Preliminary Public Review Draft Environmental Assessment/ Regulatory Impact Review/Initial Regulatory Flexibility Analysis for the Arctic Fishery Management Plan and Amendment 29 to the Fishery Management Plan for Bering Sea/Aleutian Islands King and Tanner Crabs

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Abstract: The document provides decision-makers and the public with an evaluation of the environmental, social, and economic effects of alternatives and options to manage the fishery resources in the Arctic Management Area. No large fisheries currently exist in the Arctic Management Area, and only small, subsistence fisheries have occurred historically. However, the warming of the Arctic and seasonal shrinkage of sea ice may increase opportunities for fishing in this region. The Council proposes to develop an Arctic Fishery Management Plan that would (1) close the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due concern to other ecosystem components; (2) determine the fishery management authorities in the Arctic and provide the Council with a vehicle for addressing future management issues; and (3) implement an ecosystem-based management policy that recognizes the resources of the U.S. Arctic and the potential for fishery development that might affect those resources, particularly in the face of a changing climate. This document addresses the requirements of the National Environmental Policy Act, Presidential Executive Order 12866, and the Regulatory Flexibility Act.

This document has been approved by the Council for a preliminary public review. Comments are requested prior to the Council's December 10-15, 2008 meeting in Anchorage. At that meeting, the Council's Scientific and Statistical Committee will review this document, particularly Chapter 4 and the two options for specifying MSY and OY and other conservation parameters. The Council is interested in public comments on these options. Please see Section 1.4 for comments received at the Council's October 2008 meeting and a description of the schedule for final action and adoption of an Arctic FMP.

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Executive Summary

The North Pacific Fishery Management Council (Council) recognizes emerging concerns over climate warming and receding seasonal ice cover in Alaska's Arctic region, and the potential long term effects from these changes on the Arctic marine ecosystem. Concerned over potential effects on fish populations in the Arctic region, the Council discussed a strategy to prepare for possible future change in the Arctic region, and determined that a fishery management regime for Alaska's Arctic marine waters is necessary.

This document is a preliminary public review draft Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA) of the proposed Arctic Fishery Management Plan (FMP). The North Pacific Fishery Management Council intends to adopt an Arctic FMP, and is considering several alternatives to accomplish the Council's intent to close the Arctic Management Area to commercial fisheries. These alternatives are analyzed in this document.

The Council proposes to develop an Arctic FMP that will (1) close the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due concern to other ecosystem components; (2) determine the fishery management authorities in the Arctic and provide the Council with a vehicle for addressing future management issues; and (3) implement an ecosystem-based management policy that recognizes the resources of the U.S. Arctic and the potential for fishery development that might affect those resources, particularly in the face of a changing climate.

The Arctic Management Area is all marine waters in the exclusive economic zone (EEZ) of the Chukchi and Beaufort Seas from 3 nautical miles offshore the coast of Alaska or its baseline to 200 nautical miles offshore, north of Bering Strait (from Cape Prince of Wales to Cape Dezhneva) and westward to the U.S./Russia Convention Line of 1867 and eastward to the U.S./Canada maritime boundary.

Purpose and Need

Chapter 1 describes the proposed action and its purpose and need. The purpose of the proposed action is to establish federal fisheries management in the Arctic Management Area that complies with the Magnuson-Stevens Act before an unregulated commercial fishery emerges and causes adverse impacts to the marine resources and ecosystem of the Arctic EEZ off Alaska. A secondary purpose of the proposed action is to clarify management authorities in the U.S. Arctic EEZ. The need for the proposed action is to protect the sensitive ecosystem and marine resources of the Arctic EEZ off Alaska, which are already stressed due to climate change, from potentially unregulated, or inadequately regulated, commercial fishing. The action would prevent commercial fisheries from developing in the Arctic without the required management framework and scientific information on the fish stocks, their characteristics, and the implications of fishing for the stocks and related components of the ecosystem.

Alternatives

Chapter 2 describes and compares four alternatives and two options, summarized as follows:

Alternative 1: No Action (Status quo). Maintain existing management authority.

Alternative 2: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait.

Alternative 3: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait. Alternative 3 would exempt from the Arctic FMP a red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred.

Alternative 4: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred could be prosecuted under authority of the Crab FMP. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

Either Option 1 or 2 or a combination of these options must be chosen under Alternative 2, 3, or 4 to meet the MSA required provisions for an FMP to (1) assess and specify the present and probable future condition of, and the maximum sustainable yield and optimum yield from, the fishery and (2) specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished or when overfishing is occurring.

Option 1: Specify maximum sustainable yield (MSY), status determination criteria (both maximum fishing mortality threshold (MFMT) and minimum stock size threshold (MSST)), optimum yield (OY), annual catch limits (ACL), and annual catch target (ACT) for the fisheries that the plan is intended to manage. Managed fisheries are those identified as having a non-negligible probability of developing within the foreseeable future.

Option 2: Create 4 categories of FMP species, identify species in each category, and create a process for moving species from the ecosystem component (EC) category to the Target Species category. Categorize all species of Arctic finfish and shellfish as EC species or prohibited species. EC and prohibited species are not considered managed fisheries under the FMP and do not require specification of reference points such as MSY, OY, and status determination criteria; therefore no reference points are required in this option. Reference points would be developed for a species to move it into the Target Species category.

Summary of the impacts of the alternatives

The Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA) evaluates the alternatives for their effects within the action area. Chapters 4 through 10 of this EA/RIR/IRFA assess the impacts of each alternative for finfish and shellfish, habitat, marine mammals, seabirds, ecosystem relationships, society, and the economy.

Finfish and shellfish in the Arctic Management Area

Chapter 4 analyzes the impacts of the alternatives on finfish and shellfish. Many species of marine and anadromous (and amphidromous) fish and shellfish inhabit Arctic waters seasonally or year round. However, no species of finfish or shellfish are known to occur in the Arctic Management Area in sufficient biomass to support commercial fishing, except for Arctic cod, saffron cod, and snow crab. The Council's objective for Alternatives 2, 3, and 4 is to create an FMP that closes the Arctic region to commercial harvest of all fish and shellfish species. Under these alternatives, salmon and halibut commercial fisheries would remain closed under status quo management and under any of the other three alternatives. The Arctic FMP's Fishery Management Area under Alternatives 2 and 3 would include all federal Arctic waters north of Bering Strait. However, in contrast to Alternative 2, the Arctic FMP under Alternative 3 would exempt from federal management a red king crab fishery in the southeastern part of the Chukchi Sea, of the size and nature of the historic fishery, and which would be managed exclusively by the State of Alaska. Any other crab fishery, or an increase in magnitude of this historic crab fishery, would fall under the management of this Arctic FMP. The Arctic FMP's Management Area under Alternative 4 would include all federal Arctic waters north of Bering Strait for all managed species, except for crab species. The crab FMP management boundary would remain at Pt. Hope, and the crab FMP would not be amended.

If no new fisheries are developed, then no impacts of selecting any of the alternatives are evident other than maintaining essentially the *status quo*. The primary difference in the alternatives is that under Alternative 1, the State of Alaska could open a new or developing fishery under its regulations and neither the NMFS nor the state could prevent unregistered vessels from fishing in the Arctic, potentially allowing an unknown amount of unregulated fishing. Under Alternatives 2, 3, and 4, the Federal Arctic FMP would need to be amended to manage any new fishery in compliance with applicable Federal law. Differences between the alternatives in how each treats the Chukchi Sea red king crab fishery are described immediately above. Because Alternative 1 does not prevent unregulated fishing, there is potential for significant adverse effects on fish and shellfish resources.

Options 1 and 2 present administrative methods for achieving the same results as intended by Alternatives 2, 3, and 4, prohibiting commercial fishing. Because these options describe an administrative process for scientific assessment that results in prohibiting commercial fishing in the Arctic, the effects of these options on the environment and on management resources will be the same. Additionally, both options would require an FMP amendment to authorize a fishery and the FMP amendment would need to comply with the MSA and would require a NEPA analysis of the specific measures proposed and alternatives to those measures.

Habitat and Essential Fish Habitat

Chapter 5 analyzes the impacts of the alternatives on habitat and essential fish habitat. Specific areas in the Arctic may be particularly susceptible to potential damage from bottom trawl fisheries. For these reasons, Alternative 1 has the potential to allow unregulated fishing that may result in significant negative impacts to habitat complexity, benthic biodiversity and habitat suitability; and therefore, may result in significantly negative impacts on habitat. Overall, Alternatives 2, 3, and 4 are more protective to habitat than Alternative 1 by preventing the occurrence of unregulated commercial fishing in the Arctic Management Area. Because Alternatives 2, 3, and 4 would not change the current conditions of habitat present in the Arctic Management Area, including no changes to habitat complexity, benthic diversity, and habitat suitability, the impacts of Alternatives 2, 3, and 4 on habitat are insignificant.

Birds in the Arctic Management Area

Chapter 6 analyzes the impacts of the alternatives on birds. Birds seasonally occur in substantial numbers in the Arctic Management Area. Nearly all Arctic birds are migratory, and large numbers of many species are present between May and November; only a few species remain year round. Arctic bird species that may occur in marine waters include waterfowl, shorebirds, loons, seabirds, raptors, and other species. Bird species listed under the Endangered Species Act that inhabit the areas where commercial fishing could occur include spectacled eider and Steller's eider. Short-tailed Albatross extremely rarely, if ever, inhabit this area. Two other candidate species for listing do inhabit and depend on breeding habitat in this area: Kittlitz's murrelet and the yellow-billed loon.

Potential effects on seabirds from commercial fisheries include incidental take, reduced prey availability, and habitat disturbance. Since all of the alternatives under consideration that may affect birds, other than status quo, would close commercial fisheries in the Arctic Management Area, none of the alternatives would have significant impacts on seabirds. Two alternatives would allow a red king crab fishery to occur in the southeastern Chukchi Sea; birds do not consume crab and such a fishery would not adversely interact with birds, and thus there would be no effects of these alternatives on birds. The development of unregulated fisheries under Alternative 1 has the potential to significantly adverse affect seabird species, dependent on the fishery and the seabird species affected.

Marine Mammals in the Arctic Management Area

Chapter 7 analyzes the impacts of the alternatives on marine mammals. The Arctic is known for its indigenous, and sometimes migratory, marine mammal populations. Fifteen marine mammal species are present in the Arctic Management Area: bowhead whales, gray whales, beluga whales, minke whales, killer whales, fin whales, humpback whales, narwhals, spotted seals, bearded seals, ribbon seals, ringed seals, Pacific walrus, polar bears, and harbor porpoise. Interactions between marine mammals and commercial fisheries may occur due to overlap in important marine mammal prey and the size and species of fish that are harvested in the fisheries, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities. Effects on marine mammals by the fisheries include incidental takes and entanglement, harvest of prey species, and disturbance. By prohibiting commercial fisheries, Alternatives 2, 3, and 4 would be more protective for marine mammals in the Arctic Management Area compared to the *status quo*, which does not restrict commercial fishing by vessels not permitted by the State of Alaska. Alternative 2 is the most protective to marine mammals by prohibiting all commercial fishing in the Arctic Management Area. Alternatives 3 and 4 would allow a red king crab fishery to occur in the southeastern Chukchi Sea. Several marine mammals in this region, including beluga whales, spotted and bearded seals, and Pacific walrus eat crab. Gray, humpback, and bowhead whales have become entangled in pot fishing gear and may be impacted by a crab fishery in the Kotzebue area, if the whales encounter the crab gear. The scale of the crab fishery would remain very small, so that any potential for entanglement or competition for prey would also remain very small. The potential effects of this limited crab fishery on whales, walrus, and seals are therefore insignificant. Disturbances of marine mammals under Alternatives 2, 3, and 4 are not likely to occur because of the prohibition on fishing. The small red king crab fishery is likely small enough in scope that few marine mammals would be disturbed by the fishing activity.

Cumulative impacts on marine mammals in the Arctic Management Area are likely to occur from oil, gas, and mineral exploration and development and increased shipping activity, including increased potential for introducing invasive species. These activities have the potential to adversely impact marine mammals in the Arctic, but these impacts are likely to be localized and are not expected to result in stock level effects. Oil and gas production may result in cumulative significant adverse effects on marine mammals based on the potential effects of a large oil spill, especially under ice. The continuing fishing activity and continued subsistence harvest are potentially important sources of additional annual adverse impacts on marine mammals that range from the Bering Sea into the Arctic Management Area. Both of these activities are monitored and are not expected to increase beyond the potential biological removals for most marine mammals or to greatly increase the total annual human-caused mortality. The extent of the fishery impacts would depend on the size of the fisheries, the protection measures in place, and the level of interactions between the fisheries and marine mammals. However, a number of factors will tend to reduce the impacts of fishing activity on marine mammals in the future, most importantly ecosystem management. Ecosystem-sensitive management and institutionalization of ecosystem considerations into fisheries governance are likely to increase our understanding of marine mammal populations and interactions with fisheries. The effects of actions of other federal, state, and international agencies are likely to be less important when compared to the direct interaction of the commercial fisheries, subsistence harvests, and marine mammals.

Under current conditions, the potential direct and indirect impacts from Alternatives 1, 3, and 4 are very limited (for incidental takes and harvest of prey resources) and nonexistent (for disturbance) because no fisheries are allowed at present or are likely to be allowed in the foreseeable future, with the possible exception of a very small historical king crab fishery. Therefore the past, present, and reasonably foreseeable future actions in combination with the direct and indirect impacts of Alternatives 1, 3, and 4 are not expected to result in significant impacts on Arctic marine mammals. Alternative 2 prevents any fishing in the Arctic Management Area and therefore has no effect on marine mammals. If unregulated fishing develops under Alternative 1, significant adverse effects are possible depending on the fishery and the marine mammal species.

Ecosystem

Chapter 8 analyzes the impacts of the alternatives on the ecosystem. Commercial fisheries can impact systemic relationships between components of the ecosystem by changing predator/prey relationships, energy flow and balance, and biological diversity. Since all of the alternatives under consideration, other than *status quo*, would close commercial fisheries in the Arctic Management Area, none of the alternatives would appreciably impact the ecological relationships between components of the Arctic ecosystem. Two alternatives would allow a red king crab fishery to occur in the southeastern Chukchi Sea; the ecosystem effects of allowing this small localized fishery to continue are not considered to be large, and therefore this document concludes there would be no effects of these alternatives on the ecosystem. If unregulated fishing were to develop under Alternative 1, there may be significant adverse effects on the ecosystem, especially if the target species is Arctic cod or saffron cod, important keystone species.

Economic and Social Impacts

The costs and benefits of this action are evaluated in Chapter 9, which provides a Regulatory Impact Review (RIR) of this action. All of the alternatives have the benefit of creating a framework within which future fisheries development may proceed in a sustainable manner. This should benefit a commercial fishery if one eventually evolves. It will also benefit other users of ecosystem services in the region that might be impacted by a commercial fishery, for example subsistence users of marine mammals. All of the alternatives impose a prohibition on fishing that will create an additional burden for the NOAA Office of Law Enforcement and the U.S. Coast Guard. It is not possible to evaluate the cost of these responsibilities with current information. The alternatives may create some ongoing management and specifications responsibilities for the Alaska Fisheries Science Center, the SSC, the AP, the Council, and the Sustainable Fisheries Division of NMFS. These are believed to be small. Alternative 2 prohibits what may be a small and poorly documented crab fishery in federal waters of Kotzebue Sound. Lost profits in this fishery may create a small cost but lack of information on the fishery makes it impossible to estimate this cost.

An Initial Regulatory Flexibility Analysis was conducted to examine adverse impacts of the alternatives on directly regulated small entities. This analysis, in Chapter 10, was prepared to comply with the Regulatory Flexibility Act (RFA). Alternatives 1, 3, and 4 have no known impacts on directly regulated small entities. Alternative 2 would prohibit crab fishing that may be taking place in a small and poorly documented fishery in Kotzebue Sound. This may have an adverse impact on two to four small entities.

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Chapter 1 Introduction

At its October 2006 meeting, the North Pacific Fishery Management Council (Council) discussed emerging concerns over climate warming, the receding seasonal ice cover in Alaska's Arctic region, and the potential long term effects from these changes on the Arctic marine ecosystem. The Council expressed concern over potential effects on fish populations in the Arctic region, and discussed a strategy to prepare for possible future change in the Arctic region. The Council indicated an interest in developing a fishery management regime for Alaska's Arctic marine waters, and the Council stated a preference for closing the Arctic EEZ to commercial fishing until such time that information and data are available with which to make decisions on future fishery development.

The Council, therefore, tasked staff to prepare a draft discussion paper on options for management of fisheries in the U.S. Exclusive Economic Zone (EEZ) waters of the Arctic Ocean off Alaska. The Arctic Ocean has two regional seas that are adjacent to Alaska: the Chukchi Sea and the Beaufort Sea. With the apparent climate change trends, it is conceivable that as oceans warm, the Arctic EEZ off Alaska could offer commercial fishing opportunities in the future (Newton 2005). The Council was interested in exploring possible policy options, such as a Fishery Management Plan (FMP), to address management of any existing or potential future commercial fisheries in this region. At that time, the Council expressed its view that commercial fishing may not be appropriate in the Arctic region, and that a prohibition may be appropriate until a future date when information may be available to sustainably manage any Arctic fisheries.

Under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the Council is authorized to conserve and manage the fishery resources of the EEZ off Alaska, including the Chukchi and Beaufort Seas. To date, no commercial fisheries have developed in the area, and thus the Council has not had a compelling reason to develop fishery management plans for these Arctic marine areas off Alaska. Current federal management authority in the region is described in Chapter 2, under Alternative 1 status quo.

The environment in the Alaskan Arctic is changing, with warming trends in ocean temperatures and changes in seasonal sea ice conditions potentially favoring the development of commercial fisheries. Recent popular literature has featured this issue (e.g. Hawks 2006). In 2006, scientists compiled information on changes in Arctic climate, ocean conditions, sea ice cover, and permafrost and vegetation change (Richter-Menge et al. 2006), noting dramatic reductions in sea ice. Recently, a more dramatic prediction is the transport from the Bering Sea to the Atlantic of certain mollusc species via a warming Arctic Ocean (Vermeij and Roopnarine 2008). Greater ice-free seasons coupled with warming waters and expanding ranges of fish species could together create conditions that could lead to commercial fishery development. Finfish and shellfish occur in these waters that conceivably could support commercial fisheries if exploitable biomass levels are sufficient. Although at this time there are no such fisheries in the EEZ off Alaska in the Arctic Ocean, and no routine fish surveys conducted in the region, the Council expressed its intent to explore policy and management options to prepare for future change. Because the Council does not have an FMP for the Arctic to control fishing activities, it recognizes that adopting such an FMP would be a proactive and appropriate action to take in light of potential future change in Alaska's Arctic region and possible development of fisheries.

This document contains an Environmental Assessment (EA), a Regulatory Impact Review (RIR) and an Initial Regulatory Flexibility Analysis (IRFA) that analyze the impacts of alternatives for management of fisheries resources in the Arctic Management Area. Chapters 1 through 8 provide the EA for the alternatives, as required by NEPA. Chapter 9 is the RIR that provides a cost and benefit analysis of the alternatives under consideration by the Council, as required by Presidential Executive Order 12866. Chapter 10 is the IRFA that provides an analysis of the impacts of the alternatives on small entities, as required by the Regulatory Flexibility Act.

1.1 Proposed Action

The Council proposes to develop an Arctic FMP that would (1) close the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due concern to other ecosystem components; (2) clarify the management authorities in the Arctic and provide the Council with a vehicle for addressing future management issues; and (3) implement an ecosystem-based management policy that recognizes the unique issues in the Alaskan Arctic.

1.2 Action Area

The Arctic Management Area is all marine waters in the EEZ of the Chukchi and Beaufort Seas from three nautical miles off the coast of Alaska or its baseline to 200 nautical miles (nm) offshore, north of Bering Strait (from a line between Cape Prince of Wales to Cape Dezhneva) and westward to the U.S./Russia Convention Line of 1867 and eastward to the U.S./Canada maritime boundary (Figure 1-1).

The action area is defined based on U.S. claims on our international boundaries in the Arctic; however, Russia has not ratified the agreement on the U.S./Russian boundary, and there is no agreement with Canada on the U.S./Canada boundary. The U.S. Department of State published in the Federal Register the exact coordinates for the US EEZ, including the Arctic, within which the US will exercise its sovereign rights and jurisdiction as permitted under international law, pending the establishment of permanent maritime boundaries by mutual agreement in those cases where a boundary is necessary and has not already been agreed on (60 FR 43825, August 23, 1995).

The U.S. and Russian Federation boundary line includes several areas called "special areas" that occur within each country's EEZ and are artifacts of the coincidence of the U.S./Russian Federation maritime border and the outer edge of the 200 nm line around each country's shoreline. The Chukchi Eastern Special area is the triangular area at the top of the Chukchi Sea and is one of these Eastern Special Areas. This area is part of the Russian EEZ that extends beyond the US EEZ and the maritime boundary. The other two areas are located in the Bering Sea. These special areas were established under the Agreement between the United States of America and the Union of Soviet Socialist Republics on the maritime boundary, 1 June 1990 (http://www.un.org/Depts/los/LEGISLATIONANDTREATIES/PDFFILES/TREATIES/USA-RUS1990MB.PDF).

Under the 1990 U.S.-Russian agreement, both sides have applied the agreement on a provisional basis since 1990. Under the agreement, Russia transferred to the United States the fisheries management jurisdiction it had with respect to the three Eastern Special Areas, including the one in the Chukchi Sea (and the US transferred to Russia the fisheries management jurisdiction it had with respect to the one Western Special Area) (David Bolton, U.S. State Department, personal communication). Thus, the three Eastern Special Areas are treated in essence as part of the US EEZ -- as long as provisional application of the 1990 boundary agreement continues and, certainly, if the agreement actually enters into force. Because the Chukchi Sea Eastern Special Area lies outside the boundary of the EEZ and the jurisdiction of the Council is limited to the EEZ by the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the proposed action will not include this area.

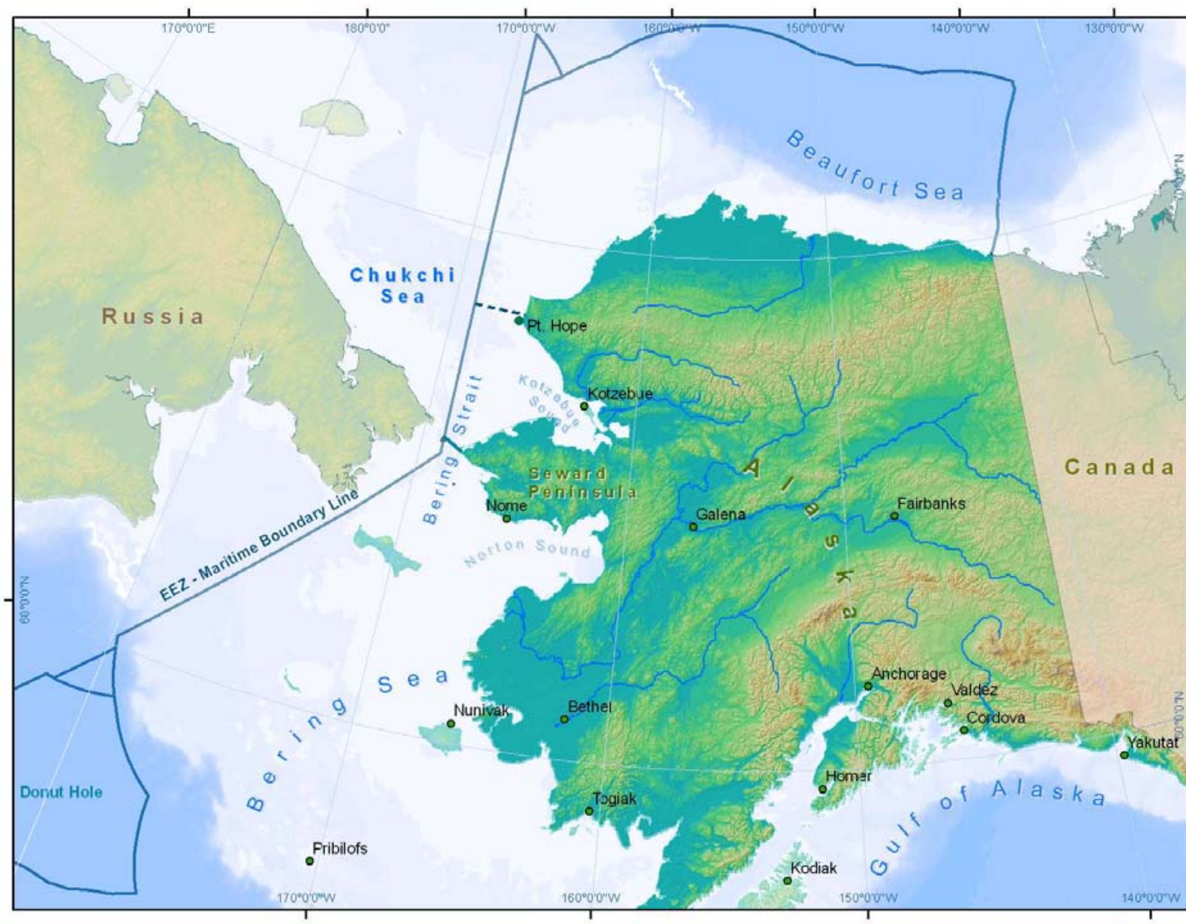

Figure 1-1 Arctic Management Area of the Chukchi and Beaufort Seas (Source: NMFS Alaska Region Analytical Team 2008)

The maritime border with Canada is an issue that remains unresolved (Figure 1-2). Canada disputes the U.S. claim, and asserts the border is a straight line northward from the landward border. The U.S. definition of its EEZ, however, as stated above, will be the delineation of the Arctic EEZ off Alaska and the Arctic Management Area for the purposes of the new Arctic FMP.

In summary, this EA/RIR/IRFA holds the current definition of the U.S. Arctic EEZ to be as described in this section, excluding the Eastern Special Area of the Chukchi Sea and including the US claimed disputed area of the Beaufort Sea.

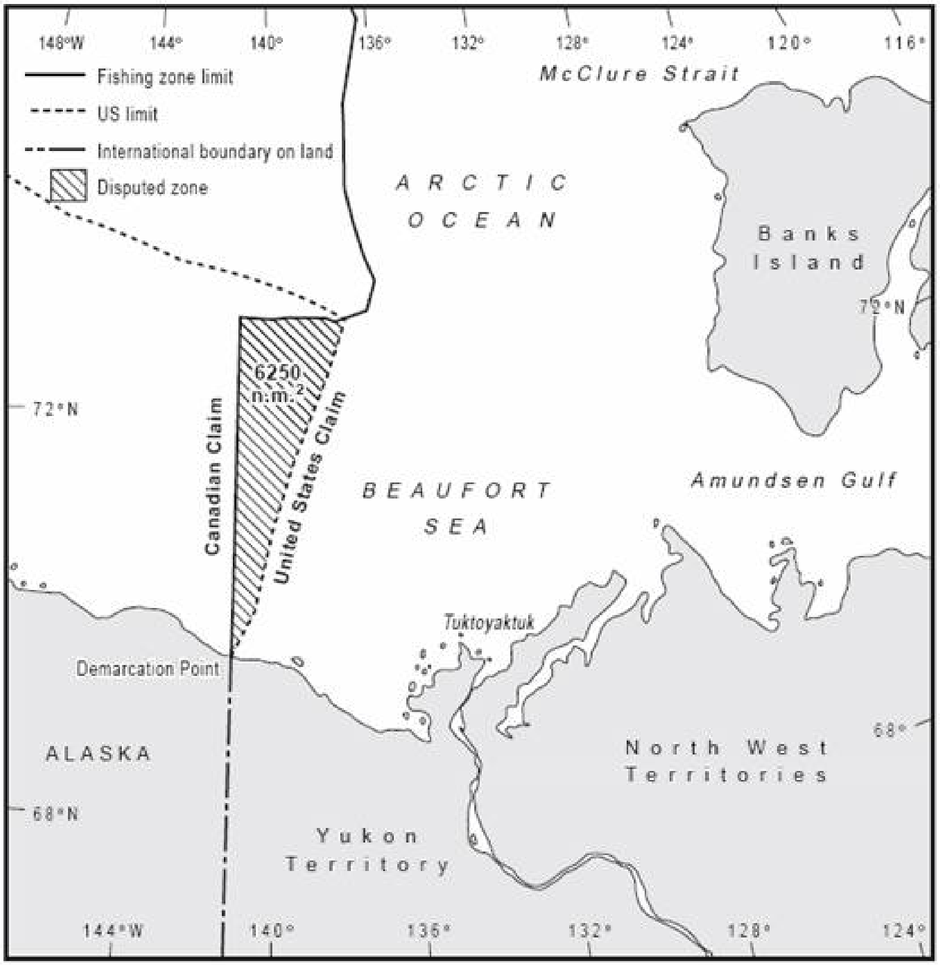

Figure 1-2 Maritime Boarder Issue Between Canada and the United States in the Beaufort Sea

1.3 Purpose and Need for this Action

The purpose and need statement "sets the scene," defines for the public the Council's view of the issue it is trying to resolve by taking the proposed action, and limits the scope of viable alternatives. In this case, a problem may eventually arise if the Council does not take action; as a warming climate may lead to increased utilization of Arctic waters for numerous purposes, including for commercial fishing, the Council sees a need to take a proactive approach to fisheries management in Arctic waters of the EEZ off Alaska by adopting an FMP before an unregulated commercial fishery develops in these waters.

The need for the proposed action is to protect the sensitive ecosystem and marine resources of the Arctic EEZ off Alaska, which are already stressed due to climate change, from potentially unregulated, or inadequately regulated, commercial fishing. The Arctic EEZ waters off Alaska include several species that are targeted by commercial fisheries elsewhere, including opilio crab and Arctic cod. During recent summers, the extent of the Arctic sea ice has diminished considerably compared to the past, resulting in larger expanses of open water that has remained open for longer durations. As a consequence, potential fishing activity could occur over larger areas of the Arctic EEZ for a longer duration than was previously possible. In addition, it is possible that warmer waters will allow species that are currently targeted by commercial fisheries in the Bering Sea to expand their range and colonize the Chukchi and Beaufort Seas.

Thus, commercial fishing in the Arctic may become economically viable, and one or more commercial fisheries may develop in the Arctic EEZ off Alaska. The emergence of unregulated commercial fisheries in the Arctic EEZ off Alaska could have adverse effects on fish habitat, fish and non-fish species that inhabit or depend on marine resources of the Arctic EEZ, and the subsistence way of life of Alaska Native residents of Arctic villages. Depending on the vulnerability of the particular stocks involved, such impacts might occur before federal fisheries managers realize that a problem exists and before they can take reactive steps to manage fishing activity.

Currently, federal management of commercial fishing in the Arctic EEZ off Alaska covers only fishing that may occur for crab between Bering Strait and the latitude of Point Hope; the Council and NMFS do not currently regulate commercial fishing for any other species in Arctic waters south of Point Hope, or for any species in the Arctic EEZ off Alaska north of Point Hope. While State of Alaska regulations prohibit commercial fishing in the Arctic EEZ off Alaska by any holder of a permit that authorizes fishing in state waters, vessels or persons without state fishing permits are not subject to this prohibition and could engage in uncontrolled commercial fishing in the Arctic EEZ off Alaska.

The purpose of the proposed action is to establish federal fisheries management in the Arctic Management Area that complies with the Magnuson-Stevens Act before an unregulated commercial fishery emerges and causes adverse impacts to the marine resources and ecosystem of the Arctic EEZ off Alaska. A secondary purpose of the proposed action is to clarify management authorities in the U.S. Arctic EEZ. There is a paucity of scientific information currently available regarding the abundance and population dynamics of fish stocks in the Arctic Management Area. Accordingly, at present there is a poor understanding of the implications of commercial fishing for Arctic fish stocks on the stocks themselves, on related components of the ecosystem, many of which soon will be or already are stressed due to climate change, and on the subsistence way of life of residents of the region. The Council believes that the requirements of the Magnuson-Stevens Act are best accomplished by adopting an FMP that closes the Arctic Management Area to any new commercial fishing until substantial new information becomes available.

Until more is known about the potential effects of commercial fishing in this environment, closing the Arctic Management Area to commercial fisheries at this time is a conservative and proactive action to take. To adopt an FMP that allows commercial fishing in the Arctic EEZ and conforms to the requirement of the Magnuson-Stevesn Act, more information is needed on Arctic fish stocks, the potential interactions between commercial fisheries and Arctic ecosystem components, and ecosystem and human relationships, including particularly how commercial fishing might affect the subsistence economy of this region.

The development of an FMP prior to a shift of commercial fisheries into the region would be a proactive and positive action. In creating the Arctic FMP, the Council is placing into effect a mechanism for future fishery management should climate or other conditions change and fishery development be proposed. Adopting the FMP would be a clear signal by the Council to the public that it intends to proactively prepare for change and have in place a fishery management structure appropriate to the current knowledge of Arctic fish resources and the Arctic ecosystem.

The Council intents to prohibit commercial fisheries in the Arctic based on a recognition of the sensitivity of the Arctic ecosystem in the face of changing climate and oceanographic trends in this marine environment, the ecological relationships among the ecosystem components of the Arctic (particularly the relationships between seasonal ice conditions and ice-dependent animals such as polar bears and ice seals), and the currently unknown availability of exploitable populations of fish in the Arctic.

People living in communities of the Arctic have depended on the marine resources of the Chukchi and Beaufort Seas for possibly thousands of years, and the subsistence way of life and economy is a very real part of Arctic community survival and cultural identity. Fish resources are part of the food base upon which many residents of Arctic communities depend, either because fish are harvested for food directly, or because fish are important prey items for marine mammals upon which these residents depend for a substantial part of their annual sustenance.

