effects of an oil spill are expected to be moderate, given the small number of spills projected, the widespread distributions of these fishes, and the relatively small area that a spill would cover.

In general, the effect of spilled oil on fishes for a 1,000 bbl or greater spill is expected to be moderate for most fish species, although high effects are possible for some diadromous species (for example, arctic cisco, arctic char, least cisco, and broad whitefish) and capelin if spawning-year individuals, aggregated multi-aged assemblages, or a year-class of young were affected. These high effects are not expected to occur.

Table D-1
Arctic Fishes of the Alaskan Beaufort Sea

Order	Family	Species	Common Name
Petromyzontiformes	*Petromyzontidae* (Lampreys)	*Lampetra camtschatica*	Arctic lamprey
Squaliformes	*Dalatidae* (Sleeper sharks)	*Somniosus pacificus*	Pacific sleeper shark
Clupeiformes	*Clupeidae* (Herrings)	*Clupea pallasii*	Pacific herring
Cypriniformes	*Catostomidae* (Suckers)	*Catostomus catostomus*	longnose sucker
Esociformes	*Esocidae* (Pikes)	*Esox lucius*	northern pike
—	*Umbridae* (Mudminnows)	*Dallia pectoralis*	Alaska blackfish
Osmeriformes	*Osmeridae* (Smelts)	*Mallotus villosus*	capelin
—	—	*Hypomesus olidus*	pond smelt
—	—	*Osmerus mordax*	rainbow smelt
Salmoniformes	*Salmonidae/Coregoninae* (Whitefishes)	*Stenodus leucichthys*	inconnu
—	—	*Coregonus sardinella*	least cisco
—	—	*Coregonus autumnalis*	Arctic cisco
—	—	*Coregonus laurettae*	Bering cisco
—	—	*Coregonus nasus*	broad whitefish
—	—	*Coregonus pidschian*	humpback whitefish
—	—	*Prosopium cylindraceum*	round whitefish
—	*Salmonidae/Thymallinae* (Graylings)	*Thymallus arcticus*	Arctic grayling
—	*Salmonidae/Salmoninae* (Trouts & salmons)	*Slavelinus namaycush*	lake trout
—	—	*Salvelinus alpinus*	Arctic char
—	—	*Salvelinus malma*	Dolly Varden
—	—	*Oncorhynchus gorbuscha*	pink salmon
—	—	*Oncorhynchus kisutch*	coho salmon
—	—	*Oncorhynchus tshawytscha*	Chinook salmon
—	—	*Oncorhynchus keta*	chum salmon
—	—	*Oncorhynchus nerka*	sockeye salmon
Myctophiformes	*Myctophidae (Lanternfishes)*	*Benthosema glaciale*	glacier lanternfish
Gadiformes	*Gadidae* (Cods)	*Lota lota*	burbot
—	—	*Boreogadus saida*	Arctic cod
—	—	*Arctogadus glacialis*	polar cod
—	—	*Arctogadus borisovi*	toothed cod
—	—	*Eleginus gracilis*	saffron cod
—	—	*Gadus ogac*	ogac
Gasterosteiformes	*Gasterosteidae* (Sticklebacks)	*Gasterosteus aculeatus*	threespine stickleback
—	—	*Pungitius pungitius*	ninespine stickleback
Scorpaeniformes	*Hexagrammidae* (Greenlings)	*Hexagrammos stelleri*	whitespotted greenling
	Cottidae (Sculpins)	*Triglops pingelii*	ribbed sculpin
—	—	*Icelus spatula*	spatulate sculpin
—	—	*Icelus bicornis*	twohorn sculpin
—	—	*Gymnocanthus tricuspis*	Arctic staghorn sculpin
—	—	*Cottus cognatus*	slimy sculpin

Table D-2
Arctic Fishes Possibly Occurring in the Alaskan Beaufort Sea

Family	Species	Common Name	Canadian Beaufort	Alaskan Chukchi
Petromyzontidae (Lampreys)	*Lampetra tridentata*	Pacific lamprey	–	X
Gadidae (Cods)	*Theragra chalcogramma*	walleye pollock	–	X
Cottidae (Sculpins)	*Enophrys diceraus*	antlered sculpin	–	X
–	*Megalocottus platycephalus*	belligerent sculpin	–	X
–	*Myoxocephalus jaok*	plain sculpin	–	X
–	*Microcottus sellaris*	brightbelly sculpin	–	X
–	*Artediellus ochotensis*	Okhotsk hookear sculpin	–	X
Hemitripteridae (Sailfin sculpins)	*Blepsias bilobus*	crested sculpin	–	X
–	*Nautichthys pribilovius*	eyeshade sculpin	–	X
Psychrolutidae (Fathead sculpins)	*Eurymen gyrinus*	smoothcheek sculpin	–	X
Agonidae (Poachers)	*Aspidophoroides monopterygius*	alligatorfish	–	X
Cyclopteridae (Lumpsuckers)	*Eumicrotremus andriashevi*	pimpled lumpsucker	–	X
–	*Eumicrotremus spinosus*	Atlantic spiny lumpsucker	X	–
Liparidae (Snailfishes)	*Liparis bristolensis*	Bristol snailfish	–	X
Zoarcidae (Eelpouts)	*Lycodes jugoricus*	shulupaoluk	X	–
–	*Lycodes raridens*	marbled eelpout	–	X
–	*Lycodes reticulatus*	Arctic eelpout	X	–
–	*Lycodes palearis*	wattled eelpout	–	X
–	*Lycodes frigidus*	glacial eelpout	–	X
Stichaeidae (Pricklebacks)	*Chirolophis snyderi*	bearded warbonnet	–	X
–	*Acantholoumpenus mackayi*	blackline prickleback	X	–
Pholidae (Gunnels)	*Pholis fasciata*	banded gunnel	–	X
Anarhichadidae (Wolffishes)	*Anarhichas denticulatus*	northern wolffish	X	–
Pleuronectidae (Righteye flounders)	*Hippglossoides robustus*	Bering flounder	–	X
–	*Pleuronectes quadrituberculatus*	Alaska plaice	–	X
–	*Limanda proboscidea*	longhead dab	–	X
–	*Limanda aspera*	yellowfin sole	–	X

Table D-3
Arctic Fish Ecological Assemblages in the Alaskan Beaufort Sea

	Freshwater			Brackish Nearshore			Marine															
							Neritic							Oceanic			Behavioral Stratification					
Species	Principle Environment	Fluvial	Lacustrine	Estuarine	Intertidal	0-2m (Infralittoral Fringe)	1-50m	51-100m	101-200m	201-300m	301-500m	501-700m	701-1000m	1001-3000m	>3000m	Demersal (D)	Bathydemersal (BD)	Bentho-Pelagic (BP)	1-200m (epipelagic) (EP)	201-1000m (mesopelagic) (MP)	>1000m (bathypelagic)	cryopelagic (CP)
Arctic lamprey	E	X	—	—	—	—	X	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—
Pacific sleeper shark	M	—	—	—	—	—	X	X	X	X	X	X	X	X	—	—	—	X	—	—	—	—
Pacific herring	M	—	—	—	—	X	X	X	X	X	—	—	—	—	—	—	—	—	X	—	—	—
longnose sucker	F	X	X	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—
northern pike	F	X	X	—	—	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—	—	—
Alaska blackfish	F	X	X	—	—	—	—	—	—	—	—	—	—	—	—	X	—	X	—	—	—	—
capelin	M	—	—	X	X	X	X	X	X	—	—	—	—	—	—	—	—	—	—	—	—	—
pond smelt	F	X	X	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—
rainbow smelt	E	X		X	X	X	X	X	X	—	—	—	—	—	—	—	—	—	X	—	—	—
inconnu	F	X	X	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—
least cisco	E	X	X	X	X	X	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—
Arctic cisco	E	X	X	X	X	X	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—
Bering cisco	E	X	—	X	X	X	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—
broad whitefish	E	X	X	X	X	X	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—
humpback whitefish	E	X	X	X	X	X	X	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—
round whitefish	F	X	X	X	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—
Arctic grayling	F	X	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
lake trout	F	X	X	—	—	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
Arctic char	E	X	X	X	X	X	X	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
Dolly Varden	E	X	X	X	X	X	X	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
pink salmon	E	X	X	X	X	X	X	X	X	X	—	—	—	—	—	X	—	X	—	—	—	—
coho salmon	E	X	X	X	X	X	X	X	X	X	—	—	—	—	—	X	—	X	—	—	—	—
Chinook salmon	E	X	X	X	X	X	X	X	X	—	—	—	—	—	—	—	—	X	—	—	—	—
chum salmon	E	X	X	X	X	X	X	X	X	X	—	—	—	—	—	—	—	X	—	—	—	—
sockeye salmon	E	X	X	X	X	X	X	X	X	X	—	—	—	—	—	—	—	X	X	—	—	—
glacier lanternfish	M	—	—	—	—	—	—	—	—	X	X	X	X	X	—	—	—	—	X	X	—	—
burbot	F	X	X	—	—	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—
Arctic cod	M	—	—	—	—	X	X	X	X	X	X	X	X	—	—	—	—	X	X	X	—	X
polar cod	M	—	—	—	—	X	X	X	X	X	X	X	X	—	—	—	—	—	X	X	—	X
toothed cod	M	—	—	—	—	X	X	—	—	—	—	—	—	—	—	X	—	—	—	—	—	X
saffron cod	M	X	—	X	X	X	X	X	X	—	—	—	—	—	—	X	—	—	—	—	—	—
ogac	M	—	—	—	—	X	X	X	X	X	X	—	—	—	—	X	—	X	—	—	—	—
threespine stickleback	E	X	X	X	X	X	X	—	—	—	—	—	—	—	—	—	—	X	—	—	—	—
ninespine stickleback	E	X	X	X	X	X	X	X	X	—	—	—	—	—	—	—	—	X	—	—	—	—
whitespotted greenling	M	—	—	—	—	X	X	X	X	—	—	—	—	—	—	X	—	—	—	—	—	—
ribbed sculpin	M	—	—	—	—	—	X	X	X	X	X	—	—	—	—	X	X	—	—	—	—	—
spatulate sculpin	M	—	—	—	—	—	X	X	X	X	X	—	—	—	—	X	X	—	—	—	—	—
twohorn sculpin	M	—	—	—	—	—	X	X	X	X	X	X	—	—	—	X	X	—	—	—	—	—
Arctic staghorn sculpin	M	—	—	—	—	X	X	X	X	X	—	—	—	—	—	X	X	—	—	—	—	—
slimy sculpin	F	X	X	X	X	X	—	—	—	—	—	—	—	—	—	X	—	—	—	—	—	—

Table 4: Appendix D
Population and Behavioral Ecology Characteristics

Distribution		Abundance			Fecundity (clutch size)			Life Span (yrs.)			Generation Time (yrs)			Age at First Maturity (yrs							
Species	Regional Distribution in Primary Envt.	Rel. Abund. In Primary Envt.	Regional Density	Regional Population Trends	Low	Average	High	Low	Average	High	Low	Average	High	Low	Average	High	Resilence to Exploitation	Decline Threshold	Intrinsic Rate of Increase per yr.	Main Prey	Trophic Level (+/- s.e.)
Arctic lamprey	W	U	DD	DD	–	DD	—	14.2	19.2	24.2	4.3	5.9	8.5	3.6	4.5	5.6	low	0.85	0.82	nekton	4.5(0.81)
Pacific sleepershark	U	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	nekton	4.3(0.50)
Pacific herring	W	A*	DD	DD	6300	29056	134000	—	5.5	—	—	1.9	—	—	1.4	—	high	0.99	2.28	zooplankton	3.2(0.36)
longnose sucker	W	FC	DD	DD	—	DD	—	21.8	28.8	41.6	6.5	8.8	12.7	5.4	6.6	8.3	low	0.85	0.56	zoobenthos	2.5(0.33)
northern pike	W	A*	DD	DD	524	17732	600000	—	22.2	—	—	8	—	—	4.6	—	low	0.85	0.54	nekton	4.5(0.79)
Alaska blackfish	W	C	DD	DD	500	—	300	7	9.5	12.6	2	2.7	3.9	2	2.5	3.1	medium	0.95	1.36	zoobenthos	3.3(0.44)
capelin	W	C	DD	DD	6000	8486	12000	—	6.3	—	—	2.1	—	—	1.7	—	high	0.99	1.9	zooplankton	3.1(0.17)
pond smelt	W	U	DD	DD	1200	2191	4000	5.2	7.1	9.6	—	2.7	—	1.6	2	2.6	medium	0.95	2.52	zooplankton	3.2(0.42)
rainbow smelt	W	A*	DD	DD	—	—	—	7	9.5	12.6	5	6	7	5	6	7	medium	0.95	1.1	nekton	4.5(0.80)
inconnu	P	A*	DD	DD	80000	183304	420000	—	28.9	—	—	11	—	—	5.9	—	low	0.85	0.38	nekton	4.1(0.75)
least cisco	W	A*	DD	DD	2500	15289	93500	—	7.1	—	—	2.7	—	—	1.3	—	high	0.99	1.44	zoobenthos	3.2(0.50)
Arctic cisco	W	A*	DD	DD	—	DD	—	19	26.2	32.3	5.9	8.1	11.6	4.9	6.1	7.6	low	0.85	0.46	zoobenthos	3.6(0.56)
Bering cisco	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	nekton	3.8(0.59
broad whitefish	W	A*	DD	DD	10000	37417	140000	—	13	—	—	5.1	—	—	3	—	medium	0.95	0.74	zoobenthos	3.3(0.44)
humpback whitefish	W	A*	DD	DD	—	DD	—	35.5	48	58	11	14	20.5	9.4	12	14.8	very low	0.7	0.32	zoobenthos	3.4(0.43)
round whitefish	W	A*	DD	DD	—	DD	—	18.9	26.2	32.3	5.9	8	11.5	5	6.2	7.7	low	0.85	0.62	zoobenthos	3.3(0.41)
Arctic grayling	W	A*	DD	DD	416	2321	12946	—	19.1	—	—	6.1	—	—	4.3	—	low	0.85	0.76	zoobenthos	3.3(0.40)
lake trout	W	FC	DD	DD	5000	9220	17000	—	24	—	—	8.8	—	—	5.1	—	low	0.85	0.46	nekton	4.3(0.71)
Arctic char	W	A*	DD	DD	400	1550	6000	—	47.6	—	—	15	—	—	11	—	low	0.85	0.32	nekton	4.3(0.75)
Dolly Varden	W	C	DD	DD	—	DD	—	14.4	19.4	24.4	4.7	6.4	9.2	3.3	4.1	5.1	low	0.85	0.58	nekton	4.5(0.80)
pink salmon	W	FC	DD	DD	1200	—	1800	6.6	8.8	11.2	2	2.8	4	1.6	2	2.5	medium	0.95	0.92	nekton	4.2(0.71)
coho salmon	P	R	DD	DD	1440	2865	5700	—	2.9	—	—	1.3	—	—	0.7	—	high	0.99	2.7	nekton	4.2(0.74)
Chinook salmon	P	R	DD	DD	—	—	—	15.2	19.4	24.4	4.8	6.5	9.4	3.3	4	4.9	Low	0.85	0.44	nekton	4.4(0.76)
chum salmon	W	U	DD	DD	2400	2728	3100	—	7.4	—	—	3.1	—	—	1.6	—	high	0.99	1.24	zoobenthos	3.5(0.48)
sockeye salmon	P	R	DD	DD	300	1136	4300	—	5	—	—	2.3	—	—	1.1	—	high	0.99	1.44	zooplankton	3.4(0.45)
glacier lanternfish	P	R	DD	DD	160	—	2000	—	6.2	—	—	2.6	—	—	2	—	high	0.99	2.64	zooplankton	3.1(0.27)
burbot	W	A*	DD	DD	45600	477494	5E+06	—	57.5	—	—	19	—	—	12	—	very low	0.7	0.26	nekton	4.0(0.69)
Arctic cod	W	A*	DD	DD	9000	24557	67000	—	12.9	—	—	4.4	—	—	3.3	—	medium	0.95	0.94	zoobenthos	3.1(0.31)
polar cod	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
toothed cod	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
saffron cod	W	U	DD	DD	—	DD	—	7.9	10.3	13.9	2.3	3.1	4.5	2	2.4	3.1	medium	0.95	0.92	zooplankton	4.1(0.72)
ogac	W	U	DD	DD	—	DD	—	11.4	15.2	19.4	3.5	4.8	6.8	2.8	3.4	4.3	medium	0.95	0.64	zoobenthos	3.6(0.58)
threespine stickleback	P	U	DD	DD	50	255	1300	—	1.6	—	—	0.7	—	—	0.5	—	high	0.99	7.72	zoobenthos	3.5(0.49)
ninespine stickleback	W	A*	DD	DD	350	592	1000	3.1	4.6	6.2	—	2	—	1.2	1.5	1.9	medium	0.95	3.52	zoobenthos	3.3(0.44)
whitespotted greenling	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.5(0.49)
ribbed sculpin	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.5(0.52)
spatulate sculpin	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.4(0.45)
twohorn sculpin	P	C	DD	DD	150	—	1000	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.1(0.37)
Arctic staghorn sculpin	W	U	DD	DD	3030	4051	5414	9.7	13.6	17	2.9	3.9	5.5	2.9	3.6	4.6	medium	0.95	0.9	zoobenthos	3.2(0.41)
slimy sculpin	W	A*	DD	DD	—	DD	—	6.9	9.7	13	—	3.9	—	2.3	2.9	3.8	medium	0.95	2.06	zoobenthos	3.5(0.5)
fourhorn sculpin	W	A*	DD	DD	—	DD	—	12.9	16.9	22.4	3.8	5.2	7.4	3.2	4	5	medium	0.95	0.6	zoobenthos	3.7(0.58)
shorthorn sculpin	W	U	DD	DD	—	2742	—	6.8	9.1	11.7	2.1	2.9	4.2	1.6	2	2.5	medium	0.95	1.1	zoobenthos	3.9(0.40)
Arctic sculpin	W	U	DD	DD	4	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.3(0.53)
spinyhook sculpin	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
hamecon	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.5(0.37)
Sadko sculpin	P	VR	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD

