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

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

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

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

IV.C. Updated Effects of the Proposed Action.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

IV.C.2. Update of Effects Analysis.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

These assessments are updated in the following section.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

The multiple-sale EIS stated that:

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

The multiple-sale EIS goes on to say that:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cascades of indirect effects:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

> The analysis of spill impacts shows that very small and small spills are unlikely to have long-term, extensive impacts that would affect water quality, habitat, or subsistence species. Larger spills that are more likely to have impacts that are more extensive have a very low probability of occurrence. Spill impacts, to the extent that they occur, would be episodic, not continuous. Local residents have shown a propensity to avoid resources from areas where spills have occurred because of a lack of confidence that subsistence resources have not been contaminated. This lack of confidence could affect subsistence use for a period beyond the time when any resources affected from spills would actually persist.
>
> As discussed in the water quality section (Section 4F.2.2), impacts on water quality can occur as a result of spills or construction-induced erosion.
>
> Air quality in Nuiqsut already meets NAAQS for all criteria pollutants. Short-term episodes of elevated particulate concentrations have been observed at Nuiqsut and are caused by wind-borne dust. Emissions from natural gas flaring (incidental) and equipment operation are not expected to contribute to the chronic exposure of local residents to particulates.
>
> Low-level aircraft noise is expected to be limited to areas surrounding facility airstrips. However, helicopter operations, which are typically at lower altitudes, can range over a larger area as these aircraft move between different facility locations. Subsistence hunters have reported the interruption of hunts in progress by low-flying aircraft, especially helicopters.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

IV.D. Updated Effects of Other Alternatives.

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

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

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

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

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

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