Also, many of the species of fish currently inhabiting Arctic EEZ waters are important food for marine mammals, seabirds, and other fishes. Prohibiting commercial fisheries in the Arctic EEZ at this time will protect the food resources for species of fish that are fished commercially in other EEZ waters off Alaska, as well as for marine mammals and birds, many species of which are relied upon by Alaskan residents of Arctic communities for sustenance and their subsistence way of life.

Further, the Council acknowledges that currently we have little data and a poor understanding of the population dynamics of Arctic marine living resources that fall under Council management. Harvest of such resources is judged to be inappropriate at this time, and the Council finds that imposing a commercial fishery closure is an appropriate and conservative strategy until such time that information is available to develop a plan for considering the opening of a commercial fishery. Council intent is that as information develops and the public indicates interest in fishery development, the Council would then entertain proposals or other expressions of interest and initiate a planning process to develop information with which the Council could make informed decisions about sustainable Arctic fishery resource development.

To date, no commercial fisheries have developed in these areas, and thus the Council has not had a compelling reason to develop Fishery Management Plans for these Arctic marine areas off Alaska. But the environment in the Alaskan Arctic is changing, with warming trends in ocean temperatures and changes in seasonal sea ice conditions potentially favoring the development of commercial fisheries. Although at this time there are no such fisheries in the EEZ off Alaska in the Arctic Ocean, and no routine fish surveys conducted in the region, the Council is interested in exploring policy and management options to prepare for future change.

The Council believes that warming of the Arctic, retreat of the annual southerly edge of seasonal sea ice, and intrusion of commercially-valuable fish or shellfish species into the Chukchi Sea (or further) could provide an opportunity for commercial fishery development, but that such development cannot occur and be managed to conform to the requirements of the Magnuson-Stevens Act until additional adequate information is available upon which to make wise fishery management decisions. At present, the Council does not know the rate and geographic extent to which these phenomena are unfolding and whether the rate of change observed in recent years is likely to continue. In the face of this considerable uncertainty, the Council is choosing to be precautionary and, thus, is proposing to adopt an Arctic FMP that closes the Arctic to commercial fishing until the state of knowledge can "catch up."

The Council's stated initial intent for closure to commercial fishing all Arctic EEZ waters would be another of the Council's precautionary and ecosystem-based management measures meant to protect not only potentially targetable fish stocks but also other elements of this marine ecosystem. The Council has taken a conservative approach to fishery management since its inception in 1977. The precautionary approach espoused by the Council includes ecosystem-based fish catch limits, bycatch reduction measures, regulations to protect seabirds and marine mammals, fishery rationalization programs, and an observer and data collection program for monitoring and enforcement (NMFS 2004a). An Arctic initiative would be precautionary by declaring a federal policy that closes the Arctic to commercial fishing until the Council and NMFS gather enough scientific information to consider other alternatives that complement the Council's precepts of ecosystem-based management.

The Council recognizes the different and changing ecological conditions of the Arctic and views the development of an Arctic FMP as an opportunity for implementing an ecosystem-based management policy that recognizes these issues in the Alaskan Arctic. The polar bear has been listed as threatened under the Endangered Species Act, and several other species are under consideration for listing or are under petition to list, including the Pacific walrus, ribbon seal, and several other species of ice seals. The Council's concerns also include the potential effects of commercial fishing on local residents who rely on subsistence fishing and hunting for resources inhabiting marine waters of the Arctic EEZ. The action would comport with the Council's ecosystem-based fishery management initiatives taken over the past decade or more, including the Council's first Fishery Ecosystem Plan in the Aleutian Islands (NPFMC 2007). A new Arctic FMP would provide the Council a vehicle for addressing future management issues, including deferral of management to the State of Alaska.

1.4 Public Participation and Outreach Program

This EA was developed with opportunity for public participation and is based on and prepared from the issues and alternatives identified during the public process. This section describes these avenues for public participation.

The Council has involved the public in the development and analysis of an FMP for the Arctic Management Area. This has included discussion of the Council's intent and review of discussion papers at Council meetings through 2006, 2007, and 2008. These discussion papers have signaled the Council's intent, and have been available on the Council's web site. Public comment has been received at nearly all of these Council meetings. The Council's Ecosystem Committee has guided the development of discussion papers, and has monitored progress in developing the Arctic FMP and associated documents, and has made recommendations to the Council. One recommendation was development and implementation of an outreach program to disseminate information on the Council's interest in developing an Arctic FMP to stakeholders and residents of the Arctic region. That outreach program is defined and more details on its implementation are provided in Appendix II of this EA/RIR/IRFA. The Council has accepted written and oral testimony at each meeting where the Arctic FMP was discussed. Staff has collected comments and issues at presentations made to groups of stakeholders in the Arctic region such as in Nome or Barrow.

The Council requested that an outreach program be implemented as the Arctic FMP and accompanying documents are prepared. This outreach would complement and be in addition to the more routine outreach to the public that is part of the Council process, such as through the receipt of public comments at Council meetings or meetings of its committees. Lellis (2004) discussed the positive aspects of adopting an Alaskan Arctic FMP, and recommended involvement of Native peoples in the development of fishery management measures for Arctic waters. The Council's intent is to involve local residents and communities or other groups interested in the Arctic in the dialogue and decision making related to adoption of an Arctic FMP. And to assure these stakeholders that this action would not disrupt the subsistence lifestyle of Native peoples of the Alaskan Arctic, the Council has explicitly stated its intent to preserve small, local fisheries, be they commercial or subsistence/personal. The Council's outreach program was designed to include Native participation and has involved consultation with regional Native resource management entities from the North Slope, Northwest Alaska, and Norton Sound regions.

Regarding the outreach plan, the Council's Ecosystem Committee's recommendations included making presentations, in person, at regional gatherings of Arctic residents; specifically recommended were presentations to the Northwest Arctic and North Slope Boroughs, the Eskimo Walrus Commission, the Alaska Eskimo Whaling Commission, Kawerak, Inc. and Maniilaq. Those recommendations were accepted by the Council, and the plan was implemented. An additional element of outreach efforts was to take opportunities, as they arose, to discuss the Council's intent for an Arctic FMP with individuals or groups in any appropriate forum. These ad hoc opportunities included presentations on progress at Council meetings as well as email contacts, phone calls, and in-person discussions with residents of the Arctic region. Presentations and updates have been given at a variety of forums including meetings of the Alaska Marine Ecosystem Forum. More formal presentations were also made to groups representing regional villages of the Arctic Alaska region. Documentation of the outreach program is provided in Appendix II.

From the Council's outreach program has come a variety of comments, suggestions, and requests for analysis or other considerations by the Council as it proceeds with the analysis of and eventual adoption of an Arctic FMP. Some individuals and groups were concerned over how commercial fishing might affect subsistence activities; the Arctic FMP would close the Arctic Management Area to commercial fishery development for the foreseeable future, and thus prevent potential effects from unmanaged fishing on subsistence resources. If fisheries were to develop in the future, the Council would involve local communities, individuals and groups in a planning process to outline how such a fishery might develop and how it would be managed.

Some local residents of the Arctic Management Area requested that the Council involve local communities in developing fisheries, and if fisheries develop, some felt that the primary beneficiaries of fishing should be local residents and communities. The Council would include these individuals and communities in planning efforts for future commercial fisheries. The Council would be required under the Magnuson-Stevens Act and its national standards to manage fisheries according to fairness, equity, and concern for local communities and consideration of community preferences and community and local resident involvement in planning would certainly be part of that effort.

Other comments received during the outreach program included concerns over what some perceive or term "industrial fishing" in the Arctic, and a general concern that large fishing vessels, particularly trawl vessels, not be permitted to enter and start fishing in Arctic waters. By closing the Arctic Management Area to commercial fishing, the Council would preclude any large fishing vessels from fishing in the region.

Representatives with the North Slope Borough expressed concerns over commercial fishery impacts on bowhead whales, a very important cultural and subsistence food for residents of the Arctic. Bowhead whales harvested have been found to have rope or net scars, and some have been entangled with fishing gear, suggesting adverse interactions with fisheries in the Bering Sea; residents would be more concerned if such interaction were to occur in the Chukchi or Beaufort Seas. Also, any commercial fishery that might target or incidentally harvest Arctic cod could adversely affect marine mammals, such as some ice seals, that consume Arctic cod.

Most residents supported closing the Arctic to commercial fishing, particularly because of concerns over the potential effects of fishing on subsistence activities and subsistence animals such as seals and whales. Residents are concerned over climate warming and how this might exacerbate fishery effects on the Arctic ecosystem. Other residents, however, supported commercial fishing, and indicated their continued support only if local residents were given the preferential opportunity to participate in any such fisheries. Most appreciated the Council's outreach program, and the discussion papers prepared early in the development of the Arctic FMP. The Council's proposed action would initially close the Arctic to commercial fishing, but would not affect subsistence harvesting of any resource in the Arctic. The FMP would provide a planning process for consideration of a future commercial fishery, however, and thus allow for that possibility, if conditions and sentiments change in the future.

Some requested that the Council consider a Community Development Quota (CDQ) program as part of the Arctic FMP. The Council does not intend to initiate a CDQ program in the Arctic since commercial fishing would be prohibited, no fishery would occur, and thus there would be no opportunity for revenues to accrue from an arctic fishery to support a CDQ program. In the future, however, a CDQ program could be considered during the planning process, should the Council initiate an Arctic fishery in the future.

Many individuals and groups expressed concern over the general lack of a state or federal research program in the Arctic. Many noted that knowledge of Arctic fishery resources is extremely poor, even non-existent for most species, and the State and U.S. should initiate a long-term research, monitoring, and fish stock assessment survey program to begin gathering such data. Such data will be important in determining baseline conditions and for monitoring climate change and how environmental change may affect fish resources. Conservation groups were particularly concerned over the lack of knowledge of the Arctic ecosystem and how a commercial fishery might affect the Arctic region; given the high degree of uncertainty, conservation organizations generally supported a closure of the Arctic to commercial fisheries.

Some noted that the combination of climate change, loss of sea ice (particularly multi-year ice), changes in marine mammal distribution, and other arctic environmental change creates a "moving target" that generates a great deal of uncertainty, which in turn makes it difficult to make management decisions, such as how to manage walrus and polar bears or even fisheries. Thus, many people support a prohibition on commercial fisheries until more information is available on fish resources, the Arctic environment, and how climate change will play out.

Some individuals were wary of the government and management structure that would accompany a commercial fishery, and of how such a bureaucracy might affect lifestyles of Arctic residents. Residents expressed an interest in being notified of meetings and requested they be consulted and listened to as fishery planning evolves in this region. But many doubted that commercial fishery management would adopt suggestions from local residents. Some felt that commercial interests would carry greater weight with decision makers than the voices of people from villages of the Arctic. The Council's outreach program was initiated in part to alleviate such concerns.

Several requested that the Council meet periodically in the Arctic region, such as in Kotzebue or Barrow. Village representatives felt that staff and Council members should travel to outlying villages to discuss Council activities and listen to residents. One suggestion was to designate one Council seat to a resident from the Arctic region. Some suggested creating a new Arctic Council to represent the interests of Arctic residents and communities in fishery management in Alaska. These comments are detailed in the attached documentation of the Council's outreach program (Appendix II).

The Council received a preliminary draft EA/RIR/IRFA at its October 2008 meeting, and also heard comments on that draft from its Scientific and Statistical Committee (SSC), Advisory Panel (AP), Ecosystem Committee (EC), and Enforcement Committee. The excerpted comments on the Arctic FMP analysis by these advisory committees are presented immediately below.

At the October 2008 meeting, the Council requested that a preliminary draft document package (this EA/RIR/IRFA and draft Arctic FMP text) be sent out at the end of October 2008 to seek public comments on these documents and the proposed alternatives and options. While this document does not fully address all of the SSC's concerns, those issues are being worked on as this document circulates for an initial public review period. The Council anticipates that the SSC will convene in December 2008 in Anchorage, during the regularly-scheduled Council meeting period, and will receive additional analysis and responses to their concerns from Council, NMFS Alaska Region, and NMFS Alaska Fisheries

Science Center staffs. The Council's directions are described in the motion passed unanimously by the Council in October:

> The Council recommends the release of the draft Arctic FMP and draft EA/RIR/IRFA for public review at the end of October 2008 after staff addresses the SSC and Ecosystem Committee concerns to the extent possible. The Council requests that the Arctic FMP package, including public review comments, be brought back for final action in February 2009, with a December 2008 SSC review step.

At the October 2008 meeting, public comments were received from a variety of individuals and organizations. Several letters from the public were reviewed. All comments generally supported the Council's proposed action to adopt an Arctic FMP and to close the Arctic Management Area to commercial fishing.

This preliminary draft document for public review contains revisions that were requested by the Council, SSC, AP, EC, and Enforcement Committee. Those comments from the SSC that could not be fully addressed will be included in another draft document expected to be released for public review at the end of December 2008.

The Council anticipates taking final action at its February 2009 meeting in Seattle. Final action will include approving the revised EA/RIR/IRFA and draft Arctic FMP text, selecting a preferred alternative and option, approving amending the current Crab FMP as appropriate and in accordance with the preferred alternative, and adopting the FMP. The Council may hear additional comments from the SSC, AP, and EC as well as from the public and may request that staff further revise the documents. The documents may then be forwarded to the Secretary of Commerce for review and approval and for completion of the rulemaking process, or the Council may find that it prefers to revise the documents further and then review them again at a future Council meeting. The public is encouraged to engage in this process and submit comments. Comments may be sent by U.S. Postal Service, email, fax, or made in person orally at upcoming Council meetings. Opportunities for oral comments include the December 2008 SSC meeting and the February 2009 Council meeting.

Comments may be transmitted to the Council offices at this location:

Chris Oliver
Executive Director
North Pacific Fishery Management Council
605 West 4th Avenue, Suite 306
Anchorage, AK 99501

Phone: 907-271-2809
Fax: 907-271-2817
Email: Chris.oliver@noaa.gov

Questions and comments may also be directed to Bill Wilson, Arctic FMP Coordinator, at the Council offices or by email: bill.wilson@noaa.gov.

1.4.1 Excerpted comments from SSC, AP, and Ecosystem and Enforcement Committees on draft Arctic FMP and EA/RIR/IRFA, October 2008. Included are remarks on how comments have been addressed to date (10/31/08).

DRAFT REPORT
of the
SCIENTIFIC AND STATISTICAL COMMITTEE
to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
September 29-October 1, 2008

C-5 Arctic FMP

Bill Wilson (NPFMC) and Grant Thompson (NMFS-AFSC) presented a draft Fishery Management Plan for Fish Resources in the Arctic and the accompanying EA. Melanie Brown (NMFS-AKR) presented the RIR/IRFA. Public testimony was provided by Chris Krenz (Oceana).

The SSC compliments the preparers of these documents for their excellent work. The EA/RIR/IRFA is well developed. The SSC comments on the previous draft reviewed in February 2008 have been addressed.

The SSC offers the following comments to be addressed before the documents are sent out for public review. Because our list of suggested changes is extensive, the SSC wishes to review the Arctic FMP and EA/RIR/IRFA one more time before it is released, preferably after response by NOAA General Counsel to legal questions about Option 2. Moreover, in scheduling a desired completion date for the revised draft FMP, it would be helpful if the timeline for revision did not coincide with the conclusion of the stock assessments. If completion of the Arctic FMP is not urgent, perhaps completion could be deferred until after the December Council meeting.

Much of the SSC discussion focused on the two options. Option 2 has much appeal, but it represents a new approach. At the time of our review, there was uncertainty about whether it is a legally valid approach. As noted by Option 2, there is too much uncertainty in the estimation of MSY to use these estimates for fishery management. Possibly, a simpler approach is to specify an MSY near 0 because no fisheries are established. Therefore, the SSC recommends adding a suboption to Option 2 that initially sets MSY near zero, leaving some room for subsistence harvest, bycatch in state fisheries and an allowance for exploratory surveys. At a minimum, the MSY estimates generated by comparison to the Barents Sea should be removed, as the SSC feels that differences between the Barents Sea and Arctic Ocean renders these estimates invalid. Baffin Bay in eastern Canada may be a more suitable comparison. **To be addressed by the AFSC staff 11/08**

In Option 1, the procedures for estimating MSY are quite elegant and the preparers are to be commended for their ingenuity. However, many uncertainties lead to low confidence in these estimates, as well, including: (1) the number of assumptions to be made that are not informed by data, (2) the 1990 survey did not fully cover the region, so CPUEs were extrapolated to unsurveyed areas, (3) the Arctic has undoubtedly changed since the 1990 survey, so that the biomass estimate from 1990 likely does not reflect the current unfished biomass and B_o is unlikely to be constant, and (4) biological parameters have not been estimated for Arctic cod, saffron cod, nor snow crab in this region. For instance, snow crabs do not grow as large as they do in the eastern Bering Sea and may not even attain maturity. Use of Bering

Sea parameter estimates for snow crabs in the Chukchi and Beaufort Sea is likely to lead to overestimates of growth and productivity in the analysis. **To be addressed by the AFSC staff 11/08**

For these reasons, the SSC recommends adding some text that qualifies the parameter estimates, including MSY. The text should also outline the expected steps by which uncertainty would be reduced in the future as new information becomes available. These include analyses of more recent (2008) survey data, which presumably will provide much better estimates of B_o, research on the included species to estimate area-specific biological parameters, and ultimate accumulation of survey time series and non-commercial fishery information, allowing the migration to age-structured analyses of the type applied in the GOA and BSAI. **To be addressed by the AFSC staff 11/08**

The SSC recommends that the steps for designating a new target fishery listed in Option 2 should also be included in Option 1. **Completed 10/08, section 4.7.3.2.** Some of the more likely fisheries in the Arctic may be those on southern stocks (e.g., pollock), should range extensions occur. So, the document should indicate how fisheries may be developed on species at the northern tails of their geographic distribution. **To be addressed by the AFSC staff 11/08** Likewise, the groundfish tier system of Option 2 should also be included in Option 1. **Completed 10/08 section 4.7.3.2.** The SSC notes that modified tiers have been developed for crab and these should be included in both Options 1 and 2. **Completed 10/08 section 4.7.3.2.** The crab tier system in both cases would need to be modified to include ABC determinations. **To be addressed by the AFSC staff 11/08**

The SSC offers the following additional editorial comments on the draft Arctic FMP:

1. P. ES-3. Delete the last phrase in the box for permit pertaining to State of Alaska. **Completed 10/08**

2. On p. 6 (item B), the list of those groups who may potentially provide a petition differs from the list provided on p. 23. The two should be reconciled. **Completed 10/08 FMP section 2.2.2**.

3. On p. 7, several instances of "Alternative" should be changed to "Option" under Option 1. Note typos in first paragraph under Option 2. **Completed 10/08**

4. Table 3-1, p. 12. The second sentence in the header for Table 3-1 should be deleted, as no ratio is provided. Also, the header should clarify whether the comparison between 1990 and 1991 pertains only to the 8 stations in common or the full set of stations. **Completed 10/08, FMP section 3.3.3 and table 3-2.**

5. Section 3.4.2.1.2 (p. 16). It might be noted that the estimate of B_{msy}/B_o (fraction of unfished biomass corresponding to maximum production) is equal to the fraction of unfished biomass at which fishery thresholds are typically set to close crab fisheries because of concerns about stock status. **Completed 10/08 in EA section 4.7.3.3.2**

6. P. 19-20. Revisit the section on non-consumptive use and consider expanding the discussion. Non-consumptive use may be valued more highly than indicated, particularly if the non-consumptive use of resources as a whole, rather than individually, are considered. Significant impacts will be difficult to define, given the lack of information on these populations. **Completed 10/08 in RIR section 9.5.16, removed from FMP**

7. P. 29, item a under 3.8.1. Define what "significant" means in the case of birds and mammals**. It is important to allow the determination of significance to be made at the time of the action and therefore should not be further defined in the FMP.**

8. P. 31, under 3.15.1, no. 2. Include birds and mammals here. Also, consider adding references to ecosystem-based management. **Completed 10/08**

9. P. 34, second paragraph, third sentence. Replace "although" with "because" and replace "can limit" with "limits". **Completed 10/08, section removed from FMP**

10. P. 115. The section on likelihood of a large oil spill can be improved, perhaps borrowing from estimates and literature on other regions. The FMP cites an MMS report concluding that the threat of a spill is "very low". If the MMS report provides an estimate of the probability, that estimate should be included in the FMP. Although it is not the responsibility of the FMP to analyze threats from oil spills, both catastrophic and chronic spills can have cumulative effects. A discussion of how oiling could impact fisheries and their "ecosystem components" is warranted here. **Completed 10/08 section removed from FMP, addressed in EA/RIR/IRFA, section 3.2**

The SSC offers the following comments on the EA/RIR/IRFA:

1. Comments offered above for the draft FMP should also be considered in the appropriate sections of the EA/RIR/IRFA**. Completed 10/08**

2. Please clarify how management may differ if red king crabs were managed under the Arctic FMP versus the Crab FMP (i.e., Alternative 3 vs. 4). **Completed 10/08, section 2.3.3**. Also, clarify what is meant by "same size and scope" when referring to the purported historic red king crab fishery in the Chukchi Sea, and how these criteria will be quantitatively estimated. **Completed 10/08, Appendix A to the FMP, quantitative estimate not possible due to no data, used Ecosystem committee recommendation.**

3. For accuracy, replace "Alaska EEZ" with wording such as "EEZ off Alaska". **Completed 10/08**

4. New information is now available on bearded seals, and the SSC will provide this information to the authors. **Completed 10/08, Section 7.1.10.2**

5. Mammal diets are provided in Table 7-4. Please point to this table earlier in chapter 7. **Completed 10/08**

6. Consideration of non-consumptive value should be included in the RIR. In particular, it may be non-trivial, when considered in a cumulative manner. **Completed 10/08 Section 9.5.16**

Ecosystem Committee Minutes
Tuesday, September 30, 2008 10am-1pm
Sheraton Hotel, Board Room 308, Anchorage, AK

Arctic FMP
The Committee received a presentation from Mr Wilson and Ms Brown, reviewing the EA/RIR/IRFA for the Arctic FMP, and the draft FMP itself.

The Committee recommends to the Council that the draft Arctic FMP and its EA/RIR/IRFA be released for public review, subject to some clarifications.

1. Address, insofar as it is possible, the comments of the SSC, in time to release the document for review by the end of October (in time for action at the December Council meeting). The comments are mostly editorial or technical, and Mr Wilson indicated that he should be able to address some of them in this timeframe, although he was not able to speak to the availability of staff from the Alaska Fisheries Science Center.
2. With respect to the SSC's comment about Alternative 3, about regarding more specificity about the historic red king crab fishery's size and scope, the Committee provides the following recommendation:
   - the size of the fishery should be no more than 1000 lbs annually,
   - the geographic scope of the fishery should be limited to the four statistical areas identified in the caption of page 203 of the EA, Figure 9-7: 646701, 646631, 646641, 636631.

Completed in Appendix A to FMP 10/08

3. Under Option 1, the Committee recommends editing the language describing the specifications process. The Committee recommends that annual catch limits be specified for a period of 3 years, and thus the Plan Team process that would support these catch limits would occur on a triennial cycle, unless new information is available, which would trigger a specifications process in that year. (The Committee noted that there is precedent for this procedure under the MMPA's marine mammal stock assessments). **Completed in Sections 2.4 and 4.7 of FMP**
4. Under Option 1, clarify that the procedures under Option 2, describing the criteria for moving a species into the target category, also apply under Option 1. The Committee noted that the procedures are also included in the draft FMP; it is important to clarify that the procedures are the focus of the Council's action at this time, as the fisheries would not open under any of the alternatives. **Completed in section 4.7 intro and 4.7.3.2**

The Committee discussed the legal question which concerned the SSC, regarding Option 2, with Lisa Lindeman, NOAA GC. She confirmed that there is no legal impediment preventing the Council from sending this document out for public review. The Committee felt strongly that the document was ready for public review, that staff has prepared an excellent document, and that the edits suggested by the SSC and the Committee can be incorporated without holding up public review. The SSC agreed that both Option 1 and 2 have merit, and the advantage of releasing the document is that the public will have an opportunity to examine and consider these two options, and provide feedback to the Council for their decisionmaking. Releasing the document does not preclude the SSC providing further review or input the next time this issue is in front of the Council.

The Committee also suggested some other minor clarifications to staff. The draft FMP is written assuming that the Council chooses Alternative 3; this should be more clearly noted on the document. **Completed 10/08 on cover page.** The document should put in perspective the calculated snow crab biomass in the Arctic, e.g., compared to the size and biomass of the eastern Bering Sea crabs and biomass. **Completed 10/08 in section 4.7.1.4 of EA** Under Option 2, a further clarification may be required to explain that MSY is calculated for individual species, not just for the ecosystem component as a whole. **Completed 10/08 in section 4.7.3 paragraph 1, and 4.7.3.4 of EA**. Under the description in Option 2, adding a heading on page 104 would highlight that the bulleted list represents the Council procedure for initiating a new target fishery, **Completed 10/08** and clarify that the three suggestions of ways of calculating MSY are just examples that could be applied once the Council moves a fish stock into the target fishery category. **Completed 10/08, section 4.7.3.4, summary**

ADVISORY PANEL MINUTES
North Pacific Fishery Management Council
September 29 – October 4, 2008
Anchorage Sheraton Hotel

C-5 Arctic FMP

The AP would like to note that Michelle Longo Eder, Commissioner, US Arctic Research Commission gave a presentation to the AP and noted that the Commission will continue to work with NPRB, Council, and NOAA to support necessary funding for research for the Arctic FMP.

The AP appreciates the outstanding efforts made by staff to develop a progressive and sophisticated analysis on Arctic Fishery Management. However, the AP recommends the Council delay sending out the document for Public Review until staff addresses the SSCs comments. This document should come back to the Council at the February 2009 meeting.

Motion passes 16/1.

Enforcement Committee Minutes
September 30, 2008
Sheraton, Anchorage, Alaska

II. Update on the Arctic FMP analysis

Melanie Brown and Bill Wilson gave an overview of the status of the Arctic FMP analysis. The Council proposes to develop an Arctic FMP that would (1) close the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due consideration of other ecosystem components; (2) determine the fishery management issues; and (3) implement an ecosystem based management policy that recognized the unique issues in the Alaska Arctic. Committee members recommend that the Arctic FMP enforcement plan might well include vessel monitoring system (VMS) as a monitoring tool. As noted in their February 2008 minutes, given the size of the area covered by the Arctic FMP and lack of suitable locations to logistically support enforcement assets which might operate in the area, the use of VMS as a tool to monitor fishing vessel activity in and around the area would be appropriate. **Completed 10/08 , section 3.10.2 of FMP**

1.5 Issues to be addressed in the EA

Beyond the need to conserve Arctic fishery resources, particularly in light of the small amount of information on these resources available to the Council, the Arctic is considered by many to be particularly sensitive to human disturbance for a variety of reasons. Some would view with concern any human activity such as commercial fishing in a "sensitive" environment, at least until adequately mitigated. These issues are unique or specific to the Arctic region, and prohibiting commercial fishing recognizes the current general lack of knowledge of how fishing activities could affect, or be affected by, these unique attributes of this region. Some of these unique features or issues of concern are listed below and analyzed in subsequent chapters.

- Little is known about the ecology, life-histories, and abundance of offshore marine fish and shellfish species and the importance of fish species to birds, marine mammals, and other fish.
- Climate change and uncertainty in resource availability exacerbate our ability to predict impacts of fishery development.
- Seasonal abundance of migratory birds and their use of the Arctic for breeding and foraging may conflict with fishing activities, particularly for target species that are important in the seasonal diet of birds.
- Marine mammals, specifically bowhead whales, walrus, ice seals, and polar bears, may be present and particularly sensitive to fishing activities and fisheries for target species also utilized by marine mammals.
- Creating an Arctic FMP will provide opportunity for proactive management in a largely undeveloped ecosystem.
- Arctic fish and other marine species are important subsistence resources used by indigenous peoples.

1.6 Related NEPA Documents

The NEPA documents listed below have detailed information on the natural resources and the economic and social activities and communities in the Arctic Management Area and on fishery management in the North Pacific, including the Arctic region. These documents contain valuable background for the action under consideration in this EA and much of the information will be incorporated by reference where appropriate.

Final Environmental Impact Statement for Issuing Annual Quotas to the Alaska Eskimo Whaling commission for a Subsistence Hunt on Bowhead Whales for the Years 2008 through 2012, January 2008 (NMFS 2008a). Available at http://www.fakr.noaa.gov/protectedresources/whales/bowhead/eis0108/bowheadEISall.pdf. This document provides recent analysis of the status of bowhead whales and cumulative effects on this species from human activities.

Beaufort Sea Planning Area Oil and Gas - Lease Sales 186, 195, and 202, Final Environmental Impact Statement. Volume I, February 2003 (MMS 2003). Available at http://www.mms.gov/alaska/ref/EIS%20EA/BeaufortMultiSaleFEIS186_195_202/2003_001vol1.pdf. This document provides information on the effects on oil and gas leasing and exploration on the marine environment in the Beaufort Sea and informs the cumulative effects analysis of this EA.

Chukchi Sea Planning Area. Oil and Gas Lease Sale 193 and Seismic Surveying Activities. Final Environmental Impact Statement, May 2007 (MMS 2007). Available at http://www.mms.gov/alaska/ref/EIS%20EA/Chukchi_feis_Sale193/feis_193.htm. This document provides information on the effects of oil and gas lease sales and exploration on the marine environment in the Chukchi Sea and informs the cumulative effects analysis of this EA.

Alaska Groundfish Fisheries Final Programmatic Supplemental Environmental Impact Statement. (NMFS 2004). Available at http://www.fakr.noaa.gov/sustainablefisheries/seis/intro.htm. This document provides the basis for the Council's precautionary approach to fisheries management and provides an extensive analysis on the potential effects of all types of groundfish fishing on ecosystem components.

Environmental Assessment/Regulatory Impact Review/Final Regulatory Flexibility Analysis For Amendment 89 To The Fishery Management Plan For Groundfish Of The Bering Sea And Aleutian Islands Management Area And Regulatory Amendments For Bering Sea Habitat Conservation, May 2008 (NMFS 2008b). Available at http://www.fakr.noaa.gov/analyses/amd89/earirfrfa_0508.pdf. This document provides criteria for determining significance and a detailed analysis of the effects of nonpelagic trawling on bottom habitat and the ecosystem components dependent on bottom habitat in the Bering Sea. Many of the ecosystem components occurring in the Bering Sea also occur in the Arctic Management Area.

Final Environmental Impact Statement for the Essential Fish Habitat Identification and Conservation in Alaska, April 2005 (NMFS 2005). Available at http://www.fakr.noaa.gov/habitat/seis/efheis.htm. This document provides a detailed analysis of the effects of all types of fishing on essential fish habitat.

1.7 Applicable Laws

When managing the fisheries in the EEZ off Alaska, NMFS and the Council must comply with a number of statutes and executive orders: the Magnuson-Stevens Act, the Halibut Act, the Endangered Species Act (ESA), the National Environmental Policy Act (NEPA), the Administrative Procedure Act (APA), the Regulatory Flexibility Act (RFA), Executive Order 12866, Executive Order 12898, Executive Order 13186, Executive Order 13175, and other applicable laws. These statutes and EO 12866 contain the analytical requirements and the processes that must be applied to fisheries management actions. EO 13186 specifically addresses the responsibilities of federal agencies to protect migratory birds. EO 12898 describes government responsibilities for considering any disproportionate impacts of its actions on minority and low-income populations in the United States. EO 13175 addresses the government's responsibilities for tribal consultation on actions. Processes for developing management measures and analyzing the effects of the measures are detailed in the statutes summarized below.

1.7.1 Magnuson-Stevens Act

Under the Magnuson-Stevens Act, the United States has exclusive fishery management authority over all marine fishery resources found within the EEZ, which extends to from 3 to 200 nautical miles from the baseline used to measure the territorial sea. The management of these marine resources is vested in the Secretary of Commerce (Secretary) and in regional fishery management councils. In the Alaska Region, the North Pacific Fishery Management Council has the responsibility to prepare FMPs for the marine fisheries it finds that require conservation and management. NMFS is charged with carrying out the federal mandates of the Department of Commerce with regard to marine fish. The mission of the Council and NMFS is the stewardship of living marine resources for the benefit of the nation through science-based conservation and management and promotion of the health of their environment. The goals for accomplishing this mission are sustainable fisheries, recovered protected species, and healthy living marine resource habitat. NMFS Alaska Regional Office and Alaska Fisheries Science Center provide research, analysis and technical support for management actions recommended by the Council. Conservation and management measures to reduce marine mammal, seabird, or other species fishery interactions in marine fisheries may be implemented under authority of the Magnuson-Stevens Act.

The Magnuson-Stevens Act established the required and discretionary provisions of an FMP and contains ten National Standards to ensure that any FMP or FMP amendment is consistent with the Magnuson-Stevens Act. Each FMP contains a suite of additional management tools that together characterize the fishery management regime. These management tools are either a framework-type measure, thereby allowing for annual or periodic adjustment using a streamlined notice process, or are conventional measures that are fixed in the FMP and its implementing regulations and require a formal plan or regulatory amendment to change.

Specifically applicable to this proposed action is the Magnuson-Stevens Act requirements for the contents of FMPs.