Table 4: Appendix D
Population and Behavioral Ecology Characteristics (continued)

Species	Distribution: Regional Distribution in Primary Envt.	Abundance: Rel. Abund. In Primary Envt.	Abundance: Regional Density	Abundance: Regional Population Trends	Fecundity (clutch size): Low	Fecundity (clutch size): Average	Fecundity (clutch size): High	Life Span (yrs.): Low	Life Span (yrs.): Average	Life Span (yrs.): High	Generation Time (yrs): Low	Generation Time (yrs): Average	Generation Time (yrs): High	Age at First Maturity (yrs: Low	Age at First Maturity (yrs: Average	Age at First Maturity (yrs: High	Resilence to Exploitation	Decline Threshold	Intrinsic Rate of Increase per yr.	Main Prey	Trophic Level (+/-s.e.)
veteran poacher	P	R	DD	4	4	DD	—	—	DD	—	—	DD	—	—	DD	DD	DD	4	DD	DD	DD
Arctic alligatorfish	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	DD	DD	DD	DD	zoobenthos	3.5(0.49
leatherfin lumpsucker	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	DD	DD	DD	DD	DD	DD
variegated snailfish	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	DD	DD	DD	DD	DD	DD
kelp snailfish	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	DD	DD	DD	DD	DD	DD
gelatinous seasnail	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	DD	DD	DD	DD	zoobenthos	3.5(0.48)
halfbarred pout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	DD	DD	DD	DD	DD	DD
fish doctor	P	R	DD	DD	—	DD	—	—	11.9	—	2.6	3.6	5.2	2.2	2.8	3.5	low	0.85	0.8	DD	DD
longear eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	Nekton	3.5(0.44)
saddled eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
estuarine eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
polar eelpout	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.2(0.38)
threespot eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.5(0.55)
archer eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.2(0.4)
pale eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.3(0.33)
scalebelly eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
doubleline eelpout	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.5(0.47)
fourline snakeblenny	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
Arctic shanny	W	U	DD	DD	—	DD	—	—	11.7	—	—	4.5	—	—	3.3	—	medium	0.95	1.98	zooplankton	3.1(0.23)
daubed shanny	P	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.3(0.39)
stout eelblenny	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.2(0.36)
slender eelblenny	W	U	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	DD	DD
Bering wolffish	W	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.3(0.44)
Pacific sand lance	W	U	DD	DD	—	DD	—	6.9	9.2	12	1.9	2.6	3.7	2	2.5	3.1	medium	0.95	1.56	zooplankton	3.0(0.26)
Bering flounder	U	R	DD	DD	—	DD	—	—	10.9	—	2.2	3.1	4.4	2.2	2.8	3.6	low	0.85	1.06	DD	DD
Greenland halibut	P	R	DD	DD	6800	45167	30000	35.7	48.2	58.2	11	15	21.8	8.8	11	13.5	Very low	0.07	0.32	Nekton	4.5(0.79)
starry flounder	W	U	DD	DD	—	DD	—	10.2	13.8	17.2	3.3	4.4	6.3	2.5	3.1	3.8	medium	0.95	0.9	zoobenthos	3.3(0.38)
Alaska plaice	U	R	DD	DD	—	DD	—	—	28.6	—	—	9.1			6.6		low	0.85	0.5	zoobenthos	3.1(0.30)
Arctic flounder	W	A*	DD	DD	—	DD	—	5.8	7.7	10.4	1.6	2.3	3.2	1.6	2	2.5	medium	0.95	1.24	zoobenthos	3.6(0.54)
longhead dab	U	R	DD	DD	—	DD	—	—	DD	—	—	DD	—	—	DD	—	DD	DD	DD	zoobenthos	3.1(0.31)
yellowfin sole	U	R	DD	DD	1E+06	1732051	3E+06	—	19	—	—	6.5	—	—	4.5	—	low	0.85	0.66	zoobenthos	3.2(0.36)

Note:	Relative Abundance Terms and Definitions
Caveat: Abundance must be considered in relation to spatial area.	**Rare:** A species that seldom occurs or is found in a given spatial area.
Abundance: The number of individuals; contrast with density.	**Casual:** A Species That Turns Up Irregularly In Small Numbers In Areas Outside Of Their Normal Distributional Range.
Abundant: A species that is plentiful in a given spatial area.	**Vagrant** A Species That Has Strayed Off Its Usual Migration Route.
Common: A species occurring or appearing frequently in a given spatial area.	**Visitor** A Species Making A Stopover During Migration Or Has Wandered Out Of Its Normal Distributional Range.
Fairly Common: A species occurring with moderate frequency in a given spatial area.	**Accidental** A Species That Has Been Seen Only A Few Times In An Area That Is Far Out Of Its Normal Distributional Range.
Uncommon: A species not ordinarily encountered in a given spatial area.	**Local:** A Species Found Only In Very Unique Biotopes (E.G. Coral Reefs).

Irruptive: A species that moves (e.g. southward) in some years in large or small numbers and for great or small distances. These irregular movements are generally but not specifically predictable; certainly they cannot be precisely mapped.

Source:

Fechhelm and Griffiths, 2001; Froeseand Pauly, 2003; Frost and Lowry, 2003; Craig, 1989.

Caveat: Distribution is based on range maps available in Mechlenburg et al., 2002. The range maps are based on coarse-grain spatial resolution. **W** = widespread occurrence irrespective of abundance. **U =** questionable or unconfirmed record. **P** = patchy records of occurrence. **D** = data deficient.

APPENDIX E

CUMULATIVE EFFECTS—OIL AND GAS FIELDS AND RELATED INFRASTRUCTURE

E. Introduction

The following is an update of the scenario information for the cumulative effects assessment.

E.1. Scope of Analysis

In this appendix, we offer information regarding the cumulative case. However, we will focus on any new information and changed circumstances that may be significantly enough different from the analysis and conclusions we offered in the Beaufort Sea multiple-sale EIS (USDOI, MMS, 2003a). The discussion of cumulative effects within this Environmental Assessment (EA), therefore, builds on and incorporates by reference the cumulative effects discussions in the multiple-sale EIS and the most recent 5-Year Oil and Gas Program EIS (USDOI, MMS, 2002a). In these documents, the following factors relating to oil and gas activities were considered:

- Oil and gas production on the OCS in Alaska, off California, and in the Gulf of Mexico.
- Past, present, and future oil and gas development onshore and offshore Alaska as well as related infrastructure.
- Transportation of Alaska oil: the effects of transporting Alaskan oil along the U.S. west coast, from Valdez to the Cook Inlet, and the transport of oil through the Trans-Alaska Pipeline System.
- Construction projects related to community development and transportation systems.
- National issues, such as global warming and alternative energy development

Along with oil and gas activities, other issues were considered such as sport and subsistence hunting and fishing, commercial fishing, sport harvest, loss of overwintering range, tourism, and recreational activities.

Oil and gas activities, considered the cumulative case for this EA and in the multiple-sale EIS, were divided into the following developmental categories:

1) Past Development/Production.
2) Present Development/Production.
3) Reasonably Foreseeable Future Development—those oil and gas discoveries that have a reasonable chance of being developed during the next 15-20 years.
4) Speculative Development—those exploration and development activities that could occur after the 15-20 years from future State and Federal lease sales.

We focus on the first three categories and consider exploration activities of the fourth category. Some activities beyond the 15- to 20-year life of the Beaufort Sea multiple sales are considered too speculative at this time to include, while other such activities are included in this analysis. In this EA and in the Beaufort Sea multiple-sale EIS, we excluded future actions from the cumulative-effects analysis, if those actions are outside the geographic boundaries or timeframes established for the cumulative-effects analysis.

E.2. Development Scenario Assumptions

For our analysis, we formulate oil and gas scenarios based on our estimate of future activities. Our scenarios are conceptual views of the future. Underlying the cumulative-effects assessment and the assessment of Alternative I for Sale 195 and the other alternatives, we offer scenarios on the timing and extent of future petroleum activities in the Beaufort Sea and on the North Slope.

Estimates of anticipated production consider many factors, including the economically recoverable resources of the area, past industry leasing and exploration efforts, and future economic conditions. In the Beaufort Sea, only 8 of 24 scheduled Federal sales have been held, and a small fraction (726) of the tracts offered (12,035 tracts in the 8 sales) were leased. Few of the leases actually were tested by drilling (30 wells on 20 prospects). Most discoveries (11 wells determined to be producible) are too small or too costly to become viable fields (one field [Northstar] is producing and one [Liberty] development has been suspended indefinitely). Under optimum conditions, the chance that commercial fields will be discovered could be 10-20%. However, on the North Slope, the success rate for finding new commercial fields is likely to be lower. Consequently, anticipated production volumes and associated environmental effects often turn out to be overstated.

For the three lease sales analyzed in the multiple-sale EIS (Sales 186, 195 and 202), MMS assumed that industry would lease and explore tracts that were nearer to existing infrastructure and relatively shallow in water depth. We still expect that the three proposed lease sales will result in more than 50% of the tracts leased be located in the Near Zone and the balance of the tracts leased in more distant areas (please see Table III.A.1 of the multiple-sale EIS). As a result of Sale 186; however, The EnCana Corporation leased 24 OCS tracts off of the Dease Inlet. While these tracts make up the bulk of the 34 tracts leased, developmental efforts related to the EnCana tracts may not generate the bulk of oil- and gas-related activities resulting from Sale 186. Other factors related to logistical accessibility and locations closer to producing fields may mean the remaining leased fields will receive the greater share of Sale 186-related development activity. Nevertheless, EnCana’s leases, coupled with ongoing leasing and exploratory activity within the National Petroleum Reserve-Alaska (NPR-A), increases the possibility that a permanent road system along the western Alaska Arctic coast will be constructed in the future.

E.3. Resource Estimations

Since publication of the multiple-sale EIS, the only oil- and gas-related activities on the OCS in the Beaufort have been the issuance of the Sale 186 leases. There have been no new seismic or drilling activities offshore; hence, we have no new oil and gas resource information. The description of the oil and gas resources, the potentially affected environmental resources, and the proposed activities described in the multiple-sale EIS reflect our best available information. While new leases have been issues, there is no new resource information. The detailed reserve and resource estimates (USDOI, MMS, 2003a:Table V-7c) used for analysis in the multiple-sale EIS remain virtually the same for this EA. In Table V-7c, offshore and onshore production for all past and present production was calculated at 5.4 billion barrels (Bbbl); onshore and offshore production from fields determined to be reasonably foreseeable was calculated at 5.6 Bbbl barrels; and onshore and offshore production that may produced from fields whose development was determined to be speculative was calculated at 3.6 Bbbl. Potential gas reserves, including from speculative fields, was estimated at 33 trillion cubic feet.

The MMS will continue to update its files regarding new and potential field/resource developments that may occur on the North Slope. This EA evaluates the suite of alternatives and issues considered in the EIS, along with any new information we receive regarding resource data, through the Request for Information and the public meetings processes.

E.4. Oil and Gas Fields and Related Infrastructure

Table V-1a in the multiple-sale EIS lists North Slope fields and discoveries. Tables V-lb and V-1c list the current and proposed transportation projects and future lease-sale activities we consider in this cumulative analysis. Figure III.A-1 shows the location of fields and discoveries in Table V-1a and areas of exploration. Table V-1a groups North Slope fields and discoveries into four categories: Past Development/Production, Present Development/Production, Reasonably Foreseeable Future Development, and Speculative Development.

Past Development includes 31 producing fields on the North Slope and nearshore areas of the Beaufort Sea. Infrastructure, cumulative production, and remaining reserves are well defined. Individual oil pools can be developed together as fields that share common wells, production pads, and pipelines. Fields can be grouped into production units with common infrastructure, such as processing facilities. Impacts associated with development have occurred over the past 3 decades, and there are data from monitoring that accurately reflect some of the long-term effects. The Endicott, Sag Delta, Sag Delta North, Point McIntyre, Niakuk, Eider, and Northstar units are located offshore.

The Present Development/Production (production within the next few years) includes fields that are in planning stages for development but have not begun production. Infrastructure components, scheduling, and reserve estimates are fairly well defined, although reserve volumes could be revised later. Commonly, new planned developments will be tied into existing infrastructure, and they depend on the continued operation of this infrastructure. Included in this group are three discoveries that are expected to start up within the next few years, all of which are onshore.

Reasonably Foreseeable Future Development (within the next 15-20 years) includes 16 discoveries that might see some development-related activities (site surveys, permitting, appraisal drilling, or construction) within the next 15-20 years, with Liberty, Kalubik, Gwydyr Bay, Sandpiper, Flaxman Island, Kuvlum, Thetis Island, Stinson, and Hammerhead located offshore. Additional onshore and offshore resources currently are undiscovered. The MMS developed the information about reasonably foreseeable future development and production and considers it the best available information. This category includes activities that are reasonably foreseeable within the next 15-20 years. It is reasonable to expect that these activities would begin with the development of discoveries in close proximity to existing (past and present) fields to share infrastructure. We have attempted to rank the chance of development according to resource size and proximity to existing infrastructure. Resource volumes are uncertain in this category. There generally are inadequate drilling data to define reserves or engineering studies to support development. Also, we cannot predict the development timing for future fields. Many of these discoveries were made decades ago and remain noncommercial today. Without technology advancements and higher petroleum prices, many of these discoveries could remain undeveloped.

Speculative Development includes additional new discoveries that could be made and developed beyond 20 years, in conjunction with 13 past onshore discoveries. The chance for development is too uncertain for detailed analysis at this time. Additional exploration activities (wells and seismic surveys) are likely to occur and have been factored into the analysis. This group includes small discoveries and undiscovered resources that are very unlikely to be developed in the timeframe of less than 20 years. Some of the discoveries listed in Table V-1a of the multiple-sale EIS were made 50 years ago and remain noncommercial today. There are a variety of reasons, including very remote locations, low production rates, and lack of gas-transportation systems that will remain in effect in the foreseeable future. With respect to undiscovered resources, it is not reasonable to estimate new infrastructure or predict the effects of development for prospects that have not been located or leased to industry for exploration. Accurate predictions of the location, size, or development schedule are not possible at this time.

These four development categories represent all known oil and gas sources that potentially could be developed on the North Slope and Beaufort Sea. The analysts preparing this EIS focus on the first three oil and gas development categories and consider the fourth category (speculative) with respect to seismic and associated exploration activities associated with future State and Federal lease sales. Other activities and issues could be analyzed as they apply to particular resource topics. These areas of additional evaluation may include cumulative effects from activities related to development in migratory overwintering ranges, environmental contamination, subsistence harvest, sport harvest, commercial fishing, marine shipping, tourism, and recreational activities.

Basic transportation and logistics assumptions also have not significantly changed since the completion of the Beaufort multiple-sale EIS. However, some issues related to North Slope transport have arisen that may influence some analytical considerations. As a result of Sale 186, 24 tracts were sold near Smith Bay. These tracts are approximately 80 miles west of Prudhoe Bay. Given the continuing exploration in the NPR-A and the pending (June 2004) Northwest NPR-A lease sale, discoveries on OCS tracts in the western Beaufort Sea and the discovery of commercially recoverable oil and gas deposits in the Northwest NPR-A will tend to lead to the construction of a permanent road system along the western North Slope. Nevertheless, such a potential growth in oil-related transport infrastructure remains speculative in nature, as its existence will rely not only on oil and gas discoveries but on the location of those discoveries.

Onshore, the State of Alaska repeatedly has indicated a desire to expand the North Slope road networks connecting the North Slope villages with access to interior Alaska and the North American road network. In November 2003, the State announced that it was going to submit its wetlands development application to the Corps of Engineers for the construction of a 105-mile (mi) long highway joining the Dalton Highway with the community of Nuiqsut (*Anchorage Daily News*, 2003). The road would begin at the Dalton Highway 57 mi south of Deadhorse and 357 mi north of Fairbanks and parallel the Brooks Range before swinging north for 40 mi to Nuiqsut. Oil companies engaged in exploring NPR-A resources are supportive of the road. Required environmental reviews and permits will need a 2 year period, with construction beginning at the earliest in 2006. The costs of such a road are estimated at $350-$400 million dollars. The State of Alaska is experiencing a steadily contracting budget due to declining revenues, and the aforementioned construction timeframe may be considered optimistic. Therefore, the probability of such a road or roads like it supplementing the North Slope road network is still categorized as speculative. Some surveys have been conducted for a Colville road route, which would join Nuiqsut to the spine road via an 18-mile, all-season road that would be built from the spine road to the Colville River crossing site. It is closer to reality; however, the State has set aside no funds for such a road and bridge. Given the tight budget of the State, the Colville River road also is considered speculative. Additional information on the routes is available on the State of Alaska, Department of Transportation and Public Facilities internet site at www dot. state.ak.us./stwplng/industrialroads/northoilroads.html.

Table V-1b, of the multiple-sale EIS, shows the various routes by which North Slope gas could be transported to market. Although these concepts remain valid, the Alaskan voters in November 2003 added an additional facet to the future of gas transportation. In that election, the voters authorized the establishment of the Alaska Natural Gas Development Authority, which was vested with power to arrange financing and select potential routes (Table V-1b of the multiple-sale EIS) and, since its inception, has attempted to market an Alaska gas pipeline to potential investors and product users. Congressional attempts to hasten the construction of the gas pipeline through Federal subsidies have not yet succeeded. Therefore, we still categorize the construction of a gas pipeline as speculative.