> **Section 303 Contents of Fishery Management Plans**
> (a) REQUIRED PROVISIONS.—Any fishery management plan which is prepared by any Council, or by the Secretary, with respect to any fishery, shall—
> (1) contain the conservation and management measures, applicable to foreign fishing and fishing by vessels of the United States, which are—
>> (A) necessary and appropriate for the conservation and management of the fishery to prevent overfishing and rebuild overfished stocks, and to protect, restore, and promote the long-term health and stability of the fishery;
>> (B) described in this subsection or subsection (b), or both; and
>> (C) consistent with the national standards, the other provisions of this Act, regulations implementing recommendations by international organizations in which the United States participates (including but not limited to closed areas, quotas, and size limits), and any other applicable law;
>
> (2) contain a description of the fishery, including, but not limited to, the number of vessels involved, the type and quantity of fishing gear used, the species of fish involved and their location, the cost likely to be incurred in management, actual and potential revenues from the fishery, any recreational interest in the fishery, and the nature and extent of foreign fishing and Indian treaty fishing rights, if any;
> (3) assess and specify the present and probable future condition of, and the maximum sustainable yield and optimum yield from, the fishery, and include a summary of the information utilized in making such specification;
> (4) assess and specify—
>> (A) the capacity and the extent to which fishing vessels of the United States, on an annual basis, will harvest the optimum yield specified under paragraph (3),
>> (B) the portion of such optimum yield which, on an annual basis, will not be harvested by fishing vessels of the United States and can be made available for foreign fishing, and
>> (C) the capacity and extent to which United States fish processors, on an annual basis, will process that portion of such optimum yield that will be harvested by fishing vessels of the United States;
>
> (5) specify the pertinent data which shall be submitted to the Secretary with respect to commercial, recreational, charter fishing, and fish processing in the fishery, including, but not limited to, information regarding the type and quantity of fishing gear used, catch by species in numbers of fish or weight thereof, areas in which fishing was engaged in, time of fishing, number of hauls, economic information necessary to meet the requirements of this Act, and the estimated processing capacity of, and the actual processing capacity utilized by, United States fish processors;
> (6) consider and provide for temporary adjustments, after consultation with the Coast Guard and persons utilizing the fishery, regarding access to the fishery for vessels otherwise prevented from harvesting because of weather or other ocean conditions affecting the safe conduct of the fishery; except that the adjustment shall not adversely affect conservation efforts in other fisheries or discriminate among participants in the affected fishery;

(7) describe and identify essential fish habitat for the fishery based on the guidelines established by the Secretary under section 305(b)(1)(A), minimize to the extent practicable adverse effects on such habitat caused by fishing, and identify other actions to encourage the conservation and enhancement of such habitat;
(8) in the case of a fishery management plan that, after January 1, 1991, is submitted to the Secretary for review under section 304(a) (including any plan for which an amendment is submitted to the Secretary for such review) or is prepared by the Secretary, assess and specify the nature and extent of scientific data which is needed for effective implementation of the plan;
(9) include a fishery impact statement for the plan or amendment (in the case of a plan or amendment thereto submitted to or prepared by the Secretary after October 1, 1990) which shall assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for—

> (A) participants in the fisheries and fishing communities affected by the plan or amendment;
> (B) participants in the fisheries conducted in adjacent areas under the authority of another Council, after consultation with such Council and representatives of those participants; and
> (C) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery;

(10) specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished (with an analysis of how the criteria were determined and the relationship of the criteria to the reproductive potential of stocks of fish in that fishery) and, in the case of a fishery which the Council or the Secretary has determined is approaching an overfished condition or is overfished, contain conservation and management measures to prevent overfishing or end overfishing and rebuild the fishery;
(11) establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery, and include conservation and management measures that, to the extent practicable and in the following priority—

> (A) minimize bycatch; and
> (B) minimize the mortality of bycatch which cannot be avoided;

(12) assess the type and amount of fish caught and released alive during recreational fishing under catch and release fishery management programs and the mortality of such fish, and include conservation and management measures that, to the extent practicable, minimize mortality and ensure the extended survival of such fish;
(13) include a description of the commercial, recreational, and charter fishing sectors which participate in the fishery, including its economic impact, and, to the extent practicable, quantify trends in landings of the managed fishery resource by the commercial, recreational, and charter fishing sectors;
(14) to the extent that rebuilding plans or other conservation and management measures which reduce the overall harvest in a fishery are necessary, allocate, taking into consideration the economic impact of the harvest restrictions or recovery benefits on the fishery participants in each sector, any harvest restrictions or recovery benefits fairly and equitably among the commercial, recreational, and charter fishing sectors in the fishery and;
(15) establish a mechanism for specifying annual catch limits in the plan (including a multiyear plan), implementing regulations, or annual specifications, at a level such that overfishing does not occur in the fishery, including measures to ensure accountability.

1.7.2 Halibut Act

Management of the Pacific halibut (hereafter halibut) fishery in and off of Alaska is based on an international agreement between Canada and the United States–the "Convention between United States of America and Canada for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea," signed at Ottawa, Canada on March 2, 1953, and amended by the "Protocol Amending the Convention," signed at Washington, D.C., March 29, 1979. This Convention, administered by the International Pacific Halibut Commission (IPHC), is given effect in the United States by the Northern Pacific Halibut Act of 1982 (Halibut Act), P.L. 97-176, 16 U.S.C. 773c(c). Generally, fishery management regulations governing the halibut fisheries are developed by the IPHC and recommended to the U.S. Secretary of State. When approved, these regulations are published by NMFS in the Federal Register as annual management measures.

The Halibut Act authorizes the regional fishery management councils having authority for the geographic area concerned to develop regulations governing the halibut fishery in U.S. portions of Convention waters that would apply to nationals or vessels of the U.S. Such an action by the Council is limited only to those regulations that (a) are in addition to and not in conflict with IPHC regulations, (b) are approved and implemented by the Secretary, and (c) are fair and equitable and consistent with other applicable Federal law. The Halibut Act is discussed in further detail in Chapter 2 in the description of Alternative 1, status quo.

1.7.3 Endangered Species Act

The Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 et seq.; ESA), provides the primary legal framework for the conservation and recovery of species in danger of or threatened with extinction. The purposes of the ESA include "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species ..." (16 U.S.C. § 1531(b)). Section 7(a)(2) of the ESA requires that each Federal agency ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of critical habitat of such species. When the action of a Federal agency may affect a protected species or its critical habitat, that agency (i.e., the "action" agency) is required to consult with either the NMFS or the U.S. Fish and Wildlife Service (USFWS), depending upon the protected species or critical habitat that may be affected. Section 7(b) of the ESA requires the Services to summarize formal consultations in biological opinions that detail how actions may affect threatened or endangered species and designated critical habitat and steps required to prevent the action from jeopardizing the continued existence or from adversely modifying or destroying critical habitat.

This EA/RIR/IRFA contains pertinent information on the ESA-listed species that occur in the action area and that have been identified in previous consultations as potentially impacted by commercial fishery. Analysis of the impacts of the alternatives is in the chapters addressing those resource components. Impacts on ESA-listed marine mammals and seabirds are discussed in Chapters 6 and 7. Before approval of the FMP, NMFS Sustainable Fisheries, Alaska Region, will conduct an ESA Section 7 consultation on the proposed action with the NMFS Protected Resources Division, Alaska Region, for listed marine mammals, NMFS Northwest Region for listed salmon, and USFWS for listed seabirds based on the analysis contain in this EA/RIR/IRFA.

1.7.4 National Environmental Policy Act

NEPA (42 U.S.C. 4331, *et seq.*) establishes our national environmental policy, provides an interdisciplinary framework for environmental planning by Federal agencies, and contains action-forcing procedures to ensure that Federal decision-makers take environmental factors into account. NEPA does not require that the most environmentally desirable alternative be chosen, but does require that the environmental effects of all the alternatives be analyzed for the benefit of decision-makers and the public.

NEPA has two principal purposes:

1. To require Federal agencies to evaluate the potential environmental effects of any major planned Federal action to ensure that public officials make well-informed decisions about the potential impacts.
2. To promote public awareness of potential impacts at the earliest planning stages of major Federal actions by requiring Federal agencies to prepare a detailed environmental evaluation for any major Federal action significantly affecting the quality of the human environment.

NEPA requires an assessment of both the biological and the social and economic consequences of fisheries management alternatives and provides that members of the public have an opportunity to be involved in and to influence decision-making on Federal actions. In short, NEPA ensures that environmental information is available to government officials and the public before decisions are made and actions taken. Title II, Section 202 of NEPA (42 U.S.C. 4332) created the Council of Environmental Quality (CEQ). The CEQ is responsible for the development and oversight of regulations and procedures implementing NEPA. The CEQ regulations provide guidance for Federal agencies regarding NEPA's requirements (40 CFR Part 1500) and require agencies to identify processes for issue scoping, for the consideration of alternatives, for developing evaluation procedures, for involving the public and reviewing public input, and for coordinating with other agencies—all of which are applicable to the Council's development of FMPs. NOAA has also prepared environmental review procedures for implementing NEPA (NOAA Administrative Order 216-6). This Administrative Order describes NOAA's policies, requirements, and procedures for complying with NEPA and the implementing regulations issued by the CEQ. A 1999 revision and update to the Administrative Order includes specific guidance regarding categorical exclusions, especially as they relate to endangered species, marine mammals, fisheries, and habitat restoration. The Administrative Order also expands on guidance for consideration of cumulative impacts and "tiering" in the environmental review of NOAA actions. This Administrative Order provides comprehensive and specific procedural guidance to NMFS and the Council for preparing and adopting FMPs. Federal fishery management actions subject to NEPA requirements include the approval of FMPs, FMP amendments, and regulations implementing FMPs. Such approval requires preparation of the appropriate level of NEPA analysis (Categorical Exclusion, Environmental Assessment, or Environmental Impact Statement). NEPA and the Magnuson-Stevens Act requirements for schedule, format, and public participation are compatible and allow one process to fulfill both obligations.

An EA is prepared pursuant to NEPA to determine whether an action will result in significant effects on the human environment. If the environmental effects of the action are determined not to be significant based on an analysis of relevant considerations, the EA and resulting finding of no significant impact are the final environmental documents required by NEPA. If an analysis concludes that the action is a major federal action significantly affecting the human environment, an environmental impact statement must be prepared.

An EA must include a discussion of the purpose and need for the action, the environmental impacts of the proposed action, and a list of agencies and persons consulted. The purpose and need are discussed in Chapter 1. The federal action and alternatives are in Chapter 2. Chapter 3 contains an overview of the information sources on the Arctic and a description of the reasonably foreseeable future actions that impact the Arctic. Chapters 4 through 8 contain recent and relevant information on each resource component and a discussion of the environmental impacts that will result from the federal action on the human environment.

1.7.5 Regulatory Flexibility Act

The Regulatory Flexibility Act (RFA) (5 U.S.C. 601 *et seq.*) requires federal agencies to assess the impacts of their proposed regulations on small entities and to seek ways to minimize economic effects on small entities that would be disproportionately or unnecessarily adverse. The most recent amendments to the RFA were enacted on March 29, 1996, with the Contract with America Advancement Act of 1996 (Public Law 104-121). Title II of that law, the Small Business Regulatory Enforcement Fairness Act (SBREFA), amended the RFA to require federal agencies to determine whether a proposed regulatory action would have a significant economic impact on a substantial number of small entities. For a federal agency, the most significant effect of SBREFA is that it made compliance with the RFA judicially reviewable.

Chapter 10 contains an initial regulatory flexibility analysis (IRFA) which analyzes whether the proposed regulatory action would have an anticipated significant economic impact on a substantial number of small entities.

1.7.6 Executive Order 12866: Regulatory planning and review

The purpose of EO 12866 is to enhance planning and coordination with respect to new and existing regulations, and to make the regulatory process more accessible and open to the public. In addition, EO 12866 requires agencies to take a deliberative, analytical approach to rule making, including assessment of costs and benefits of the intended regulations. For fisheries management purposes, it requires NOAA Fisheries to (a) prepare a Regulatory Impact Review (RIR) for all regulatory actions; (b) prepare a unified regulatory agenda twice a year to inform the public of the agency's expected regulatory actions; and (c) conduct a periodic review of existing regulations. Chapter 9 contains the RIR prepared for this action.

1.7.7 Information Quality Act

Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554) directed OMB to issue government-wide guidelines that provide policy and procedural guidance for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies. This bill is known as the Information Quality Act (IQA). OMB's guidelines require all federal agencies to develop their own guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by the agency. NMFS published its guidelines in February 2002 (available online at http://www.commerce.gov).

1.7.8 Executive Orders 12898 and 13175: Environmental justice and Tribal Consultation

Many federal laws, treaties, executive orders, policy directives, and federal regulations place legal responsibilities for addressing community and tribal interests on executive branch agencies. The relationship between the U.S. government and federally-recognized Indian tribes is considered to be government-to-government in nature. These orders indicate that United States and its agencies, including NOAA, acknowledge the governmental powers of the recognized tribes, and that such power stems not from a delegation of U.S. authority, but from a pre-existing state of sovereignty.

For example, the National Environmental Policy Act (NEPA) establishes a framework of public and tribal involvement in land management planning and actions. NEPA also provides for consideration of historic, cultural, and natural aspects of our environment. Specifically, places of cultural and religious significance to tribes are to be considered by federal agencies in policy and project planning.

The following sections highlight two key executive orders pertaining to the consideration of Native/tribal community interests during the development of federal regulations, policy, or legislation.

Executive Order 12898

Executive Order 12898, approved on February 11, 1994, states that each federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations in the United States. Among groups specifically singled-out for impact assessment are Native Americans. Note that E.O. 12898 also covers groups that are not necessarily federally-recognized tribal entities. In addition, included is a provision that states that each federal agency responsibility set forth under the order shall apply equally to Native American programs (Section 6-606). The provision further states that the Department of the Interior, after consultation with tribal leaders, shall coordinate steps to be taken pursuant to this order that address federally-recognized Indian Tribes.

Executive Order 13175

Executive Order 13175 on consultation and coordination with Indian tribal governments establishes the requirement for regular and meaningful consultation and collaboration with Indian tribal governments in the development of federal regulatory practices that significantly or uniquely affect their communities; to reduce the imposition on unfunded mandates on Indian tribal governments; and to streamline the application process for and increase the availability of waivers to Indian tribal governments. This Executive Order requires federal agencies to have an effective process to involve and consult with representatives of Indian tribal governments in developing regulatory policies and prohibits regulations that impose substantial, direct compliance costs on Indian tribal communities.

Additionally, Congress extended the consultation requirements of Executive Order 13175 to Alaska Native corporations in Section 161 of the Consolidated Appropriations Act of 2004 (Public Law 108-199), as amended by Section 518 of the Consolidated Appropriations Act of 2005 (Public Law 108-447). Public Law 108-199 states in section 161 that "The Director of the Office of Management and Budget shall hereafter consult with Alaska Native corporations on the same basis as Indian tribes under Executive Order No. 13175." Public Law 108-447, in section 518, amends section 161 of Public Law 108-199 to replace Office of Management and Budget with all federal agencies.

While the Council does not fall under the definition of executive agency for the purposes of E.O. 13175 and is not required to provide formal consultation with tribes, the Council is undergoing an effort to improve communication and consultation with communities and Alaska Native groups, per its programmatic workplan priority. Note that this does not mean that the Council could not be party to a consultation process undertaken by NMFS, but it does mean that the responsibility for consultation as required under E.O. 13175 remains with NMFS.

NMFS undertakes a formal consultation process with federally-recognized tribal governments under E.O. 13175 during the development of proposed management actions. Almost half of all federally-recognized tribes in the U.S. are located in Alaska. There are currently 229 tribal entities within Alaska that are federally-recognized tribes, which are those officially recognized as such by inclusion in the list of

"Indian Entities Recognized and Eligible to Receive Services from the U.S. Bureau of Indian Affairs." This list is updated annually.[1] There are currently 13 Alaska Native Regional Corporations (ANRCs) and over 100 Alaska Native village corporations, as created under the provisions of the Alaska Native Claims Settlement Act (ANCSA).

[1]73 FR 18553, April 4, 2008.

Chapter 2 Description of the Alternatives

This EA presents four alternatives and two options, predicts the impacts associated with proceeding under those alternatives and options, and presents the environmental impacts in comparative form. To do this, this EA sharply defines the issues and provides a clear basis for choice among alternatives and options by the decision-maker and the public. Each alternative represents a fishery management plan for the Arctic Management Area. These alternatives and options have been selected to represent the range of management programs that are available under the Magnuson-Stevens Act. The action alternatives and options (listed below) were selected because they accomplish the stated purpose and need of the action.

This document analyzes the following alternatives and options:

Alternative 1: No Action (Status quo)

Alternative 2: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait.

Alternative 3: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait. Exempt from the FMP a red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has occurred, and allow that fishery to be managed by the State.

Alternative 4: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred could be prosecuted under authority of the Crab FMP. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

Either Option 1 or 2 must be chosen under Alternative 2, 3, or 4 to meet the MSA required provisions for an FMP to (1) assess and specify the present and probable future condition of, and the maximum sustainable yield and optimum yield from, the fishery and (2) specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished or when overfishing is occurring.

Option 1: Specify maximum sustainable yield (MSY), status determination criteria (both maximum fishing mortality threshold (MFMT) and minimum stock size threshold (MSST)), optimum yield (OY), annual catch limits (ACL), and annual catch target (ACT) for the fisheries that the plan is intended to manage. Managed fisheries are those identified as having a non-negligible probability of developing within the foreseeable future.

Option 2: Create 4 categories of FMP species, identify species in each category, and create a process for moving species from the ecosystem component (EC) category to the Target Species category. Categorize all species of Arctic finfish and shellfish as EC species or prohibited species. EC and prohibited species are not considered managed fisheries under the FMP and do not require specification of reference points such as MSY, OY, and status determination criteria, therefore no reference points are provided in this option. Reference points would be developed for a species to move it into the Target Species category.

2.1 Development of the Alternatives

The Council's December 2006 discussion paper briefly summarized information on the environment and fishery resources of the Arctic Ocean offshore Alaska, and explored some of the issues associated with establishing a fishery management policy for this region. This document also outlined some possible options the Council may wish to pursue in its future discussions of fishery management in this region. The document discussed options for conservation and management measures that may be appropriate for possible future fisheries emerging in the region.

The Council received that report at the December 2006 meeting and further expressed its view that commercial fisheries may not be appropriate at this time. The Council tasked staff to further develop options for fishery management in the Arctic. Specifically, the Council's December 2006 motion was as follows:

For waters north of Bering Strait, the Council moves to develop an analysis that would include the following alternatives:

- Status quo for those waters.
- Amend the existing scallop FMP, the BSAI groundfish FMP, and the BSAI king and Tanner crab FMP to prohibit commercial fishing in the Chukchi Sea.
- Adopt a new FMP for the waters north of Bering Strait for any species not covered by an FMP (including krill and other forage species) with the following sub options:
    - Close all Federal waters to commercial fishing until such time as the Council develops a policy for opening the waters to select commercial fishing practices, or
    - Close all Federal waters north of Bering Strait to commercial fishing for forage species, and all waters north of a line at Point Hope to commercial fishing for all species [Figure 1-1].

The Council's motion was accompanied with additional notes:

- The effect of [the second option] would be to allow for commercial fishing for fish species (other than forage species) in the waters between Bering Strait and Pt. Hope.
- The policy for opening waters north of Bering Strait could be developed through a Fishery Ecosystem Plan or other mechanism as the Council deems appropriate.
- Initial analysis should flesh out what is required under each alternative, such as what is required as part of an FMP (e.g. EFH), and whether these requirements could be deferred until such time as the Council decides to open a fishery.
- Under each alternative, describe the requirements for deferring management to the State of Alaska, and the procedures for deferring management.

Another discussion paper was prepared that summarized information on the above alternatives, and was presented to the Council at its June 2007 meeting. Each alternative was reviewed by the Council, and the Council chose to move forward with an analysis of these alternatives, which is the subject of this EA/RIR/IRFA.

The Council's motion recommended developing an Arctic FMP, amending the scallop and crab FMPs to terminate their geographic coverage at Bering Strait, and closing the entire Arctic EEZ to commercial fishing. The Council has indicated, as an option, that it could "grandfather" or allow the existing small red king crab fishery in the southern Chukchi Sea area to continue. The Council requested that an analysis of these alternative options, and status quo, be completed and presented to the Council in December 2007. The alternatives to be analyzed in the Council's motion are as follows:

1. Status quo;

2. Adopt an Arctic FMP, and amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait, with two options:

a) Close all waters north of Bering Strait to commercial fishing for all species, including forage species;

b) Close all waters north of Bering Strait to commercial fishing for all species, including forage species, but leave waters between Bering Strait and Point Hope open to commercial fishing for red king crab.

In this document, these alternatives are presented, and environmental effects of the alternatives are analyzed. The Council's full motion is provided as Appendix I. More detailed discussion of these alternatives has been provided above. The Council has indicated its intent to prohibit commercial fisheries in the Arctic. The Council has based this on a desire to acknowledge the ecological conditions of the Arctic, the unknown effects of climate change, and the unknown availability of exploitable populations of fish in the Arctic.

The second option to the FMP alternative in the Council's motion (Appendix I) is based on information that a small red king crab fishery has been prosecuted by local residents in the past. In the descriptive information related to the motion, the Council's stated intent is to not disrupt or prohibit any small, local commercial fisheries that may have occurred, or presently occur, in the region. Thus, the Council established an alternative to exempt any known small, local commercial fisheries from the general prohibition on commercial fishing. Each of the latter two options would include amending the crab and scallop FMPs to terminate their geographic coverage at Bering Strait, thereby creating a new multi-species FMP for all EEZ waters of the Chukchi and Beaufort Seas for fish (except halibut and salmon), including scallops and crab.

Staff reviewed these alternatives and, in the process of beginning the analysis of each, discovered another optional means to accomplish the Council's intent in the FMP Alternative and second option. This would be to develop another alternative that would embody elements of the FMP Alternative and second option (prohibit commercial fisheries but authorize the Chukchi crab fishery under the new Arctic FMP) and elements of Alternative 1 *status quo* (authorize the Chukchi crab fishery under the existing crab FMP, and not amend the crab FMP to change its geographic coverage). This new hybrid alternative would, then, result in amending only the scallop FMP to terminate its geographic coverage at Bering Strait, retain the crab FMP *as is* and retain management of the Chukchi crab fishery under the crab FMP, and create an Arctic FMP with authority over all other commercial fisheries in the EEZ of the Chukchi and Beaufort Seas (including crab north of Pt. Hope).

Upon further review by NMFS staff in August 2008, it was determined that the Scallop FMP does not need to be amended to meet the purpose and need of this action. The scallop FMP management unit is limited to the Bering Sea at the Bering Strait. The State manages the scallop fishery in the Bering Sea under Registration Area Q which extends to Point Hope and is described in an appendix to the Scallop FMP. This descriptive text for registration is provided as a convenience to the reader of the FMP and does not affect the specified scallop FMP management unit. The authority of the scallop FMP ends at the Bering Strait, and no amendment to the scallop FMP is necessary for this action.

These considerations would result in four alternatives, as described below. This suite of alternatives gives the Council flexibility by providing two alternatives to allow the Chukchi Sea red king crab fishery to continue – one under the new Arctic FMP but exempt from Federal management (Alternative 3), and another under the existing crab FMP with deferred management authority to the State (Alternative 4). Table 2-1 summarizes the differences among these alternatives. For the purposes of this action, fish includes all finfish, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds, as defined by Section (3)(13) of the MSA, and excluding salmon and halibut.

Table 2-1 Summary of Alternatives

Alternative	MSA Defined Fish Harvest Authorized in Arctic?	Authority	Scallop Harvest Authorized in Arctic?	Authority	Crab Harvest Authorized in Arctic?	Authority	Crab FMP northern boundary	Notes on Chukchi Sea red king crab fishery management
1	no	State regs*	yes	State regs.*	yes	Crab FMP	Pt Hope	Open - Crab FMP defers mgt authority to State
2	no	Arctic FMP	no	Arctic FMP	no	Arctic FMP	Bering Strait	Closed
3	no	Arctic FMP	no	Arctic FMP	Yes-limited to historical RKC in Chukchi Sea	Arctic FMP/State	Bering Strait	Open by State – exempt from Federal management
4	no	Arctic FMP	no	Arctic FMP	yes	Crab FMP	Pt Hope	Open - Crab FMP defers mgt. authority to State

*Authority limited to State registered vessels fishing in Registration Area Q (to Point Hope).

2.2 Alternative 1, No Action - Status Quo

Alternative 1 would retain management authorities as they presently exist. Under status quo, a federal fishery in Arctic waters, which is any area of the Chukchi Sea and the Beaufort Sea EEZ, north of Bering Strait, would be regulated under the authority of either the Council and NMFS or the State of Alaska. Any fishery not covered by an existing FMP would be managed by the State. Under *status quo*, all fishing in any waters of the State or the EEZ would be prohibited for vessels registered with the state, unless specifically authorized. No foreign fishing is allowed.

Salmon fishing is managed under the authority of the federal salmon FMP, which currently closes all federal waters of the Arctic to commercial salmon fishing. Halibut is managed under the provisions of the Halibut Treaty and Halibut Act and could be authorized only by action by the International Pacific Halibut Commission.

The Federal crab FMP is the management authority for EEZ crab fisheries north of Bering Strait to Pt. Hope. No other federal FMP covers arctic waters. A fishery for the listed species of crabs in the king and Tanner crab FMP may occur within the areas covered by this FMP, which includes the U.S. portion of the Chukchi Sea from Bering Strait to Point Hope.

Any fishery in the Arctic, including state and EEZ waters, not specifically authorized by the State is prohibited under State statute. The State has extended its fishing regulations to cover waters of the EEZ where a federal FMP does not exist. Currently the state has authorized and developed management regulations for fisheries for king and Tanner crabs, miscellaneous shellfish (scallops, octopus, sea urchins, clams, etc.), herring, and groundfish in adjacent waters of the EEZ. State regulations, however, affect only vessels registered with the State. The State cannot prohibit unregistered vessels from fishing in EEZ waters of the Arctic since there was no FMP in place for these waters on August 1, 1996, as stated in the MSA. The MSA authorizes the State to manage unregistered vessels in Arctic EEZ waters only if the Council and the Secretary of Commerce find that there is a legitimate interest of the State to do so for the conservation and management of a fishery. The Council has chosen to not proceed with this option (to develop a finding), and instead proceed with adoption of an Arctic FMP.

“Registered under the laws of the State of Alaska” is defined in Alaska Statutes, Title 16:

Sec. 16.05.475. Registration of fishing vessels.

(a) A person may not employ a fishing vessel in the water of this state unless it is registered under the laws of the state. Vessels registered under the laws of another state, and persons residing in another state, are not excused from this provision.

(b) The term "employ", as used in this section, shall be defined by the Board of Fisheries through the adoption of regulations under AS 44.62 (Administrative Procedure Act). The definition may include any activities involving the use or navigation of fishing vessels.

(c) The term "registered under the laws of the state", as used in this section, shall be defined by the Board of Fisheries through the adoption of regulations under AS 44.62 (Administrative Procedure Act). The definition may include any existing requirements regarding registration, licenses, permits, and similar matters imposed by law or regulation together with modifications of them and with any additional requirements the board finds necessary to maximize the authority of the state to apply and enforce fisheries regulations under 16 U.S.C. 1801-1882 (Magnuson-Stevens Fishery Conservation and Management Act of 1976 (P.L. 94-265, 90 Stat. 331)).

(d) In this section "fishing vessel" means any vessel, boat, ship, or other craft that is used for, equipped to be used for, or of a type which is normally used for

(1) fishing, or

(2) aiding or assisting one or more vessels at sea in the performance of any activity relating to fishing, including, but not limited to, preparation, supply, storage, refrigeration, transportation, or processing.

Registration is further defined in 5 AAC 29.120:

(a) A person who owns a commercial fishing vessel or that person's authorized agent shall register that vessel by completing a vessel license application or renewal form and submitting it to the Commercial Fisheries Entry Commission, unless the vessel is not required to be licensed under AS 16.05.495 . Vessel registration is required before fishing or transporting unprocessed fish in any waters of Alaska. A vessel, if it is in compliance with all regulations governing registration and if it displays a license issued under AS 16.05.530 , unless the vessel is not required to be licensed under AS 16.05.495 , is considered to be registered under the laws of the state and may take or transport unprocessed fish. It is unlawful to take, attempt to take, or possess unprocessed fish aboard a vessel in the waters of Alaska unless the vessel is registered under the laws of the state. For purposes of this subsection,

(1) "employ," as used in AS 16.05.475 , means taking or attempting to take fish, or transporting fish which have been taken or any operation of a vessel aiding or assisting in the taking or transporting of unprocessed fish;

(2) "in compliance with all regulations governing registration" includes vessel registration required by 5 AAC 28.020, 5 AAC 31.020, 5 AAC 31.030, 5 AAC 32.020, 5 AAC 32.030, 5 AAC 34.020, 5 AAC 34.030, 5 AAC 35.020, 5 AAC 35.030, 5 AAC 38.020, and 5 AAC 38.030, and includes district or subdistrict registration requirements of 5 AAC 03 - 5 AAC 38, and includes the provisions of this section;

(3) "registered under the laws of the state" means that a vessel displays a license described in 20 AAC 05.1958 and issued under AS 16.05.530, unless the vessel is not required to be licensed under AS 16.05.495, and that the registration provisions of 5 AAC 03 - 5 AAC 39 have been complied with and evidence of compliance is immediately available at all times during fishing or transporting operations, and can be shown upon request to an authorized representative of the department.

Additional details and definitions of terms used in the registration statute can be viewed at: http://www.touchngo.com/lglcntr/akstats/aac/title05/chapter039/section120.htm

To date, the Council has exercised limited authority for managing fishery resources in U.S. EEZ waters north of Bering Strait, which in this EA are considered the Arctic Management Area.

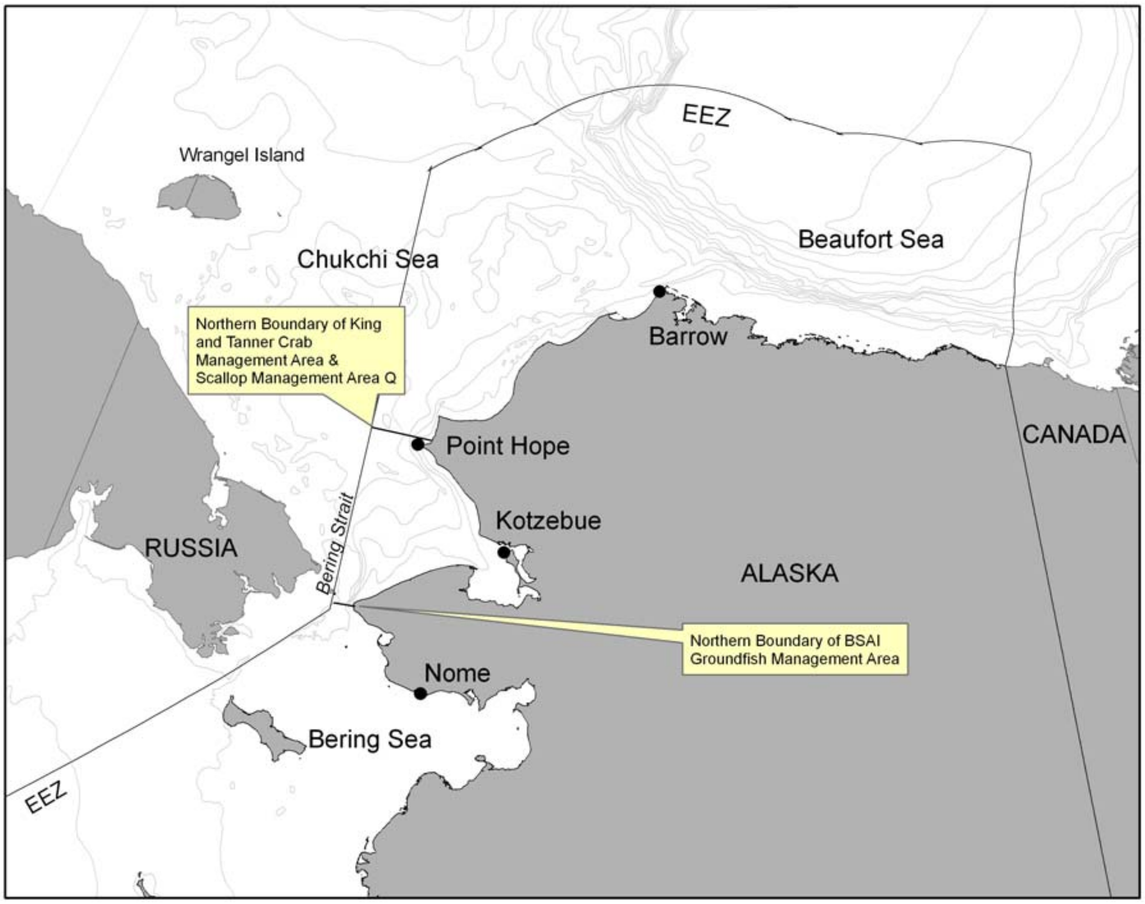

Figure 2-1 Boundaries of Federal and State Fishery Management Areas for Crab, Groundfish, and Scallops

The following summarizes current FMPs and their authorities over fishing in the Alaskan Arctic, other fisheries not part of current FMPs, and management in the Arctic under the State laws and regulations.

2.2.1 Bering Sea/Aleutian Islands Groundfish FMP

The Management Area for the Bering Sea and Aleutian Islands (BSAI) groundfish FMP is described in the FMP as "…the United States (U.S.) exclusive economic zone (EEZ) of the Bering Sea and that portion of the North Pacific Ocean adjacent to the Aleutian Islands which is between 170˚ W. longitude and the U.S.-Russian Convention Line of 1867." The FMP further defines the northern boundary of the Bering Sea as "…Bering Strait, defined as a straight line from Cape Prince of Whales [sic] to Cape Dezhneva, Russia." The FMP covers all stocks of finfish and marine invertebrates distributed or are exploited in the BSAI Management Area, except salmonids, shrimps, scallops, snails, king crab, Tanner crab, Dungeness crab, corals, surf clams, horsehair crab, lyre crab, Pacific halibut, and Pacific herring. The BSAI groundfish FMP extends to Bering Strait, but does not encompass waters of the Chukchi or Beaufort Seas.