Appendix F

Comment Letters on Proposed Lease Sale 195 and Agency Responses

Three comments were received in response to the Request for Information (RFI) and Notice of Intent (NOI) to prepare an EA. The RFI/NOI was published in the *Federal Register* on December 16, 2003. The comment period ended January 30, 2004. The RFI requested comments on any significant new information that has become available since the MMS issued its February 2003 Beaufort Sea Multiple-sale EIS.

The only comments were from the State of Alaska, Office of Project Management and Permitting; the Mayor of the NSB (NSB); and the Executive Director of the Alaska Eskimo Whaling Commission (AEWC). No comments were received from industry in response to the RFI/NOI

The State of Alaska, Office of Project Management and Permitting, stated there was no new significant information available since the Beaufort Sea multiple sale EIS (USDOI, MMS, Alaska OCS Region, 2003a).

The NSB Mayor and the AEWC Executive Director commented on several issues. In the following, we identify (in bold text) each issue and provide a summary followed by the MMS's initial response. In addition, where possible, we identify the location of further responses.

Need to prepare a supplemental EIS rather than an EA.

> The NSB believes that the final 2003 Beaufort Sea Multiple-sale 186, 195, and 202 EIS is flawed; that it does not comply with the intent of the NEPA; and that the deficiencies in the Multiple-sale EIS prevent its use as a support document for any decision to eliminate or reduce previously adopted area deferrals in the extreme eastern and western portions of the planning area. The NSB believes that an EA would be inadequate to accommodate the analysis needed to address their concerns and that a supplemental EIS (SEIS) is needed before proceeding with Sale 195. The AEWC believes that the new information and the potentially serious adverse consequences for the bowhead subsistence hunt are sufficient to compel the preparation of a SEIS for Sale 195.

The MMS considers and critically evaluates the reliability and usefulness of all forms of available information. As part of our responsibility for conducting a NEPA review, the MMS synthesizes existing studies and other information, including traditional and local knowledge, and analyses of potential effects on subsistence resources and subsistence activities. The MMS has determined at this point that new studies are not necessary for the environmental analysis in support of Sale 195. The MMS has sufficient information for impact analysis in support of areawide leasing decisions for the Beaufort, Outer Continental Shelf (OCS). The level of information and detail in the EIS is appropriate for an areawide lease sale analysis and is in accordance with the provisions of NEPA to keep EIS's concise and no longer than absolutely necessary (40 CFR 1502.2(c)) and to use tiering to focus on actual issues ripe for decision (40 CFR 1502.20). The EA analysis for Sale 195 will review and incorporate all pertinent new information into the environmental analysis and, if a new NEPA significant effect is identified, the MMS will prepare a supplemental EIS.

Inadequacy of the alternatives evaluated in the multiple-sale EIS.

> The NSB believes that the deferrals for Sale 186 were inadequate and that the scenario in the Multiple-sale EIS did not accurately predict industry bidding in Sale 186 (specifically, bids offshore of (Smith Bay)). The NSB wants the development scenarios to be reevaluated. They believe reevaluation will support more relevant deferral areas. The AEWC states that there has been no change in circumstance that would justify offering Sale 195 without the Barrow and Kaktovik deferral areas. Further, the AEWC states that the MMS must address the need for a deferral area around Cross Island (Nuiqsut's whaling area), Barrow, and Kaktovik.

The MMS considers the six alternatives, which are evaluated in the EIS and this EA, to be fully adequate. In addition to the Proposal and no action alternatives, the EIS and this EA evaluated four deferral alternatives. In Section I.C.2.b (page I-13) and Appendix E (Scoping Report) of the multiple-sale EIS, the MMS evaluated other alternatives and provided information and analysis for its decision that other suggested alternatives should not be included for further analysis. Section IV.A (Page IV-1) of the multiple-sale EIS provides information to the reader about the uncertainty involved in scenario development and the Agency's ability to project where companies may bid, explore, and develop. The EIS specifically states that: "(a)lthough the scenarios prepared for this EIS do not assume development in the Far Zone until after Sale 202, companies could bid on and be awarded leases in any of the zones in any of the sales." It adds that: "(b)ecause this EIS evaluates the effects of leasing in all three zones, the effects attributed to any zone could occur as a result of any lease sale, if they occur at all."

This EA evaluates the same six alternatives considered in the EIS. For the Notice of Sale, the Secretary may select the proposal, the no action alternative, or any combination of the four proposed deferral alternatives, which include the Barrow, Kaktovik (Cross Island), and/or Nuiqsut Deferrals, as well as the Eastern Deferral. The Secretary may also include any of the standard mitigating measures evaluated in the FEIS, plus any new mitigation developed and analyzed in the EA.

Adequacy of existing statutes, regulations, lease sale mitigating measures, and permit conditions to protect critical subsistence resources.

> The North Slope community does not believe that existing statutes, regulations, lease sale mitigating measures, and permit conditions will adequately protect the critical subsistence activities. They do not understand the rationale for or believe in the adequacy of the criteria that the MMS uses to develop scenarios and oil spill trajectories.

Existing statutes and regulations have supported decades of safe and environmentally sound offshore oil and gas operations in the Gulf of Mexico, offshore California, and offshore Alaska. The MMS regulations are intended to ensure safe operations and prevent pollution. Both the MMS operating regulations and Oil Pollution Act of 1990 requirements are very robust, requiring the "best available and safest" practices. The same regulatory framework would apply to permitted operations in the Arctic OCS. Lease stipulations and conditions of permit approval are additional enforceable measures and are intended to address protection of sensitive resources in a specific area. The MMS performs rigorous engineering and environmental reviews of proposed activities prior to approval. We have a vigorous inspection program to ensure compliance with regulations and other operating requirements. Through our NEPA processes, the MMS is constantly updating information, the evaluation of potential adverse effects, and mitigation measures. The MMS is mandated by law to protect subsistence resources and activities from significant adverse effects from oil and gas activities. The standard mitigation package developed and evaluated for the three sales in the Beaufort Sea provide considerable protection to subsistence resources.

The NEPA analysis in the EIS and this EA use the best resource information available to the MMS and the scenarios we developed to assist us in evaluating the potential effects are considered realistic. However, we cannot always predict where industry will bid; therefore, we provide an analysis that evaluates exploration and development, should it occur, anywhere within the area identified for evaluation. The oil spill analysis uses the best models and information available to the MMS. We continue working with the NSB and others to further refine and improve these models. The MMS is confident that they provide the best available assessment of potential effects.

Need NEPA evaluation of the ongoing revisions to the NSB Coastal Management Program.

> The NSB is revising their NSB Coastal Management Program. The NSB believes the new standards and policies need to be evaluated before Sale 195 decisions.

Exploration, development, and production activities on the OCS occur outside of the NSB boundary and are not subject to the land management regulations that are part of the NSB plan. However; in compliance with the Coastal Zone Management Act, the MMS oil and gas lease sales will be consistent to the maximum extent practicable with the provisions of the NSB's plan to the extent that such provisions are incorporated as enforceable policies in the federally approved NSB Coastal Management Program (CMP). When the Consistency Determination (CD) for proposed Sale 195 is prepared, the CD will evaluate the sale and related activities for consistency with the standards and policies that are in force at that time.

Regulations require that all activities taking place in the coastal zone or affecting any coastal use or resource must be consistent with the applicable coastal management program. All proposed activities must be reviewed by the State and the coastal districts for compliance with their coastal programs. The MMS cannot issue a permit for activities unless the State concurs with an applicant's consistency certification; is presumed to concur; or, if on appeal, the Secretary of Commerce overrides the State's objection. The MMS permittees must certify, in their permit applications, that any of the proposed activities with a reasonably foreseeable affect on any coastal use or resources will be conducted so as to be consistent with the Alaska Coastal Management Plan, including the NSB CMP enforceable policies. This certification is reviewed by the State and the NSB prior to the MMS approval of the permit. If the State does not concur with the certification, the MMS, **by law,** cannot issue the permit until the lessee revises their plan to make it consistent or, if on appeal, the Secretary of Commerce overrides the State's objection.

Need to evaluate recent bowhead whale feeding studies and other studies in the NEPA analysis for Sale 195. Need to complete additional studies on bowheads for Sale 195 analysis.

> The NSB and AEWC want the MMS to fund new bowhead feeding studies and incorporate them into the NEPA analysis. Regarding bowhead whale feeding areas, a new study (in press) challenges the recently completed MMS study and offers new facts to consider in evaluating the feeding ecology of the bowhead whale. The NSB maintains that, in light of this new information, the MMS must reevaluate the deferral area designations. The NSB believes that the evaluation shows industrial noise displaces bowhead whales. Preliminary results show that industrial noise (in this case boat noise) alters the migration pattern of bowhead whales. The NSB believes that this study confirms that industrial noise is the reason that subsistence hunts are gradually moving into deeper waters, making the hunts more dangerous for subsistence hunters, and making it more likely that the whales may spoil before being landed.

The MMS considers the information and evaluation of effects in the EIS to be adequate and to meet the needs and requirements of the Agency as identified in NEPA. The EA for proposed Beaufort Sea Sale 195 will identify, review, and evaluate pertinent new information including the studies noted by the NSB and AEWC. The EIS did include information about the feeding area offshore of the Arctic National Wildlife Refuge, and the EA will include an analysis of the Eastern Deferral. The MMS acknowledges that whales, including bowhead whales, feed in the Beaufort Sea. However to date, we have not identified any specific area(s) within the Beaufort Sea planning area that are critical for the survival of the species; nor did the National Oceanic and Atmospheric Administration (NOAA) Fisheries identify such areas in the Endangered Species consultation for Sale 186. The 2003 Multiple-sale EIS and the Sale 195 NEPA analyses include the current, pertinent, and necessary environmental information for assessment of the potential effects to North Slope subsistence resources and to the residents of the North Slope due to the proposed OCS leasing in the Beaufort Sea.

The design, procurement, collection of data, and preparation of reports for large studies such as those proposed by the NSB and the AEWC take many years. As noted below, MMS intends to continue working with the NSB and others to obtain additional information and knowledge about marine mammals and other resources in the Arctic.

The issue of the impact of noise on marine mammals is complex. Many variables affect the propagation of sound from a given source; and whether a particular animal will hear the sound, whether that animal will be impacted in any manner by the sound, whether any impacts are measurable and interpretable in a meaningful way, and whether any impact is biologically significant. Many of these issues recently have been, or are being, addressed in studies and by a variety of committees and groups, including groups convened by the Marine Mammal Commission, the NOAA Fisheries, the U. S. Navy, and scientific societies.

Recent information from the suite of studies conducted by Dr. J. Richardson and colleagues on the activities at Northstar, the detection of noise from that facility, and potential effects on bowhead whales and seals, as well as information from other relevant studies in the Beaufort Sea, also is available. Thus, new and recent information exists on these topics, and other information presumably will be forthcoming from the many joint efforts on this topic. As information has become available, the MMS has incorporated it in our assessments, such as those presented in the EIS. The MMS will summarize available information on potential impacts of OCS oil- and gas-related noise (and other information related to evaluating impacts of our Proposed Action on bowheads) in an appendix of the environmental evaluation for Beaufort Sea Sale 195. The MMS will continue to consider and to critically evaluate all relevant available information in our analyses. We also continue to evaluate the need for further studies to provide additional information on key topics.

At present, we believe that the information available on the potential impacts of industry-related noise in the Beaufort Sea provides us with a sufficient basis for our analyses and decisionmaking. However, as part of our ongoing iterative process, we will carefully reconsider the available information relative to the request for further study of the characteristics and propagation of industry-related noise in the Beaufort Sea, and potential impacts from that noise on subsistence species, including the bowhead whale. Our existing program of monitoring impacts to marine resources from offshore oil and gas activities is being conducted under our Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) suite of studies. We will evaluate any new information from recent studies in the EA.

The MMS Environmental Studies Program (ESP) has a well-established process for identifying studies and for determining study content and design. Our process incorporates extensive peer review at many levels and milestones in its processes. The MMS will invite the NSB to participate more fully within this existing framework. To that end, the MMS will provide the NSB with our environmental study plans, schedules for Scientific Committee meetings, and other pertinent information.

Need additional evaluation of oil spill data.

> The NSB's Science Advisory Committee (SAC) review of the oil spill risk estimates made by the MMS concludes that the risk assessment is not adequate to meet the needs of the North Slope (protect their subsistence resources in case of a spill) and that the risk assessment does not provide adequate indication of its accuracy or reliability. The NSB wants the recommendations of SAC taken into consideration before proceeding with Sale 195.

The oil-spill-risk estimates are appropriate to support the analyses in the EIS and to support the decisions to be made on areawide leasing on the Beaufort OCS. The EIS and the EA both assume an oil spill greater than 1,000 barrels will occur, and they evaluate the potential effects to the various resources of such a spill. The NSB SAC recommendations focuses on the description of the risk of a spill occurring. Changes in the risk of spill occurrence would not alter the assessment of the effects of a large oil spill.

Some of the recommendations from the SAC were incorporated into the oil-spill analysis in the EIS for Sales 186, 195, and 202. Some recommendations are being incorporated into the EA for Sale 195. Other recommendations have been developed into studies that are proceeding through the study process. The MMS also might be able to arrange for further discussions among the MMS technical experts (Dr. Walter Johnson, Dr. Richard Prentki, Ms. Cheryl Anderson, Ms. Caryn Smith, etc.) and the NSB SAC representatives in order to further evaluate and discuss some of the SAC proposals.

During Fiscal Year 2004, MMS prepared for procurement study #NSL AK-04-02, entitled *Improvements in the Fault Tree Approach to Oil Spill Occurrence Estimators for the Beaufort and Chukchi Seas*. The variability in the non-Arctic effects is to be addressed in this study.

That study is based on a fault-tree method that modifies the Gulf of Mexico oil-spill rates to expected arctic oil-spill conditions. None of the terms in the fault tree can be "known" for arctic conditions with certainty until there are more Arctic specific operations with performance data to analyze. A testable hypothesis of the arctic spill rates will have to rely on future performance.

Need to incorporate National Petroleum Reserve-Alaska (NPR-A) activities, other onshore activities, and NRC (NRC) reports in the cumulative analysis.

> The NSB believes that the Multiple-sale EIS failed to incorporate the results of two NRC reports on cumulative effects (1994 and March 2003). The NSB wants the activities associated with exploration and possible development in NRP-A Northeast addressed in the cumulative impacts. They want the cumulative analysis to include also the effect to allotment holders and cabin holders at Teshekpuk Lake from barge traffic and industrial noise (which they feel deflect the whales farther offshore and affect the migration during whaling); the location of staging areas; and the activities from the Sale 186 (which they feel will result in significant impacts and weren't evaluated in the EIS).

The MMS has reviewed the 1994 and 2003 NRC reports. Information from the reports is considered in our NEPA analyses, as appropriate. The NRC's recommendations are being taken into consideration in developing the MMS Environmental Studies Plan.

The EIS did evaluate and consider potential effects of onshore leasing, exploration, and development, including activities in the NPR-A. The cumulative analysis in the EA will include any available new information about onshore activities on the Arctic. However, much of the activity associated with the

Bureau of Land Management (BLM) proposed sales in the Northwest NPR-A and the proposed modifications to the Northeast NPR-A Plan are speculative in nature. The EIS did consider all known and reasonably foreseeable oil and gas projects on the North Slope, and the EA will consider any new reasonably foreseeable activities.

The scenarios evaluated in the Beaufort Sea EIS for Sale 186, 195, and 202 did identify and evaluate potential effects of onshore oil and gas facilities supporting offshore activities, including a shore base at Point Thompson or Smith Bay (USDOI, MMS, Alaska OCS Region, 2003a:Section IV.B.2.b(2)(c), p. IV-10). The EA will evaluate any new information and potential effects associated with reasonable foreseeable projects. We believe that part of the NSB's concern is related to offshore vessel traffic in support of onshore oil and gas activities. The MMS does not control, permit, or regulate offshore barge or shipping activities associated with onshore facilities.

Need to improve communication and consultation between the MMS and the NSB communities.

> The NSB community feels there is a "disconnect" between the MMS and residents of the North Slope as to how decisions are made on lease sale actions.

In an August 27, 2003, letter, the MMS made a commitment to ongoing consultative processes among the MMS, NSB, AEWC, and ICAS for the purpose of resolving outstanding issues. As part of this process, MMS met with North Slope groups in late January and early February. Those results of those meetings are summarized and available upon request.

The Alaska OCS Region staff met on February 5, 2004, with ICAS in Barrow for a government-to-government meeting. At this meeting, MMS discussed all three of the comments received in response to the RFI/NOI, the proposed schedule, and the next step in the 15-month process for Sale 195. A complete summary of this meeting is available upon request.

The MMS is considering the merits of entering into a Memorandum of Understanding (MOU) with the NSB, ICAS, and AEWC. We intend to fully respond to their requests either through the MOU process, the Sale 195 NEPA evaluation, and/or additional correspondence.

Appendix G

Summary of Meetings in Barrow and Anchorage

Government-to-Government Meeting with the Inupiat Community of the Arctic Slope (ICAS) in Barrow on February 5, 2004

The following attendees are from ICAS except as otherwise noted:

Rosemary Ahtuangaruak	Janice Meadows
Joseph Akpik	Lucille Mayer
Edward Arey	Jack Shaeffer
Rebecca Brower	Mike Stotes
Martha Ipalook-Folk	Cindy Thomas
Doreen Lampe	Vera Williams
Albert Barros, MMS	Paul Stang, MMS

Paul Stang provided information on Beaufort Sea Sale 195. He stated that the Request for Information and comments were due January 30, 2003. He then provided a summary of the comments received and left the council a hard copy of the summary. He stated that MMS will do an Environmental Assessment (EA) for the sale. However, he said that among the comments received, the NSB (NSB) and the Alaska Eskimo Whaling Commission (AEWC) want a supplemental EIS rather than an EA.

The MMS distributed copies of the Sale 193 Chukchi Sea/Hope Basin Call for Information and Nominations. Those on the conference call asked a series of questions about it as follows:

Someone asked, what tribes did you visit? Paul Stang answered Gambell; Savoonga; Emmonak (a meeting of tribal, nonprofit corporations, and local government for an economic meeting); Point Hope; Kivalina; and Kotzebue; we also made a presentation at a meeting of Kawerak, Inc., a regional corporation, which was attended by Tribal representatives.

When Paul stated that the Call was for industry interest, he was asked if tribes were considered as industry. Paul responded no, that industry is those oil and gas companies that operate in or may relocate to Alaska. A sale will not be held if industry does not express an interest in bidding, even if tribes want to have the sale. If there is interest, MMS will discuss with the company to determine the general area of interest and then issue another *Federal Register* notice. The sale would be one of competitive bidding. The lease-sale process takes about 2 years from interest to actual bidding and awarding of leases.

Doreen Lampe asked how many years are the leases active. Paul said 5, 8, or 10 years; it is specified in the lease. Lessee can get an extension if there is activity, but they must have made progress with activities on the lease. They need to demonstrate intent to proceed with exploration and, if they make a commercial discovery, go on to development to keep the lease.

Paul was asked what MMS is promising to tribes if they support exploration. Paul said development depends on a sizable find that is economically profitable, but that we do not promise anything. Martha said that a good example of a cooperative agreement is the Alpine and Nuiqsut agreement. Paul stated that the MMS cannot tell companies to make such a deal.

Paul then answered a few general questions about the sale area for 193.

A concern was expressed for spring whaling in the Chukchi Sea. The villages along the west coast of Alaska do not hunt for whales in the fall. Paul replied that there are stipulations that address conflict avoidance, and that they are negotiated by the AEWC.

Someone asked if all studies for Sale 195 are available? Paul gave Cleve Cowles' phone number as head of the studies section.

Another attendee asked if MMS received all of the testimony? Paul answered yes, the comment period ended on January 30.

Doreen was concerned that the State of Alaska said that there is "no new information available." She said that the NSB has new information on bowhead whale feeding areas. How does that come into play? Paul stated that all comments are considered, but that more specific comments are of particular value to MMS.

Action Item: The MMS will send 20 copies of the 25 years of testimony on the North Slope to ICAS and also 5 copies of a document on working effectively with the villages of Nuiqsut and Kaktovik.

Jack Shaeffer stated that last summer, there was a bad storm that caused a research ship to come into their harbor. The ship was studying gray whale feeding behavior because of a concern about the plankton and the fact that the gray whales are moving farther north. He thinks it is a University of Alaska, Fairbanks study.

Action Item: Send maps of Beaufort Sea Sale 195 to ICAS for use in their meeting room whenever they have discussions.

Paul explained that deferral areas are areas that are set aside during a lease sale, and those tracts will not be available to bid on. Subsistence areas are one reason for deferrals. Paul was then asked if deferral areas can become automatic if they are deferred in one sale. He responded that each sale is different from previous sales, and the Secretary of the Interior makes those decisions each time a sale is held.

Someone asked: Does MMS have to be in compliance with the State of Alaska's Coastal Zone Management (CZM) Plan? Paul answered yes; also, the NSB has plans that are included in the State plan. The MMS is guided by the State and local plans.

Paul explained that under the provisions for Federal consistency, a procedural difference exists between a lease sale and exploration or development. For a lease sale, the sale can proceed if a State objects to a Federal Agency's consistency determination, and the State would have to prevail in litigation to stop it. However, an exploration or development plan cannot be approved until the State says it is consistent with their management plan. The approving Federal Agency is prevented from approving the plan over the State's objections unless an elaborate appeal process takes place.

Vera Williams stated that the same applies to NSB's Title 19 Section 96.

Joseph Akpik asked if MMS received the summaries from NSB and AEWC? He is supportive of the NSB comments—the 195 EIS is a flawed document. Paul said no, the summary is a composite put together by MMS from all comments received.

MMS Meeting with the NSB and Alaska Eskimo Whaling Commission at 3000 C St. Suite 210, Anchorage on February 10, 2004

Participants:

Mayor George Ahmaogak, Sr., NSB
Tom Lohman, NSB
Maggie Ahmaogak, AEWC
Harry Brower, Jr., AEWC
John Goll, MMS
Paul Stang, MMS
Albert Barros, MMS

Paul Stang opened the meeting with a discussion of the recent Call and how the process will work for the Chukchi Sea/Hope Basin “Special Interest” Sale 193. Tom Lohman stated that he remembers Point Hope being interested in oil and gas for local power and economic development.

Sale 195

Paul explained that the 2003 Beaufort Sea EIS was for the three lease sales in the current 5-Year Program, including Sale 186 that was held in September 2003. The final EIS stated that MMS would do an EA for each of the two subsequent sales (Sales 195 and 202) and make it available for comment. The Call for Information for Sale 195, closed and we have received three comments: one from the AEWC, one from the NSB, and one from the State that mainly says that they have no additional comments. Mayor Ahmaogak asked who from the State made that comment. Paul said it was the State’s Office of Project Management and Permitting.

Tom Lohman asked if in the letter they discussed deferrals in State sales versus OCS deferrals. He said that the Alaska Governor supported the AEWC and the NSB but then asked if they (State of Alaska) should take out or modify deferrals in their sales. Paul responded that the letter did not mention deferrals.

Mayor Ahmaogak stated that when he was in Washington, D.C., he personally delivered to MMS Director Burton a copy of the January 16, 2004, letter from the NSB submitting a Memorandum of Understanding for MMS to sign.

Mayor Ahmaogak asked: What is the position of the Department of the Interior after receiving the three comment letters? The Mayor emphasized the NSB request for a supplemental EIS. Our response was that wee will do the staff work and make recommendations to MMS Headquarters for consultation with the Department of the Interior on whether to do an EA or an EIS.

John Goll stated that we would follow National Environmental Policy Act rules and would be obliged to do a supplemental EIS if MMS found, while doing the EA and addressing the issues that the NSB and AEWC have brought up, any new information indicating that additional significant effects would be likely from Sale 195. These would have to be effects that were not addressed in the 2003 final EIS.

John said that the Area Identification starts off with a clean slate—everything is included. The candidate deferral areas will be included in an assessment. Mayor Ahmaogak asked if there will be a public input process. We answered that the EA will go out for a 30-day comment period. Additional comment also will be requested after the Proposed Notice of Sale is issued. However, there is no formal consultation except for Government-to-Government with federally recognized Tribes.

John Goll asked if the charts that were referred to in the NSB Memorandum of Understanding proposal were the ones that MMS submitted to the NSB as a timeline for comment opportunities.

Tom Lohman stated that yes they were, but they were modified. Todd Sherwood should make those available to MMS.

John Goll stated that we will honor what we said we would do in our August 27, 2004, letter to the NSB/AEWC and the IICAS for meeting with the NSB.

If MMS decides that an EA is sufficient, the Proposed Notice of Sale is another opportunity for public comment.

Tom Lohman said the State's CZM is changing.

John Goll replied that we still have to go through the CZM process for consistency.

Paul indicated that according to our schedule, the EA should have a 30-day comment period starting about June 1, 2004. The Proposed Notice of Sale will be issued in October. Beaufort Sea Lease Sale 195 is tentatively set for March 30, 2005.

Action Item: Paul will provide the NSB and the AEWC with copies of key MMS milestones for lease sales.

Mayor Ahmaogak asked: Still no decision on an EA or supplemental EIS?

Paul Stang responded that we will do an EA and, if we find new significant effects, we would conclude that a supplemental EIS is needed. A supplemental EIS would addresses new issue(s) that are different from what was discussed in Sale 186.

Someone from the AEWC said that Smith Bay was not covered in the EIS. There was no consideration of the Smith Bay area in the EIS.

John Goll stated that our lawyers made us look at all areas, and Smith Bay was included in a scenario.

Another AEWC representative stated that the MMS should look at what happens if a platform is situated at a specific point.

John Goll responded that we look at resources and what activities do to species in a general area. We will discuss with Headquarters if we can discuss hypothetically what would happen if we site a platform at Cross Island.

Mayor Ahmaogak stated that the new issues are: (1) oil and gas activities are getting closer to Barrow; the new leasing in Smith Bay; and the activities associated with exploration and possible development in the Northeast NPR-A; and (2) allotment holders and cabin holders at Teshekpuk Lake are concerned about barge traffic and industrial noise. ConocoPhillips was drilling onshore at Puviak but offloaded supplies and drilling rig at Lonely by barge. This was done before the fall hunt, but whales still were deflected out to 20 plus miles according to Whaling Captains' information. We are concerned about what will happen at Smith Bay in relation to deflection of whales during the hunt. Where are the staging areas going to be? How are you going to mitigate effects?

John Goll said that MMS will provide oversight, and the NMFS would have to be asked for a Letter of Authorization. Was there any oversight on barges that were providing support for Puviak?

Mayor Ahmaogak said no. This will be a significant issue when EnCanna goes out there to explore the MMS tracts they just bought; there will be a lot of impacts. There was no discussion of this in the EIS.

John Goll replied we would require that these activities not take place during whaling.

Mayor Ahmaogak said there is new information, not just mitigation; a new issue requires an EIS. This is significant information. The Department of the Interior ought to be supporting a new EIS. The last one was lacking in alternatives and had nothing on logistics, let alone impacts for activity in that area.

Paul Stang responded that the EISS had some discussion on activities in three different zones.

Tom Lohman: I am the one from the Borough that reads these things, and I would rather read a short document than a long one. Let's work together to increase confidence in each other especially with the Barrow Whalers.

Harry Brower, Jr., President of Barrow Whaling Captains, said: Put a rig in Smith Bay and discuss what would happen, especially where activities would be coming onshore. You should work with the Bureau of Land Management. I am concerned about the effects of onshore activities combined with offshore activities. Nuiqsut got their whales in their usual place but in Barrow, Jake Adams' crew got theirs early, about 5-12 miles out. The rest were 20 miles out due to barge traffic. They were operating for 2 weeks. The first week was one barge, then 1 week of bad weather with no traffic. There is some evidence that barge and tug traffic affected the migration.

An AEWC representative said there was more than one barge, there were two barges; and they made multiple round trips that each took about 48 hours. They said they were going to be right along the coast, but they were about 10 miles out and off course.

Tom Lohman said the tugs were working harder due to the bad weather, making more noise. The whalers are concerned that there is only anecdotal information on relatively benign tug activity.

An AEWC representative said the first week barges were working, and the second week they were whaling. Brad Smith was asked to try to stop this activity. ConocoPhillips' attitude was that they have no obligation – we are not impacting the whale hunt.

Barrow whaling captains were led to believe by ConocoPhillips that there was only one barge instead of many.

Action Item: The AEWC agreed to provide information on this incident.

John Goll said that under Stipulation No. 5, companies have to ensure no unnecessary impacts. We can control what happens offshore for MMS activities but cannot regulate onshore activities.

Mayor Ahmaogak said that with effects at Kuvlum and Smith Bay effects would be cumulative, and you must address them. What happens onshore is up to the Bureau of Land Management and the NSB. If a discovery is made, then companies would have to go through CZM. History is already set – NPR-A and the BLM. The BLM did not envision staging out of Barrow. This is new information. Sale 195 comments relating to Sale 186 are significant to the AEWC.

Tom Lohman said this new activity is significant for Sale 195 with previously sold leases. We need Barrow and Kaktovik deferrals.

Mayor Ahmaogak (interjecting): And Cross Island.

An AEWC representative said that if there is activity east of Cross Island, then we want a Cross Island deferral.

Tom Lohman stated: With these noise impacts, we need a new discussion to gather facts, especially the Bureau of Land Management onshore. We need first-person statements from the AEWC and whaling captains.

An AEWC member asked: Who is responsible for contacting ConocoPhillips?

Maggie has a modified route map for the barges. We need to address how MMS's mitigating measures would address the issues. The BLM could not address the barges. They said "It is not us." The barges were meeting the whales head on. The whaling captains need extra gas to enable them to go out farther.

John Goll replied that we can do what Tom (Lohman) describes. Stipulation No. 5 would work in this situation for activity on OCS leases.

An AEWC representative: Barge traffic—BLM should have requirements for mitigation.

Mayor Ahmaogak said the MMS should do a supplemental EIS bottom line, not an EA. The bowhead whale migration and feeding is all new information.

Tom Lohman said we are asking for an EIS. With only an EA, we would be losing some valuable information. If you do an EA, the document should address what we may lose. Meetings to discuss these issues are much better than public hearings. People are tired of public hearings and don't come as much as they used to.

Paul Stang stated that when I am the hearing officer, I try to have a combination of public hearing and public meeting, so we all have an opportunity to interact.

Mayor Ahmaogak said: We discussed with Director Burton the need to do a supplemental EIS. Albert provided the Memorandum of Understanding to the Director after we gave it to him. We want the Department's response. A copy of what we were going to discuss only had my signature. We were still in the process of getting the other two signatures when Albert asked for a copy. Albert has explained that

MMS can do some of the items we want and said MMS is looking into the others. The NSB will respond, possibly by going to court over Sale 195 if we are not satisfied with the response.

John Goll: We are going through the seven points; some of the sticking points are the legal points, the “wills” and “musts.” We are reviewing the Memorandum of Understanding.

Mayor Ahmaogak said the Memorandum of Understanding is to improve your process, to improve our comfort zone. We want to see exploration and development go forth under these conditions.

Paul Stang: We need to get our ducks in order and then discuss before we give a formal reply in writing.

Mayor Ahmaogak: The lease-sale process needs to be well written and our comments taken seriously. We are considering litigation. The seven points are to help your process. We tried to work with you to improve the process. I now have my marching orders from the NSB Assembly to go to court if we do not get an acceptable response.

Tom Lohman: We are concerned about the cumulative impacts of MMS and BLM activities moving west. BLM is revising the eastern area of the NPR-A. The Northwest NPR-A consistency report is coming out in April. We are willing to meet after you hear from your Solicitor on the Memorandum of Understanding. It is intended to improve your process.

Mayor Ahmaogak stated: The two big issues are the Northern Economics Study and the ANIMIDA report. I had Bob Harcharek review the economics report. I found the report very derogatory, calling Eskimos lazy; it had poor history and data. This is supposed to be the cornerstone for data for the OCS. We want you to do it right; we will help. The NSB wants to help with the scope of work and participate.

The MMS responded that Tim Holder, the Contracting Officer’s Technical Representative for the project, will sit down with the contractor to see if it can be fixed.

Mayor Ahmaogak continued: Secondly, the ANIMIDA report; this is another poor report. I cannot live with the NSB biologist being shut out. I am not happy with the report. We have problems with it. The MMS should get an update—this is not going in the right direction. The NSB has had no input. Todd O’Hara was on the scientific review board but was not allowed to provide input.

Paul Stang asked: Who made the complaints about the study and who is your contact so we can get to specifics?

Mayor Ahmaogak: Todd O’Hara had problems with the study, but he is now at the University of Alaska, Fairbanks. The key contact for the NSB is Craig George. He has the information.

The MMS responded that Phases 1 and 2 are being completed. It is moving on.

Mayor Ahmaogak: It is a nightmare; put it in the trash if it continues on its present course.

Maggie Ahmaogak and the AEWC: We are working with the National Pollution Center on OPA 90. I have a copy of a letter from Ms. Boltin. We are pleased that Ms. Boltin is going to incorporate the Good Neighbor Plan into OPA 90. The AEWC gave a copy of the letter to the AEWC’s attorney who wrote to Ms. Boltin.

Harry Brower, Jr.’s closing statement: I support what George and Maggie have said.

The meeting adjourned at 11:40 a.m.

MMS Meeting with NSB and Inupiat Community of the Arctic Slope at MMS Office in Anchorage on May 28, 2004

Participants:

Arnold Brower, Jr., President, ICAS
Harold Curran, NSB
Todd Sherwood, NSB
Tom Lohman, NSB
John Goll, MMS
Paul Stang, MMS
Jeff Walker, MMS
Deborah Cranswick, MMS

The NSB, AEWC, and ICAS submitted comments in response to MMS Request for Information for proposed Beaufort Sea Sale 195. The NSB also sent a letter dated January 16, 2004, to MMS proposing a Memorandum of Understanding to address multiple issues of the NSB, AEWC, ICAS, and communities of the North Slope. The purpose of the meeting was to update NSB and ICAS on how their concerns are being addressed in the Environmental Assessment for proposed Sale 195 and to continue the ongoing discussions on NSB, AEWC, and ICAS issues related to the OCS Program. The MMS presented several positive steps that MMS and the NSB can take to address several issues including NSB input into the MMS Environmental Studies Program, peer review, working toward 95% confidence intervals for oil spill risk, potential effects of noise on bowhead whaling, and developing industry guidance for implementation of Lease Stipulation 5.

The NSB is updating their Comprehensive Plan. The revised Plan will be a broad document that will consider all activities on the North Slope from a multidisciplinary point-of-view. MMS has been invited to participate in review of the Plan.

Appendix H

Evaluation of Potential Impacts on Subsistence Activities from MMS-Permitted Activities in the Cross Island and Smith Bay Areas

H. Introduction

During the information-gathering process for proposed Beaufort Sale 195, representatives from the North Slope Borough (NSB), Alaska Eskimo Whaling Commission (AEWC), and the Inupiat Community of the Arctic Slope (ICAS) requested that the Minerals Management Service (MMS) evaluate the potential effects of outer continental shelf (OCS) oil and gas activities near Cross Island in the traditional whaling subsistence area for the community of Nuiqsut and near Smith Bay "upstream" of traditional subsistence whaling areas for Barrow. They want to know if future subsistence whaling activities for the communities of Nuiqsut and Barrow would be affected by oil and gas activities that might occur in those areas. They would like to better understand the effectiveness of mitigation developed to reduce or eliminate potential adverse effects to subsistence whaling activities. This document provides that information.