Implementing regulations for the BSAI groundfish FMP at CFR 679.1(b) state that the BSAI Management Area means the Bering Sea and Aleutian Islands sub areas, referring to Figure 1 of part 679.

The regulations define the Bering Sea sub area of the BSAI as "that portion of the EEZ contained in Statistical Areas 508, 509, 512, 513, 514, 516, 517, 518, 519, 521, 523, 524, and 530". The Chukchi Sea is designated Statistical Area 400 (excluded from the above list), and is defined as the area north of a diagonal line between 66˚ 00' N, 169˚ 42.5' W (Cape Dezhneva, Russia) and 65˚ 37.5' N, 168˚ 7.5' W (Cape Prince of Wales, Alaska) and to the limits of the U.S. EEZ as described in the current edition of NOAA chart INT 814 Bering Sea (Northern Part). Inspection of this chart suggests that only a portion of the U.S. EEZ of the Chukchi Sea is considered part of Statistical Area 400. Statistical Area 514 is the northernmost statistical area in the BSAI, but it extends only as far north as "the southern boundary of the Chukchi Sea, area 400." Thus, the Chukchi Sea is not part of the BSAI groundfish management area, nor is the Beaufort Sea.

2.2.2 King and Tanner Crab FMP

The Management Area for the king and Tanner crab FMP is described in the FMP as "…those waters of the EEZ lying south of Point Hope (68˚21' N.), east of the U.S.-U.S.S.R. convention line of 1988, and extending south of the Aleutian Islands for 200 miles between the convention line and Scotch Cap Light (164˚44'36" W. longitude) …" Most of the fishery management authority in the king and Tanner crab FMP is deferred to the State of Alaska with federal oversight. The FMP applies to fisheries for red king crab, blue king crab, golden (or brown) king crab, Tanner crab (*Chionoecetes bairdi*), snow crab (*C. opilio*). The king and Tanner crab FMP does extend north of Bering Strait and thus partially encompasses waters of the Chukchi Sea.

Implementing regulations at 50 CFR 679.2 define the Management Area for king and Tanner crab consistent with the above description. Thus the regulations associated with these fisheries extend partly into the Chukchi Sea, but not into the Beaufort Sea.

2.2.3 Scallop FMP

The Management Area for the scallop FMP is described in the FMP as "…all Federal waters of the Gulf of Alaska (GOA) and the Bering Sea/Aleutian Islands area (BSAI). The GOA is defined as the U.S. exclusive economic zone (EEZ) of the North Pacific Ocean, exclusive of the Bering Sea, between the eastern Aleutian Islands at 170˚ W longitude and Dixon Entrance at 132˚40' W longitude. The BSAI is defined as the U.S. EEZ south of Bering Strait to the Alaska Peninsula and Aleutian Islands and extending south of the Aleutian Islands west of 170˚ W long." Under the scallop FMP, authority for some management measures for the scallop fishery has been deferred to the State. All scallop fisheries are managed by the State with regulations applicable to specific scallop Registration Areas. Even though the FMP adopts State registration areas (Scallop FMP Section 4.1.1), Registration Area Q extends beyond the FMP management unit described in the Executive Summary for the scallop FMP. Registration Area Q (Bristol Bay-Bering Sea) is the farthest north and its northern boundary is described in Appendix B of the FMP as "…the latitude of Point Hope (68˚ 21' N. lat.)."

Under state regulations, any state-licensed vessel in the scallop fishery north of Registration Area Q and in adjacent waters of the EEZ, which in this case would be the remainder of the Chukchi Sea north of Point Hope, currently would be regulated by the State under authority of 5 AAC 38.010. (This regulatory authority would also include EEZ waters of the Beaufort Sea.) Scallop fishing regulations at 50 CFR 679.1(h) govern "commercial fishing for scallops in the Federal waters off Alaska by vessels of the United States…" Currently, some management measures are deferred to the State of Alaska. State regulations specify that scallop fishing is permitted in specific registration areas, and, as noted above, the northern most scallop fishing registration area is Area Q, which includes a portion of the Chukchi Sea.

2.2.4 Salmon FMP

The salmon FMP specifically prohibits commercial fishing for salmon in arctic waters. The Management Unit for the salmon FMP is described in the FMP as "…all of the EEZ off the coast of Alaska and the salmon and fisheries that occur there. The area covered by this fishery management plan is the EEZ off the coast of Alaska…, including parts of the Gulf of Alaska, Bering Sea, Chukchi Sea, and Arctic Ocean." The FMP further divides the Management Unit into West and East Areas, with the divide at Cape Suckling (143˚53'36" W longitude). The West Area encompasses Arctic waters (Figure 2-2). The FMP allows commercial fishing only in the East Area[2], and allows sport salmon fishing in both areas; the FMP covers all five species of salmon from North America – Chinook, coho, pink, sockeye, and chum.

Regulations at 50 CFR 679.3(f) prohibit commercial fishing for salmon in the West Area, i.e., the U.S. EEZ West of Cape Suckling, which includes waters of the Chukchi and Beaufort Seas. The implementing regulations at 50 CFR 679.2 state that they govern fishing for salmon by fishing vessels off the United States in the Salmon Management Area, which is defined as "…the waters of the EEZ off the coast of Alaska (Figure 23 to part 679), including parts of the North Pacific Ocean, Bering Sea, Chukchi Sea, and Beaufort Sea."

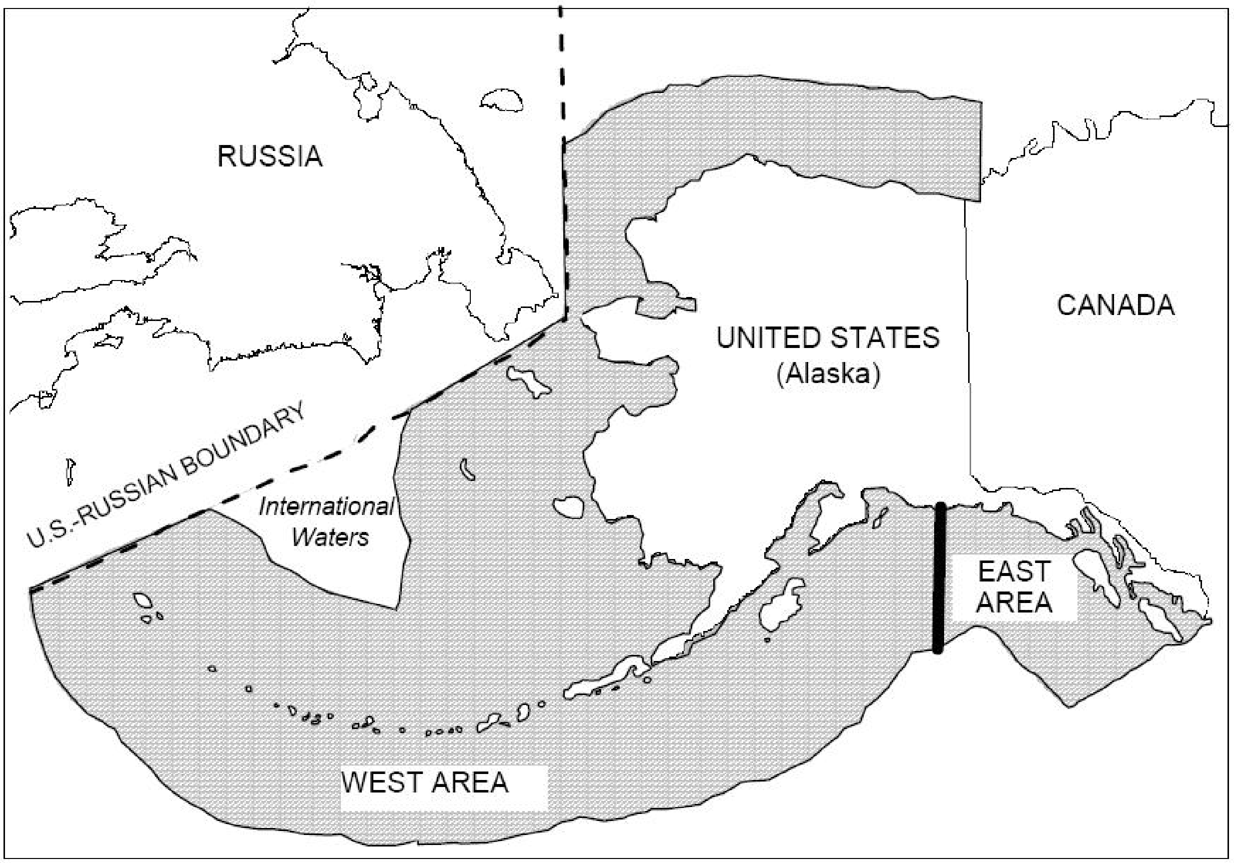

Figure 2-2 Salmon Management Area from the Salmon FMP

[2] Three historic commercial net fisheries are permitted in federal waters in the West Area: in Cook Inlet, near the mouth of the Copper River, and near False Pass.

2.2.5 Halibut

The IPHC exercises jurisdiction in all maritime waters of the U.S. and Canada wherever halibut are present (Gregg Williams, IPHC, pers. comm.). The IPHC has previously received proposals for an experimental fishery in the Chukchi Sea, but no fishery has developed. The Halibut Convention of 1923 established an agreement between Canada and the U.S. for management of halibut fisheries in "Convention Waters," which were defined to mean the "territorial waters and the high seas off the western coasts of the United States of America and of Canada, including the southern as well as the western coasts of Alaska.".

The Northern Pacific Halibut Act of 1982, which updated and redefined the role of the IPHC in the management of the fishery as a consequence of passage of the MSA (McCaughran and Hoag 1992), defines "Convention Waters" as "…the waters off the west coasts of Canada and the United States, including the southern as well as the western coasts of Alaska, within the respective maritime areas in which either Party exercises exclusive fisheries jurisdiction." It is apparent that, based on the original Halibut Convention, Convention Waters include the Chukchi and Beaufort Seas, because the Halibut Act definition includes waters where the U.S. has exercised exclusive fisheries jurisdiction. The U.S. exercises exclusive fisheries jurisdiction is the entire U.S. EEZ, which implies inclusion of EEZ waters of the Chukchi and Beaufort Seas. IPHC regulations define the northernmost edge of Regulatory Area 4E at 65˚ 34' 00" which is close to the northern boundary of the Bering Sea sub area in the BSAI groundfish FMP (Bering Strait). The northern edge of IPHC Regulatory Area 4D as specified in regulations appears to be at the intersection of its eastern boundary and the U.S.-Russia convention line.

Commercial fishing for halibut in the Arctic Management Area is prohibited until the IPHC specifically authorizes such fishing.

2.2.6 Other Fisheries or Fisheries Not Part of Current FMPs

A fishery not explicitly covered by the Council's FMPs or their implementing regulations is regulated by the State of Alaska, as authorized under Section 306(a) of the Magnuson-Stevens Act in the following circumstances.

- First, Section 306(a)(3)(A) provides for state regulation of a fishing vessel outside State boundaries if the vessel is registered with the State and there is no FMP or other applicable federal regulations for the fishery in which the vessel is operating. If there is an FMP, this section also provides for state regulation of fishing outside state boundaries if the State's laws and regulations are consistent with the FMP and applicable Federal regulations for the fishery in which the vessel is operating.
- Second, Section 306(a)(3)(B) provides for state management when an FMP specifically delegates that management authority and the State's laws and regulations are consistent with that FMP.
- Third, Section 306(a)(3)(C) provides for fishing vessels that are <u>not</u> registered under the law of the State of Alaska and operate in a fishery in the EEZ for which there was no FMP in place on August 1, 1996. In this case, if the Council and the Secretary find a legitimate interest of the State in the conservation and management of such a fishery, then the State may regulate fishing until an FMP is approved and implemented.

2.2.7 Management under State of Alaska Laws and Regulations

Under current state statutes, all fishing in any waters of the State or the EEZ is prohibited unless specifically authorized by statute or regulation (AS 16.05.920(a))[3]. The State has extended its fishing regulations to cover EEZ waters for all groundfish species not included in a federal FMP or for where a federal FMP delegates authority to the State (5 AAC 28.010). Thus, for fishing to occur, explicit regulations allowing fishing would need to be promulgated by the Alaska Board of Fisheries.

The State's Chukchi-Beaufort Groundfish Area (its Registration Area Y) includes all state waters north of the latitude of Cape Prince of Wales (65E 36N N. lat). At this time state regulations allow groundfish to be taken at any time provided a vessel registers with the State. Groundfish fisheries in Area Y are managed as parallel fisheries. Under parallel fishery management, the State adopts the seasons, bycatch and gear types promulgated in adjacent Federal waters. Under current state regulations the State could allow an exploratory fishery under a Commissioner's permit within the three mile limit.

State regulations applicable to king crab (5 AAC 34.010), Tanner crab (5 AAC 35.010), miscellaneous shellfish which includes scallops (5 AAC 38.010), and herring (5 AAC 27.010) also specifically apply to the adjacent waters of the EEZ. State regulations authorize king crab fishing south of Point Hope, and herring fishing in the waters of Kotzebue Sound. While state regulations authorize salmon fishing in the waters of Kotzebue Sound, the Salmon FMP prohibits salmon fishing in federal waters in the action area, and thus prevents the application of state salmon regulations in federal waters. State regulations do not authorize fishing for other species in the action area.

Note that while the State has extended authority over EEZ waters in the Arctic, this applies only to vessels registered with the State. Unregistered vessels would not be restricted under either Federal or State laws and regulations from commercially fishing the the U.S. Arctic EEZ off Alaska.

2.3 Alternatives 2, 3, and 4

Under the MSA, the Council is authorized to prepare and submit to the Secretary FMP and FMP amendments for each fishery under its authority that requires conservation and management. Amendments to existing FMPs undergo the same review process as an FMP. NMFS has prepared guidelines for the FMP preparation and review process (NMFS 1997); these guidelines specify procedures for preparation of the document, public review and Council adoption, final review and approval, preparation of proposed regulations, and final rulemaking. Under ideal circumstances, this process can take 12 to 18 months, but for more controversial or complex actions the process can extend for years. With passage of the Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006 (PL 109-479), Congress added to the requirements for FMPs additional economic data collection requirements (Section 104); in response, NOAA Fisheries may provide additional guidelines on the FMP amendment process.

Alternatives 2, 3, and 4 would adopt a new multispecies FMP for the Arctic Management Area that would close all federal Arctic waters to commercial fishing for all fish species, except salmon, halibut, Dolly varden char, Pacific herring, and whitefish. Management for these species would remain under status quo as described under Alternative 1. The alternatives differ in how they define the Arctic FMP's Fishery

[3] Which reads, "Unless permitted by AS 16.05 - AS 16.40, by AS 41.14, or by regulation adopted under AS 16.05 - AS 16.40 or AS 41.14, a person may not take, possess, transport, sell, offer to sell, purchase, or offer to purchase fish, game, or marine aquatic plants, or any part of fish, game, or aquatic plants, or a nest or egg of fish or game."

Management Unit (FMU) and the management authority for a red king crab fishery in the Chukchi Sea. Options 1 and 2 provide the information required in section 303 of the Magnuson-Stevens Act and to comply with NOAA guidelines for writing an FMP.

Under Alternatives 2, 3, and 4, the Arctic FMP would be written to provide for exempted fishing permits (EFP) that would allow commercial fishing activities that would otherwise be prohibited by 50 CFR part 679. These types of permits are provided for a limited time for the purpose of doing a study to provide information that would be useful in the management of a fishery. The impact of activities under an EFP would be analyzed under the appropriate NEPA analysis and would include consultation with the Alaksa Fisheries Science Center and the Council before the permit could be issued.

2.3.1 Alternative 2 All Fisheries under the Arctic FMP Fishery Management Unit

The Arctic FMP's FMU under Alternative 2 would include all federal Arctic waters off Alaska north of Bering Strait. Alternative 2 would amend the crab FMP to change its fishery management units to terminate its geographic coverage at Bering Strait, thereby placing crab, scallop, and groundfish management authority in all Arctic EEZ waters under the Arctic FMP. Adopting this alternative would preclude a red king crab fishery in the Chukchi Sea. Amending management area boundaries in the existing crab FMP requires an amendment process and Secretarial review and approval. There are no known commercially exploitable scallop resources this far north, and prohibition of scallop fishing likely would not be contentious.

The Council's king and Tanner crab FMP authorizes crab fishing in arctic EEZ waters south of a line of latitude at approximately Point Hope, Alaska. Under the crab FMP, authority for some management measures for the king and Tanner crab fisheries has been deferred to the State. The State's Northern Bering Sea Statistical Area covers waters of the Chukchi Sea northward to a line of latitude at Point Hope. Under State regulations, any EEZ crab fishery northward and outside of the Northern Bering Sea Statistical Area, which would be the remainder of the Chukchi Sea north of Point Hope and the Beaufort Sea, currently would be regulated by the State under authority of 5 AAC 38.010. To terminate the authority of the crab FMP at Bering Strait, an FMP amendment would be required. The crab FMP would be revised so that the description and figure for the northern boundary of the fishery management unit ends at the southern boundary of the Chukchi Sea statistical area (Figure 1 to 50 CFR part 679) and Appendix H would be revised to clarify that the State Registration Area Q extends beyond the boundaries of the fishery management unit of the FMP. The harvest specifications description in the Arctic FMP for crab management would mirror the description in the crab FMP, and therefore, the management of any future crab harvest in the Arctic would be done in the same manner as under the crab FMP.

2.3.2 Alternative 3 Exempted Kotzebue Red King Crab Fishery from Arctic FMP

Alternative 3 is similar to Alternative 2. The Arctic FMP's FMU under Alternative 3 would include all Alaskan Arctic Federal waters north of Bering Strait. Alternative 3 would amend the crab FMP to terminate its geographic coverage at Bering Strait, thereby placing crab management authority in all Arctic EEZ waters under the Arctic FMP. Amending management area boundaries in the existing crab FMP requires an amendment process and Secretarial review and approval, as discussed in section 2.2.1.

In contrast to Alternative 2, the Arctic FMP under Alternative 3 would exempt from Federal management a red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred. Adopting this alternative would allow a red king crab fishery in the southern part of the Chukchi Sea offshore from the village of Kotzebue to be managed by the State of Alaska without Federal oversight as provided in the Crab FMP. Although this is a very small fishery involving a few participants, and it has not been prosecuted continuously in the EEZ, this alternative would allow a small amount of commercial crab fishing in this area, under exclusive State management authority. This crab fishery is located in the St. Lawrence Island Section Q of the Northern District of the Bering Sea Registration Area (Statistical Area Q), as described in State regulations and extends to Pt. Hope. This area description would be used to exempt the fishery from the Arctic FMP. The remaining red king crab in the Arctic Management Area would be under the Arctic FMP.

Section 306(a)(3) of the Magnuson-Stevens Act provides for State management authority in Federal waters off Alaska in the absence of Federal management of the species in question. NMFS and the Council would need to make a finding that the State of Alaska has a legitimate interest in the conservation and management of this stock and that Federal conservation and management is not necessary. The State would have sole management authority for this species, as they do for hair crab (the hair crab fishery, which occurs in the EEZ, was removed from the FMP) and a number of other crab species.

The State of Alaska would continue existing State management for this crab stock. Under status quo, the Federal crab FMP defers the management of this fishery to the State. Therefore, the State already manages this stock and collects all of the biological information. Neither NMFS nor ADF&G survey this stock. Harvest histories of the unsurveyed stocks are sporadic and the harvests from those stocks are managed as a limited exploratory fishery. Any future exploratory fishery would be operated by ADF&G commissioner's permit, which means the State determines if and when these fisheries occur, who may participate, observer requirements, and how much is harvested.

2.3.3 Alternative 4 Arctic FMP Crab Management at Pt. Hope

The Arctic FMP's FMU under Alternative 4 would include all federal Arctic waters north of the Bering Strait for all managed species, except that crab species would be managed in the Arctic FMP north of Pt. Hope. The crab FMP management boundary would remain at Pt. Hope and the crab FMP would not be amended. This would result in the management of crab up to Pt. Hope under the existing crab FMP where management is differed to the state under the criteria specified in the crab FMP and in compliance with the Magnuson-Stevens Act.

Any crab fishing in the Chukchi Sea up to Pt. Hope would remain under the existing BSAI crab FMP, which defers most aspects of crab fishery management to the State. Management would be done following the criteria established in the crab FMP and in compliance with the Magnuson-Stevens Act. Under Alternative 4, the State could allow a red king crab fishery to occur in the southern Chukchi Sea EEZ up to the latitude of Point Hope under the deferred authority of the BSAI crab FMP after completing the Council process to amend the crab FMP to provide for the fishery. Crab resources north of Pt. Hope would be managed under the Arctic FMP which would close fishing to crab until more information is available to indicate a sustainable commercial fishery is possible. The Arctic FMP crab management area would be identified as those waters located north of Point Hope. The criteria used for specifications for crab in the Arctic FMP would be the same as those in the crab FMP.

Whether crab management is deffered to the State south of Pt. Hope under the crab FMP or included from the Bering Strait north as part of the Arctic FMP, in both instances, the entire Arctic crab fishery would be managed under FMPs with the same criteria for specifications so that the resulting management for crab in the entire Arctic would be similar under Alternatives 2, 3, and 4. If a crab fishery were to develop under the Arctic FMP, the decision to defer management to the State can be made at the time that the FMP is amended to provide for the fishery. Alternative 3 would differ from Alternatives 2 and 4 by removing the management of the small historical crab fishery in the Kotzebue area from any FMP and allowing complete State control without the federal oversight offered by an FMP. In any case, the crab FMP or the Arctic FMP would need to be amended to provide for the small red king crab historical fishery under Alternatives 2 and 4.

2.4 Arctic Fishery Management Plan Options

Alternatives 2, 3, and 4 required the adoption of harvest specifications procedures to meet requirements of the Magnuson-Stevens Act. Options 1 and 2 were developed to specifically address Section 303 of the Magnuson-Stevens Act which contains the required contents of FMPs (section 1.7.1 of this EA contains the Section 303 Magnuson-Stevens Act language). FMPs or amendments must be consistent with National Standards (MSA 301(a)) and any advisory guidelines issued by the Secretary to assist in the development of FMPs (MSA 301(b)). Magnuson-Stevens Act Section 3(5) defines conservation and management to include employing measures to maintain the marine environment and to assure that a multiplicity of options will be available with respect to future uses of fishery resources and the marine environment. Alternatives 2, 3, and 4 require the adoption of either Option 1, Option 2 or a combination of features from Options 1 and 2.

Since the Arctic FMP will initially prohibit commercial fishing in the Arctic, this requires the description of species to be managed in the FMP and how the Council would specify those management measures necessary for conservation and management of these species, and initially the justification for prohibiting commercial fishing. To that end, the NMFS Alaska Fisheries Science Center stock assessment scientists have assisted in developing the process of specifying conservation measures, as required by the MSA. These two methods are presented in detail in the draft Arctic FMP and analyzed in Chapter 4 of this EA/RIR/IRFA. Table 2-2 summarizes the options for structuring the conservation and management measures for the Arctic FMP. The stock assessment and harvest specifications process under either option would be conducted on a 3 year cycle unless new information indicates a shorter time period is appropriate.

2.4.1 Definition of Terms

To understand options 1 and 2, one needs to understand the terms used in the harvest specifications process. The following terms are definitions adopted by the Council for all fisheries in the U.S. EEZ off Alaska.

Maximum sustainable yield (MSY) is the largest long-term average catch or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions.

Optimum yield (OY) is the amount of fish which–

a) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;

b) is prescribed as such on the basis of the MSY from the fishery, as reduced by any relevant economic, social, or ecological factor; and

c) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the MSY in such fishery.

Overfishing level (OFL) is a limit reference point set for a stock or stock complex. Overfishing occurs whenever a stock or stock complex is subjected to a rate or level of fishing mortality that jeopardizes the capacity of a stock or stock complex to produce MSY on a continuing basis.

Minimum Stock Size Threshold (MSST) is a level of abundance that, if the stock fall below, the stock would be considered overfished.

Maximum Fishing Mortality Threshold (MFMT) is the rate of level of fishing that, if exceeded for a period of 1 year or more would constitute overfishing.

Acceptable biological catch (ABC) is an annual sustainable target harvest (or range of harvests) for a stock or stock complex, determined by a Plan Team and the Scientific and Statistical Committee during the assessment process. It is derived from the status and dynamics of the stock, environmental conditions, and other ecological factors, given the prevailing technological characteristics of the fishery. The target reference point is set below the limit reference point for overfishing.

Total allowable catch (TAC) is the annual harvest limit for a stock or stock complex, derived from the ABC by considering social and economic factors.

Annual Catch Limit (ACL) is the upper limit on the amount of catch that managers specify for a particular stock or complex in a year. It should be set at a level to ensure that overfishing does not occur, and based on the Scientific and Statistical Committee's fishing level recommendation.

Annual Catch Target (ACT) is a catch target that reflects the degree of management uncertainty in the fishery and can be set equal to or below the ACL.

Table 2-2 Summary of Options for Conservation and Management Measures

Option	Identification of FMP fisheries /species	Current FMP Fisheries	MSY	OY	Status Determination Criteria: MFMT	Status Determination Criteria: MSST	ACL	ACT
1	Creates an algorithm to identify FMP fisheries, which are fisheries with a non-negligible probability of developing as a significant commercial enterprise in the future.	Snow crab Arctic cod Saffron cod	Contains formula for setting MSY and specifies MSY values for the three FMP fisheries.	For the three FMP fisheries, provides methods to calculate OY from the MSY. OY is specified as *de minimis* catch to only allow for bycatch in subsistence fisheries for other species.	MFMT= F_{MSY} Specifies values for F_{MSY} for FMP fisheries.	MSST= B_{MSY} Specifies values for B_{MSY} for FMP fisheries.	ACL=OFL F_{OFL}=F_{MSY}	ACT=0
2	Creates 4 categories of FMP species, identifies species in each category, and creates a process for moving species from the ecosystem component (EC) category to the Target Species category.	None – all species are either in the prohibited species or EC species categories.	MSY not specified (or required) for EC species. Provides 3 approaches for a system-level MSY.	Not specified but would be developed for a Target Species in parallel with the definitions in the BSAI and GOA groundfish FMPs.	Prescribes a tier system for setting F_{OFL} and F_{ABC} for Target Species based on available information. Not applicable to EC or prohibited species.		Not specified but would be developed for a Target Species in parallel with the definitions in the BSAI and GOA groundfish FMPs.	Not specified but would be developed for a Target Species in parallel with the definitions in the BSAI and GOA groundfish FMPs.

2.4.2 Option 1 Conservation and Management Measures

Option 1 begins by identifying those fisheries with non-negligible probability of developing within the foreseeable future, and treats these as the fisheries that the plan is intended to manage. The fisheries for snow crab (*Chionoecetes opilio*), Arctic cod, and saffron cod are thereby identified as the subject of the FMP. If unanticipated fisheries develop in the future, Option 1would require that the FMP be amended to incorporate them. Option 1 specifies maximum sustainable yield (MSY), status determination criteria (both maximum fishing mortality threshold (MFMT) and minimum stock size threshold (MSST)), optimum yield (OY), annual catch limits (ACL), and annual catch target (ACT) for the three managed fisheries. The OY specification is the result of a series of analyses in which possible reductions from MSY are examined, considering a variety of socioeconomic factors such as uncertainty, non-consumptive value, and costs, and ecological factors such as protection of keystone species. The result of these analyses is that OY is specified for each of the three fisheries as an annual *de minimis* catch, sufficient only to account for bycatch in subsistence fisheries for other species. However, Option 1 also contains a provision to the effect that, if new scientific information becomes available suggesting that the conditions estimated or assumed in the process of making this specification are no longer valid, a new analysis should be conducted. Because OY is virtually zero for every fishery with a non-negligible probability of developing within the foreseeable future, Option 1 protects all species in the ecosystem, even though it applies to the fisheries for only three target species.

2.4.3 Option 2 Conservation and Management Measures

Option 2 begins by making species, rather than fisheries, the subject of the FMP. All species of Arctic finfish and marine invertebrates are included in the FMP. However, no fisheries are identified in the FMP. Instead, the species are included in the FMP by virtue of being members of an “ecosystem component” or a prohibited species category. Although Option 2 would not apply to any fisheries initially, this option contains a detailed procedure whereby the FMP could be amended to apply to one or more fisheries in the future.

The ecosystem component (EC) concept was introduced in the proposed rule for revising the National Standard 1 guidelines. According to the proposed rule (§600.310(d)(5)), EC species are not considered part of the fishery(ies) managed by an FMP, and they do not require specification of reference points such as MSY and OY, although a Council should consider measures to minimize bycatch thereof. Option 2 would not specify MSY, OY, ACLs, and ACTs for EC species or prohibited species. Under Option 2, these reference points would be developed in the future for a Target Species in parallel with the definitions in the BSAI and GOA groundfish FMPs. Option 2 prescribes a tier system for setting F_{OFL} and F_{ABC} for Target Species based on available information.

2.5 Alternatives considered but not evaluated

During the development of the alternatives for the proposed action, the Council considered several different measures. This section provides a summary of the measures that did not receive detailed analysis because the Council judged each of them to be deficient, unwieldy, inappropriate, or did not accomplish the Council’s stated goals and objectives in the purpose and need statement. Each summary provides a brief explanation as to why the measure was eliminated from detailed study.

The Council could amend the Bering Sea/Aleutian Islands groundfish FMP so that its geographic coverage would extend northward to include the Chukchi and Beaufort Seas. This could take the form of including Statistical Area 400, the Chukchi Sea, in the amended BSAI FMP, and the Council could add a new Management Area for the Beaufort Sea and then develop regulations that would prohibit commercial fishing in these areas. Currently, the BSAI groundfish FMP does not include any areas north of Bering Strait. The Council determined that species other than groundfish occur in the Arctic EEZ, and thus amending a groundfish FMP may not create an appropriate vehicle for future Arctic fishery management. Also, the Council felt that this would be a more cumbersome process than creating a new multispecies FMP.

The Council also considered developing a policy document in the form of a Fishery Ecosystem Plan (FEP) that would acknowledge the unique habitat features and fishery resources of the area. The FEP would describe the area, describe current fisheries, identify known species and habitats, and identify current issues and research needs. The FEP could provide a mechanism for continued Council interactions with other stakeholders in the region. An FEP would tie together the various provisions of existing FMPs and examine the status quo in light of ongoing and new scientific research, pending resource development (e.g. oil and gas lease sales), and continued climate change, and based on this information the Council could state its policy to prohibit commercial fishing in the Arctic. However, the Council was advised that a FEP provides no legal management authority to the Council; only a Fishery Management Plan can do that, so the Council rejected pursuing a FEP.

Other options considered by the Council included development of a FMP that specifies that commercial fishing for only certain marine organisms would not be allowed (allowing other fisheries to occur). Currently, the king and Tanner crab FMP covers part of the Chukchi Sea, and the current Salmon FMP prohibits salmon fishing in Arctic EEZ waters. The Council considered that it could expressly determine that other kinds of fishing not part of existing FMPs could be prohibited, such as fishing for krill. The Council felt that this too was a cumbersome mechanism and could be misunderstood by the public, particularly since this option could result in a situation where a crab FMP would cover crab fishing in parts of the Arctic, and another FMP would cover other species and other portions of the Arctic.

The Council also considered deferring to the State of Alaska the authority to prohibit commercial fishing in the Arctic. While under status quo the State effectively has already done this for state-licensed vessels, the Council could specifically adopt a FMP that defers to the State the authority to close the Arctic to commercial fishing. This was judged by the Council to also be a cumbersome and potentially confusing way to accomplish its goal, and it would leave open the possibility of unregulated fishing by vessels not registered with the State (see next paragraph).

The Council also considered an interim measure to close a potential "loophole" that would allow vessels not registered with the State to fish in Arctic waters off Alaska. The Council may find that it is a legitimate interest of the State of Alaska in the conservation and management of Arctic commercial fisheries to manage these unregistered fishing vessels. Currently, as described above, the State has already closed the Arctic EEZ to commercial fishing, but this applies to vessels registered under the laws of the State of Alaska (cf Alaska Statute (AS) 16.05.475). Conceivably, unregistered vessels could commercially fish in Arctic EEZ waters.[4] However, the Council decided not to pursue such an action at its June 2008 meeting, since the Council intended the Arctic FMP would be the governing authority over all vessels that may wish to fish in Arctic EEZ waters. Thus, this would be an interim step by a Council action that would be considered a "finding" under MSA Section 306(a)(3)(C).

[4] Registration under the laws of the State of Alaska is described in Alaska Statutes Title 16.05.475 and other passages that further describe the registration responsibility, including vessel licensing.

Also, NMFS could presumably authorize a fishery in Arctic EEZ waters by emergency rule if the Council and the agency determine that an emergency situation exists. This authority will continue to exist under an Arctic FMP and, thus, the Council did not further pursue such an option.

The Council considered an option to authorize under the Arctic FMP a red king crab fishery from Bering Strait northward to the latitude of Point Hope. Under this option, the Arctic FMP would establish certain authorities for management of a crab fishery in the Arctic that would be deferred to the State. However, deferring some aspects of fisheries management to the State would require that all of the MSA measures mandated be in an FMP (overfishing levels, bycatch measures, EFH descriptions, etc.). These measures are currently in the BSAI crab FMP. This would create unnecessary redundancy between the Arctic FMP and the BSAI crab FMP.