H.1 Background Information

The MMS described and evaluated the potential effects of leasing, exploration, and development in the these areas in the Final Environmental Impact Statement (multiple-sale EIS) for Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, and 202 (USDOI, MMS, 2003a). The only oil- and gas-related activities on the Beaufort OCS since the completion of the multiple-sale EIS in February 2003 have been the issuance of Sale 186 leases, including 19 leases adjacent to and near the existing leases off of Smith Bay, and relinquishment of the McCovey leases west of Cross Island after exploratory drilling. No new seismic or drilling information has become available. A series of wells have been drilled in State waters off Milne Point. The MMS received no unanticipated information through the Request for Information, published in the *Federal Register* on December 16, 2003. The description of the oil and gas resources and the estimated activities in the EIS are still valid and reflect the best available information.

The EIS scenarios are based on both geologic possibilities and what is expected to be leased, discovered, developed, and produced in the sale area under consideration. The location of any oil deposits is purely hypothetical, until oil is proven to be there by drilling. While these scenarios are reasonable and provide a basis for analyzing potential effects, considerable uncertainty exists about where and when activities may take place, if they take place at all. The hypothetical scenarios developed for the analysis in the multiple-sale EIS are based on two key assumptions. The reader should not consider these two assumptions to be predictive of what will occur.

First, we assume economic hydrocarbons will be discovered and developed. This continues to be an optimistic assumption. Historically, a small percentage of the areas offered in frontier areas have been leased, and a small percentage of those leases have been explored. Since 1979, MMS has held eight OCS oil and gas lease sales in the Beaufort Sea Planning Area. Thousands of potential lease blocks have been offered repeatedly. The MMS has issued 688 leases; of these, 35 leases remain active as of April 2004. To date, 31 exploration wells have been drilled. To date, the only production resulting from MMS leasing activities in the Beaufort Sea is from the joint Federal/State Northstar Field from a State-managed gravel island. The level of company interest and bidding in the recent Alaska OCS sales is considerably less than it was for sales in the 1980s.

Second, the multiple-sale EIS assumes for analysis purposes that an oil spill will occur. The EIS fully evaluates the potential effects of an unlikely oil spill (Sections IV.A.4, IV.A.5, IV.C.5.a, IV.C.11, and IV.C.12). Although the EIS assumes an oil spill will occur, there has never been a crude oil spill from exploration or production activities in the Alaskan Beaufort Sea.

Many of the issues related to noise in the marine environment recently have been, or are being, addressed in studies and by a variety of committees and groups, including groups convened by the Marine Mammal Commission, NOAA Fisheries, the Navy, and scientific societies. Information from the suite of studies at the Northstar facility, the detection of noise from that facility, and potential effects on bowhead whales and seals, as well as information from other relevant studies in the Beaufort Sea, recently has become available. Traditional Knowledge and contemporary and local knowledge on the effects of noise on bowhead whales also is incorporated and considered in the analysis. The MMS remains committed to monitoring OCS permitted activities. Through monitoring MMS will have the ability to determine whether current mitigating practices are adequate, and if they are not, MMS believes the stipulations in place provide the needed vehicles to work with the NSB, AEWC, ICAS, and the OCS operators and lessees to modify and or adjust the timing of processes and or practices to continue to minimize effects to the residents on the North Slope.

H.2 General Description of the Cross Island and Smith Bay Areas

For scenario development and analysis in the multiple-sale EIS, MMS divided the Beaufort Sea leasing area into three zones: the Near, Midrange, and Far zones. The zones are defined primarily by their proximity to existing North Slope infrastructure and secondarily by water depths. Distance from existing infrastructure is a major economic factor. The farther away a project is located from existing infrastructure, the higher the costs; therefore, a greater quantity of oil is needed to make the project economic. Water depth influences the types of structures used for exploration and development. We expect most development would take place in water depths less than 125 ft (35 m) and within 25 mi from shore. The Near Zone is located in the central Beaufort Sea (offshore Prudhoe Bay) between the Canning River on the east and Colville River on west. Water depths typically are less than 30 ft (about 10 m) and distances from existing facilities are not more than a few tens of miles. The Midrange Zone is farther away from existing development. This zone extends from Barter Island in the east to Cape Halkett in the west and includes water depths up to approximately 100 ft (about 30 m). The Far Zone extends from the Canadian Border in the east to near Barrow in the west, and water depths may exceed 600 ft (200 m).

The Cross Island area is in the Near Zone approximately 15 mi northeast of Prudhoe Bay. The leased area off Smith Bay is in the Far Zone north of Smith Bay and approximately 50 mi southeast of Point Barrow. Water depths range from 30-100 ft in both the Cross Island and Smith Bay areas.

The scenarios in the multiple-sale EIS reflect our analytical assumption, based on professional judgment, that most leasing, exploration, and development that might result from Sales 186 and 195 would take place in the Near and Midrange zones offshore of current development. Although the scenarios prepared for the EIS do not assume development in the Far Zone until after Sale 202, companies could bid on and be awarded leases in any of the zones in any of the three sales. Because the EIS evaluates the effects of leasing in all three zones, the effects attributed to any zone could occur as a result of any lease sale.

H.1.a Bowhead Whales in the Cross Island and Smith Bay Areas

Appendix C of the EA contains a Biological Evaluation of potential impacts to bowhead whales, which was prepared and submitted to NOAA Fisheries for consultation under Section 7 of the Endangered Species Act. Section III.B. of the Biological Evaluation provides information about the distribution and movement of the bowhead whale. Section III.D. provides descriptive information about their feeding activities. Section IV.A provides additional information about the effects of noise and disturbance on bowhead whales. Section IV.B evaluates the potential effects from seismic survey operations. Section III provides the historical background and current status of the bowhead, including information about population size and abundance. As noted in the summary to Section III of the Biological Evaluation, "All recent available information indicated that the population continues to increase in abundance." The Biological Evaluation also concludes "Available new information also does not indicate there has been any significant change in the distribution of this population."

H.1.b Subsistence Whaling Activities in the Cross Island Area

Cross Island is the primary base for whaling activities for the community of Nuiqsut. The most current and complete information about the types of activities that occur at Cross Island are from the Annual Report for

Task Order 4 of the Arctic Nearshore Impact Monitoring in Development Area (ANIMIDA) study by Michael Galiginaitis (Galginaitis, 2003a,b). This study focuses on the subsistence-whaling activities at Cross Island, and the remainder of this section is taken from that report.

In 2002, three crews from Nuiqsut whaled from Cross Island.

> One of these crews initially started with two whaling boats, and the others used three vessels. One crew used all three vessels as whaling boats, while the other crew used the third vessel mainly for support activities. The crew with two boats did 'add' a third small boat late in the whaling season, used mainly in a support capacity. All three crews started with nine to eleven members, comparable to the multi-boat crews of 2001. The number of unique individuals (not all necessarily on Cross Island at the same time) per crew ranged from nine to fourteen.
>
> All crews had a majority of adult members, but differed in the age of the youngest member and the ratio of older to younger members. Two crews had no members younger than a high school student, while a boy of 13 was a member of the third. A whaling boat normally requires a minimum of three crew members – a driver, a harpooner, and a person in charge of the float – although boats will sometimes go out with only two crew members. Depending on conditions and intuition, a whaling captain may desire to take as few crew members as possible (to have a light, fast boat) or as many extra as possible (to have as many eyes watching for whales as possible). In other cases, the whaling boats had only two. One or two adults were principally 'support' crew members and did not usually go out whaling. Crews of 3 to 5 are most common.

The typical whaling season lasts 20-25 days. Some days, weather or other activities such as butchering, processing, and boat and boat-engine repair, may halt whaling activities. Generally, all crews go whaling in suitable weather, and any deviation from that pattern has an explanation. After a whale is butchered, the harvesting crews transport the "fresh killed" meat and muktuk between Cross Island and Nuiqsut. Other community members from Nuiqsut travel to Cross Island and stay for a day or two and help with whatever tasks need to be done, such as butchering and processing the whale (Galginaitis, 2003a,b). Although a great deal of "nonwhaling" activity takes place throughout the year to support the whaling effort, very little nonwhaling subsistence activity was documented on or near Cross Island during the whaling season.

The following are the Nuiqsut whalers' observations of whale behavior in 2002, as noted in the draft report (Galginaitis, 2003a,b).

- Weather and ice conditions in 2002 were more moderate than in 2001. There was not much ice cover, or at least whalers reported encountering ice only sporadically.
- Ice cover was reported as contributing to not being able to follow certain whales, but not to the same extent as in 2001.
- Nuiqsut whalers reported seeing more whales during hunting trips in 2002 than in 2001. While there were days when few or no whales were observed, there also were instances when numerous whales were observed at the same time. This was reported to be more the "normal" case than what was observed in 2001.
- Nuiqsut whalers could find whales relatively close to Cross Island (6-8 miles) but could not always follow these whales. Whales could be found consistently within 15-20 miles. At least one whale consistently was observed and reported at the same location on several different days. Whales were harvested closer to Cross Island in 2002 than in 2001, but whalers probably traveled as far on their trips in 2002 as in 2001.
- There were some observations of skittish or "spooky" whales. These behaviors were not explicitly compared to those observed in 2001, however. It was noted that some whales stayed around icefloes (as they had in 2001). No observations on surface versus subsurface swimming were noted. Several crews were able to follow individual whales for several dives before either losing the whale or being able to strike it, so that it seemed that crews were better able to track whales in 2002 than in 2001.
- Two whales sank after they were killed; whalers did discuss what could account for this, but no consensus (other than loss of buoyancy) was reached.

A key part of this study collected GPS information, including waypoints, routes, and whale sightings. No conclusions or analysis of that data was included in the report.

H.1.c Subsistence Whaling Activities in the Smith Bay Area

Bowhead whales migrate from the eastern Beaufort Sea to the west each fall and some of them swim and feed in the Smith Bay area. There are number of traditional hunting camps on the shoreline of the bay and up the Ikpikpuk River drainage. Barrow hunters follow a historical subsistence-access route that follows the Smith Bay shoreline to harvest areas in the Teshekpuk Lake region and other harvest areas to the south. The Smith Bay area is 20-30 mi "upstream" from Barrow's traditional subsistence whaling area. Few (4) bowhead whales have been harvested north and east of Cape Simpson.

H.2 Summary of Effects

The potential effects from four oil and gas related activities: (1) prelease and postlease seismic surveying; (2) exploration; (3) development and construction; and (4) production are summarized below. For each, we provide a short summary of the types of effects to bowhead whales that could occur and explain how the mitigation reduces or eliminates the potential effects to subsistence hunting.

H.2.a Potential Effects of Noise to Bowhead Whales

The following text summarizes the best available information we have about potential effects to bowhead whales from noise as presented in the Biological Evaluation (Appendix C of the EA):

> Bowheads are not affected much by any aircraft overflights at altitudes above 300 m (984 ft). Below this altitude, some changes in whale behavior may occur, depending on the type of plane and the responsiveness of the whales present in the vicinity of the aircraft. The effects from such an encounter with either fixed-wing aircraft or helicopters generally are brief, and the whales should resume their normal activities within minutes. Bowheads may exhibit temporary avoidance behavior if approached by vessels at a distance of 1-4 km (0.62-2.5 mi). Marine-vessel traffic also may include seagoing barges transporting equipment and supplies from Southcentral Alaska to drilling locations, most likely between mid-August and mid- to late September. If the barge traffic continues into September, some bowheads may be disturbed. Fleeing behavior from vessel traffic generally stopped within minutes after the vessel passed, but scattering may persist for a longer period. In some instances, at least some bowheads returned to their original locations. In many cases, vessel activities are likely to be in shallow, nearshore waters outside the main bowhead-migration route.
>
> 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 (2.86-12.4 mi) when the sound-to-noise ratio is 30 dB. Whales appear to exhibit less avoidance behavior with stationary sources of relatively constant noise than with moving sound sources.
>
> Island-construction activities likely would be conducted during the winter and generally are in nearshore shallow waters shoreward of the main bowhead whale migration route. These activities are not expected to affect bowhead whales.
>
> Bowheads do not seem to travel more than a few kilometers in response to a single disturbance incident and behavioral changes are temporary, lasting from minutes (in the case of vessels and aircraft) up to 30-60 minutes (in the case of seismic activity in earlier seismic studies). In recent studies, avoidance of the area within 20 km of seismic operations did not persist beyond 12 hours after the end of seismic operations.
>
> Behavioral studies have suggested that bowheads habituate to noise from distant, ongoing drilling or seismic operations (Richardson et al., 1985), but there still is some apparent localized avoidance (Davies, 1987). There is insufficient evidence to indicate whether or not industrial activity in an area for a number of years would adversely impact bowhead

use of that area (Richardson et al., 1985), but there has been no documented evidence that noise from OCS operations would serve as a barrier to migration.

Overall, bowhead whales exposed to noise-producing activities such as vessel and aircraft traffic, drilling operations, seismic surveys, and construction activities most likely would experience temporary, nonlethal effects. There is variability in their response to certain noise sources. Some of the variability appears to be context specific (i.e., feeding versus migrating whales) and also may be related to reproductive status and/or sex or age.

There could be a number of minor alterations in bowhead habitat as a result of exploration. Discharge of drilling muds and cuttings during exploration activities are not expected to cause significant effects, either directly through contact or indirectly by affecting prey species. Any effects would be primarily localized around the drill rig because of the rapid dilution/deposition of these materials. Bottom-founded drilling units and/or gravel islands may cover small areas of benthic habitat, and drilling muds and cuttings may cover portions of the seafloor that support epibenthic invertebrates used for food by bowhead whales. However, the effects likely would be negligible, because bowheads feed primarily on pelagic zooplankton and the areas of sea bottom that are impacted would be inconsequential in relation to the available habitat.

Gravel-island-construction activities, including placement of fill material, or installation of sheetpile or gravel bags for slope protection would cause sediment suspension or turbidity in the water. It is likely that most of these construction activities would occur during the winter when bowheads are not present in the area. Activities occurring during the open-water season likely would be completed before the bowhead whales begin their fall migration. Bowheads should not be affected by these activities.

H.2.b Prelease and Post-lease Seismic Surveying

Before leasing, seismic companies and/or oil and gas companies want to obtain new geologic information from seismic surveys. After issuance of a lease, lessees often seek additional seismic surveys before making other exploration-related decision. Offshore seismic survey operations are usually conducted during the open-water season using specialized seismic surveying vessels. There currently are no seismic surveying vessels in U.S. Arctic waters. Whether companies will bear the expense of bringing seismic boats back to the Arctic Ocean or relying on existing data for prelease seismic is unknown at this time.

If seismic surveying were to occur, potential effects to bowhead whales could occur from:

- noise from seismic surveys, aircraft, and marine support boats; and
- traffic from seismic-survey vessels and aircraft.

Subsistence whalers are concerned the noises and traffic from seismic surveys could drive the bowhead whale migration farther offshore. Traditional Knowledge and studies have confirmed that bowhead whales react to noise associated with the acoustic sound generated for seismic surveying and alter their course. If the bowhead whales move further offshore, whalers must travel farther to hunt them, increasing the risks associated with the hunt and requiring a longer time to bring a harvested whale to land for processing. If the transport and processing take too long, the whale meat and muktuk may be unusable because they have started to spoil from the heat inside the whale.

The multiple-sale EIS provides an extensive discussion of noise in the marine environment, noise associated with various OCS activities, and potential disturbance effects of noise on bowhead whales (Section IV.C.5.a(1)(a):IV-51 to IV-72). The endangered bowhead whale may exhibit temporary avoidance behavior to seismic surveys and vessel and aircraft activities, but overall effects to bowheads from disturbance and noise likely would be temporary and nonlethal (USDOI, MMS, 2003a:IV-51 to IV-72 and IV-80 to IV-88). Seismic surveying activities can be scheduled to avoid conflicts with subsistence whaling.

Over the years, MMS has worked with AEWC and the NSB to reduce or eliminate adverse effects to bowhead whales and subsistence whalers. Standard lease stipulations were included in the multiple-sale

EIS. Stipulation 2 *Orientation Program* reduces potential effects by educating offshore oil and gas workers to environmental conditions, existing regulations governing seismic operations, and to the subsistence and socio-cultural importance of whaling to the indigenous residents. Stipulation 5 *Subsistence Whaling and Other Subsistence-Harvesting Activities* requires companies proposing operations on the North Slope to coordinate with the AEWC about the proposed activities, which allows subsistence users to influence the timing of the seismic operations to occur prior to or after subsistence whaling activities. Stipulation 4 *Industry Site-Specific Bowhead Whale-Monitoring Program* requires industry to have observers and a monitoring program in place to observe effects to bowheads, which allow MMS to take additional corrective action if necessary. Permits from NOAA Fisheries usually require observers on seismic vessels and operations may be shut down if bowhead whales are observed in the area. The MMS requires seismic survey operations to "ramp up" slowly to help prevent adverse effects to whales. In combination, these mitigating measures have been shown to eliminate or reduce the potential adverse effects of seismic activities to bowhead whales and subsistence hunters. The MMS believes these measures are effective in reducing or eliminating potential effects to subsistence whaling in the Cross Island area and the areas "upstream" of traditional subsistence whaling areas for Barrow such as the Smith Bay area.

H.2.c Exploration

If exploration does take place, the following impact factors could result, in addition to the aforementioned seismic surveying activities:

- noise from construction or installation of ice roads, exploration drilling islands, or platforms;
- air and vessel traffic for crew, fuel, and supplies; and
- maintenance noise and lights from platforms (generators, motors, running lights, etc).

The multiple-sale EIS provides an extensive discussion of noise in the marine environment, noise associated with various OCS activities, and potential disturbance effects of noise on bowhead whales (USDOI, MMS, 2003a:IV-51 to IV-72). Studies at Northstar indicated that bowhead whales deviated from their migration path slightly in response to vessel traffic. No responses to operational noises were noted. The endangered bowhead whale may exhibit temporary avoidance behavior to seismic surveys, vessel and aircraft activities, drilling, and construction, but overall effects to bowheads from disturbance and noise likely would be temporary and nonlethal (USDOI, MMS, 2003a:IV-51 to IV-72 and IV-80 to IV-88). Stipulation 5 was developed to mitigate potential conflicts between OCS activities and subsistence whaling by requiring the scheduling to the maximum extent possible the arrival and departure of vessels to effectively limit effects on migrating bowhead whales.

An exploration drilling platform would likely be moved onto location during the open-water season. The platform would be inactive during the remainder of the open-water season—during bowhead whale migration and subsistence whaling. Drilling operations would occur primarily during the winter at both the Smith Bay and Cross Island locations, and potential adverse effects to bowhead whales and subsistence whaling activities at both locations would be minimal.

The above approach was used by EnCana for exploration at the McCovey prospect near Cross Island. The feedback MMS received from the NSB and AEWC indicated the approach was successful in mitigating the potential impacts of concern to the local residents.

H.2.d Development and Construction

Potential development projects in the 30- to 100-ft water depths found in the Cross Island and Smith Bay areas most likely would use bottom-founded structures designed with ice-management systems. The exact locations of potential gravel islands, platforms, or pipelines cannot be determined until development plans are submitted. Most construction activities would occur during the winter months. During development, one or more sealifts would likely occur during the open-water season. One sealift per year would be expected during production activities. Sealift activities could include towing or moving a platform on location and/or supplying a facility with equipment and supplies. As required by Stipulation 5, the lessee or their designated operators would coordinate the timing of the sealifts with the NSB.

If development occurs, the following potential impact factors may affect bowhead whales and subsistence hunting activities:

- noise from construction of ice roads, development of production islands or facilities, pipelines, and production;
- noise and disturbance from routine and recurring vessel and air traffic associated with crew and supply activities; and
- physical placement, presence, and removal of offshore production facilities, including islands or platforms, storage and production facilities, and pipelines to onshore common carrier pipelines.

Stipulation 2 *Orientation Program* reduces potential effects by educating offshore oil and gas workers to environmental conditions, existing regulations governing seismic operations, and to the subsistence and socio-cultural importance of whaling to the indigenous residents. Stipulation 5 *Subsistence Whaling and Other Subsistence-Harvesting Activities* requires companies proposing operations on the North Slope to coordinate with the AEWC about the proposed activities, which allows subsistence users to influence the timing of the operations to occur prior to or after subsistence whaling activities. Stipulation 4 *Industry Site-Specific Bowhead Whale-Monitoring Program* requires industry to monitor potential effects to bowheads, which allow MMS to take additional corrective action if necessary. The NOAA Fisheries may require additional monitoring or measures to protect the bowhead whale. The *Pre-Booming Requirements for Fuel Transfers* stipulation could provide additional protect to the bowhead whale and could help minimize the potential adverse effects of a fuel spill to the subsistence harvest of bowheads. Stipulation 3 provides additional protection by requiring pipelines, if economically feasible, which would reduce noise effects associated with tankering as an alternate form of transportation. The MMS believes these measures will be effective in reducing or eliminating the potential effects to subsistence whaling in the Cross Island and Smith Bay areas. So only small to negligible effects to Nuiqsut and Barrow subsistence hunters are expected. Construction of OCS facilities is an intense, but short-term, activity. The MMS expects conflict between these activities and subsistence whaling to be avoided through the consultation and coordination required by Stipulation 5. Drilling of most of the development wells would likely be completed within the first few years of development and production. Additional development wells as well as injection wells may be drilled sporadically throughout the life of the field. The timing of these drilling operations would be addressed under Stipulation 5 to minimize potential impacts to subsistence whaling activities.

H.2.e Production

The multiple-sale EIS provides information about effects from routine production activities. The description and timing of typical offshore production activities are described in the multiple-sale EIS (USDOI, MMS, 2003a:IV-5 and 6; and Section IV.B.2.b(2), pp. IV-9 to IV-11).

The potential sources of effects from production include:

- noise and disturbance from routine and recurring vessel and air traffic associated with crew and supply activities;
- noise from drilling of additional production wells, drilling of injection wells, and periodic well maintenance and workovers;
- noise from the operation of generators, pumps, and other motors;
- space use conflicts resulting from the island and loss of habitat; and
- physical placement, presence, and removal of offshore production facilities, including islands or platforms, storage and production facilities, and pipelines to onshore common carrier pipelines.

Most routine production operations would have little to negligible effects on the bowhead whale and/or subsistence whaling activities. Based upon the current information available from Northstar (See the Biological Evaluation in Appendix C), the bowhead whale migration and subsistence hunting activities would not be measurably impacted by OCS production operations located in the bowhead whale migration area. Studies at Northstar indicated that bowhead whales deviated from their migration path slightly in response to vessel traffic. The MMS has not detected any substantial change in the overall whale migration pattern as a result of the activities at the Northstar location. We believe Stipulation 5 provides a mechanism to coordinate and minimize vessel and aircraft traffic during in the hunting period to minimize conflicts and noise that might deflect the whales farther offshore.

No responses to operational noises were noted during the studies at Northstar. Studies of broadband noise from Northstar operations showed that production noise was indistinguishable from ambient noise at 2 km from the site. Potential deflections of migrating bowhead whales caused by noise would be expected to be well within their current migratory range. Potential deflections resulting from production operation noise in the Cross Island area might have effects on subsistence whaling activities in the immediate area. Such deflections from production operations in the Smith Bay area would not be expected to effect whaling activities around Barrow. The MMS BWASP program would help monitor the whale migration patterns, and if substantial shifts in the location of the whale migration were to occur as the result of OCS activities (production noise as well as vessel or aircraft sounds) MMS could take action to correct.

The mitigation measures, especially Stipulation 5, that would provide protection during construction and development would also provide protection during production. As mentioned above, additional development wells and injection wells may be drilled sporadically throughout the production life of the field. Well maintenance and workovers would also occur periodically throughout the production life of the fields. These operations and other facility maintenance would likely be scheduled for winter periods, when the bowhead whale is not present in the area. Potential conflicts between vessel/air traffic and subsistence whaling is expected to be minimized through coordination on the routes and timing of support traffic.

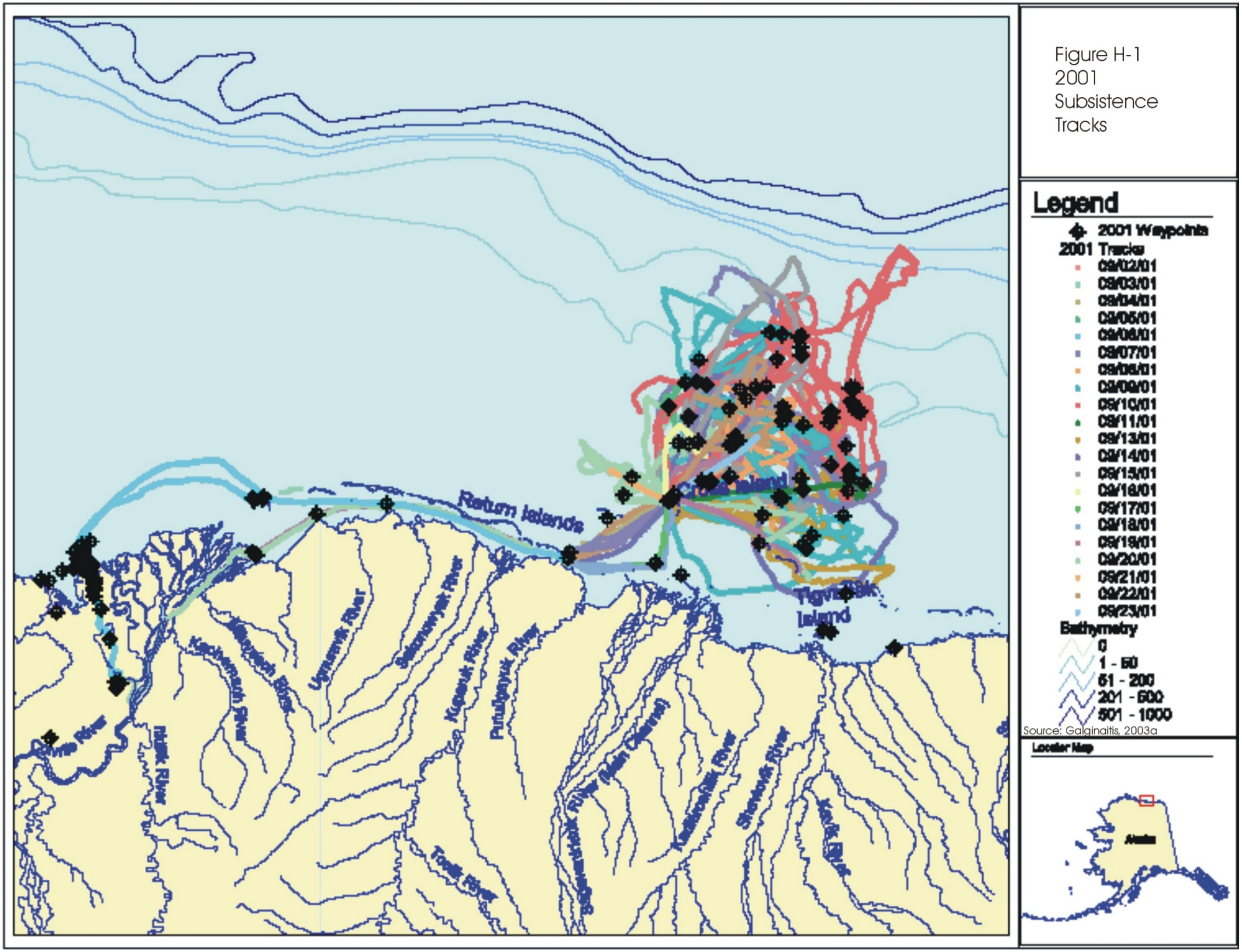

Figure H-1
2001
Subsistence
Tracks

Source: Galginaitis, 2003a

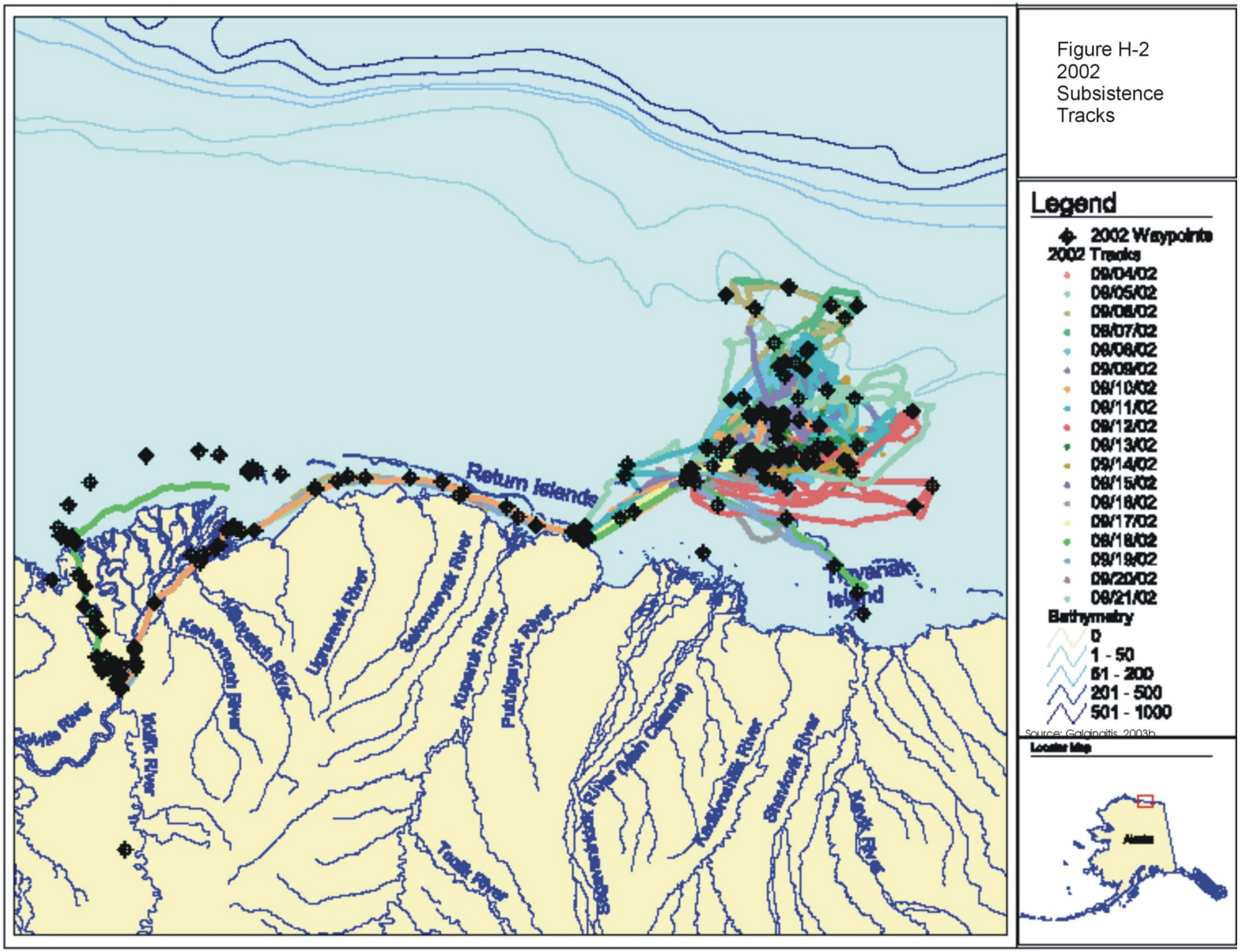

Figure H-2
2002
Subsistence
Tracks

Appendix I

Speculative Effects in the Context of Arctic Climate Changes

I. Global Change Introduction

In the last few decades there has been a warming trend in the Arctic, and there has been a considerable amount of literature written about climate change and global warming. Because many of the resources in Arctic are ice associated or ice dependent, climate change is an issue that MMS is following closely. While the trend over the last decade shows a relatively rapid change, the ability of science to accurately predict whether those changes continue into the future, level off, or reverse directions is speculative. We know that there are shorter-term cycles in the climate and the environment. We were unable to definitively determine whether the observed changes are within established cycles or if we are truly moving into new systems. We will continue to watch the new data, information, and analyses about climate changes in the Arctic and the scientific basis for projecting such changes into the future. The historical, evolutionary, and geological records have documented very large climate changes in the past. The MMS tries not to include speculative information in our scenarios and assessment because such information may distort and mislead the analysis.

Besides the contradictory information about climate change, there are many different predictive models for estimating the rate of change. The outcomes from any analysis predicting the effects of climate change for future projects are governed by the assumed rate of change. For the most part, the higher the predictive rate of climate change, the larger the potential effect on the resource.

We are including the following information for the reader and decision maker about what may occur if the current trends in climate change continue into the future. We encourage the reader to remember the speculative nature of the climate change predictions.

I.1. Regional Climate Changes

Lease areas in the Arctic differ from other OCS lease areas in that the Arctic Ocean ice cover persists during most of the year. In OCS lease areas where there is not a persistent ice cover, climate changes might be quite subtle (for example, a degree of warming in the surface water) and there would be few reasons to assess the cumulative effects of climate change. However, in the Arctic there is evidence that the summer ice cover and associated biota have changed, diminishing in the proposed lease area during recent years. Some of the changes in the ice cover have been documented by NASA personnel, using satellite thermal infrared data (Comiso, 2002, 2003; Comiso et al., 2003). Recent analyses of seasonal ice cover in the Arctic over the past 20-30 years shows a decrease in ice extent and in ice thickness coincidental with temperature warming trends (Maslanik et al., 1996 and Martin et al., 1997, as cited by Tynan and DeMaster, 1997). Climate warming has reduced the total sea-ice coverage in the Arctic by about 15% in the past 20 years (Stirling and Lunn, 2001).

Other observed Arctic changes related to trends of temperature increase include:

- increased snowfall;
- drier summers and falls;
- forest decline;
- reduced river and lake ice;
- permafrost degradation;
- increased storms and coastal erosion;
- cooling in the Labrador Sea (associated with increased sea-ice melt); and
- ozone depletion.

Precipitation in the Arctic has increased 15% in the past 40 years, and there is a trend toward an earlier spring melt (AMAP, 1997). Permafrost degradation and thermokarsting is expected to continue to cause forest damage, roads and buildings to sink, riverbanks to erode, and alterations in tundra vegetation. Warmer temperatures on Alaska's North Slope are promoting the growth of dwarf birch, alder, and willow shrubs (Schneider, 2001).

Some local observations of change on the North Slope are summarized in Section IV.F.8.n(1)(e)11)c) of the Northwest NPR-A IAP/ EIS (USDOI, BLM and MMS, 2003). The following are excerpts from the NPR-A EIS:

> In Barrow, Eugene Brower, President of the Barrow Whaling Captains Association related: "Last year the ice went over the horizon and stayed over the horizon all summer. We would have to go over 20 or 30 miles just to hunt seals" (Talbott, 2000).
>
> At Barrow, the break up of sea ice is much earlier than it used to be, occurring now in June rather than July; sea water freezes only from the top rather than also on the bottom as it use to (Huntington, 2000).
>
> Inupiat in Barrow have had ice cellars drip water for the first time in memory, and in Katovik, a robin built its nest in town in 2003. (There is no word in the Inupiat language for robins.) The banks of the Okpilak River—"Okpilak" means "river with no willows"—are now crowded with willows. Salmon are arriving in Kaktovik where there were almost no salmon a generation ago. Ninety two-year-old Nora Agiak observes: "The weather is different, really different… We're not getting as many icebergs as we used to. Maybe the world moved, because it's getting warmer" (AMAP, 1997; Groat, 2001; Kristof, 2003).