And the Council considered adopting an FMP that would only partially cover the Arctic EEZ off Alaska. Closing less than the entire Arctic Management Area might be a little less complicated, and thus this might be an alternative worth pursuing – the logic being: a smaller area would be included in the FMP, thus there would be less complexity to the analysis. However, there is no appropriate, scientifically-defensible, and manageable way to delineate only a portion of the Arctic to consider as part of a new FMP; and there is no realistic way to determine, if the FMP were to contain only a portion of the Arctic, which portion that would be. For example, the Council could consider an option for closing to commercial fishing only the Chukchi Sea since it is closest to the northern Bering Sea, and it might "feel" the initial effects of climate warming and loss of sea ice first, and thus might receive the first pressure for a fishery opening; in this option, only the Chukchi Sea, then, would be part of the Arctic FMP. However, there is no physical boundary between the Chukchi and Beaufort Seas, so where to draw the line is problematic. Further, species of fish inhabiting the Chukchi Sea also inhabit the Beaufort Sea, so there may be no meaningful biological reason to do so. This alternative, therefore, was not given further analysis effort. It was judged to be very much more difficult to specify and define, and to analyze, and would not accomplish the MSA goals for managing and conserving species; rather, it would complicate and make difficult that requirement by injecting unnecessary uncertainty to the process. The Council judges that this alternative was inappropriate for further analysis, as it didn't meet the Council's objectives in its purpose and need statement, and thus was rejected and not analyzed further.

Chapter 3 Affected Environment

This chapter provides an overview of the information sources on the Arctic and a description of the reasonable foreseeable future actions that may change how the Arctic FMP impacts the resource components identified in Chapters 4 through 8. Relevant and recent information on each of the resource components analyzed in this EA is contained in the chapter addressing that resource component and is not repeated in this chapter.

3.1 Information Sources on the Arctic

This EA/RIR/IRFA is not intended to be an exhaustive review of available knowledge of the Alaskan Arctic marine ecosystem. Rather, it reviews many of the relevant and available reports and documents on the Arctic region and its resources, and includes additional information from web sites, poster papers, and presentations at recent scientific symposia.

The Arctic region has attracted considerable attention in the past 5-10 years, and 2007-2008 has been designated an International Polar Year, during which the many research efforts are being undertaken throughout the circumpolar north to improve knowledge of this region. In the face of a possibly warming climate and the changes this may bring to the Arctic region, many research programs have been initiated, the results from which are yet to be reported, or are works in progress, and cannot all be summarized here. Some of these newer or Arctic-related programs include the following (most of which has been excerpted from program web sites):

International Polar Year. The International Polar Year (IPY) is a large scientific program focused on the Arctic and the Antarctic extending from March 2007 to March 2009. IPY, organized through the International Council for Science (ICSU) and the World Meteorological Organization (WMO), is actually the fourth polar year, following those in 1882-3, 1932-3, and 1957-8. In order to have full and equal coverage of both the Arctic and the Antarctic, IPY 2007-8 covers two full annual cycles from March 2007 to March 2009 and will involve over 200 projects, with thousands of scientists from over 60 nations examining a wide range of physical, biological and social research topics. The IPY involves scientists working together to understand why the poles are changing so rapidly through research at remote polar regions. [www.ipy.org]

National Academy of Science, Polar Research Board (PRB). The PRB provides independent analysis to the federal government and the nation on matters of science and technology research needs, environmental quality, natural resources, and other issues in the Arctic, the Antarctic, and cold regions in general. [www.nsf.gov]

Scott Polar Research Institute. The Institute is a long-established center for research into both polar regions. It is part of the University of Cambridge and has several groups investigating a wide range of issues in environmental and social sciences of relevance to the Arctic. The Institute houses comprehensive holdings of scholarly books and journals on polar research, archival collections from the exploration of the Arctic, and online bibliographic and other informational resources. Staff and students provide a core of intellectual activity focused on the Arctic and Antarctic and their adjacent seas. [www.spri.cam.ac.uk]

Polar Science Center (PSC). The PSC is part of the Applied Physics Laboratory, University of Washington, established in 1978 as the Arctic Ice Dynamics Joint Experiment program ended. PSC researchers observe and model the physical processes that control the nature and distribution of sea ice and polar ice sheets, the structure and movement of high-latitude oceans, and the interactions between air, sea, ice and biota. The Center has made major contributions to the understanding of how the arctic system has undergone important changes during the past four decades. [www.psc.apl.washington.edu]

Cold Regions Research and Engineering Laboratory (CRREL). CRREL is a research facility of the U.S. Army Corps of Engineers established to solve interdisciplinary, strategically important problems of the US Army Corps of Engineers, Army, DOD, and the Nation by advancing and applying science and engineering to complex environments, materials, and processes in all seasons and climates, with unique core competencies related to the Earth's cold regions. [www.crrel.usace.army.mil]

The North Pacific Marine Science Organization (PICES). PICES was established in 1992 to promote and coordinate marine research in the northern North Pacific and adjacent seas. Member countries are the U.S., Canada, Japan, People's Republic of China, the Russian Federation, and the Republic of Korea. While most of the research conducted and coordinated by PICES is focused on the North Pacific Ocean ecosystem, including the Bering Sea, some work extends into subarctic and arctic environments. PICES and Global Ocean Ecosystem Dynamics (GLOBEC) jointly sponsored a workshop to compare four sub-arctic marine ecosystems, those of the Okhotsk Sea/Oyashio region, the Bering Sea, the Newfoundland/Labrador Shelf and the Barents Sea. The workshop was held in St. Petersburg, Russia, from June 12-14, 2006, and provided a foundation for the GLOBEC regional program, Ecosystem Studies of Sub-Arctic Seas (ESSAS) (www.globec.org/structure/regional/essas/essas.htm). [www.pices.int]

Arctic Council. The Ottawa Declaration of 1996 formally established the Arctic Council as a high level intergovernmental forum to provide a means for promoting cooperation, coordination, and interaction among the Arctic States, with the involvement of the Arctic Indigenous communities and other Arctic inhabitants on common Arctic issues, in particular issues of sustainable development and environmental protection in the Arctic. Member States of the Arctic Council are Canada, Denmark (including Greenland and the Faroe Islands), Finland, Iceland, Norway, Russian Federation, Sweden, and the U.S. The category of Permanent Participation is created to provide for active participation of, and full consultation with, the Arctic Indigenous representatives within the Arctic Council. This principle applies to all meetings and activities of the Arctic Council.

The following organizations are Permanent Participants of the Arctic Council:

- Aleut International Association (AIA)
- Arctic Athabaskan Council (AAC)
- Gwich'in Council International (GCI)
- Inuit Circumpolar Council (ICC)
- Saami Council
- Russian Arctic Indigenous Peoples of the North (RAIPON)

The Arctic Council's Protection of the Arctic Marine Environment Working Group (PAME) directs its activities towards protection of the Arctic marine environment. Increased economic activity and significant changes due to climatic processes are resulting in increased use of and opportunities and threats to the Arctic marine and coastal environments. Predicted changes require more integrated approaches to address both existing and emerging challenges of the Arctic marine and coastal environments. PAME's mandate is to address policy and non-emergency pollution prevention and control measures related to the protection of the Arctic marine environment from both land and sea-based activities. One of PAME's studies is the Arctic Marine Shipping Assessment (AMSA). The assessment is intended to provide a baseline report of shipping activity in the Arctic for 2004, potential scenarios concerning Arctic shipping for 2020 and 2050, as well as other critical information. This study examines potential effects of trans-polar shipping, much of which could pass through Bering Strait, if climate warming continues and more ice-free shipping lanes open. Staff from the North Pacific Fishery Management Council are assisting with the preparation of the AMSA report which is due to be presented to the Arctic Council in 2009. Other Arctic Council working groups include the Arctic Contaminants Action Program; Arctic Monitoring and Assessment Program; Conservation of Arctic Flora and Fauna; Emergency Prevention, Preparedness and Response; and Sustainable Development. [www.arctic-council.org/]

Russian-American Long-term Assessment of the Arctic. RUSALCA started with an expedition to the Bering and Chukchi Seas (Arctic Ocean) conducted in 2004. This initial cruise was a collaborative U.S – Russian Federation oceanographic expedition to the Arctic seas regions shared by both countries. These seas and the life within are thought to be particularly sensitive to global climate change because they are centers where steep thermohaline and nutrient gradients in the ocean coincide with steep thermal gradients in the atmosphere. Bering Strait acts as the only Pacific gateway into and out of the Arctic Ocean and as such is critical for the flux of heat between the Arctic and the rest of the world. Monitoring the flux of fresh and salt water as well as establishing benchmark information about the distribution and migration patterns of the life in these seas are also critical pieces of information needed prior to the placement of a climate-monitoring network in this region. An additional cruise is proposed for 2009. [www.arctic.noaa.gov/aro/russian-american]

North Pacific Research Board (NPRB). NPRB was created by Congress to conduct research activities on or relating to the fisheries and marine ecosystems of the North Pacific Ocean, including the Bering Sea and Arctic Ocean, with priority on cooperative research efforts addressing pressing fishery management or marine ecosystem information needs. Research proposals may be funded by NPRB to address these issues, including proposals for research in the Alaskan Arctic. NPRB's programs include some Arctic ecosystem research projects. NPRB's Bering Sea Integrated Ecosystem Research Program (BSIERP) is a partnership with the National Science Foundation's Bering Ecosystem Study (BEST) to comprehensively study the eastern Bering Sea through a series of project conducted over the period 2007-2012. Seventy federal, state and university scientists will study a range of issues in the Bering Sea ecosystem, from atmospheric forcing and physical oceanography to humans and communities, including the attendant economic and social impacts of a changing ecosystem. Some projects will occur in the northern portions of the eastern Bering Sea to Bering Strait. [www.nprb.org]

National Science Foundation, Office of Polar Programs (OPP). NSF's OPP includes the Division of Arctic Sciences which supports scientific research in the Arctic, related research, and operational support. Science programs include disciplinary, multidisciplinary, and broad, interdisciplinary investigations directed toward both the Arctic as a region of special scientific interest and a region important to global systems. Disciplinary interests encompass the atmospheric, biological, physical, earth, ocean, and social sciences. The Arctic System Science Program provides opportunities for interdisciplinary investigations of the Arctic as a system. OPP also encourages research relevant to both polar regions, especially glaciology, permafrost, sea ice, oceanography, ecology, and aeronomy. NSF also chairs the U.S. Interagency Arctic Research Policy Committee (IARPC) which consists of fifteen-plus agencies, departments, and offices across the Federal government. The IARPC was established by Congress through the Arctic Research and Policy Act. NSF also supports other Arctic-related initiatives and programs including the Alaska Native Knowledge Network (ANKN), Alaska Native Science Commission (ANSC), several Arctic-related research sites such as Toolik Lake and the Arctic Long Term Ecological Research (ALTER) site, the Arctic System Science (ARCSS) Program, the North Pole Environmental Observatory, and the Arctic Observing Network and its Cooperative Arctic Data and Information Service.
[www.nsf.gov/dir/index.jsp?org=OPP]

National Snow and Ice Data Center (NSIDC). The NSIDC is part of the Cooperative Institute for Research in Environmental Sciences at the University of Colorado at Boulder. NSIDC supports research into our world's frozen realms: the snow, ice, glaciers, frozen ground, and climate interactions that make up Earth's cryosphere. Scientific data, whether taken in the field or relayed from satellites orbiting Earth, form the foundation for the scientific research that informs the world about the earth and its climate systems. NSIDC manages and distributes scientific data, creates tools for data access, supports data users, performs scientific research, and educates the public about the cryosphere. The University of Colorado also hosts the Institute of Arctic and Alpine Research (INSTAAR) which conducts research, education, and outreach related to earth sciences and global change in Arctic environments. [www.nsidc.org]

International Arctic Science Committee, Pacific Arctic Group. The Pacific Arctic Group (PAG) has as its mission to serve as a Pacific Arctic regional partnership to plan, coordinate, and collaborate on science activities of mutual interest. PAG is a group of institutes and individuals with a Pacific perspective on Arctic Science. PAG's science focus is on ten main themes of research on Arctic ecosystem processes: ocean observations, oceanic and atmospheric processes, freshwater input and sea ice melt, ecosystem and biological indicators, sea ice thermodynamics, Atlantic inflow to the Pacific sector, Arctic seafloor mapping, Pacific water inflow through Bering Strait, nearshore coastal processes and subsea permafrost dynamics, and the paleorecord of prior climatic processes. [www.arcticportal.org/iasc]

Arctic Research Commission. The U.S. Arctic Research Commission (ARC) was established by the Arctic Research and Policy Act of 1984 (as amended, Public Law 101-609). The Commission's principal duties are (1) to establish the national policy, priorities, and goals necessary to construct a federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences; (2) to promote Arctic research, to recommend Arctic research policy, and to communicate our research and policy recommendations to the President and the Congress; (3) to work with the National Science Foundation as the lead agency responsible for implementing the Arctic research policy and to support cooperation and collaboration throughout the Federal Government; (4) to give guidance to the Interagency Arctic Research Policy Committee (IARPC) to develop national Arctic research projects and a five-year plan to implement those projects; and (5) to interact with Arctic residents, international Arctic research programs and organizations and local institutions including regional governments in order to obtain the broadest possible view of Arctic research needs. [www.arctic.gov]

Arctic Climate Impact Assessment. The Arctic Climate Impact Assessment (ACIA) is an international project of the Arctic Council and the International Arctic Science Committee (IASC) to evaluate and synthesize knowledge on climate variability, climate change, and increased ultraviolet radiation and their consequences. The results of the assessment were released at the ACIA International Scientific Symposium held in Reykjavik, Iceland in November 2004. The report "Impacts of a warming climate" has been widely referenced as a current statement of the effects of warming trends in the Arctic region on the Arctic environment. [www.acia.uaf.edu]

Arctic Research Consortium of the United States (ARCUS). ARCUS was formed in 1988 to identify and bring together the distributed human and facilities resources of the Arctic research community to create a synergy for the Arctic in which each resource, when combined with others, can result in a strength that enables the community to rise to the many challenges facing the Arctic and the United States. ARCUS provides a mechanism for the Arctic community to complement the advisory roles of other national organizations, such as the US Arctic Research Commission (USARC), the Polar Research Board (PRB), and Interagency Arctic Research Policy Committee (IARPC), which are concerned with the Arctic. ARCUS is a non-profit corporation consisting of institutions organized and operated for educational, professional, or scientific purposes, and is based in Fairbanks, Alaska. ARCUS seeks to 1) serve as a forum for planning, facilitating, coordinating, and implementing disciplinary and interdisciplinary studies of the Arctic; 2) act as a synthesizer and disseminator of scientific information relevant to state, national, and international programs of arctic research; and 3) encourage and facilitate the education of scientists and the public in the needs and opportunities of research in the Arctic. ARCUS publishes the series "Witness the Arctic", a twice-yearly newsletter providing information on current arctic research efforts and finds, significant research initiatives, national policy affecting Arctic research, international activities, and profiles of institutions with major arctic research efforts. [www.arcus.org]

Barrow Arctic Science Consortium (BASC). BASC is a not-for-profit organization based in Barrow, Alaska that is dedicated to the encouragement of research and educational activities pertaining to Alaska's North Slope and the adjacent portions of the Arctic Ocean. BASC was organized in 1995 as a way for three local organizations and other interested persons to work together in support of arctic science. The three Barrow based organizations contributing to the formation and support of BASC are: the North Slope Borough (the regional government for Alaska's North Slope), the Ukpeagvik Iñupiat Corporation (a corporation owned by the Native people of Barrow, founded under authority of the Alaska Native Claims Settlement Act), and Ilisagvik College (the local center for post-secondary education). BASC objectives are: to encourage research and educational activities pertaining to Alaska's North Slope and adjacent portions of the Arctic Ocean, to manage the Barrow Environmental Observatory (BEO) in a manner that will encourage its use by scientists, educators and others interested in better understanding natural processes in the Arctic, to assist scientists in establishing and conducting research projects in the BEO and surrounding terrestrial and marine areas, and to facilitate the two way transfer of information between scientists and the people of Alaska's North Slope. [www.arcticscience.org]

Smithsonian Institution, Arctic Studies Center (ASC). The Smithsonian's ASC was established in 1988 as a U.S. government program with a special focus on northern cultural research and education. In keeping with this mandate, the Arctic Studies Center specifically studies northern peoples, exploring history, archaeology, social change and human lifeways across the circumpolar world. All Arctic Studies Center programs and exhibits are co-designed with universities, northern communities and government and non-profit agencies to realize diverse scientific and educational goals. One important partnership with the Anchorage Museum of History and Art resulted in the opening of an ASC office in Anchorage, Alaska in 1994. [www.mnh.si.edu/arctic/]

National Oceanic and Atmospheric Administration, Arctic Research Program. NOAA's Arctic Research Office serves as a focal point for NOAA's research activities in the Arctic, Bering Sea, North Pacific and North Atlantic regions. The office manages the Arctic Research Initiative and other funds allocated to it, supporting both internal NOAA and extramural research. It represents NOAA on the Interagency Arctic Research Policy Committee, leads U.S. involvement in the Arctic Monitoring and Assessment Program, and provides a point of contact between NOAA and the Cooperative Institute for Arctic Research and the International Arctic Research Center at the University of Alaska Fairbanks. The Arctic Research Office is a component of NOAA's Office of Oceanic and Atmospheric Research. It has started publishing annual reports, for example "Arctic Report Card 2007," which provide status reports on the Arctic environment. [www.arctic.noaa.gov/aro/]

National Marine Fisheries Service, National Marine Mammal Laboratory (NMML). NMML has established a Polar Ecosystems Program that conducts research and monitoring on pinnipeds in the Arctic, sub-Arctic, and Antarctic marine ecosystems. The research projects focus primarily on abundance, trends, distribution, and foraging behavior of harbor, bearded, ringed, spotted, and ribbon seals in Alaska. The primary objectives of the program are to support management and assessment of population status under the Marine Mammal Protection Act, and to gain a better understanding of the factors responsible for the dynamics of populations and their roles in the ecosystem. [www.afsc.noaa.gov/nmml/polar/]

National Oceanic and Atmospheric Administration, Study of Environmental Arctic Change (SEARCH). The NOAA Atmospheric Observatory program is establishing long-term, intensive measurements of clouds, radiation, aerosols, surface energy fluxes and chemistry in Eureka/Alert Canada and Tiksi, Russia.

These measurements will allow comparison with similar observatory measurements in Barrow, Alaska. The three sites in combination encompass 3 different major Arctic climate regimes. The locations and measurement suite has been carefully designed so that the collected data can be used to determine the mechanisms that drive climate change through a combination of process studies, satellite validation and modeling work. It is anticipated that the Atmospheric Observatory sites will also be the focus of a number of interdisciplinary measurements of regional hydrology, permafrost, ecosystems and the cryosphere that will link the atmospheric measurements into the broader Arctic system. The program is heavily leveraged against Canadian and Russian programs, and has a vigorous interagency cooperation with NSF and DOE. [www.arctic.noaa.gov/search/]

NOAA Beaufort Sea Marine Fish Survey: A marine fish survey was conducted in August 6-22, 2008 in a portion of the Beaufort Sea (Figure 3-1). The description of the project and updates are available from the AFSC website at http://www.afsc.noaa.gov/REFM/Stocks/fit/Beaufort.php. Three major institutions conducting marine research in Alaska collaborated on this study: Alaska Fisheries Science Center; Institute of Marine Science, University of Alaska Fairbanks; and School of Aquatic and Fishery Sciences, University of Washington. The Minerals Management Service funded this study. The distribution and abundance of fish was assessed by bottom trawl and acoustic surveys. The distribution of zooplankton was sampled with bongo nets and oceanographic properties were measured with conductivity-temperature-depth probes.

This study had 3 principal objectives:

1) Quantify the distribution and abundance of benthic and pelagic fish;
2) Quantify the characteristics of the marine habitats occupied by benthic and pelagic fish;
3) Recommend methods for future monitoring.

Bottom trawl survey: The distribution and abundance of adult and juvenile demersal fish and their dominant benthic invertebrate prey in offshore habitats (20 m to the shelf break) was assessed with a 83-112 eastern otter trawl, the standard for AFSC bottom trawl surveys of the Bering Sea shelf. AFSC standard survey methods were followed including maintaining a constant vessel speed and tow duration; and monitoring of vertical and horizontal net openings with net sounders. A stratified sampling plan was employed with survey effort distributed among three strata defined by water depth: 20 – 50 m, 50 – 100 m, and 100 m – 500 m, which correspond to documented changes in water masses in the Beaufort Sea that are likely to affect the distribution of fish and their prey.

Acoustic survey: The distribution and abundance of pelagic fish was assessed using acoustic methods but limited to times and areas that did not conflict with subsistence whaling operations. Adult and juvenile fish were surveyed with echo integration trawl (EIT) survey methods similar to those used during other routine AFSC acoustic surveys. 5 parallel transects oriented inshore to offshore from the 20m to the 500m isobath were surveyed. The transects were 30 nmi long and spaced 15 nmi apart. Midwater trawl hauls were conducted when and where significant amounts of fish were detected by the acoustic system to determine the species composition and to collect other biological information from the sound reflecting layers (a.k.a. “backscattering”).

Oceanography: Concurrent physical, chemical and biological data were collected to assess water column properties and the food fields upon which the fish depend. The water column properties include the distribution of water mass types defined by temperature, salinity and density profiles, and the flow fields setting the boundaries and distribution of the water masses. The physical information was provided by CTD (conductivity – temperature – depth) measurements. Plankton tows completed in conjunction with the CTD measurements collected the samples needed to quantify the species composition, abundance and biomass of the zooplankton available to the fish. The food fields available to the benthic fish were assessed by sampling the invertebrates taken during the bottom trawls. The shipboard physical oceanographic sampling and zooplankton sampling took place along 3 of the 10 cross-shelf acoustic transects described above.

Biological sampling: Researchers collected and processed archival biological samples. Fish otoliths and stomachs were collected and stored for later laboratory analysis at AFSC, pending the availability of future funding. Fish and benthic invertebrate samples were also collected and provided to collaborating scientists from other programs for analyses such as proximate composition, fatty acid composition, contaminants, and genetics.

[www.afsc.noaa.gov/REFM/Stocks/fit/Beaufort.php]

Alaska Ocean Observing System. As part of its mission to develop an integrated ocean observing system for Alaska and the Arctic, the Alaska Ocean Observing System (AOOS) considers sea ice observations to be a key component of an Alaska observing system for the Arctic (Chukchi and Beaufort Seas), Bering Sea, and Cook Inlet in order to meet stakeholder and resource management needs. In 2006, AOOS and the U.S. Arctic Research Commission (USARC) established a Sea Ice Working Group (SIWG) to develop strategies for furthering knowledge of coastal sea ice in Alaska. The SIWG will assess the status of past and current sea ice data for Alaska, identify data gaps, and provide recommendations to AOOS and the USARC. [www.aoos.org]

The Sea Around Us Project. The Sea Around Us Project, started in 1999, investigates the impact of fisheries on the world's marine ecosystems. According to their web site, this is achieved by using a Geographic Information System (GIS) to map global fisheries catches from 1950 to the present, under explicit consideration of major critical habitats of fish, marine invertebrates, marine mammals and other components of marine biodiversity. The data presented, which are freely available, are meant to support studies of global fisheries trends and the development of sustainable, ecosystem-based fisheries policies. The Sea Around Us Project is a Fisheries Centre partnership between the University of British Columbia’s Fisheries Centre and Philadelphia's Pew Charitable Trusts. Data available at this site are organized according to Large Marine Ecosystem units which include the Chukchi and Beaufort Seas and the Arctic Ocean. [http://www.seaaroundus.org/default.htm]

National Academy of Sciences, Global Climate Change Study and Summit. In response to Public Law 110-161, the National Academies will conduct a series of coordinated activities to study the serious and sweeping issues associated with global climate change, including the science and technology challenges involved, and provide advice on the most effective steps and most promising strategies that can be taken to respond. This work will be led by a Climate Change Study Committee responsible for coordinating the work of four panels, convening a Summit on Global Climate Change, convening additional workshops as needed, and writing a final report. Collectively, the activities will produce a broad, action-oriented, and authoritative set of analyses to informn and guide responses to climate change across the nation. The study and summit are funded at $5.8 million.

[http://dels.nas.edu/basc/climate-change/cc_study_menu.shtml]

Arctic Fish Catalog. The U.S. Geological Survey and Minerals Management Service are preparing a catalog of arctic fishes in the Beaufort and Chukchi Seas, including species accounts, a synthesis of ecological information, and an identification of information needs, particularly as related to offshore oil and gas development. [http://biology.usgs.gov/wro/]

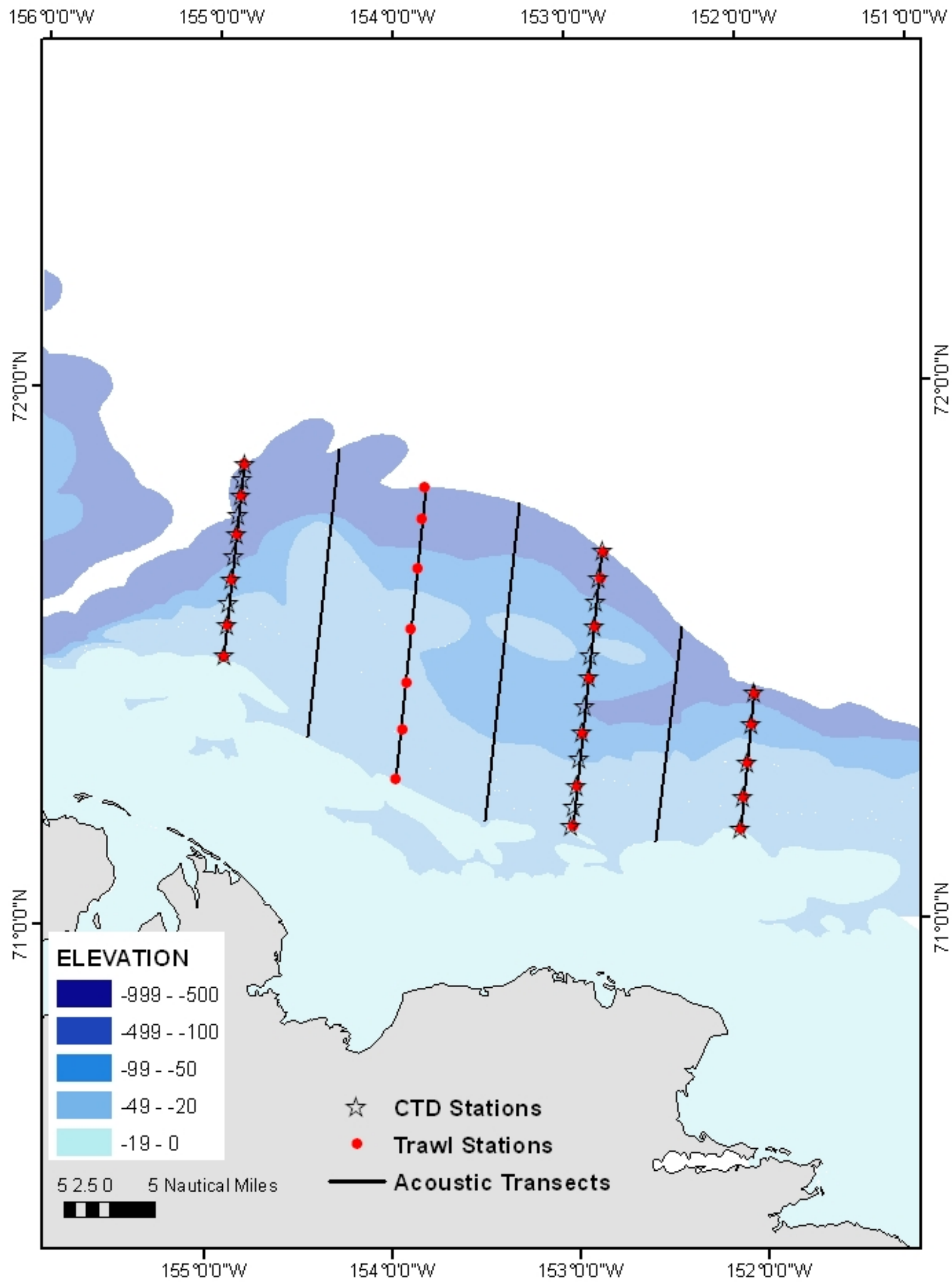

Figure 3-1 Planned locations of bottom trawls, CTD (and zooplankton tows) and acoustic transects in the Beaufort Sea. Actual station locations varied somewhat from those shown.

3.2 Cumulative Actions in the Arctic Management Area

This section lists cumulative actions, including past, present, and reasonably foreseeable actions that may affect the Arctic Management Area and the cumulative impacts of the action on various components of the environment. This list is provided here to allow for detailed description of the cumulative action that may affect more than one environmental component. In subsequents chapters, cumulative impacts will be specifically analyzed under each environmental component with reference to this section of the details of the actions that apply to that component. The actions in the list have been grouped in the following categories:

- Oil, gas, and mineral development
- Transportation and shipping
- Introduction of invasive species
- Changing infrastructure demands
- Subsistence
- Commercial whaling
- Scientific research
- Actions by other Federal, State, and international agencies

Table 3-1 summarizes the past, present and reasonably foreseeable "actions" identified in this analysis that are likely to have an impact on a resource component within the action area and timeframe. These actions may occur in both the federal waters of the Arctic EEZ off of Alaska, as well as State of Alaska marine waters. Actions are understood to be human actions (e.g., oil and gas lease sales), as distinguished from natural events (e.g., an ecological regime shift).

CEQ regulations require a consideration of actions, whether taken by a government or by private persons that are reasonably foreseeable. This is interpreted as indicating actions that are more than merely possible or speculative. Actions have been considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation, publication of a proposed rule, or a decision by a corporate board of directors to take an action. Actions simply "under consideration" have not generally been included because they may change substantially or may not be adopted, and so cannot be reasonably described, predicted, or foreseen.

Identification of actions likely to impact a resource component within this action's area and time frame will allow the public and Council to make a reasoned choice among alternatives.

Table 3-1 **Past , Present, and Reasonably foreseeable future actions**

Oil, gas, and mineral development	• Lease sales, seismic exploration, and exploratory drilling • Chuckchi Sea routine exploration • Beaufort Sea routine exploration • Other mineral development • Introduction of invasive species
Transportation and shipping	• Seasonal tug, barge, freight transport supporting local development • New polar shipping routes • Introduction of invasive species
Changing infrastructure demands	• Infrastructure changes in response to melting permafrost, increases in flooding, and coastal erosion
Subsistence and Commercial Harvests	• Subsistence – bowheads, beluga, seals, fish, birds • Past commercial whaling
Scientific research	• Icebreakers • Seasonal surveys • Marine mammal research
Actions by other federal, state, and international agencies	• US Coast Guard activities • Expansion and construction of boat harbors • Tourism

These actions are described in this stand-alone section because they may affect more than one environmental component and the potential interest of the forecasts. The discussions relevant to each resource component have been included in each chapter, first to provide the reader with an understanding of the changes in the impacts of the alternatives on each resource component when we take into account the reasonably foreseeable future actions; second to help each chapter stand alone as a self-contained analysis, for the convenience of the reader; and finally to ensure that the threads of each discussion for each resource component remain distinct and do not become confused.

Oil, gas, and mineral development

Lease sales

The Minerals Management Agency (MMS) is the federal agency responsible for overseeing oil and gas development in the EEZ of the Beaufort and Chukchi Seas. The MMS currently has about 2,100 square miles under lease in the Beaufort Sea, and about 4,300 square miles in the Chukchi Sea. The most recent lease sale, Chukchi Sea Lease Sale 193 was held on February 6, 2008. The sale was record breaking with 667 bids on 488 blocks and bringing in $2.6 billion in high bids. This was the third lease sale the MMS has held in the Chukchi Sea. All leases from the previous two sales have expired. (MMS, web site).

The current MMS schedule for future lease sales in the Chukchi and Beaufort Seas calls for four additional sales: (1) Beaufort Sea Sale 209 in 2009; (2) Chukchi Sea Sale 212 in 2010; (3) Beaufort Sea Sale 217 in 2011; and (4) Chukchi Sea Sale 221 in 2012. The MMS plans to prepare a single EIS to cover all four sales. Scoping for this has taken place, and a scoping report has been published. (MMS web site, "Arctic Multiple Lease Sales," available at http://www.mms.gov/alaska/cproject/ArcticMultiSale/ArcticMultiiindex.htm, (last visited on August 22, 2008)).

Sales of leases are only part of a longer process that may lead to oil and gas development. An MMS schematic of the overall development process is shown in Figure 3-2.

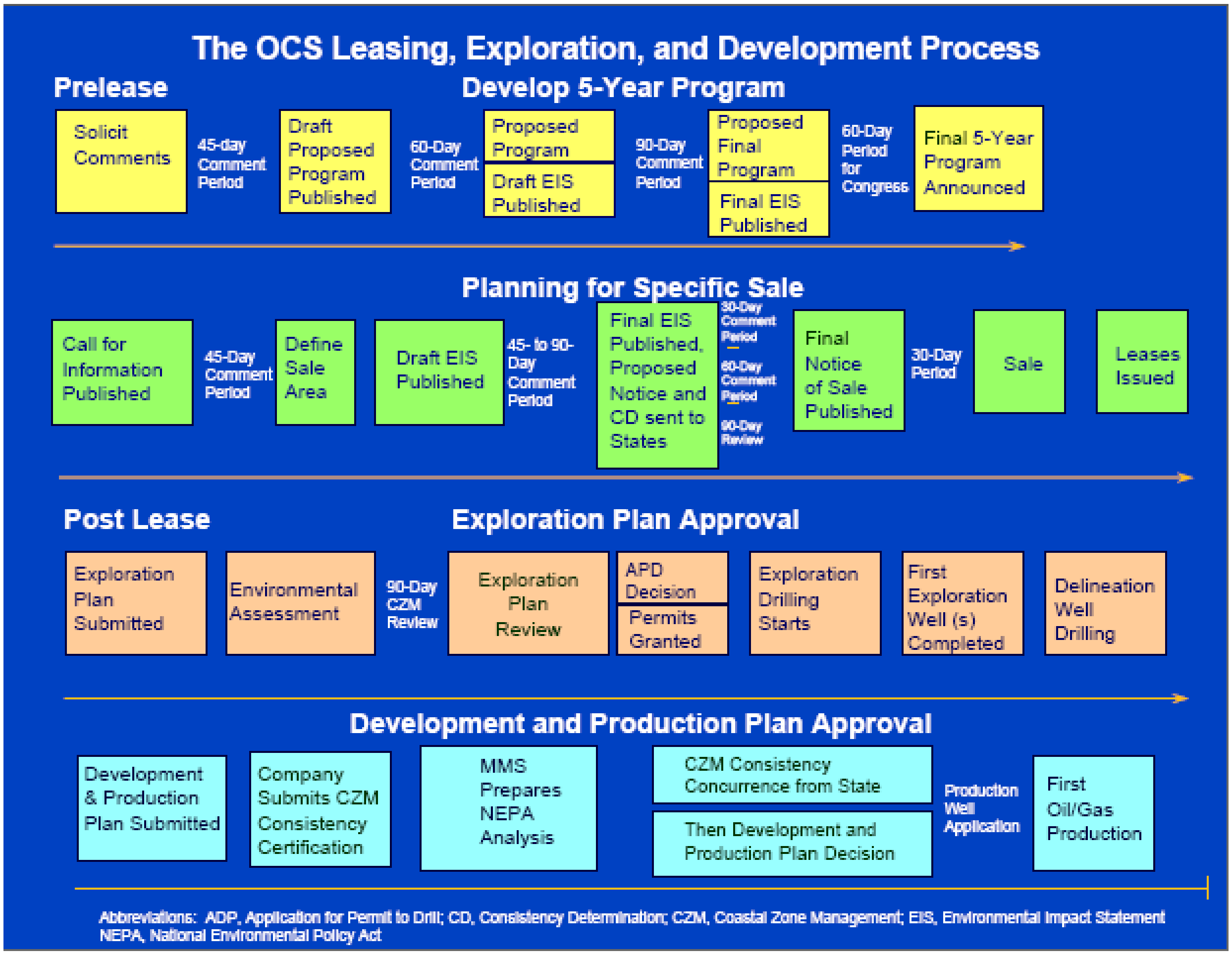

Figure 3-2 Minerals Management Service Outer Continental Shelf Leasing, Exploration and Development Process. (Source: Minerals Management Service Alaska Region web site:

http://www.mms.gov/alaska/allsteps092005.pdf)

A successful bidder obtains the rights to explore and develop oil and gas resources on the lease for a period of 10 years. At the end of the period, if the firm can show efforts to develop oil and gas resources, the lease can be extended. Lessees bid for the leases, pay minimal rental payments prior to development, and pay royalties following development. Lessees must follow all laws, including NEPA. The Minerals Management Service retains the right to impose additional environmental conditions on the operation of a lease if this becomes important (King).[5]

Development takes a significant amount of time. Following the discovery of oil or gas, it can easily take 10 years to bring a lease into production. Actual efforts to do so will depend on projections of oil and gas prices, the productivity of the lease as determined during exploration, the cost of production and distribution, which depend on the nature of the oil and gas found on the lease, and other developments, such as factors affecting the availability of transportation infrastructure.

[5] King, Fred. Minerals Management Service, Anchorage Alaska. Personal communication on August 24, 2008.

What happens after a lease sale[6]

The development process may go through several stages:

- Leasing and exploration includes seismic geophysical surveys, high-resolution and shallow hazard surveys, exploratory drilling using various platforms, and boat and aircraft activity;
- Development, production, and transportation includes drilling from artificial islands, drilling platforms or drill ships, pipeline development, and tinkering;
- Abandonment includes rig demobilization, platform removal, and site restoration.

Offshore petroleum exploration, development, and production activities have been conducted in Alaska State waters or on the Alaska OCS in the Beaufort and Chukchi seas as a result of previous lease sales since 1979. Extensive 2D seismic surveying has occurred in both program areas. MMS-permitted seismic surveys have been conducted in the Chukchi and Beaufort seas since the late 1960s and early 1970s. Much more seismic activity has occurred in the Beaufort Sea OCS than in the Chukchi Sea OCS. The 2D marine seismic surveys in the Beaufort Sea began with two exploration geophysical permits issued in 1968 and four in 1969.

Marine seismic operations use high-energy airguns to produce a burst of underwater sound from the release of compressed air, which forms a bubble that rapidly expands and then contracts. Typically, seismic sources used in such surveys involve the rapid release of compressed air to produce an impulsive signal that is directed downward through the seabed. Thus, the source for the sound is called an airgun. (NMFS 2008c)

Seismic surveys can be done using either 2D or 3D techniques for examining the geology, with 3D providing a clearer image of the geologic features. Both over-ice (29 permits) and marine 2D (43 permits) seismic surveys were conducted in the 1970s. With one exception, all 80 marine and 43 over-ice surveys permitted in the Beaufort Sea OCS by MMS in the 1980s were 2D. In the Beaufort Sea, 23 MMS G&G permits were issued in 1982 (11 marine and 12 over-ice 2D surveys) and 24 MMS G&G permits were issued in 1983 (1, 3D over-ice survey; 14, 2D over-ice surveys; and 9 2D marine surveys). The first 3-D on-ice survey occurred in the Beaufort Sea OCS in 1983. In the 1990s, both 2D (2 on-ice and 21 marine) and 3D (11 over-ice and 7 marine OBC) seismic surveys were conducted in the Beaufort Sea. The first marine 3D seismic survey in the Beaufort Sea OCS occurred in 1996.

Thirty exploratory wells have been drilled in the federal Beaufort Sea waters over a 21 year period between 1981 and 2002. This drilling occurred from a variety of drilling platforms (e.g., gravel islands, SSDC, drillships, etc.) and during different seasons of the year, including the open water period. The last exploration well in the Beaufort Sea OCS was drilled in the winter of 2002 at the McCovey prospect.

Production in the Beaufort Sea EEZ is currently limited. The Northstar Development exploits some fedral waters, as well as State of Alaska waters. BP Alaska is in the process of pursuing the Liberty Project in federal Beaufort Sea waters east of Prudhoe Bay. Current plans call for accessing the project through directional drilling from a nearby existing gravel island (which will be increased in size).

Compared to the North Slope/Beaufort Sea, there has been little oil- and gas-related activity in the Chukchi Sea. There is no existing OCS offshore development or production in the Chukchi Sea. Outer Continental Shelf Lease Sale 193 (Chukchi Sea OCS planning area) was held on February 6, 2008. Sale 193 offered approximately 29 million acres for leasing, and bids were received for over 1,100,000 acres.

[6] This section is drawn, with minor changes, primarily from the NMFS biological opinion on oil and gas exploration in the Beaufort and Chukchi Seas (NMFS, 2008).

Five exploratory wells have been drilled in the Chukchi Sea from past lease sales, all using drillships. These wells were drilled between 1989 and 1991. The last Chukchi Sea well was drilled in 1991 at the Diamond Prospect. Recently several companies have conducted 2D/3D seismic work in the Chukchi, leading to Sale 193.

Environmental impacts

Considerable uncertainty exists regarding future discoveries, future costs and prices, and complementary developments (for example, a gas pipeline from the North Slope to Alberta). Moreover, long time periods are required to move from discovery to production on a lease, to deal with the controversy associated with offshore oil production, and to provide for additional permitting to bring a lease into production. Given these issues, this analysis focuses primarily on leasing and associated exploration activity as reasonably foreseeable future actions that are currently underway. There is some ongoing production activity from the Northstar field and in state waters, and development is underway and reasonably foreseeable on the Liberty field in federal waters. As noted below, leasing, exploration, and production are also taking place in state waters.

Chukchi Sea routine exploration[7]

If the lease sale is held and exploration and development follows, the associated industrial activities would generate some degree of disturbance, noise, and discharges into the environment. Some potential significant effects from the anticipated routine, permitted activities may occur.

Potential effects from the lease sale would not cause any overall measurable degradation to the Chukchi Sea water quality. Effects to air quality from emissions would cause only small, local, and temporary increases in the concentration of criteria pollutants but would not exceed ambient air quality standards. Effects to lower trophic-level organisms from disturbance caused by drilling platform emplacement and other effects from other routine operations would have moderate to low effects on local populations. Some measurable effect on fish resources would be likely. Some individual fish could be affected during construction and drilling activities; most fish in the immediate area would avoid these activities and would be otherwise unaffected. There is some research that points to reductions in fish catch rates as a result of seismic survey activity (Alaska Marine Conservation Council). Seismic surveys, turbidity, and pipeline construction (both offshore and onshore) could cause adverse effects to essential fish habitat; however, the magnitude of impacts are considered low and are not expected to result in measurable effects at the regional ecosystem level.

Noise and other disturbance caused by exploration, development, and production activities and disturbance from aircraft and vessels could result in localized effects on endangered species. Of particular concern is the bowhead whale. Concerns exist over impacts associated with “key habitat types” such as those used for calving, feeding, breeding, and resting, as well as those portions of the migratory pathway where the movements of the whales are constrained. Although small numbers of individuals could be affected, regional populations or migrant populations of nonendangered marine mammals (gray whales) and terrestrial mammals (brown bears, muskoxen, Arctic foxes, and others) could experience localized impacts.

Wetlands and vegetation could experience adverse impacts onshore as a result of development activities but likely would not be affected by the majority of the exploration activities. There is a high potential for

[7] This section has been adapted with some modification from the EIS for Chukchi Sea Lease Sale 193 (MMS, 2007). The use of the word “significant” in this discussion refers back to the specific significance criteria used by the MMS in its NEPA analysis.

marine and coastal birds to experience disturbance and habitat alteration. However, little recent site specific data are available on habitat and use patterns, routes, and timing of specific species use of the arctic environment.

Short-term, local disturbance could affect subsistence harvests, but no resource or harvest area likely would become unavailable. Construction disturbance temporarily could displace a few individuals of subsistence species.

MMS concluded that the sociocultural systems would not be altered, because the sale and possible followup activities would result in few new residents. No "disproportionately high adverse effects," as defined by the Environmental Justice Executive Order, are expected to occur from planned and permitted activities associated with the Chukchi Sea lease sale 193. Disturbance of historic and prehistoric archaeological resources is possible, but not likely, during exploration and development activities both onshore and offshore. In addition, terrestrial and marine archaeological surveys would identify any potential resources prior to activities taking place, and the sites would be avoided or the effects mitigated.

***Beaufort Sea routine exploration*[8]**

If any of the lease sales are held and result in exploration and/or development, routine industrial activities associated with oil exploration and development would generate some degree of disturbance, noise, and discharges into the environment. The EIS found that no significant effects are anticipated from routine permitted activities.

Potential effects to water quality from any or all of the sales would be of short duration and localized to a few square kilometers from the discharge site, but there likely would be no regional effects. Effects to lower trophic-level organisms from increased turbidity from permitted construction activities would be local and short term. Nearby benthic organisms would experience sublethal effects from permitted discharges of drilling muds and cuttings over the life of the field. No measurable effect on fish populations (including incidental anadromous species) would be likely. Although a few individual fish could be harmed or killed during construction, most fish in the immediate area likely 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 likely on overwintering fish populations. There is some research that points to reductions in fish catch rates as a result of seismic survey activity (Alaska Marine Conservation Council). Effects to essential fish habitat likely would be greatest in the central Beaufort Sea onshore area, where the lakes and rivers in the area provide the best freshwater (overwintering) habitat. Effects on prey to essential fish habitat likely would be localized, with low population changes in abundance and distribution and for a short time. Ice-road construction, which uses some freshwater, could have moderate to low effects to onshore freshwater habitat by removing up to 15% of an overwintering waterbody. Removal of water from a lake or deep-water hole in a river potentially could reduce survival of overwintering juvenile salmon.

The endangered bowhead whale may exhibit temporary avoidance behavior in response to seismic surveys, vessel and aircraft activities, drilling, and construction, but overall effects to bowheads from disturbance and noise likely would be temporary and nonlethal. Disturbance of the threatened spectacled and Steller's eiders associated with construction activities may cause decreased fitness or production of young. Eider mortality from collisions with structures is not likely to be an effect. Frequent disturbance during the construction of exploration or production facilities may cause decreased fitness or production

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[8] This section has been adapted with some modification from the EIS for oil and gas lease sales 186, 195, and 202 (MMS, 2003). The use of the word "significant" in this discussion refers back to the specific significance criteria used by the MMS in its NEPA analysis.

of young to other marine and coastal birds. Bird mortality from collisions with structures is not likely to be a significant effect. Small numbers of marine mammals (pinnipeds, polar bears, and beluga and gray whales) could be affected, with recovery expected in about 1 year. Destruction of less than a few hundred acres of vegetation and wetlands from gravel mining, construction of a landfall gravel pad, and onshore pipeline installation likely would occur, with effects persisting for more than 10 years. Periodic disturbances could affect subsistence-harvest resources, but no resource or harvest area likely would become unavailable, and no resource population likely would experience an overall decrease.

Chronic disruptions to sociocultural systems likely would occur, but these disruptions are not likely to cause permanent displacement of ongoing traditional activities of harvesting, sharing, and processing subsistence resources. No "disproportionately high adverse effects" as defined by the Environmental Justice Executive Order would likely occur from planned and permitted activeties associated with any of the three proposed OCS lease sales evaluated in this EIS. Disturbance of historic and prehistoric archaeological resources is possible, but not likely, during exploration and development activities both onshore and offshore. However, terrestrial and marine archaeological surveys should identify any potential resource prior to activities taking place, and they can be avoided or their effects can be mitigated. Air quality effects likely would not cause ambient air quality standards to be exceeded.

Likelihood of a big oil spill during exploration[9]

The NMFS Biological Opinion on the exploration activity in the Beaufort and Chukchi Seas evaluated the potential for a large oil spill during the exploration phase of development (NMFS 2008c).[10] It found the likelihood of such a spill to be small. The MMS estimates the chance of a large (>1,000 bbl) oil spill from exploratory activities to be very low. On the Beaufort and Chukchi Federal OCS, the oil industry drilled 35 exploratory wells. During the time of this drilling, industry has had 35 small spills totaling 1,120 gallons (gal) or 26.7 bbl. Of the 26.7 bbl spilled, approximately 24 bbl were recovered or cleaned up. Small (1,000 gal or less) operational spills of diesel, refined fuel, or crude oil may occur. The MMS estimates this to be the typical scenario during exploratory drilling in the Beaufort and Chukchi seas. These small spills often are onto containment and gravel islands or ice and can be cleaned up. No exploratory drilling blowouts have occurred on the Arctic or the Alaskan OCS. Since 1971, industry has drilled approximately 172 exploration wells in the Pacific, 51 in the Atlantic, 10,524 in the Gulf of Mexico, and 97 in Alaska, for a total of 10,844 wells (Brajas, Howard, and Monkelein 1999). From 1971-1999, there were 53 blowouts during exploration drilling. With the exception of three spills, 200, 100, and 11 bbl, respectively, no additional oil spills have occurred. Therefore, more than 13,000 wells have been drilled, and three spills resulted in crude reaching the environment during exploration.

Recovery in the Arctic from an oil spill will likely be a slow process due to the cold and ice environment. High winds can move oil inland to lagoons and ponds during open water periods, affecting animals that may use these areas, such as seabirds. The recovery of animals exposed to oil pollution will depend on other stress the animals are currently experiencing. Ice dependent species are likely to currently be experiencing stress with the shrinkage of ice in the Arctic, and therefore may take longer to recover or not recover at all from the effects of a large oil spill. Oil spills under the ice may be of particular concern as it would be very difficult, if not impossible, to clean up. Breathing holes and dens in the ice used by

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[9] This section is based on the Biological Opinion prepared pursuant to the Endangered Species Act for oil and gas exploration in the Beaufort and Chukchi Seas (NMFS 2008c).

[10] The Chukchi Sea Lease Sale 193 EIS evaluated the potential environmental impacts of a large oil spill over the hypothetical lifetime of development and production. Because the analysis considered the potential for large spills following development, and because this analysis treats exploration as the reasonably foreseeable future action, the NMFS analysis is utilized here.

mammal would collect toxic fumes from the spill, and open areas of water in the ice would collect the oil so that there would be no place to swim without exposure to the oil for either mammals or seabirds.[11]

Beaufort Sea production

The Federal Government owns part of the waters leased by BP for its Northstar producing unit. The Northstar production infrastructure is on an artificial island six miles northwest of Prudhoe Bay. While most of the unit is in state waters, some is on offshore leases in federal waters. Production capacity is 47,000 barrels of oil a day. Oil is transported to shore via an underwater pipeline (Rosen 2007).

This summer (2008) BP has begun development of the Liberty oil reservoir, which lies in federal waters. Drilling infrastructure is to be located several miles away in state waters on one of the islands that is a part of the Endicott field complex. The work will involve expansion of an existing drilling island in state waters from 11 to 30 acres. Drilling is expected to start in 2010 and first production is slated for 2011. The horizontal drilling distance of 34,000 to 44,000 feet would be the longest in the world to date. The project is expected to produce 100 million barrels of oil over its lifetime (Bailey 2008 and Lee 2008).

The production and transportation of large volumes of oil creates the possibility of spillage. The potential for large scale spills from producing oil fields, and the potential environmental impacts of such spills are discussed in detail in the Minerals Management Service EIS for the Chukchi Sea Lease Sale 193, the MMS EIS for Beaufort Sea Lease Sales 186, 195, and 202, [and the National Marine Fisheries Service ESA section 7 biological opinion for oil and gas exploration in the Beaufort and Chukchi Seas.] (MMS 2007; MMS 2003; NMFS 2008c).

Beaufort Sea state territorial waters[12]

There are 644,410 offshore acres of leases currently active, with 561,899 being in the Beaufort Sea and 82,510 being off-shore Prudhoe Bay. Figure 3-3 shows the locations of North Slope Oil and Gas development. The producing off-shore fields with off-shore facilities are:

- Endicott/Duck Island Unit. This Unit has two islands and cause-ways between them and shore. One of the islands will contain the drill rig that will drill the Liberty field, which lies in Federal waters.
- Northstar, with offshore facilities at Tern Island. There should be some further wells drilled here.
- Point McIntyre: This field has a long cause-way but no island.
- Oooguruk. The newest development, starting production earlier this year. It is produced from a six-acre off-shore drill-site that ties in via a 5.7 mile sub-sea pipeline to an on-shore pad. 35 horizontal wells are planned to be drilled.

Some fields (Badami, Niakuk, Milne Point) are located under state waters but are produced from on-shore facilities.

[11] Jeep Rice, Alaska Fisheries Science Center , Auke Bay Lab, personal communication, 10/28/08
[12] This section is based on revisions to a personal communication received from Greg Bidwell, Commercial Analyst with the Oil and Gas Division of the Alaska Department of Natural Resources, on September 4, 2008. Greg Bidwell. Oil and Gas Division, Alaska Department of Natural Resources, 550 W 7th Ave Ste 800 Anchorage, AK 99501-3560.

Recently, the ENI company sanctioned Nikaitchuq, a field in shallow waters just east (or located in) Harrison Bay. ENI plans to build a gravel Island near Spy Island, 3.8 miles north of Oliktok point, from which to do some drilling. Some of the drilling will be done from Oliktok Point. Around 73 wells will be drilled, with first oil in 2010.

The State's Department of Natural Resources holds area-wide lease sales in the Beaufort Sea every October. In the Beaufort Sea annual State lease sales since 2000, bidders have bid $18.75 million to obtain oil and gas leases 508,593 acres of State offshore acreage. Not all leased lands will lead to development. There appear to be three explorers who have obtained large off-shore lease positions and have taken further steps to explore their acreage.

- FEX, a subsidiary of Calgary's Talisman Energy has spent close to $4.5 million in 2004 and 2006 lease sales to acquire a number of leases in Smith Bay and Harrison Bay. In 2006 they did seismic work in Harrison Bay.
- Brooks Range, a subsidiary of the Alaska Venture Capital Group (ACVG), has purchased a number of leases north of Prudhoe Bay. They have drilled North Shore No. 1 in the Gwydyr Bay area, and Sak River No. 1. There are known accumulations in this area, but they are small, and the geology is complex.
- Savant has purchased leases around Liberty. They have drilled off-shore wells in State waters.
- In addition, there well might be additional exploration as step-outs from the Nikaitchuq and Oooguruk developments.

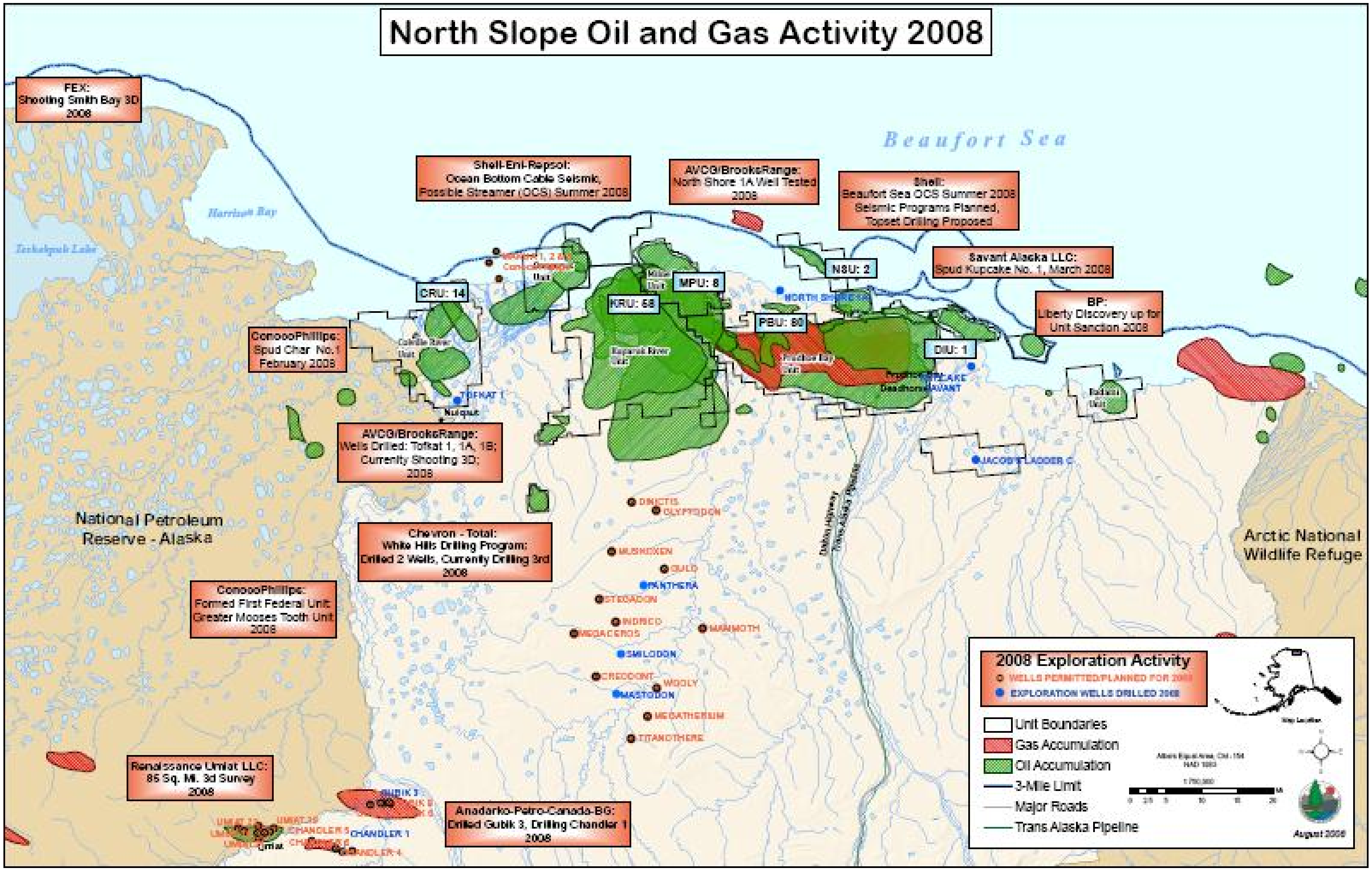

Figure 3-3 North Slope Oil and Gas Activity, 2008 (Source: Alaska Department of Natural Resources, Oil and Gas Division)

New pipeline development

There is interest in the development of pipelines to carry natural gas from the North Slope across Alaska and the Yukon, to connect with the continental pipeline system in northern Alberta. Two competing proposals are under development. One, proposed by the TransCanada pipeline company, has received a license from the State of Alaska. Another sponsored by BP and ConocoPhillips is proceeding independently of the state. While it is not clear which line, or whether any line, will be built, the State of Alaska, and several companies, including TransCanada, BP, and ConocoPhillips, have taken significant steps towards pipeline development. At this time the North Slope does not produce natural gas, because of the lack of transportation infrastructure. Construction of a natural gas pipeline would be likely to lead to additional, gas-related development activity in Northern Alaska, in the Beaufort Sea, and possibly in the Chukchi Sea.

Other mineral development

The North Slope contains mineral resources other than oil and gas. Coal was mined at Cape Beaufort in 1979 to provide fuel for whaling vessels. Large coal deposits extend from the Chukchi Sea coast east to the area of the Colville River. While the deposits are very large, it is unlikely they can be mined economically on a large scale for many years to come. Coalbed methane deposits may exceed those in the lower-48 states combined. In the action area, a demonstration project has been established at Wainwright. Large methane gas hydrate deposits were found on the North Slope.[13] While the onshore Arctic is likely location for these deposits, economic and technical issues will preclude large scale development of this resource for 20 to 60 years. The North Slope contains important base metal deposits, including lead, zinc, silver, cadmium, germanium, copper and gold. The Red Dog Mine is exploiting lead, zinc, and silver ores. Production there is expected to last 50 years. At least one significant additional deposit is believed to be nearby (Committee, 2003).

Transportation and Shipping[14]

There is little shipping infrastructure in this region, and shipping is limited to the ice-free period from June to September or October.

The city of Nome has a harbor and port facilities. The Port of Nome is located on the southern side of the Seward Peninsula in Norton Sound. Improvements to the harbor have been completed in summer of 2006 that added over 3,000 ft of breakwater. The harbor contains both a city dock as well as privately owned (Westgold). The latter handles nearly all of the exported rock/gravel for the region and is the primary location to load/unload heavy equipment. A small boat harbor is located inside the causeway. Smaller cargo vessels and landing crafts load village freight and fuel at the east, west and south inner harbor sheet pile docks, east beach landing and west barge ramp for delivery in the region.

Another new addition to the Nome facility is a 60-foot wide concrete barge ramp located inside the inner harbor just west of the Snake River entrance. The ramp provides the bulk cargo carriers with a suitable location closer to the Causeway to trans-load freight to landing crafts and roll equipment on and off barges. http://www.nomealaska.org/port/070515FACTSHEET.pdf

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[13] "Gas hydrate is a solid, icelike, material that contains molecules of gas bound in a lattice of water molecules. On decomposition, a gas hydrate solid can produce as much as 160 times its volume of gas. Gas hydrate occurs in the deep-water regions of the oceans and in permafrost regions where temperature and pressure conditions are favorable for its formation and stability." (Committee, 2003, page 62)

[14] Section 9.5.12 provides additional discussion of local marine traffic.

Red Dog Mine is located in the DeLong Mountains north of Noatak, about 90 miles north of Kotzebue and 55 miles inland from the Chukchi Sea. The lands are owned by NANA Regional Corp. NANA/Lynden hauls the zinc and lead concentrates from the mine to the port site, and hauls fuel and freight on the return. Ore concentrate taken from the mine is trucked westward to a shipping facility on the Chukchi Sea and stored there until the shipping season. There is a 55-mile gravel road from the mine to the shallow-water port for staging and exporting zinc and lead ore. The port is ice-free only 100 days a year. The port and road are state-owned. Barges deliver supplies, fuel and equipment each summer. Due to a shallow port, two lightering barges and four tugboats (operated by Foss Maritime) transfer the concentrate to ships anchored offshore. The State of Alaska web site contains additional information, http://www.commerce.state.ak.us/dca/commdb/CIS.cfm?Comm_Boro_Name=Red+Dog+Mine.

The Alaska Department of Transportation provides a directory of the state's official harbors (ADOT 1996). At the latest printing, no additional harbors are listed that are located north of Bering Strait area. Interest has been expressed to build port facilities in the towns of Kotzebue and Cape Blossom and in Barrow; however, no dates have been specified (Mike Lukshin ADOT personnel communication Dec. 26, 2007).

Kotzebue is the service and transportation center for all villages in the northwest region. Due to its location at the confluence of three river drainages, Kotzebue is the transfer point between ocean and inland shipping. The shipping season lasts 100 days, from early July to early October, when the Sound is ice-free. Due to river sediments deposited by the Noatak River 4 miles above Kotzebue, the harbor is shallow. Deep draft vessels must anchor 15 miles out, and cargo is lightered to shore and warehoused. Crowley Marine Services operates shallow draft barges to deliver cargo to area communities. The City of Kotzebue wants to examine the feasibility of developing a deep water port, since the cost of cargo delivery is high with the existing transportation systems.

Shipping activities may increase in the future for several reasons. Arctic warming may extend the period during which the Arctic is ice-free and reduce the amounts of thicker multi-year ice. Increasing commodity prices, driven by world economic development, may increase the prices of raw materials that may be obtained in the Arctic and lead to increased development activity. Warming climates may reduce the stability of permafrost and increase the costs of using substitute transportation methods, such as pipelines or roads. Increasing incomes and accessibility may increase the demand for eco-tourism cruises into the Arctic. Security concerns may increase military use of the Arctic. Technological change in ship construction is leading to vessels that are better adapted to movement through "ice infested" waters.

Two general types of traffic are possible. Local traffic associated with resource development in Alaska, western Canada, and eastern Russia is likely to increase. This includes shipping associated with development of oil and gas, minerals, and tourism. In addition, through traffic between the Atlantic and Pacific may increase as well. Arctic routes between Europe and East Asia, or between parts of the U.S. East Coast and East Asia are considerably shorter than alternative shipping routes through the Suez or Panama Canals, or around Cape Horn. Long distance container, tanker, or bulk freight traffic between the Atlantic and Pacific may well increase.

Arctic traffic between the Atlantic and Pacific may follow several routes; Russia's Northern Sea Route from the Barents Sea to the Bering Strait has already been used by commercial vessels. Alternatively, vessels may eventually use Canada's Northwest Passage, or even cross the central Arctic Ocean. These routes all pass through the Chukchi Sea and Bering Strait, but the Northern Sea Route would not enter the Beaufort Sea.

There are substitutes for both local and long-distance traffic. Local development may be supported with traditional and ice roads, pipelines, and air traffic. Development in Canada's Beaufort Sea could be supported with barges brought down the MacKenzie River from the Port of Hay River in the Northwest Territories. As noted, transit between the Atlantic and Pacific may move through the Suez and Panama Canals, around Cape Horn, or by train, truck, or pipeline across the U.S. or through Cental Asia. Within the Arctic Ocean, traffic may move across Russia's Northern Sea Route, across the Central Arctic Ocean, or through Canada's Northwest Passage. These routes have somewhat different implications for traffic on Alaska's Chukchi Sea and Beaufort Sea coasts.

Steps are already being taken to develop these routes and support vessel traffic in the north. The Arctic Council is currently conducting a study of potential transportation issues. The U.S. Coast Guard's 17th District has recently indicated an intention to establish an enhanced presence in northern Alaska. Possible Coast Guard actions in the Arctic region are discussed in detail in Section 8.5.13 of this document. The U.S. Congress is considering replacement of the aging U.S. ice breaker fleet. The Soviet Union and the Russian Federation have long maintained infrastructure along the Northern Sea Route. The International Maritime Organization has developed guidelines for ships operating in Arctic waters. It is reasonably foreseeable that national and international efforts to develop infrastructure to support shipping in the north will continue; there are, however, considerable uncertainties associated with the development of shipping, particularly long-distance East-West/West-East transit.

Increased vessel traffic in the Beaufort and Chukchi Seas would be likely to result in greater incidents of pollutant discharges and disturbance effects on foraging bowheads or other marine mammals and could result in a higher incidence of ship strikes with the potential for serious injury and mortality. However, if bowhead whales and other marine mammals are able to move away from future shipping lanes and still find suitable foraging areas, the increased risk of ship strikes could be minimal.

Introduction of Invasive Species

With the increase of vessels traveling through the Arctic Management Area and the use of oil rigs from locations outside the Arctic Ocean, the risk of introducing an invasive species increases. Invasive species could be released in ballast water from ships, carried on ship hull fouling communities or brought in on drilling rigs that had been used in waters other than the Arctic. Invasive species may also be carried into the Arctic Ocean by currents and rising ocean temperatures, and sea ice retreat may allow the colonization of invasive species that otherwise would not have been able to survive in the Arctic. Invasive species could potentially compete with or prey on Arctic marine fish or shellfish species which may disrupt the ecosystem and predators that may depend on indigenous species. Unfortunately, no baseline or monitoring program exists to establish the current assemblage of Arctic species so that the introduction of an invasive species could be discovered. The significance of this effect would depend on the ability of the invasive species to survive and reproduce in the Arctic environment and the effect on Arctic fish or shellfish species, and as well as other species that depend on the affected organisms. We are not aware at this time of any potential invasive species introduced into the Arctic that may colonize the Arctic region and adversely affect the ecosystem (Linda Shaw, NMFS Habitat Conservation Division, personal communication August 28, 2008).

Changing infrastructure demands[15]

Scientists expect Alaska's climate to get warmer in the coming years—and the changing climate could make it roughly 10% to 20% more expensive to build and maintain public infrastructure in Alaska between now and 2030 and 10% more expensive between now and 2080.

[15] This section is based in large part on Larsen et al. 2007.

A warming climate may damage Alaskan infrastructure that is designed for a cold climate. The damage will be concentrated in places where permafrost thaws, flooding increases, and coastal erosion worsens. The extra costs will likely diminish over time, as government agencies increasingly adapt infrastructure to changing conditions.