Many similar observations of recent warming for other arctic regions are contained in the Northwest NPR-A EIS and the Arctic Climate Impact Assessment (ACIA) (www.acia.uaf.edu). The latter document is being drafted by an international group, including several employees of the FWS and National Oceanic and Atmospheric Administration. Some MMS employees have attended ACIA meetings and reviewed drafts of the assessment; even though MMS is aware of the arctic assessment, it does not agree with all of the preliminary findings. For example, the assessment describes the recent warming as very unusual, but on a longer time scale of evolutionary or geological time the recent warming trend is probably not the largest or warmest during the last millennium (Soon and Baliunas, 2003). Because of such changes in the arctic ice cover, the following sections assess the effects on each resource of proposed Sale 195 in the context of projected climate changes during the life of the field (about 3 decades).

Climate-Change Projections. Projections of changes in the arctic ice cover are included in a study for the U.S. Global Change Research Program, a study for which the Department's United States Geological Survey was a participating agency (Center for Global Change and Arctic System Research, 1999). Projections also are included in a report on the Arctic Ocean for the Office of Naval Research (Office of Naval Research, 2001). Most of the Navy projections are included in Appendix A of the report, entitled *The Arctic Ocean and Climate Change: A Scenario for the US Navy*. We are aware of the projections and have used the projections for the life of the field (about 3 decades) in our assessments, but we consider the results to be theoretical and uncertain. The Council on Environmental Quality (CEQ) guidelines for the National Environmental Policy Act address the use of theoretical approaches to assessments in 40 CFR 1502.22. The guidelines specify that, when an agency is evaluating effects with such information, the agency shall include warnings about it. Therefore, we start this assessment with an acknowledgement that climate-change information is relevant to the MMS decision about proposed Sale 195; and that while many recent observations of change are consistent with climate-change theories, the projections for the next few decades are theoretical and uncertain.

I.2 Resource-Specific Cumulative Effects

The following sections assess the effects of the proposed lease sale in the context of climate change and infrastructure developments. The overall conclusions in the multiple-sale EIS about cumulative effects (Section V.A.6) are partly that:

- Potential cumulative effects on the bowhead whale, subsistence, sociocultural systems, spectacled eider, Boulder Patch kelp habitat, polar bears, and caribou would be of primary concern and warrant continued close attention and effective mitigation practices.

In this section, the cumulative effects of the proposed sale are assessed in the context of new information on climate changes in the arctic, and this overall conclusion is updated. The following updated assessments focus on a few major resource categories (birds, subsistence-harvest patterns and sociocultural systems, local water quality, and bowhead whales). The section concludes with a brief summary of the cumulative effects in Section IV.E.3; part of the conclusion is that we identify ringed seals and other ice-dependent pinnipeds as additional resources of primary concern due to the cumulative effects of proposed Lease Sale 195.

I.2.a Marine and Coastal Birds

The multiple-sale EIS concludes generally with regard to cumulative effects on threatened and endangered species that: "Potential cumulative effects on the…spectacled eider…would be of primary concern and warrants continued close attention and effective mitigation practices" (USDOI, MMS, 2003a:Section V.A.6). Projected long-term global climate change represents a factor with the potential for substantial effects on bird populations. Global climate models (Section l.1.) project a 3-6^{o} Fahrenheit (1.5-3.5^{o} Celsius) increase in average annual temperature in Alaska and a sharp reduction of summer sea ice in the Arctic Ocean (Office of Naval Research, 2001). As with all model projections, the results are theoretical. Long-term effects of such changes are difficult to predict, but general observations and some specific studies suggest a potential for

- earlier and more extensive spring pack-ice breakup and melting,
- northward migration of the summer ice edge,
- northward migration of subarctic habitat types and associated species,
- generally drier coastal plain habitats,
- earlier melting of lakes and rivers, and
- an extended summer season.

Such changes may result in more favorable (extended, warmer) bird migration and breeding seasons. However, these changes also may decrease the availability of wetter breeding habitats occupied by sea ducks and other species and alter the availability of prey species, thereby increasing the competition for these limited resources. However, the currently estimated timeframe for the progression of warming phenomena to levels that would cause adverse effects and elevate the status of additional bird species to that of significantly affected generally is much longer than the estimated period of development for Sale 195. This suggests that over the latter period, a significant effect from such phenomena is not likely to occur.

We still conclude that potential cumulative effects on spectacled eider would be of primary concern and would warrant continued close attention and effective mitigation practices.

I.2.b Subsistence-Harvest Patterns and Sociocultural Systems

Cumulative effects on subsistence-harvest patterns and sociocultural systems in the context of climate change are updated in the following section, and the same update for environmental justice is in Section I.2.f.

For subsistence-harvest patterns and sociocultural systems, the multiple-sale EIS concludes generally in Section V.A.6 that: "Potential cumulative effects on…subsistence (and) sociocultural systems…would be of primary concern and warrant continued close attention and effective mitigation practices."

A factor of increasing concern is the potential for adverse effects on subsistence-harvest patterns and subsistence resources from global climate change. The 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 have to be considered in the NEPA assessment. The CEQ considers that there is adequate scientific evidence (for example, 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, 2001a).

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 by weeks 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 can lead, through time, 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*, 2001; Parson et al., 2001; AMAP, 1997; *Anchorage Daily News*, 1997; Weller, Anderson and Nelson, 1998; IPCC, 2001a). 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, 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).

The potential effects of the lease sale are assessed within the context of climate change. If a major effect due to climate change were to occur, MMS would require changes to exploration or development/production designs and activities.

Summary for Subsistence-Harvest Patterns: If the present rates of climate change continue, changes in diversity and abundance to arctic flora and fauna could still 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).

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 195 development (IPCC, 2001; NRC, 2003).

Summary for Sociocultural Systems: 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 still conclude that Arctic communities would experience significant cultural stresses in addition to 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; USGCRP, 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 aailable 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.

Conclusion: We still conclude that potential cumulative effects on subsistence-harvest patterns and sociocultural systems would be of primary concern and would warrant continued close attention and effective mitigation practices.

I.2.c. Local Water Quality

We are aware of two projected climate changes that might influence the water-quality effects of proposed Sale 195. One projected climate change in the Arctic Ocean is increased melting of the summer ice cover, though during the winter the entire Arctic Basin is projected to remain ice covered (Office of Naval Research, 2001:Appendix A). The effect on water-quality—on the water under the ice—is that the summer open-water season would last slightly longer. As a result, the risk of open-water spills would increase slightly, and the risk of spills during the solid-ice season would decrease slightly. We are aware of no projected changes in the duration of the broken-ice period, which is the period when spill responses are most difficult.

Another projected consequence of climate change is that changes in the timing and composition of river runoff might affect temporarily the surface seawater (Office of Naval Research, 2001:Appendix A). River runoff generally occurs before the nearshore ice cover melts, so the nearshore ice cover would separate the effects of any offshore activities from the areas within which surface seawater might be temporarily affected.

Overall, we conclude that the effects of Sale 195 on water quality in the context of climate change would probably be similar to the effects that are summarized in EA Section IV.E.2.c.

I.2.d Bowhead Whales

The potential for effects to adversely affect bowhead whales is of great concern because of their current endangered status, which resulted from past human activity (overexploitation by commercial whalers), and because of their importance as a subsistence species to Alaskan Native residents of coastal villages adjacent to their range. In our general conclusions about cumulative effects in the Beaufort Sea multiple-sale final EIS (USDOI, MMS, 2003a), we stated: "Potential cumulative effects on the bowhead whale…would be of primary concern and warrant continued close attention and effective mitigation practices."

With regard to climate change, specifically, the multiple-sale EIS concluded that:

> Climatic change in terms of global warming should not be measurable, as any trends in global warming are on a greater scale than 10-15 years and would not be measurable in this shorter timeframe. If ice roads were to experience a shorter season of supportive cold temperature, the operations would be suspended accordingly or supported by helicopter similar to the roadless development sites.

However, climate change is increasingly a subject of concern for residents of the Arctic. Investigation of climate change and potential biological and physical effects is rapidly increasing. Thus, in this section, we expand the timeframe of our climate change analyses to the life of the project (about 30 years) and consider recently available information regarding potential impacts of climate change that could impact bowhead whales.

Potential effects to bowhead whales related to climate change/climate warming could include:

- increased noise and disturbance related to increased shipping;
- increased interactions with commercial fisheries, including increased noise and disturbance, incidental take, and gear entanglement;
- decreases in ice cover with the potential for resultant changes in prey species concentrations and distribution; changes in subsistence-hunting practices that could result in smaller, younger whales being taken and, possibly, in fewer whales being taken; and
- more frequent climatic anomalies, such as El Ninos and La Ninas, with potential resultant changes in prey concentrations.

In the following, we provide a short summary from four highly credible summaries of available information on climate warming and on predictions related to potential climate-warming-related changes that could result in effects on this population of bowhead whales. These sources are the IPCC (2001), the NRC (2002), Tynan and DeMaster (2001), and the IWC (1997). We highlight which statements from this literature are based on observations (for example, observations of warming or ice-cover changes) and which are based on predictions. We also note where there is apparently broad agreement within the scientific community, and where there is some or a high level of uncertainty about key predictions.

The effects on bowheads in the context of climate change are assessed further in Appendix C, Section VI.C.4. We conclude that the potential effects of global warming on this population of bowhead whales are somewhat uncertain. However, we are aware of no information that indicates such change, over the course of the next 30 years could have a significant adverse impact on bowheads. There is no evidence suggesting that many of the changes that could occur, such as changes in timing of migrations and shifts in distribution, would be associated with adverse effects on these whales. In Shelden et al.'s (2003) response to Taylor's statements regarding the expectation of future downward trends in abundance based on what he termed "available evidence" regarding global warming, they point out that Taylor did not provide citations supporting this claim. Shelden et al. (2003:918-919) state that:

> Although available data do indicate that the Bering Sea environment is changing (e.g., Angel & Smith 2002), we are aware of no evidence that environmental changes will be detrimental to the population in the foreseeable future. In fact, our review…on this issue suggests that climate change may actually result in more favorable conditions for BCB bowheads.

Relatedly, Taylor argued that there will be downward trends in basic life history parameters as a function of global warming. Shelden et al. (2003) responded that Taylor did not list which life-history parameters he was referring to and did not provide the factor that he believed would result in the change of each parameter. They pointed out that members of the IWC's Scientific Committee had "tested extensively" the robustness of BCB bowheads, including changes in key population parameters.

Perhaps the greatest potential adverse effect to bowhead whales associated with global warming could occur if the predictions that the Northwest Passage may become ice free for significant lengths of time prove accurate, opening sea routes across the Beaufort Sea. For example, with respect to the Northwest Passage, Andre Maillet, the head of Arctic icebreaking operations for the Canadian Coast Guard is quoted in the Boston Globe (Nickerson, 2000) as saying: "The waters are opening, this is not science fiction…. Whether it's a few years away or a couple decades, the passage is going to become a vital commercial channel…. The shipping companies already have their eye on the route,"he said. "And they are not going to wait."

Increases in shipping have already occurred, suggesting that projections of further increase have merit. For example, in the fall of 1999, the Russian ocean tug, the *Irbis* made what was reported as the first industrial transit of the Northwest Passage by a non-Canadian vessel by traveling from Russia's far eastern Kamchatka Peninsula to Freeport, Bahamas, hauling a huge floating drydock through the icy labyrinth. Tour-boat traffic in the Beaufort Sea also has increased in recent years.

If shipping increases, adverse effect to bowheads could occur due to shipping-related noise and disturbance, vessel strikes, and pollution. Quantification of such potential changes are not possible at this time due to the level of uncertainty about changes that might occur over the course of the proposed project and the shipping industry's response to greater cross-Beaufort transiting opportunities, when they occur.

Conclusion: We still conclude that effects on bowhead whales would be of primary concern and would warrant continued close attention and effective mitigation practices.

I.2.e. Other Resources (Other Marine Mammals, Fishes and Essential Fish Habitat, etc.)

The multiple-sale EIS includes specific conclusions for each of the following resources.

I.2.e(1) Other Marine Mammals

The multiple-sale EIS concludes in Section V.A.6 that the "(p)otential cumulative effects on…polar bear…would be of primary concern and warrant continued close attention and effective mitigation practices."

Recent analyses of seasonal ice cover in the Arctic over the past 20-30 years show a decrease in ice extent and in ice thickness coincidental with temperature warming trends (Maslanik et al., 1996 and Martin et al. 1997, as cited by Tynan and DeMaster, 1997). Climate warming has reduced the total arctic sea ice coverage by about 15% in the past 20 years (Stirling and Lunn, 2001). Changes in the extent, concentration, and thickness of the sea ice in the Arctic may alter the distribution, geographic ranges, migration patterns, nutritional status, reproductive success and, ultimately, the abundance of ringed seals and other ice-dependent pinnipeds that rely on the ice platform for pupping, resting, and molting (Tynan and DeMaster 1997). Reductions in sea-ice coverage would adversely affect the availability of pinnipeds as prey for polar bears (Stirling and Lunn, 2001). Effects on polar bears in particular were noted in the Northwest NPR-A IAP/EIS (USDOI, BLM and MMS, 2003:Sections IV.F.7.k and IV.F.8.j(2)a)8)). As a result of these changes, more polar bears might stay onshore during summer, as they do in Hudson's Bay during summer. If the arctic climate continues to warm and early spring rains become widespread, ringed seal lairs might collapse prematurely, exposing ringed seal pups to increased predation by polar bears and arctic foxes, negatively affecting the ringed seal population and therefore eventually the polar bear population (Stirling and Smith, 2004). If the current warming trend continues with reduced summer ice coverage, early breakup, and early snow melt, polar bears, seals, and other ice-dependent pinniped populations could decline in distribution and/or abundance.

Conclusion: Partly because of projected 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 additional resources of primary concern. Therefore, we conclude that the potential cumulative effects on polar bears, seals and other ide-dependent pinnipeds would be of primary concern and would warrant continued close attention and effective migration practices.

I.2.e(2) Fishes and Essential Fish Habitat

The following are some general findings concerning climate change and arctic fisheries in the IPCC, 2001b Report.

> A warmer climate will create a more pluvial runoff regime as a greater proportion of the annual precipitation is delivered by rain rather than snow and a flattening of the seasonal runoff cycle occurs. Enhancement of winter flow will mean streams that currently freeze to their beds will retain a layer of water beneath the ice. The effects of changed drainage patterns and active-layer detachments (Dyke, 2000)—increasing sediment-nutrient loads in lakes and rivers—will alter biological productivity in aquatic ecosystems considerably (McDonald et al., 1996). Primary productivity of Arctic aquatic systems also should be boosted by a greater supply of organic matter and nutrients draining from a more biologically productive terrestrial landscape (Schindler, 1997; Hobbie et al., 1999). This will be beneficial to invertebrates and fish populations.
>
> Warming will lead to a shortened ice season and thinner ice cover. For large northward-flowing rivers (for example, the Mackenzie River), this could reduce the severity of ice jamming in spring, especially if the magnitude of the peak snowmelt that drives breakup also is reduced (Beltaos and Prowse, 2000). Reductions in the frequency and severity of ice-jam flooding would have a serious impact on northern riparian ecosystems, particularly the highly productive river deltas, where periodic flooding has been shown to be critical to the survival of adjacent lakes and ponds (Marsh and Hey, 1989; Prowse and Conly, 1998). (Such lakes and ponds may serve as habitat to freshwater and diadromous fishes of the Alaskan arctic region.)
>
> Ice edges are biologically productive systems, with diatoms and other algae forming a dense layer on the surface that sustains secondary production. Of concern as ice melts is the loss of prey species of marine mammals, such as Arctic cod and amphipods, that are associated with ice edges (Tynan and DeMaster, 1997). The degree of plasticity within and between species to adapt to these possible long-term changes in ice conditions and prey availability is poorly known and requires study. Regime shifts in the ocean will impact the distribution of commercially important fish stocks. Recruitment seems to be significantly better in warm years than in cold years, and the same is valid for growth (Loeng, 1989). The distribution of fish stocks and their migration routes also could vary considerably (Buch et al., 1994; Vilhjalmsson, 1997).

I.2.e(2)(a) Arctic Cod and Cryopelagic Fishes

The arctic cod is a pivotal species in the arctic food web, as evidenced by its importance to other marine fishes, sea birds, and marine mammals. In arctic regions, no other prey species compare with arctic cod in abundance and energetic value (Finley, Bradstreet and Miller, 1990.). The distribution and diet of arctic cod vary with ice conditions (Frost and Lowry, 1984); Crawford and Jorenson, 1993) and (relatively) large numbers of fishes can occur locally, especially in areas of marginal ice zones (Andriashev, 1970). Cryopelagic fishes such as arctic cod are adapted to feed under the ice where they consume crustaceans associated with the ice undersurface and adjacent water column (Lønne and Gulliksen, 1989). Tynan and DeMaster (1997) state:

> The placement and orientation of the mouth of arctic cod suggests an adaptation to under-ice feeding (Dunbar, 1981). In Admiralty Inlet (Northwest Territories, Canada), hydroacoustic surveys of fish recorded the highest densities immediately below landfast sea ice (Crawford and Jorgensen, 1990). The distributions of fish, presumably arctic cod, were associated with layers of zooplankton…behaviors of arctic cod that lead to the formation of large aggregations are probably quite crucial to the foraging of higher vertebrates.