"Public infrastructure" means all the federal, state, and local infrastructure that keeps Alaska functioning: roads, bridges, airports, harbors, schools, military bases, post offices, fire stations, sanitation systems, the power grid, and more. Privately owned infrastructure, homes and facilities operated by private business, may also be affected by climate change. This could increase the costs of living and doing business in these remote areas. Of particular concern is the thawing of the permafrost, which may increase the costs of pipeline construction and operation. Shorter cold seasons may also reduce the useful annual lifetimes of ice roads, making it more difficult to move equipment, materials, and wastes, to and from construction sites in cold weather.

Rising sea levels and loss of protective shore ice is exposing some coastal communities to a serious threat from erosion. This raises problems beyond an increased cost of replacing and maintaining existing infrastructure. In these instances heavy new investments may be needed to protect communities, or to relocate some or all of the communities. The Army Corps of Engineers recently evaluated the costs of erosion control for seven communities in western and northern Alaska. Three of these communities, Kivalina, Kaktovik, and Shismaref are in the action area. Kaktovik was estimated to have a future life of over 100 years, even in the absence of future erosion protection. However, Kivalina and Shismaref were given lifetimes of 10 to 15 years (Corps 2006).

Subsistence

Subsistence harvest of Arctic fish, marine mammals, and birds is a past, present and future action. The harvest of bowhead whales is well controlled and monitored, but less detailed information is available for other marine species. The amount of subsistence harvest is not expected to increase unless the population of the region increases as new development takes place. The continuation of subsistence activities will result in continued human-caused mortality for targeted Arctic marine species. The potential effects of this mortality on targeted species are discussed in later sections of this document. Subsistence uses of regional fisheries and marine mammal resources, and the cultural importance of subsistence activities are discussed in detail in Chapter 9.

Commercial Whaling

A summary of commercial whaling in Arctic waters is available in the Marine Mammal Stock assessment for each species (Angliss and Outlaw, 2008). The two whale species occurring in the Arctic that were commercially harvested are bowhead and humpback whales. Commercially whaling no longer occurs for humpback or bowhead whales. Commercial whaling in the Arctic Management Area targeted bowhead whales while humpback whales were harvested in the North Pacific.

Pelagic commercial whaling for bowheads principally occurred in the Bering Sea from 1848 to 1919.
In the first two decades of the fishery (1850-1870), over 60% of the estimated pre-whaling abundance was harvested, although effort remained high into the 20th century (Braham 1984). It is estimated that the pelagic whaling industry harvested 18,684 whales from this stock (Woodby and Botkin 1993). During 1848-1919, shorebased whaling operations (including landings as well as struck and lost estimates from U. S., Canadian, and Russian shores) took an additional 1,527 animals (Woodby and Botkin 1993). An unknown percentage of the animals taken by the shore-based operations was harvested for subsistence, and not commercial purposes. The estimated mortality likely underestimates the actual kill as a result of under-reporting of the Soviet catches (Yablokov 1994) and the lack of reports on struck and lost animals.

Humpback whales experienced intensive commercial whaling with more than 28,000 animals removed from the North Pacific during the 20th century (Rice 1978). From 1961 to 1971, an additional 6,793 humpback whales were killed illegally by the U.S.S.R. Many animals during this period were taken from the Gulf of Alaska and Bering Sea (Doroshenko 2000); however, additional illegal catches were made across the North Pacific, from the Kuril Islands to the Queen Charlottes, and other takes in earlier years may have gone unrecorded. Humpback whales in the North Pacific were theoretically protected in 1965, but illegal catches by the USSR continued until 1972 (Ivashchenko et al. 2007).

Scientific research

Research is expected to continue in the area. Noise from conventional or ice-breaking vessels and other sources (e.g., seismic, sonar) would continue to add to the cumulative levels of noise in the whale's environment. Increased noise may result in disturbance and temporary displacement of the whales or temporary deflection of the migration. At present, data do not indicate that current noise levels result in adverse behavioral or physiological effects on the bowheads in this stock or other marine mammals. The impacts of scientific research include the harassment of marine mammals and the potential takes of marine mammals, seabirds, and fish during research activities.

Other federal, state and international agencies

The level of future military activities in the area is expected to remain low, but transit of vessels or aircraft through the area is expected to continue. In routine operations, submarines use passive sonar, which is not likely to disturb bowhead whales. The use of submarines as research platforms is likely to continue, resulting in potential disturbance to bowheads. The United States Coast Guard has increased its level of activity in the action area in 2008 and is expected to be more active in the area in the future. Coast Guard activity in 2008 is discussed in more detail in Section 9.5.13 ("Coast Guard in the Arctic").

The U.S. Army Corps of Engineers is currently in the process of evaluating the feasibility of expanding the Delong Mountain Terminal port so that cargo ships can access the terminal directly, instead of being loaded offshore. This would result in fewer barges being needed for transport of concentrate from the terminal to cargo ships, but would not change the number of cargo ships in the area. Noise associated with dredging during construction would result in temporary noise disturbance to bowhead whales and beluga whales. Future development associated with the Red Dog Mine facility includes onshore developments, such as roads and/or infrastructure, which would have no impact on bowhead whales.

Tourism activities are likely to increase in the area, resulting in more tourist vessel voyages in the region, increasing opportunities for ship interactions and increased noise and disturbance.

Chapter 4 Finfish, Shellfish, and Other Related Marine Organisms

Many species of marine and anadromous fish and shellfish inhabit arctic waters. Marine fish include Arctic cod, saffron cod, two-horn and four-horn sculpins, Canadian eelpout, Arctic flounder, capelin, Pacific herring, Pacific sand lance, and snailfish. Migratory (anadromous) fish common to the arctic environment include Arctic cisco, least cisco, Bering cisco, rainbow smelt, humpback whitefish, broad whitefish, Dolly Varden char, and inconnu. Although uncommon in the North Slope region, salmon are present in arctic waters (Craig and Haldorson 1986; MMS 2002). Shellfish include snow crab, red and blue king crab, shrimp, mollusks, and green sea urchins.

4.1 Fish Species Distribution and Abundance

Review of knowledge of Arctic fish resources

Little is known about the ecology and life-histories of offshore marine fishes of the Chukchi and Beaufort Seas. Surveys of fish species present in this region have been few. Early exploration of this region by wooden sailing ships and whaling vessels included both commercial interests (whales, other marine mammals), enforcement (U.S. Coast Guard revenue cutters), and scientific interests and produced a few records of fish species present. In the middle of the 20th Century, exploration of the region was sponsored by the U.S. Coast Guard, National Science Foundation, the U.S. Navy and its Naval Arctic Research Laboratory, and eventually by the oil and gas industry, leading to a minimal qualitative sampling of marine organisms inhabiting the region.

One of the earliest contemporary summaries of species present in Arctic waters was compiled by Walters (1955), who assembled a dichotomous key to both marine and freshwater Alaskan species based on existing literature records, museum specimens, and Walters' field collections. In Russia, Andriiashev (1954) published a landmark treatise on the distribution, life history and commercial importance of Arctic fishes of the circumpolar north. Based on the increase in development of fisheries in Canada's Arctic, McAllister (1960) published a key to the arctic marine fishes of Canada for the National Museum of Canada. In the mid 1960s, Alverson and Wilimovsky (1966) compiled information on fish species present in the Cape Thompson region of the Chukchi Sea, and later the U.S. Coast Guard's ecological survey of the eastern Chukchi Sea provided additional information on fish species present in the area north of Bering Strait to Icy Cape and a few sampling stations near Point Barrow (Quast 1972). Based on this work, Quast and Hall (1972) published a list and a literature review of information on fishes of Alaska. Then in the mid-1970s, spurred by the prospects of a large push for oil and gas exploration and development in marine waters off the coasts of Alaska, the Outer Continental Shelf Environmental Assessment Program (OCSEAP) was initiated by the U.S. Bureau of Land Management's Outer Continental Shelf Office, later renamed Minerals Management Service. The OCSEAP study program resulted in millions of dollars being spent on marine research, expanding the knowledge of subarctic and arctic marine areas offshore (e.g. Bendock 1977; Carey 1978; Lowry et al. 1979; Fechhelm et al. 1985).

Relative to the amount of study that has been directed at coastal water habitats over the past three decades in response to Arctic oil development, few offshore studies have been conducted. Those few studies were designed to sample fish in pelagic larval and semi-planktonic juvenile stages (NMFS 1976; Galbraith and Hunter 1979; Tarbox and Thorne 1979; Tarbox and Moulton 1980; Ratynski 1983; Dames and Moore 1989; Thorsteinson et al. 1990, 1991), but were not designed to survey the vast majority of species which are demersal in their post-larval stages: e.g., sculpins, poachers, snailfishes, eelpouts, pricklebacks, gunnels, wolffishes, and flounder. There have been only a few offshore surveys of demersal fishes in the Beaufort Sea (McAllister 1962; Frost and Lowry 1983). In contrast to the Beaufort Sea, there have been several major offshore surveys of demersal fishes and their ecology in the Alaskan Chukchi Sea (Quast 1972; NMFS 1976; Frost and Lowry 1983; Fechhelm et al. 1985; Coyle et al. 1997; Smith et al. 1997a, 1997b; Wyllie-Echeverria et al. 1997).

Early surveys of demersal fishes in the offshore waters (more than 50 km offshore) of the western and central Beaufort Sea have identified 17 species of marine fish (Frost and Lowry 1983). Incidental collection of marine species from nearshore studies designed to monitor oil and gas development activities have identified an additional dozen or so "deepwater species." They include sculpins, poachers, snailfish, eelpouts, pricklebacks, wolffishes, and gunnels (Bob Fechhelm, LGL, pers. comm.). Most of these species have been reported to occur from the Canadian Beaufort Sea westward through the northeastern Chukchi Sea (Walters 1955; McAllister 1962; Quast 1972; Carey 1978; Fechhelm et. al 1985). They reflect a numerically low, yet geographically extensive, marine faunal assemblage throughout Arctic marine waters. McAllister (1962) suggested that this "Inuit" faunal assemblage extends continuously from the central Canadian Arctic westward through the Beaufort, Chukchi, East Siberian, Laptev, Kara, and Barents seas.

The shoreward extent of the distributions of offshore marine species in the Beaufort Sea is unknown. Those studies that have sampled in deep water with bottom sampling gear typically reported collecting only nominal numbers of "offshore" marine species (e.g., Galbraith and Hunter 1979; Byers and Kashino 1980). In the Chukchi Sea, offshore marine species have been reported in substantial numbers from depths as shallow as seven m (Fechhelm et al. 1985). In all cases, waters were always relatively unstratified with salinities greater than 28 ppt. The onshore distribution of these species in the Beaufort Sea is likely a function of localized oceanographic conditions and depth (Bob Fechhelm, pers. comm.). Nearshore Beaufort Sea marine fish distribution and abundance are generally correlated with salinity, with marine species increasing in abundance during periods of higher salinity waters that occur closer to shore during and after west wind events. Griffiths et al (1998) noted that marine species abundance in nearshore waters near Prudhoe Bay was correlated with coast-wide meteorological conditions.

Indeed, Moulton and Tarbox (1987) noted that Arctic cod collected in a series of otter trawl surveys offshore from Prudhoe Bay in 1978-1979 appeared to aggregate in a transition layer that was intermediate between high salinity/low temperature and low salinity/high temperature water masses. They hypothesized that these oceanographic conditions may concentrate prey for Arctic cod. Arctic cod dominated (98 % of the trawl surveys) the collections (Moulton and Tarbox 1987).

Jarvela and Thorsteinson (1999) sampled the nearshore waters of the central Beaufort Sea from the Colville Delta eastward to the region east of Barter Island in 1988, 1990, and 1991. Arctic cod, capelin, and liparids were the most common offshore or marine fishes collected by purse seine and surface tow net; amphidromous Arctic cisco were also collected. Sampling gear focused on juvenile fishes, with age 0 cod and capelin abundance fluctuating, presumably because of oceanographic conditions.

Alverson and Wilimovsky (1966) surveyed fish resources of the eastern Chukchi Sea as part of the Project Chariot study; the surveys were completed in 1959. The more abundant fishes collected were Arctic cod, herring, Bering flounder, saffron cod, capelin, rainbow smelt, hamecon, and several other sculpins (Arctic staghorn, shorthorn, and ribbed). Several flounders were noted to be of potential commercial interest, including yellowfin sole and other flounders, but all were small (smaller than 20 cm); Alverson and Wilimovsky (1966) noted that these fishes were likely below the sizes accepted in U.S. fishery markets. They also stated that the low density of fishes collected, along with their small size, may be indicative of climate limits on population growth. Arctic cod were the most common fish species collected, averaging about 16 cm in length. These surveys also collected several species of salmonids (pink and chum salmon) and Dolly Varden, but these were few in number. Tanner crab (opilio), some shrimp (crangonid, hippolytid, and pandalid), and a few king crab (blue) were collected, but in low numbers; clams were also collected and scallops (reported to be *Chylamys islandica*) were found near Point Hope (58 to 246 individuals per station at only three stations). Surveys of the benthic environment in this same region by Sparks and Pereyra (1966) concluded that the nature of the scallop resource in this area is not known. Alverson and Wilimovsky (1966) concluded that no commercial quantities were encountered of any of these species of fish and shellfish.

NMFS (1976) conducted pelagic and demersal fish collections in the eastern Chukchi Sea. The cruise focused on species composition, abundance, and distribution of fish using pelagic and bottom trawls and gillnets. Arctic cod were the most common species collected. Other species collected included Alaska plaice, saffron cod, smelt, herring, yellowfin sole, and starry flounder. Opilio Tanner crab were collected at most of the stations sampled, and only a few king crab were collected (blue and red). The cruise report indicates that shallow waters (0-25 m) were more productive than deeper waters and that the average size of fish collected was noticeably smaller than the same species found in the eastern Bering Sea (NMFS 1976).

Frost and Lowry's (1983) surveys of demersal fishes in the Chukchi and Beaufort Seas in the mid 1970s were accomplished as part of a study of ringed seal and bearded seal feeding habits and trophic relationships. Using small otter trawls, surveys showed that three species of fish were encountered most frequently: Arctic cod, Canadian eelpout, and twohorn sculpin. The Arctic cod ranged in length from 4.5 to 18 cm (mode at 8 cm). Frost and Lowry (1983) also sampled the benthic invertebrate community, noting the presence of brittle stars, soft corals, sea cucumbers, scallops (*Delectopecten groenlandicus*), and sea urchins. Crabs were also encountered, including *Chionoecetes opilio* and *Hyas coarctatus*, both of which are very important prey for bearded seals. Fourteen species of shrimp were collected, primarily hippolytid and crangonid shrimp and only a single pandalid shrimp; some of these species are important prey items for bearded seals and occasionally ringed seals. Also collected were gammarid amphipods, prey items for fish, seabirds, Arctic cod, and ringed and bearded seals and bowhead whales. Other species groups encountered were gastropods (most commonly buccinid and neptunid snails), bivalve mollusks (the most abundant was the small, transparent scallop *D. groenlandicus*), polychaetes, and echinoderms (the most abundant group of invertebrates). Walruses and bearded seals prey on bivalves and gastropods.

As part of the Outer Continental Shelf Environmental Assessment Program in the late 1970s and through the 1980s, Fechhelm et al. (1985) conducted a survey of fishes and habitat characteristics in the northeastern Chukchi Sea in 1983. The study consisted of ship surveys and analysis of other data along the Chukchi Sea coast from Peard Bay to Point Hope; data were collected in summer and to a lesser extent in winter. Winter sampling produced 205 fish, 204 of which were Arctic cod, ranging in length from 44-99 mm fork length. Summer sampling by fyke nets and fillnets resulted in thousands of fish captured comprising 17 species; dominant in this catch were Arctic cod (39%), capelin (25%), fourhorn sculpin (20%), and Arctic flounder (13%). Most of this sampling was nearshore or in embayments. Offshore sampling using a trawl and gillnet resulted in capture of 7,894 fish representing 31 species. In terms of biomass, the most abundant species were Arctic cod (54%), Arctic staghorn sculpin (24%), shorthorn sculpin (7%), saffron cod (6%), and hamecon (a hookear sculpin) (2%). Fechhelm et al. (1985) report that these five species accounted for 96% of the offshore fish biomass collected. The offshore trawl catch included 28 walleye pollock (110-165 mm total length), 44 yellowfin sole (35-115 mm fork length), and one Alaska plaice (140 mm total length). This study also included a report on subsistence jig fishing under the ice offshore from Kotzebue in November 1978; called "tomcod" locally, the jig catch by local residents was comprised of saffron cod.

There are few detailed data regarding intra- and inter-annual variability in the distribution and abundance of marine species in the Chukchi or Beaufort Seas. Work conducted in the Northeast Chukchi Sea on Arctic staghorn sculpin and Bering flounder indicates that even deep-water species undergo substantial natural fluctuations in distribution, abundance, and age structure (Smith et al. 1997a, 1997b). The authors also concluded that both species are subject to an unpredictable and dynamic physical environment that can result in mass mortalities, recruitment failures, or dispersal of individuals.

Fair and Nelson (1999) reviewed some of the fishery surveys conducted in the Chukchi Sea region. During surveys of the Chukchi Sea northward to Cape Lisburne in 1959, the most abundant fishes sampled were Arctic cod, Arctic staghorn sculpin, and Bering flounder; eelpouts and several other sculpins also were captured (Alverson and Wilimovsky 1966). Some crab and shrimp species were also collected (Sparks and Pererya 1966). In NMFS trawl surveys during 1976 in the Chukchi Sea, Wolotira et al. (1977) reported saffron cod, warty sculpin, starry flounder, yellowfin sole, halibut, and Arctic staghorn sculpin were the most common fish species; invertebrates sampled included starfish, green sea urchins, snow crab and whelks; some red king crab also were collected. MMS-sponsored surveys from 1989 through 1992 (Barber et al. 1994) collected similar species as the above surveys; highest biomass was of Arctic cod, saffron cod, and warty sculpin as well as snow crab and species of mollusks (primarily gastropods). Quast (1972) reported the presence of Alaska plaice and Pacific ocean perch in the eastern Chukchi Sea.

In 1990 and 1991, Barber et al. (1997) surveyed demersal fish resources the southeastern Chukchi Sea, collecting 66 species. Two, Arctic and saffron cod, made up 82% of the abundance of these species. They observed a trend toward greater abundance and biomass of fish species in the southern part of their study area (generally south of the latitude of Pt. Lay). They also noted that cottids were the most prevalent in terms of individual species per family, followed by zoarcids, pleuronectids, stichaeids, and agonids.

Trawl surveys in the Chukchi Sea and Kotzebue Sound were conducted in 1998 by the Bering Sea Fishermen's Association (Fair and Nelson 1999). The most abundant fish species collected was saffron cod followed by Arctic staghorn sculpin, yellowfin sole, warty sculpin, and Arctic cod. A few halibut were collected. Most of these fish species were small in size (14 to 18 cm in length). In terms of commercially-exploitable species, Fair and Nelson (1999) collected a few halibut, pollock, yellowfin sole, and Pacific cod; other species with potential commercial interest were saffron cod, starry flounder, Alaska plaice and longhead dab. These trawl surveys also caught snow crab, starfish, green sea urchins, and northern Argid shrimp. In terms of potential commercial interest, invertebrates collected included snow crab, mollusks, and green sea urchins. While snow crabs were relatively abundant, nearly all were immature females and sublegal males.

Industrial development of petroleum resources at Prudhoe Bay and surrounding oil fields has prompted concern over effects on coastal fishes (Thorsteinson and Wilson 1995), and several decades of nearshore fish studies have been conducted in this region (Craig 1984: Wilson and Gallaway 1997, Streever and Wilson 2001). Recently, the University of Alaska, in cooperation with other investigators, has conducted several surveys of the region, in particular a series of cruises with Russian Scientists with support from NOAA. The North Pacific Research Board recently sponsored a synthesis of information on the Chukchi and Beaufort Sea marine ecosystem (Hopcroft et al. 2007). Monitoring effects of oil field development, focusing on impacts of several causeways in the Prudhoe Bay region, has been ongoing in waters of the nearshore Beaufort Sea since the 1980s. Decades of fishery studies in these waters indicate the persistent annual, seasonal presence of several species of whitefish (Arctic cisco, least cisco, broad whitefish) and Dolly Varden char (Craig 1984; Gallaway and Fechhelm 2000). These anadromous and amphidromous species reside in fresh waters during winter months, migrating into nearshore brackish and marine waters during the summer months to forage. Most feed on invertebrates, but Dolly Varden also prey on small fishes. Dolly Varden also may move far offshore and feed among ice floes (Fechhelm et al. 1997).

Fish that disperse into coastal estuarine and marine waters tend to remain in a band of relatively warm and brackish water along the coast of the Beaufort Sea (Craig 1984); nearshore fish behavior in the Chukchi Sea region is unknown, except for the annual chum salmon and Dolly Varden migrations into the Kotzebue Sound region that are monitored during the local commercial fishery. This nearshore, estuarine-like zone is an important feeding and movement corridor for these whitefish and Dolly Varden populations, most of which originate in river systems of both Alaska and the Yukon Territory in Canada. Craig (1984) reported that the dominant anadromous or amphidromous species were Arctic cisco, least cisco, and Dolly Varden that enter these previously-frozen nearshore areas to feed on the seasonally abundant epibenthis mysids and amphipods. It is during summer that these fish species accumulate most of their annual growth and preparation for overwintering. Studies of oil and gas causeways in the nearshore Beaufort Sea have resulted in a large amount of scientific information on these fish species (Steever and Wilson 2001).

The fish surveys and monitoring of oil and gas development in the coastal areas of the nearshore Beaufort Sea have included collections of marine species. The most common species include Arctic cod, fourhorn sculpin, and Arctic flounder. These species move inshore during summer, presumably to feed or because of more favorable temperature or salinity conditions, but monitoring studies indicate that Arctic cod abundance fluctuates widely along the coast while fourhorn sculpin abundance fluctuates in synchrony with salinity (Streever and Wilson 2001).

One major species of finfish in the Beaufort is the Arctic cod *Boreogadus saida*, a gadid that can be seasonally abundant but may not occur in commercially exploitable quantities; data are not available to assess the stock dynamics of Arctic cod in the Arctic offshore of Alaska. The pelagic Arctic cod is distributed throughout the circumpolar north, and may be found throughout the Arctic Ocean and throughout its Beaufort and Chukchi Seas. Andriiashev (1954) notes that the species (called polar cod at that time) is widespread not only in the marginal seas of the Arctic Ocean but throughout the ocean to the "Extreme North" (specimens had been captured near the sea surface near the North Pole). Biomass estimates are few; one estimate is a calculation by Frost and Lowry (1984) of approximately 86,000 mt. The Arctic cod is a small fish, growing to 13-16 cm (George et al. 2007); Mecklenberg et al. (2002) report Arctic cod can grow to 40 cm but are usually less than 25 cm total length. This species is a food source for marine mammals and birds of the Arctic, and as juveniles Arctic cod is known to be prey for other species of fish, particularly anadromous and amphidromous fishes that occur in nearshore Beaufort and Chukchi Sea waters during the summer open water season. Competitive interactions among marine mammals, seabirds, and fishes in the Arctic were reviewed by Frost and Lowry (1984). They noted the importance of Arctic cod in the overall Arctic marine ecosystem by concluding that Arctic cod may be the most important secondary consumer in this area, providing the bulk of the diet of ringed seals, several species of seabirds, and to some extent beluga whales. Bearded seals also prey heavily on Arctic cod (George et al. 2007).

Benson and Trites (2002) reviewed literature on fish species that could be affected by warming trends, noting the reported presence of pollock north of Bering Strait in years of light ice cover (Wyllie-Echeverria 1995).

Shellfish such as crab and shrimp occur in the Chukchi Sea, but commercially exploitable populations likely are rare north of Norton Sound and Bering Strait. A very small fishery for red king crab has occurred in the Kotzebue Sound area (Charlie Lean, pers. comm.) and may still hold potential for the future. Snail populations occur in the Chukchi Sea, although they have not been commercially exploited.

Crab and epibenthic crustaceans occur in the Beaufort Sea. Very little is known about the shellfish fauna of the region.

Recent surveys of the Chukchi Sea conducted in July-August 2004 jointly by the U.S. and Russia resulted in collections of fish and invertebrate species. The joint U.S.-Russia research program in the Bering and Chukchi Seas focused on sampling and instrument deployment in both U.S. and Russian territorial waters. This activity is known as the Russian-American Long-term Census of the Arctic (RUSALCA) and was administered through the University of Alaska's Cooperative Institute for Arctic Research (CIFAR).

Preliminary results from the RUSALCA studies, which are summarized in the CIFAR annual report,[16] show benthic macrofaunal biomass was very high in the southern Chukchi Sea in a known region of high water column production. The study collected several specimens of the Northern Pacific crab *(Telmessus cheiragonus*) in the southeastern Chukchi Sea, which is the third northernmost documentation of this species in the Chukchi Sea. In addition, the Pacific crab *Oregonia gracilis* and the bivalve *Pododesmus macrochisma* were also found; the study report states that this appears to be the first time the bivalve has been reported in the Chukchi Sea, suggesting a continued warming trend in the Chukchi Sea. Fish collected in these surveys showed some possible range extensions, including Bering flounder (*Hippoglossoides robustus*) and walleye pollock. Researchers in these studies noted that, qualitatively, it appears that the benthic community in the Chukchi Sea is highly diverse and patchy, and the fish abundance and diversity in the Chukchi is far lower than in the northern Bering Sea. Mecklenburg et al. (2007) summarized the 2004 RUSALCA fish collections data from the Chukchi Sea, noting that two cottids (Arctic staghorn and shorthorn sculpin), Bering flounder, and Arctic cod accounted for 79 % of the catch by numbers.

RUSALCA studies in 2005-2006[17] continued to collect larval and adult fishes from the Bering Strait and Chukchi Sea region. Ichthyoplankton and juvenile demersal fishes were collected at approximately 18 sites in conjunction with CTD (conductivity, temperature, depth) data. Ichthyoplankton samples contained 23 taxa representing eight families; they were dominated by Arctic cod Boreogadus saida, yellowfin sole Limanda aspera, and Bering flounder. Juvenile demersal fish collections were composed of 32 taxa in nine families. Catches were dominated by Arctic staghorn sculpin Gymnocanthus tricuspis, shorthorn sculpin Myoxocephalus scorpius, and hamecon Artediellus scaber. The RUSALCA studies also include an epibenthic community structure and benthic food web structure component. More detailed results from the RUSALCA studies are pending publication.

Qualitative information on the organisms inhabiting the Arctic Ocean is available on a web site[18] that archives data on the Arctic Ocean Biodiversity Census of Marine Life project. This effort is aimed at coordinating research efforts examining the diversity in each of the major three realms: sea ice, water column and sea floor, including fish, mammals, and birds. This program's stated objective is to consolidate what is known and fill knowledge gaps. The project is the lead for the Arctic Ocean diversity cluster within the International Polar Year. Photographs of fishes collected during the RUSALCA cruises and other Arctic projects are available on this site. No reports or data are available, however.

A recent issue of Ecological Applications [18(2)] provides a new synthesis of information on the ecology of marine mammals in the circumpolar Arctic region, including summaries of information on feeding habits and how marine mammals may fare as climate changes. Bluhm and Gradinger (2008) summarized data on marine mammal prey preferences throughout the Arctic, noting the importance of Arctic cod to beluga whales, ringed seals, spotted seals, and ribbon seals. Arctic cod associate with the under ice

[16] http://www.nrc.noaa.gov/ci/locations/annualreports/cifar_FY05.pdf
[17] http://www.nrc.noaa.gov/ci/locations/annualreports/cifar_FY06.pdf
[18] http://www.arcodiv.org/index.html

community, preying on gammarid amphipods and other organisms including zooplankton, thereby providing a trophic link from the ice community to the water column and other organisms (Bluhm and Gradinger 2008). Bluhm and Gradinger (2008) state that Arctic cod are generally associated with sea ice year round, but in open water are pelagic and may occur in small groups associated with seawater wedges in offshore pack ice or in dense swarms of millions of fish. Bluhm and Gradinger (2008) also note that Arctic cod is a crucial link between the sea ice food web and arctic marine mammals and birds. It is unknown what densities Arctic cod may comprise in the overall Chukchi and Beaufort Sea ecosystems, but scientific studies of seabirds and marine mammals all conclude the major importance of Arctic cod as a prey item. Welch et al. (1992) calculated that in Lancaster Sound, in the Canadian high arctic, marine mammals and seabirds consumed 148,000 mt of Arctic cod per year.

New fish research has been initiated by NMFS in the Chukchi (program started in 2006) and the Beaufort Sea (trawl surveys began in 2008); limitede offshore results are available (see below). Preliminary information from 2006 and 2007 Chukchi and Beaufort Seas nearshore fish sampling, using beach seines and small bottom trawls, suggests that nearshore areas during summer are used by several species of forage fish, especially capelin. In samples collected both west and east of Barrow, in the Chukchi Sea and Beaufort Sea, respectively, Arctic cod were the most abundant species in the Beaufort and Capelin the most abundant in the Chukchi (Johnson et al. 2008). By area, catch was considerably greater in the Chukchi; catch was much higher using beach seine gear; and of the total catch in the surveys conducted to date, the three species accounting for 97 % of the total were capelin, Pacific sand lance, and Arctic cod (Johnson et al. 2008).

Offshore trawl surveys were conducted in November 2007 in the Bering and Chukchi Seas to collect juvenile salmon. Juvenile pink and chum salmon captured in the Chukchi Sea were significantly larger than those captured in the Bering Sea (Moss et al. 2008). Preliminary diet composition information from juvenile pink and chum salmon collected in 2007 indicates fish and euphausiids were common in their diets in the Chukchi Sea. Fish are a major prey item for juvenile pink and chum salmon in the Chukchi Sea. In the Kotzebue Sound area, juvenile pink salmon diet was primarily decapod larvae and euphausiids and juvenile chum salmon diet was a mix of euphausiids and tunicate, coelenterate, and decapod larvae (Moss et al. 2008).

As presented in "**Cruise Report for the 2008 Beaufort Sea Survey,** July 27 – August 30, 2008, F/V *Ocean Explorer*"[19] and shamelessly lifted and placed here, the Alaska Fisheries Science Center's Status of Stocks and Multispecies Assessment (SSMA) Program's Fishery Interaction Team (FIT) conducted a fish survey in the marine offshore waters of the Beaufort Sea (155°W to 152°W) during the month of August, 2008. The Minerals Management Service (MMS) provided funding for the survey. The results of the survey will provide estimates of abundance, species composition and biological information of marine fish and invertebrates, oceanographic properties and information on the macro- and micro- zooplankton communities. The distribution and abundance of adult and juvenile demersal fish and their dominant benthic invertebrate prey in offshore habitats (20 m to the shelf break) was assessed with 83-112 eastern otter trawls, the standard for AFSC bottom trawl surveys of the Bering Sea shelf. AFSC standard survey methods were followed including maintaining a constant vessel speed and monitoring of vertical and horizontal net openings with net sounders. A stratified sampling plan was employed with survey effort distributed among three strata defined by water depth: 20 – 50 m, 50 – 100 m, and 100 m – 500 m, which correspond to documented changes in water masses in the Beaufort Sea that are likely to affect the distribution of fish and their prey. Fish comprised 6% of the total weight captured in the bottom tows of which 38 species of fish were identified. Several species could only be identified to the genus or family level in the field. Of the total weight of fish captured in the bottom tows, 80% was Arctic cod and several species of eelpouts made up 13% of the total weight. Arctic cod occurred at all bottom trawl stations. All

[19] http://www.afsc.noaa.gov/REFM/Stocks/fit/PDFS/Beaufort_sea_cruise_report.pdf

species were vouchered and will be confirmed and/or identified in the laboratory at the Alaska Fisheries Science Center in Seattle. Arctic cod were also the dominant catch in the mid-water hauls by weight and numbers. A total of 798.49 kg of catch were processed and 764.11 kg was Arctic cod. The second most prevalent species in the mid-water hauls were jellyfish (*Chrysaora* sp., *Cyanea* sp., and jellyfish unid.) at 22.73 kg total for all mid-water hauls combined.

Future status of fish and fisheries in the Arctic region

Based on the above literature review, and given the potential for continued change in climate conditions, particularly oceanographic processes and the physical and chemical characteristics of ocean waters of the Bering Sea and Arctic region, some speculation could be made for the future of fishery development in this region.

Of all species reported to occur in the Chukchi or Beaufort Seas, walleye pollock and yellowfin sole presumably could develop as target fisheries well into the future if environmental conditions favor growth in biomass of these species to a level sufficient to support a sustainable harvest. However, at this time almost no information is available on these or any other fish species in Arctic waters, and a sustained research and stock survey program would be required to ascertain commercial potential for these species.

Pollock are reportedly being caught further and further north during the B season in the Bering Sea. These more northern catches could be due to warming and range expansion. If this trend were to continue, pollock biomass could increase and extend into the Chukchi Sea. Since it is a major target in the Bering Sea, it likely would be a desirable target in the Chukchi Sea. It has been collected during past surveys of the Chukchi Sea, and historic data compiled for the EFH maps indicate this species is occasionally present in the Chukchi Sea. Mecklenburg et al. (2002) document pollock in the Chukchi Sea based on records from NMFS and UAF trawl survey reports and the *Ocean Hope III* cruise in 1990.

Similar to pollock, yellowfin sole may be expanding northward in the Bering Sea as evidenced in recent years by larger catches in the bottom trawl fisheries of the northern Bering Sea, and if this trend were to continue into the Chukchi Sea, presumably yellowfin sole could be a desirable target species in the Chukchi. EFH maps indicate yellowfin sole are seasonally present and may spawn in the Chukchi Sea. yellowfin sole was one of the most abundant larval fish species collected in the RUSALCA surveys, suggesting it may be transported northward through Bering Strait or reproduce in the Chukchi. Mecklenburg et al (2002) document yellowfin sole in the Chukchi Sea based on records from UAF surveys in 1990 and 1991 and UBC collections.