Tynan and DeMaster (1997) emphasize that it is difficult to predict how arctic cod may be redistributed in a warmer Arctic. Because their life history is closely linked to sea ice, they speculate that regional changes in the extent of sea ice may lead to redistributions of arctic cod, and consequently to redistributions of marine mammals. They further state:

> In the High Arctic, the base of the food chain consists of ice algae rather than phytoplankton (Alexander, 19950. Many species of copepods reproduce under the ice before the phytoplankton bloom and feed on sedimenting ice algae (Drolet et al., 1991). Large *Calanus* copepods, together

> with amphipods, constitute the bulk of the diet of arctic cod (Bradstreet et al., 1986). In turn, the larvae of arctic cod depend on the production of ice algae to support the productivity cycles of copepods, which supply the copepod eggs and nauplii upon which fish larvae feed (Drolet et al., 1991). Therefore, the timing of the phytoplankton bloom, driven by the breakup and melting of ice, is critical to the immediate success of first-feeding larvae of arctic cod [thereby affecting the recruitment of arctic cod into the arctic food web]. Regional decreases in the recruitment of arctic cod larvae, due to a loss of critical ice-edge habitat or alteration in the seasonal timing of spring blooms….

This would be expected to adversely affect some fish populations that prey on arctic cod.

One of the central questions regarding climate change and the effects on cryopelagic fishes is whether a reduction of sea ice will increase productivity in a way that maintains suitable densities of cryopelagic fishes, such as arctic cod (Tynan and DeMaster, 1997). The implications of reducing ice edge and associated fauna may have deleterious consequences for other species having evolved with cryopelagic communities (Tynan and DeMaster, 1997).

I.2.e(2)(b) Pacific Salmon and Essential Fish Habitat

Babaluk, et al. (2000) notes the following concerning Pacific salmon:

> …capture records for Pacific salmon [chum and pink salmon; collected in 1993] in the western Canadian Arctic represent significant extensions of known, normal distributions. Significant temperature increases in Arctic areas as a result of climate change (for example, Quadfasel et al., 1991; Watson et al., 1996) may result in greater numbers of Pacific salmon in the area. Welch et al. (1998) have predicted that global warming will greatly reduce the acceptable summer and winter thermal habitat for Pacific salmon, in particular sockeye salmon, restricting it to the Bering Sea and areas to the north during summer. The present distribution of Pacific salmon in the Arctic is most likely limited by low water temperatures (Craig and Halderson, 1986), and anadromous [diadromous] fishes in the Arctic in general are limited by availability of overwintering and spawning habitats (Craig, 1989). If more frequent straying of Pacific salmon into Arctic waters occurs, the impact on indigenous salmonids (e.g., arctic charr and Dolly Varden) may be significant and should be closely monitored. Furthermore, changes in distributions for salmon may be useful as proxies for monitoring the effects of climate change on the Beaufort Sea.

The Office of Naval Research (2001) reported that the response of marine resources to changing climate is very difficult to predict but northward migrations are likely. In particular, northward movement of Bering Sea species into the Beaufort/Chukchi Sea region north of Bering Strait is likely. Climate warming is likely to bring extensive fishing activity to the Arctic, particularly in the Barents Sea and Beaufort/Chukchi region where commercial operations have been minimal in the past. In addition, Bering Sea fishing opportunities will increase as sea ice cover begins later and ends sooner in the year. The Office of Naval Research further notes:

> The timing of stream runoff will change, reducing the percentage of continental runoff released during the summer and increasing the proportion of winter runoff. This is already becoming evident during in Siberian Rivers. As permafrost becomes thinner and is reduced in spatial extent, the proportions of groundwater in stream runoff will increase as the proportion of surface runoff decreases increasing river alkalinity and electrical conductivity. This could impact mixing of fresh and saline waters, formation of the halocline, and seawater chemistry. [All of which can impact fish populations inhabiting freshwater, nearshore brackish, or marine ecosystems of the Alaskan arctic.]…changes in the hydrological regime should improve productivity of terrestrial aquatic and marine ecosystems. Increases in winter baseflow will markedly improve winter habitat in streams and rivers for freshwater and anadromous [diadromous] fishes. There is a possibility that these rivers could eventually support commercial fishing industries. There are numerous economic and natural barriers constraining potential marine industrial development, however if the sea ice degradation does allow civilian vessels to work in the Arctic Ocean during at least the summer months, then we should expect a fishing industry to develop. As pressure on fishing resources continues to intensify throughout the North Pacific and North Atlantic, the fishing industry may

indeed 'push these limits' and attempt to establish market influence sooner than natural conditions permit.

I.2.e(2)(c) Summary of Climate Change Effects

Climate change (warming) in the region will likely alter habitat and the diversity, distribution, and abundance of fishes. If climactic warming continues in the region for another 3 decades along the same warming trend as documented for the last 40 years, we may observe significant changes in the diversity, distribution, and abundance of fishes in the Alaskan Beaufort Sea. Although a significant change may not be realized during the lifetime of the Proposed Action, the change appears to be already taking place, as evident by the range changes exhibited by several Pacific salmon species. Regime shifts in the ocean from regional climate change will impact the distribution and abundance of various fish populations. The underlying mechanisms that account for changes in population sizes are poorly understood, particularly because plankton production and trophic interactions may be extensively altered by changes in climate. Shifts in oceanic circulation associated with global or regional climate warming are likely to affect the migration routes of some fishes. Some species are likely to become more widespread and/or abundant (for example, Pacific salmon), whereas other species are likely to become less abundant or modify their distribution. Arctic cod may be redistributed in a warmer Arctic. Since their life history is closely linked to sea ice, regional climate warming may change the extent of sea ice and cause arctic cod to decline in abundance or redistribute accordingly. If more frequent straying of Pacific salmon into Arctic waters occurs, the impact on indigenous salmonids (for example, arctic char and Dolly Varden) should be closely monitored. Regional climate change is likely to bring additional fishing activity to the Arctic, particularly in the Barents Sea and Beaufort/Chukchi region where commercial operations have been minimal in the past. Oil spills associated with the Proposed Action or other hydrocarbon leasing activities may interact and modify effects attributed to climate change on fish populations.

The introduction of non-native, invasive species into aquatic environments of the Beaufort Sea (chiefly nearshore and marine waters) is a concern as vessel traffic increases in the region, however, it appears premature to specify what non-native, invasive species might be capable of colonizing the harsh environmental conditions present in the region. If climate warming of the region continues, such colonization by invasive species introduced by vessels may become more likely. Hence, fish habitat in the region is expected to be increasingly modified, and fish populations are anticipated to be increasingly adversely impacted by ever-increasing human activities in the region.

I.2.e(3). Air Quality and Other Resources

We are aware of no projected climate changes that would influence the effects of OCS Sale 195 on air quality, vegetation and wetlands, or terrestrial mammals. With respect to lower trophic-level organisms, which includes the kelp community in the Boulder Patch, the multiple-sale EIS concluded generally in Section V.A.6 that "Potential cumulative effects on the…Boulder Patch…would be of primary concern and warrant continued close attention and effective mitigation practices." As summarized in Section I.2.C above, the projected climate changes include reduction in the summer ice cover and changes in nearshore surface seawater. Reduction in the summer ice cover and any changes in the optical transparency of nearshore seawater might influence slightly the growth of kelp. So, we still conclude that the potential cumulative effects on the Boulder Patch kelp community would be a primary concern.

Conclusion: Partly because of projected climate changes, we still conclude that potential effects on polar bears and Boulder Patch kelp habitat would be a primary concern. We identify ringed seals and other ice-dependent pinnipeds as additional resources of primary concern. Therefore, we conclude that the potential cumulative effects on polar bears, seals and other ide-dependent pinnipeds would be of primary concern and would warrant continued close attention and effective migration practices.

I.2.f. Environmental Justice

Alaskan Inupiat Natives, a recognized minority, are the predominant residents of the NSB, the area potentially most affected by Sale 195 exploration and development. Effects on Inupiat Natives could occur because of their reliance on subsistence foods, and 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.b, would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik.

For environmental justice, the multiple-sale final EIS concludes in Section V.C.16 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.

After publication of the multiple-sale EIS, the effects of a proposed lease sale in the Northwest NPR-A and an expansion of the Alpine field were assessed (USDOI, BLM and MMS, 2003; USDOI, BLM, 2004). Sections IV.F.8.p of the NPR-A assessment summarizes the effects of an offshore spill on environmental justice:

Conclusion for Environmental Justice: Because potential impacts on marine and terrestrial ecosystems in the Arctic could cause impacts on subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities in the NSB would be expected to experience disproportionate, high, adverse environmental and health effects.

I.2.g. Summary of Effects in the Context of Climate Change

The update focuses primarily on the effects of the proposed lease sale in the context of climate change and infrastructure developments. The following are the conclusions of the resource-specific cumulative assessments.

Marine and Coastal Birds: The updated information presented suggests, as stated in the multiple-sale EIS, that: "The incremental contribution of Sale [195] to the cumulative effects likely would be quite small." Specific potential effects may include the loss of small numbers of spectacled eiders and other sea ducks or aquatic bird species as cumulative projects are developed and minor declines in fitness, survival, or production of young resulting from exposure of these species to disturbance factors. Mortality from collision with structures warrants continued close attention, and effective mitigation practices are expected to elevate the status of additional bird species to that of significantly affected. Mortality from a large oil spill, an unlikely event, could be relatively substantial and represent a significant effect for any sea duck 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.

Subsistence-Harvest Patterns and Sociocultural Systems: The incremental contribution of Sale 195 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, and Northeast and Northwest NPR-A) and offshore (Northstar and Liberty). In the unlikely event of a large spill from Sale 195, 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.

Because the occurrence of a large oil spill is unlikely, attaining a level of significant effect also is unlikely. These conclusions and updated levels of effect on subsistence-harvest patterns, sociocultural systems, and Environmental Justice would be the same as in the multiple-sale EIS. Factoring in potential climate-change impacts suggests potential adverse impacts even without a large oil spill. We still conclude that potential effects on subsistence and sociocultural systems would be significant, warrant continued close attention, and effective mitigation practices. Also, we still conclude that potential environmental justice effects would focus on the Inupiat communities of Barrow, Nuiqsut, and Kaktovik within the NSB; such impacts would be considered disproportionately high adverse effects on Alaska Natives.

Local Water Quality: We conclude that the effects of Sale 195 on water quality in the context of climate change would probably be similar to the effects that are summarized in EA Section IV.E.2.c.

Bowhead Whales: The best available information on past, current, and reasonably foreseeable anthropogenic actions on the Western Arctic stock of bowhead whales supports the conclusion that it is unlikely that there would be significant cumulative impacts on the Western Arctic stock of bowhead whales over the lifetime of the proposed project. The incremental contribution of Sale 195 to the effects likely would be small. While there is uncertainty about the exact level and nature of potential effects that presently may be associated with, or that could result from, particular activities or effectors, available data indicate that this population is robust and is increasing at a healthy rate. It is highly unlikely to become extinct over the next 100 years (Shelden et al., 2001). This population also is highly regulated and relatively well monitored. Whatever adverse effects it currently is or historically has suffered from human activities, there is no indication such effectors currently have important adverse effects on this population. There are multiple regulatory tools available to adequately protect this population from many of the potential adverse human-related effects.

Most effects are not expected to be additive or synergistic, as many of the potential effects would be expected to occur in different areas and, by chance, affect different individuals. However, we acknowledge some uncertainty about this conclusion. If certain activities were clustered in their space (for example, shipping and offshore petroleum development both increase in the area of the Beaufort Sea offshore of the Mackenzie River where bowheads commonly aggregated to feed in the summer), there could be additive or synergistic effects on this population. This would be particularly true if there is a threshold level of noise/disturbance that causes bowheads, or some key component of the bowhead population, to avoid an area that otherwise would hold benefit to them. We still conclude that this population is of primary concern and, thus, warrant continued close attention and effective mitigation practices.

Other Resources: With regard to other marine mammals, the overall effects (mainly from one oil spill assumed for this analysis) is the potential loss of perhaps up to 10 polar bears and a few hundred seals and walruses, and small numbers (probably fewer than 10) of beluga and gray whales. In the likely case, pinnipeds, polar bear, and beluga and gray whale populations are expected to recover within 1 year, assuming only one large spill (greater than or equal to 1,000 bbl) occurs. Potential oil spills along the tanker route to the U.S. west coast could have a long-term (more than one generation or perhaps 5-10 years) effect on sea otters and perhaps harbor seals and other marine mammals. Noise and disturbance in the Beaufort Sea Planning Area is expected to briefly and locally disturb or displace a few seals, walruses, beluga and gray whales, and polar bears. A few polar bears could be temporarily attracted to the production island, with no significant effects on the population's distribution and abundance. Potential global warming and resulting arctic climate change could have adverse effects on the distribution and/or abundance of ice-dependent marine mammals, especially polar bears and pinnipeds (ice seals and walruses) in the Alaskan Arctic. The contribution of Sale 195 is expected to be about 2-4% of the local short-term disturbance and habitat effects on pinnipeds, polar bears, and beluga and gray whales (based on 0.46-Bbbl/11.5-Bbbl oil reserves in Table V-12 of the multiple-sale EIS). The Proposed Action for Sale 195 likely would contribute about 17% of cumulative offshore spills. The estimated mean number of cumulative offshore spills is 0.65, but the most likely number of offshore spills is zero (USDOI, MMS, 2003a).

Conclusion: Partly because of projected climate changes, we still conclude that potential effects on polar bears would be a primary concern and would warrant continued close attention and effective mitigation practices. Further, we have identified ringed seals and other ice-dependent pinnipeds as additional resources of primary concern.

With regard to fishes, impacts from activities beyond the scope of the Proposed Action may beneficially and/or adversely impact fish resources and essential fish habitat in the region. Past, present, and future exploration and development of onshore and offshore hydrocarbons in the region have potential to alter fish habitats and adversely impact fish populations. Oil spills (large or small) from these activities have potential to adversely impact fish populations and habitat, as may other activities. Community development and fishing pressure are anticipated to increase in the region, as is vessel traffic expected to increase. Regime shifts in the ocean from regional climate change will impact the distribution and abundance of various fish populations. The underlying mechanisms that account for changes in population sizes are poorly understood, particularly because plankton production and trophic interactions may be extensively altered by changes in climate. Shifts in oceanic circulation associated with global or regional climate warming are likely to affect the migration routes of some fishes. Some species are likely to become more widespread and/or abundant (for example, Pacific salmon), whereas other species are likely to become less abundant. Arctic cod may be redistributed in a warmer Arctic. Since their life history is closely linked to sea ice, regional climate warming may change the extent of sea ice and cause arctic cod to decline in abundance or redistribute accordingly. If more frequent straying of Pacific salmon into Arctic waters occurs, the impact on indigenous salmonids (for example, arctic char and Dolly Varden) should be closely monitored. Regional climate change is likely to bring additional fishing activity to the Arctic, particularly in the Beaufort/Chukchi region where commercial operations have been minimal in the past. Oil spills associated with the Proposed Action or other hydrocarbon leasing activities may interact and modify effects attributed to climate change on fish populations.

Environmental Justice: Because potential cumulative impacts on marine and terrestrial ecosystems in the Arctic could cause impacts on subsistence resources, traditional culture, and community infrastructure, subsistence-based indigenous communities in the NSB would be expected to experience disproportionate, high, adverse environmental and health effects.

Summary: The updated information presented suggests that, as concluded in the multiple-sale EIS, “The incremental contribution of Sale 195 to the cumulative effects likely would be quite small.” In the context of new information about climate change that has become available since publication of the multiple-sale EIS, the conclusions about most resources would not change substantially. For example, there would be detrimental and beneficial effects on marine and coastal birds, bowhead whales, fishes and essential fish habitat. The most severe adverse effects might be on marine mammals that are dependent on the late spring and summer ice cover, such as the polar bear, ringed seal and other ice-dependent pinnipeds. Part of the reason would be due to the projected earlier onset of spring melt over the sea ice, which means that ringed seal pupping in snow lairs might be less successful. Another reason would be that, because of the projected decreases in the arctic summer ice, polar bear could not prey as effectively on seals and might be forced to stay onshore during summer.

We would not be responsible for moderating the effects of climate change on these animals, but we would be responsible for moderating any increased effects on them because of the proposed lease sale. For example, if more polar bears stay onshore during summer, we would be responsible for moderating the effects of increased interaction between polar bear and oil industry personnel. We note that that there are facilities and programs for safe interaction of humans and polar bears on the North Slope.

The following are examples of mitigating measures that would help to limit harmful encounters between petroleum-industry personnel and animals within and adjacent to the proposed Beaufort Sea lease area:

- Stipulation No. 1 Protection of Biological Resources, which requires, in part, that lessees conduct operations during those periods of time that do not adversely affect biological resources.
- Stipulation No. 2 Orientation Program, which OCS workers must attend each year and which could include more information on polar bears.
- Information to Lessee No. 4 Information on Bird and Marine Mammal Protection. Lessees are advised that during the conduct of all activities…the lessee will be subject to the Marine Mammals

Protection Act. Disturbance of marine mammals could be determined to constitute a "taking" under the Act.

- Information to Lessee No. 9 Information on Polar Bear Interaction. Lessees are advised to conduct their activities in a manner which will limit potential encounters and interaction between lease operations and polar bears.

Further, geological and geophysical (seismic) exploration is conducted on the ice during winter, when no changes are predicted for the ice cover. Regardless, the MMS permits for seismic exploration include mitigation that might further reduce harmful encounters between humans and polar bears or ringed seals during offshore operations. In the case of polar bears, seismic permit applications usually explain that the operator and the Fish and Wildlife Service have prepared a Polar Bear Interaction Plan. The plans generally specify that all waste/garbage will be incinerated to keep human/polar bear interactions to a minimum. Additionally, the operator's plans usually note that, if polar bears are sighted, employees must stay inside, and that the sighting would be reported to the Fish and Wildlife Service.

Conclusion: In light of these effects and mitigation, we reviewed the general conclusions about cumulative effects in the multiple-sale EIS (in Section V.A.6). Part of the general conclusion is that: "Potential cumulative effects on the bowhead whale, subsistence, sociocultural systems, spectacled eider, boulder patch, polar bear, and caribou would be of primary concern and warrant continued close attention and effective mitigation practices."

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.

The Department of the Interior Mission
As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

The Minerals Management Service Mission
As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Royalty Management Program** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.