But the conditions for other species may not change as speculated above. The following species occur in the Chukchi and/or Beaufort Seas, and perhaps in the far distant future, circumstances could arise that would favor the development of fisheries for some of these species. However, at this time there are insufficient data to do much more than hand waving, which is the nature of what is presented below.

Bering flounder was one of the most abundant larval and adult species collected during the RUSALCA cruises in the Chukchi Sea, and while it may be "seeded" in the Arctic from larval drift from the Bering Sea, environmental conditions may eventually change sufficiently to allow biomass of Bering flounder to increase substantially. Wyllie-Echeverria et al. (1997) concluded that Bering flounder populations in the Chukchi Sea are maintained by larval drift through Bering Strait. Mecklenburg et al. (2002) document this species in the Chukchi from UAF surveys, and they note it may possibly also occur in the Beaufort. This species is small (up to 52 cm total length), however, and while it is present in the Bering Sea, apparently Bering flounder is not a commercial target (it not listed in the "Other Flatfish" category in the 2008 BSAI SAFE). Since it is available for commercial harvest, but is not harvested and it is relatively small in size, Bering flounder is unlikely to become a fishery in the near future.

Arctic and saffron cod have been discussed above. Both species are abundant in the Arctic, and there is a small amount of use of these species in the subsistence economy of some coastal Arctic villages according to George et al. (2007). Mecklenburg et al. (2002) report both species as common in Arctic waters based on records from UAF surveys. Saffron and Arctic cod are present in the Bering Sea but are not commercial target species. Both species are conspicuous in the diets of many marine mammals and marine birds in the Arctic region, and particularly Arctic cod are the most important prey item for some species of marine mammals and birds. Arctic cod are generally small, up to 40 mm total length but more commonly up to 25 cm total length, with saffron cod a bit larger, to 55 cm total length. Because of their high importance in the diets of marine mammals and birds, their use in the subsistence economy in the region, their small size, and the lack of commercial interest in saffron and Arctic cod in the Bering Sea, these species are not likely to become targets in the near future.

Mecklenburg et al. (2002) indicate the Alaska plaice is fairly abundant in the Chukchi Sea based on UAF surveys in 1990 and 1991, and may occur in the Beaufort Sea. EFH maps show that adults may be present seasonally in the Chukchi Sea. This species is fairly small, 30-60 cm TL, but it is annually assessed in the BSAI SAFE document because of its potential commercial use. In the Bering Sea, the ABC for Alaska plaice was nearly 200,000 mt for 2008, indicating a high level of potential abundance and possibly commercial interest. However, low market interest indicates this species may not be a particularly desirable target, even if abundance increases in Arctic waters. Wilderbuer et al. (2007) indicate it is lightly harvested in the Bering Sea, generally along with yellowfin sole and in other fisheries, and often is discarded. Because of the likely low commercial interest in this species, and its low relative abundance in RUSALCA cruises, it is not likely to develop into a commercial fishery in the near future.

Starry flounder are present in the Chukchi and Beaufort Seas, and are harvested in some areas of the North Pacific Ocean. This flatfish is generally more coastally oriented according to George et al. (2007), and can be found in some Arctic rivers in brackish water. It can be fairly large in size, up to 91 cm TL, but it was not present in recent surveys conducted in the RUSALCA project. It is harvested in the Bering Sea commercial fishery for "other flatfish" and Wilderbuer et al. (2007) indicate starry flounder and rex sole accounted for 88% of the "other flatfish" harvests in the Bering Sea in 2007. Mecklenburg et al. (2002) report that starry flounder is present in Arctic waters, and EFH maps show that adults and juveniles are found in the southeastern Chukchi Sea, generally not far offshore. Because starry flounder were not present in recent surveys of the Chukchi, even though the species is commercially harvested in the Bering Sea, it does not seem probable that a directed fishery for starry flounder would evolve in Arctic waters in the near future. It could be harvested and marketed along with other species, but given its low economic value compared with several other potential target species that could emerge as fisheries in the Arctic, it does not seem likely starry flounder will become a commercial target, at least in the foreseeable future. However, local subsistence use of this species could increase, as they are harvested elsewhere as a sport or personal use species.

Red and blue king crab and the Tanner (snow) crab, *Chionoecetes opilio,* are present in the southern portions of the Alaskan Chukchi Sea, and a small red king crab fishery has occurred there in recent years, with one commercial landing reported in Kotzebue. EFH maps indicate both red and blue king crabs are occasionally present in the southern part of the Chukchi Sea, with blue king crab adults present in the Bering Strait area year round. Residents of villages in the Kotzebue Sound and Nome areas report blue and red king crab are harvested in subsistence crab fisheries in the southeastern Chukchi Sea, and red king crab are harvested north to areas offshore from Cape Krusenstern. The RUSALCA surveys in recent years did not capture red or blue king crab, but did find that opilio crab were present, but all were sub legal in size. Given the importance to subsistence fisheries, and the relatively low abundance of these crab species, it seem unlikely that a commercial fishery could develop in the near term. Opilio crab are evaluated in more detail in the draft Arctic FMP where they are considered a potential target; the reader should consult the analysis performed by stock assessment scientists in the draft Arctic FMP for more insights into the potential for an opilio fishery in the future.

The reported small red king crab "commercial fishery" near Kotzebue is based on a single ADF&G fish ticket, and anecdotal reports suggest this was either an error or subsistence-harvested crab sold illegally. This "fishery" would either be closed under Alternative 2 or exempted under Alternative 3. If this alternative were chosen, a red king crab fishery of the size and geographic extent of this historic "fishery" would be exempted from the Arctic FMP. Under Alternative 4, all crab south of Point Hope would remain under the existing BSAI crab FMP that defers management of any crab fishery to the State of Alaska. In either case, this reported red king crab fishery likely is not a true commercial fishery, and based on reports from local residents all crab targeted in the Chukchi Sea are for personal or subsistence use. Because of the importance of these species of crab in the local economy and culture, it seems unlikely a commercial fishery of any magnitude targeting these species could develop in the area.

EFH maps indicate the presence of Pacific herring, rainbow smelt, and capelin in Arctic waters. Mecklenburg et al (2002) also report these species in Arctic waters, as well as Pacific sand lance. All are important forage species in other EEZ waters off Alaska, and are not targeted commercially except as bycatch. And George et al. (2007) report that there is some subsistence use of rainbow smelt in some Arctic villages. Thus, because of their subsistence use and particularly because of their key role as forage species, a target fishery for these species in the Arctic EEZ is unlikely. Chinook, chum, pink, and sockeye salmon have been reported from Arctic waters (cf EFH maps) as has coho salmon (Mecklenburg et al. 2002) and Dolly Varden char. Salmon are PSC in other EEZ waters off Alaska, and cannot be targeted in any areas off Alaska (except the SE AK troll Chinook fishery) under the salmon FMP and thus would not be targets in the Arctic. Similarly, Dolly Varden char and several whitefish species (Arctic and least cisco, broad and occasionally round whitefish, and Bering cisco) are important as subsistence species (George et al. 2007) and would likely be considered a PSC species in Arctic waters, and therefore would not become target species in the future. PSC species are discussed under Option 2 in section 4.7 of this EA and in the draft Arctic FMP, and the reader should review the discussion and rationale for listing species as PSC in the draft FMP.

Mecklenburg et al. (2002) also report the presence of several other fish species from Arctic waters: these include spiny dogfish, Pacific sleeper shark, salmon shark, ogac (*Gadus ogac* – far eastern Beaufort Sea only), and many cottid species (butterfly, spatulate, belligerent, antlered, Arctic staghorn, ribbed, fourhorn, Arctic, plain, and shorthorn sculpins and hamecon). Presumably one or more of these species could be a desirable target for human consumption; for example, some larger cottids are harvested as food in some parts of Alaska, and some sport fisheries target sharks for human consumption. However, very little is known of these species, most have not been collected in recent surveys (cf RUSALCA data), and these species may not be present in this region except as rare, occasional or accidental visitors. Thus, at this time it is very unlikely these species could be targeted commercially in the near future. Also see below for further discussion of the importance of some of these species to local communities and subsistence.

4.2 Fisheries of the Chukchi and Beaufort Seas

Chapter 9 Regulatory Impact Review summarizes information on the commercial, sport, and subsistence fisheries in the waters of the action area. Currently only one small, and poorly documented, commercial crab fishery may have existed in the EEZ north of Bering Strait. The potential for commercial fisheries is largely unknown, although local residents indicate that personal use of crab species is common in the region, with crab taken from small skiffs, or through the winter ice, in offshore waters. Crab harvested include red and blue king crab. Since the one reported commercial landing of red king crab indicates a commercial fishery may have occurred in the region in the past, it could be argued that indeed commercial fisheries occur in the Arctic Management Area. However, anecdotal information indicates this landing may have been a mistake, and not a commercial harvest, but rather a personal use fishery landing mistakenly sold and recorded as a commercial sale. Local residents and regional state commercial fishery managers indicate that no commercial fisheries presently occur in EEZ waters of the Arctic Management Area, nor have any such fisheries occurred in the region in the past. Local residents are interested in participating in future commercial fisheries, however, should fisheries develop.

4.3 Climate Change and Uncertainty in Fish Resource Availability

While uncertainty can be a compelling reason in and of itself for limiting commercial fishing activities in the Arctic, uncertainty coupled with climate change is probably a greater factor that clearly could exacerbate the effects of a commercial fishery in the Arctic. Uncertainty in the size of fish populations, their population dynamics, their interrelationships with other marine organisms, and their ability to sustain harvest may be a compelling reason to not pursue commercial fishing until this uncertainty is removed or reduced to acceptable levels. In the Arctic where the climate is changing most rapidly, add in climate change and uncertainty increases. Recent studies suggest that ocean warming may alter distribution and abundance of forage organisms, impacting millions of waterfowl, shorebirds, and cliff-nesting seabirds that seasonally inhabit the Arctic to reproduce and fledge young (Roseneau 2007). These forage items are also likely preyed upon by fish or other marine organisms, potentially impacting the future yields of some commercially-exploited species.

To quote MMS (2006):

> The climate of the Arctic is changing. Arctic warming is altering the distribution and abundance of marine life in the Arctic. The better known fish resources (i.e., abundant species) can exhibit very large interannual fluctuations in distribution, abundance, and biomass (e.g., capelin, arctic cod, Pacific sand lance, Bering flounder). Climate change experienced in the past and apparently accelerating in arctic Alaska likely is altering the distribution and abundance of their respective populations from what was known from past surveys.

This general lack of knowledge of the seasonal ecological processes of the Arctic creates a level of uncertainty about potential effects of initiating commercial fishing in the area. Large uncertainty seems to call for conservative and precautionary measures until more information is available to support sustainable management. The Arctic experiences high variability in distribution and abundance of fish species, partly due to the high variability in physical processes. For example, in some years, winds are favorable (east winds) for the transport of young-of-the-year Arctic cisco from the Mackenzie River in Canada to nearshore Alaskan Beaufort Sea waters, while in other years west winds disfavor this transport and a cohort is missed in the future dynamics of this population (Fechhelm and Griffiths 1990; Bond and Erickson 1997). Arctic cod are patchy, occurring in large numbers in some areas during parts of the year, but may be only minimally present or absent from these same areas at other times (Craig et al. 1982; Underwood et al. 1995), partly because of unknown factors. With climate change trends comes increasing uncertainty in the seasonal and year-to-year functioning of the Arctic marine ecosystem, rendering additional uncertainty and stochasticity to fish population dynamics, potentially leading to fishery mis-management. Climate change may exacerbate the already irregular nature of the Arctic, and increase the vulnerability of fish populations to overharvest. The Council chooses to be proactive and precautionary, and prohibit commercial fish harvest until such time that scientific studies are completed to develop a better understanding of Arctic climate, oceanographic, and biological processes, and the dynamics of fish populations in the Arctic ecosystem.

4.4 Commercial Fisheries in Other Arctic Regions

Several nations that border the Arctic Ocean participate in commercial fishing in Arctic waters. According to Booth and Watts (2007), Canada's arctic fisheries occur within the United Nations Fish and Agriculture Organization's (FAO) statistical areas 18 and 21. The Canadian Arctic is characterized by small coastal communities with high dependence on marine mammals and fish. Commercial fisheries started in the late 1950s in the Iqaluit area, but by 1960 several additional areas initiated commercial fisheries. Between 1960 and 1996, Booth and Watts (2007) report that 26 communities participated in commercial fishing of some sort. Fish are also harvested in small scale subsistence fisheries, and fish are used for human consumption and as food for sled dogs, but not for commercial sale. In the subsistence fisheries, most of the fish are used as dog food (approximately four times as much); human consumption is a small fraction of the total subsistence harvest. Commercial harvest is even smaller. In recent years, harvests have declined from higher levels in the 1950s when an average of 466 kg per person per year of fish were harvested for both human use and dog food, to 32.7 kg per person per year in 2001. Charr (*Salvelinus alpinus*) are the predominant species harvested (86% of all catches), with other species accounting for the remainder. Other species include whitefishes, flounder, Arctic and saffron cod, sculpins, and Dolly Varden.

Pauly and Swartz (2007) report on marine fisheries of four large marine areas offshore from Siberia: the Kara, Laptev, East Siberian, and Chukchi Seas. Based on few data, they calculate harvests of fish from the Kara Sea at 4,000 mt, but decreasing in recent years; about 4,000 mt per year each from the Laptev and East Siberian Seas; and 100 mt per year from the Russian portion of the Chukchi Sea. Coregonid species were the largest portion of commercial catches in the Kara, Laptev, and East Siberian Seas. Pauly and Swartz (2007) note that harvests come from the lower segments of rivers, estuaries, and nearshore marine areas. Commercial harvests from the Kara Sea also include some Siberian sturgeon (*Acipenser baeri*) from the lower segments of larger rivers and report this species is in a critical state because of heavy commercial exploitation, oil pollution, and hydroelectric development. Another Kara Sea fishery is for smelt (*Osmerus mordax*). Pauly and Swartz (2007) reported no other fisheries for the Laptev Sea other than whitefishes, perhaps due to the impoverished fish fauna in this part of the Arctic. They did estimate up to 10-30% of fish harvested from the Laptev Sea area have been non-Coregonid species. Similarly, mostly Coregonid species are harvested in the East Siberian Sea. In the Chukchi Sea, Pauly and Swartz (2007) estimate that the human population of about 1,000 people along the Siberian coast of the Chukchi could harvest about 90-100 mt per year. Again, most species harvested in Siberia from the Chukchi Sea are likely Coregonids. A recent report (J. Balsiger, NMFS, All Hands Memorandum 10/3/08) indicates that the Russians plan to embark on a fishing fleet rebuilding program and expand fisheries research efforts in the Chukchi Sea in 2009.

Additional information on Arctic and saffron cod are available in FAO reports. The following sections have been excerpted from two of these reports. Figure 4-1 shows the global harvest of Arctic cod, which is greatly reduced from harvest levels in the 1970s.

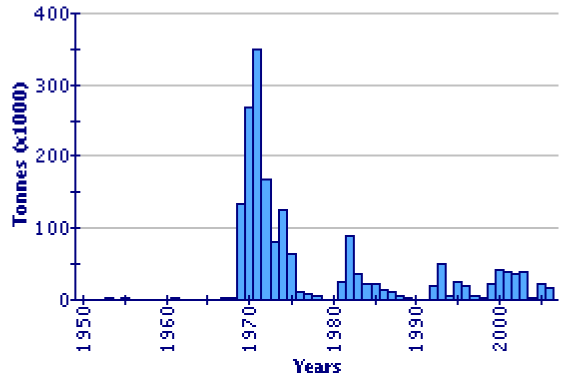

Figure 4-1 Global Capture production for *Boreogadus saida* **(FAO Fishery Statistics)**

Arctic cod used to be intensively fished by former USSR, Norway, Danish and German vessels using bottom trawl and mid-water trawl. The fishing grounds are the European part of former USSR, Barents and White Seas, and the northwest Atlantic. The fish is pursued from January through May producing massive catches during February. In 1984, world catches totaled 23,709 t, and after that year they declined steadily, although the stocks are little affected by fishing because r-selected species can support higher levels of fishing mortality and have a quicker recovery time. The total catch reported for 1987 in the FAO Yearbook for Fishery Statistics is 11,713 t, all taken by former USSR.

In Canadian waters, Arctic cod has a limited commercial value because it is small and apparently not abundant. The flesh is said to be of low quality. It is exploited in a minor way as an industrial fish, but has great potential for increased catches. Its major utilization by Norwegians is for fish meal and oil. The total catch reported for this species to FAO for 1999 was 22,005 t. The countries with the largest catches were Russian Federation (22,005 t).

Figure 4-2 shows the global harvest of saffron cod, which has not experienced large decreases in harvest as seen for Arctic cod.

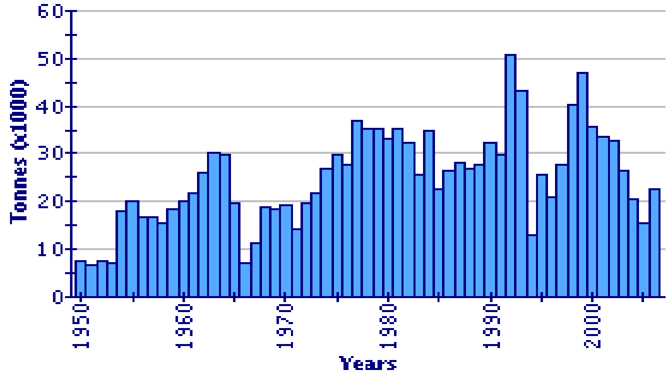

Figure 4-2 Global Capture production for *Eleginus gracilis* **(FAO Fishery Statistics)**

Saffron cod is taken commercially in many areas of the northwestern Pacific and harvested for almost 100 years. Until 1973, total catches fluctuated between 6,600-22,300 t annually, they increased continuously in recent years to an average of 39,000 t/year between 1977 and 1980. The major fishing grounds are in the western North Pacific: Peter the Great Bay, Sakhalin region, Sea of Okhotsk and Kamchatka waters. Fishing is carried out during late autumn and winter by the USSR and, in Norton Sound, by Alaskan fishermen. Fishing gear used is not highly mechanized and includes hook and line, beach and Danish seines, gill nets, hoop-nets, fyke nets, and trawls. The catch reported for 1987 in the FAO Yearbook of Fishery Statistics is 27,929 t, all taken in the northwestern Pacific by USSR. The catch reported for 1996 in the FAO Yearbook of Fishery Statistics is 21,110 t, all taken in the northwestern Pacific by USSR. The size of the saffron cod does not permit its substitution into existing Pacific cod and walleye pollock markets and costs would not permit it to be profitably used in the pet food industry. The total catch reported for this species to FAO for 1999 was 47,032 t. The countries with the largest catches were Russian Federation (47,032t). It is used for human consumption in USSR, fresh or frozen.

The most heavily commercially exploited Arctic marine area is the Barents Sea where fish are harvested both by Norway and the Russian Federation. The Barents Sea is quite different from other arctic seas discussed above. Relatively shallow and supplied with nutrients from adjacent rivers and water transported north from the Atlantic, production is moderately high. Atlantic Ocean water is important for zooplankton vital to the productivity of the Barents Sea (Hunt and Megrey 2005). Highly variable climatic and oceanographic conditions, however, create conditions where primary and secondary productivity is also irregular, resulting in interannual variability in fish recruitment. Atlantic cod (*Gadus morhua*) are the dominant gadid species (Hunt and Megrey 2005); cod harvests are around 250,000 mt annually. While the Barents Sea has supported very large biomass levels of capelin (*Mallotus villosus*) in some years, such as in the late 1970s when harvests were around 2.5 million mt annually, the stock subsequently declined to levels supporting annual fisheries of about 1 million mt. But the capelin stock then collapsed and the fishery was closed in 2004 (WWF Undated). Capelin and other forage species are important trophic links between zooplankton and larger fish targeted by commercial fisheries. The WWF (Undated) reported annual harvests of all fish from the Barents Sea area of 354,200 mt in 2002. Russian scientists introduced non-native red king crab (*Paralithodes camtschatikus*) to the Barents Sea reportedly in the 1960s, and crab are now harvested by both Norwegian and Russian fishers. Russia's quota for 2006 was 3 million crab and Norway's at 300,000 crab. The WWF (Undated) notes that introduced crab in the Barents Sea could result in adverse competitive interaction with other marine species. Barents Sea fishery quotas for trans-boundary species are established annually by the joint Russian Norwegian Fisheries Commission.

Commercial species from the Barents Sea include capelin, Atlantic cod, haddock (*Melanogrammus aeglefinus*), Arctic cod (*Boreogadus saida*), Atlantic herring (*Clupea harengus*), and wolfish, flatfish, and redfish. Red king crab, shrimp, and scallops also are harvested commercially. Hunt and Megrey (2005) compared the productivity of the Barents Sea with the Bering Sea, noting differences in bathymetry, nutrient input and productivity, and major ecosystem fish species. Noting that flatfish were heavily exploited in the Bering Sea, no flatfish species was among the top five fishery harvests from the Barents Sea. Hunt and Megrey (2005) reported the top five fishery harvests from the Barents Sea summed for the years 1998-2002 were 1.78 million mt cod, 1.1 million mt herring, 0.56 million mt capelin, 0.34 million mt haddock, and 0.29 million mt shrimp.

4.5 Arctic Fish Species Not in the Arctic FMP

The Council intends to not include in the Arctic FMP fish species harvested in Native or community subsistence and personal use fisheries, species that are subject to already existing commercial fisheries in State waters, and species that are entirely dependent on largely state coastal waters for the periods of time they occur in marine waters. These fish species include Dolly Varden char, Pacific herring, and whitefish. Additionally, the Council does not intent to close fisheries for species managed under existing federal FMPs or international agreements. Therefore, the Arctic FMP will not manage salmonids or Pacific halibut.

Dolly Varden char (taxonomically distinct from Arctic char) are migratory between fresh and marine waters. They spawn near headwater springs in some rivers of the Arctic, and migrate to sea at age 4+. They return to fresh water annually to overwinter, and when mature, to spawn. They are subject to sport fishing, particularly in the eastern Arctic area such as in the ANWR area. They are also taken to a small extent in coastal subsistence fisheries of the Beaufort and Chukchi coastal areas and rivers. Their life cycle is essentially like the salmon's, occur mostly in State waters, and are managed by the State as a sport fish. Dolly Varden migrate to sea annually, but generally remain in nearshore, brackish waters to feed on other fish and on benthic mysids and amphipods.

Herring are rare in the Arctic, but when present spawn coastally and thus for an important portion of their life cycle are present in State waters. They are harvested to a small extent for subsistence purposes, but, since they are rarely encountered, are not prevalent in subsistence catches. This species is more appropriately managed by the state because of their use of coastal, nearshore habitats for reproduction.

Whitefish are in a similar life history category as Dolly Varden, overwintering in fresh water but foraging in nearshore marine waters during the open water period (late June to September). Several species occur seasonally in the nearshore, brackish coastal waters when they migrate out of rivers to feed, remaining in the estuarine-like waters until freezeup. This band of brackish water is one or more kilometer in width, expanding and contracting in size as winds shift and either bring offshore marine waters closer to shore or divert nearshore waters more offshore. With the onset of winter, freezing nearshore waters gradually constrict available habitat until the nearshore zone is frozen to the seafloor, constricting habitat available to fish. Whitefish are not tolerant of higher salinities, and thus migrate into rivers to overwinter in pockets of unfrozen water in lower rivers and deltas. These species are essentially in state waters nearly their whole life. Whitefish species include Arctic and least cisco, Bering cisco, broad whitefish, humpback whitefish, and round whitefish. Arctic and least cisco, as well as broad whitefish and several other species, are harvested annually in a state-managed fishery in the Colville River delta. Caught by under-ice gill nets, these species are already under state management.

4.6 Impacts of Alternatives on Fish and Shellfish Resources

This section analyzes the impact of the alternatives on fish and shellfish resources of the Arctic region. Evaluation criteria have been developed for environmental components recently in the Bering Sea Habitat Conservation EA (NMFS 2008b). The analysis used in this EA is based on the significance criteria used in the Bering Sea Habitat Conservation EA (NMFS 2008b) because of the similar type of action analyzed and the latest techniques for analyzing effects provided by these analyses.

The four ratings used to assess each potential effect for all environmental components analyzed in this EA are:

Significantly negative: Significant adverse effect in relation to the reference point. Information, data, and/or professional judgment indicate that the action will cause a significant adverse effect on the resource.

Insignificant impact: Insignificant effect in relation to the reference point. Information, data, or professional judgment suggests that the action will not cause a significant adverse effect on the resource.

Significantly positive: Significant beneficial effect in relation to the reference point. Information, data, and/or professional judgment indicate that the action will cause a significant benefit to the resource.

Unknown: Unknown effect in relation to the reference point. Information is absent to determine a reference point for the resource, species, or issue and data are insufficient to adequately assess the effect of the action or the direction of the effect of the action. Professional judgment also is not able to determine the effect of the action on the resource.

The reference point condition, where used, represents the state of the environmental component in a stable condition or in a condition judged not to be threatened at the present time. For example, a reference point condition for a fish stock would be the state of that stock in a healthy condition, able to sustain itself, successfully reproducing, and not threatened with a population-level decline. Each environmental component analyzed includes the significance criteria used to evaluate the proposed alternatives. Significance findings for social and economic impacts would not by themselves require the preparation of an EIS; see 40 CFR 1508.14. Economic and social impacts are described in Chapter 9 Regulatory Impact Review. In light of 40 CFR 1508.14, significance determinations are not made for these impacts.

The significance criteria used to evaluate the effects of the action on fish and shellfish species is in Table 4-1. These criteria are based on the significance criteria used in the Bering Sea Habitat Conservation EA (NMFS 2008b), which provides a recent method for determining significance on a similar resource as some species occur in both the Bering Sea and in the Arctic Management Area. The significant positive effect for fishing mortality in NMFS 2008b is based on an area where fishing have taken place and is described as allowing the stock to return to an unfished biomass. Because the Arctic region fish stocks are essentially unfished, no significant positive effect on fishing mortality could be identified for this analysis.

Table 4-1 Criteria used to estimate the significance of effects on the Fish and Shellfish stocks.

Effect	Criteria			
	Significantly Negative (-)	**Insignificant (I)**	**Significantly Positive (+)**	**Unknown (U)**
Stock Biomass: Potential for increasing and reducing stock size	Changes in fishing mortality are expected to jeopardize the ability of the stock to sustain itself.	Changes in fishing mortality are expected to maintain the stock's ability to sustain itself.	Changes in fishing mortality are expected to enhance the stocks ability to sustain itself.	Magnitude and/or direction of effects are unknown
Fishing mortality	Reasonably expected to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Reasonably expected not to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	No significant positive effect identified because Arctic stocks are unfished.	Magnitude and/or direction of effects are unknown
Spatial or temporal distribution	Reasonably expected to adversely affect the distribution of harvested stocks either spatially or temporally such that it jeopardizes the ability of the stock to sustain itself.	Unlikely to affect the distribution of harvested stocks either spatially or temporally such that it has an effect on the ability of the stock to sustain itself.	Reasonably expected to positively affect the harvested stocks through spatial or temporal increases in abundance such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown
Change in prey availability	Evidence that the action may lead to changed prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action will not lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action may result in a change in prey availability such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown

The Council's objective for Alternatives 2, 3, and 4 is to create a federal FMP that closes the Arctic region to commercial harvest of all fish and shellfish species, except for the limited Kotzebue red king crab fishery under Alternatives 3 and 4. If no new fisheries are developed, then no impacts of selecting any of the alternatives are evident other than maintaining essentially the status quo. The primary difference is that, under Alternative 1, the state could open a new or developing fishery under its regulations, and no federal or state authority would be in place to prevent unlicensed vessels from fishing in the Arctic EEZ. Under Alternative 2, 3, and 4, the federal Arctic FMP would need to be amended to allow for the development of a commercial fishery and any new fishery would need to comply with applicable federal law.

As discussed below, the alternatives would have different impacts on the small red king crab fishery currently prosecuted in the southern Chukchi Sea area near Kotzebue. Alternative 2 would close this small fishery in the EEZ. Alternatives 1, 3, and 4 would allow the state to authorize a fishery. More detail is provided below.

4.6.1 Alternative 1 Status Quo Impacts

Currently, the Council recognizes that there is not sufficient information on species of fish or shellfish, or other marine species that would fall under the management responsibility of the Council, to sustainably manage a commercial fishery in the Arctic Management Area. A summary of what is known of the fish species present in the Arctic Management Area is provided in section 4.1.

Under Alternative 1, the State has not opened commercial fishing in the Arctic EEZ, except for the red king crab fishery in the southern Chukchi Sea. However, the State has the authority under their regulations and under the Magnuson-Stevens Act to open commercial fisheries in the EEZ since no federal FMP currently covers this area except for the crab FMP, which defers certain management authorities to the State. For fishing to occur, explicit regulations allowing fishing in the Arctic EEZ would need to be analyzed by ADF&G and promulgated by the Alaska Board of Fisheries. A fishery under State regulations, in the absence of a federal FMP, would not need to comply with the Magnuson-Stevens Act, NEPA, the Regulatory Flexibility Act, or EO 12866.

The potential effect of Alternative 1 on fish and shellfish resources is the possibility of uncontrolled commercial fishing. Currently, there is no indication that commercial fishing on any Arctic species is being planned, but the potential for fishing may become greater as fish species occurrence, stock biomass and distribution, and ice conditions change with global warming. Unmanaged commercial fishing impacts on those species that have been identified as potential target species may jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis. Commercial fishing that may target spawning aggregations may impact the spatial and temporal distribution of the target species, affecting the ability of the species to reproduce effectively to allow the stock to sustain itself. In addition, any uncontrolled commercial fishing that may target an Arctic prey species, such as Arctic cod, may affect the prey availability to other fish resources that depend on that prey species. Alternative 1 allows **potential significant negative effects on fish and shellfish resources** by not preventing uncontrolled commercial fishing in the Arctic Management Area. The likelihood of the significant effects occurring would depend on the level of participation in the fishery, time and area of harvests, amounts of harvests, and the biology of the targeted and bycatch species.

4.6.2 Alternatives 2, 3, and 4

Alternatives 2, 3, and 4 would adopt an Arctic FMP that would (1) close the Arctic to commercial fishing until information improves so that fishing can be conducted sustainably and with due concern to other ecosystem components; (2) determine the fishery management authorities in the Arctic and provide the Council with a vehicle for addressing future management issues; and (3) implement an ecosystem-based management policy that recognizes the resources of the Alaskan Arctic and the potential for fishery development that might affect those resources, particularly in the face of an apparently changing climate.

Alternatives 2, 3, and 4, would implement a process for the Council to conside authorizing a commercial fishery. Certain fish species that are fished commercially in other EEZ waters off Alaska outside the Arctic are known to occur in the Arctic Management Area. However, very little information is available on these species. Many fish species are important in the diets of marine mammals, seabirds, and other fishes, as well as to some residents of villages in the region. Arctic cod are prominent in the diets of several marine mammals, particularly seals. The ecosystem importance of Arctic cod and other species is discussed in the ecosystem description presented in the draft Arctic FMP. Also, subsistence and personal use of these species would not be regulated under this FMP. The FMP does not cover salmonids, whitefish, Dolly Varden char, Pacific halibut, or Pacific herring. Conservation and management measures contained in this FMP apply exclusively to domestic fishing activities. No foreign harvesting or processing of any fish resource is authorized in the Arctic Management Area.

Two options exist for developing the MSA required conservation and management measures for arctic fish species. These are described in detail in the draft Arctic FMP and discussed in the subsequent section.

Under Alternative 2, commercial fishing on any species would be prohibited. Under Alternative 2, the crab FMP would be amended to terminate its geographic coverage at Bering Strait. A single, multi-species FMP would provide the authority for commercial fisheries in the Arctic Management Area. Since no fishery on any of these species currently occurs in the Arctic EEZ, there would be no impacts on fish species of the prohibition. If the small previously recorded red king crab fishery were indeed a commercial fisheries, then such a fishery would be prohibited in the future; however, the recorded crab fishery is considered to be a mistaken record. No impacts on personal use fisheries would occur because those fisheries would not be managed under this Arctic FMP. Alternative 2 would prevent the potential for significant impacts on fish resources that may occur under Alternative 1; therefore, Alternative 2 has the beneficial effect of protecting the fish and shellfish resources from the potential effects of uncontrolled commercial fisheries. Because no commercial fishing is occurring now (assuming the red king crab fishery in Kotzebue is personal use) no changes to fishing mortality, spatial or temporal distribution, stock biomass or prey availability would occur under Alternative 2**. The effects of Alternative 2 are therefore insignificant**.

Under Alternative 3, the crab FMP would be amended to terminate its geographic coverage at Bering Strait. A single, multi-species FMP would provide the authority for commercial fisheries in the Arctic Management Area. Alternative 3 would prohibit commercial fishing on any fish species. However, under Alternative 3, the Council would exempt a red king crab fishery, of the size and nature of the previously-recorded crab harvest, from the Arctic FMP. Any exempted red king crab fishery would be managed by the State. The fishery would be limited in geographic scope to the location from which previous harvests occurred, known to be the area offshore from Cape Kruzenstern. No other crab fishery would be allowed, however, under this alternative, nor would crab fishing outside the location where it previously occurred be permitted. Thus, under Alternative 3, the small red king crab fishery could continue in future years, but it would be limited to very small annual landings, and could be prosecuted only in the area where harvests previously occurred. The Council and the State would consult and define the details of such a fishery. No known scallop resources occur in the Arctic Management Area. Since no fishery on scallops or other species, except for red king crab, currently occurs in the Arctic EEZ, there would be no impacts on fish species of the prohibition. This alternative specifically allows for a small red king crab fishery to occur in the region, managed outside any Federal FMP. Because all fisheries would be managed either by the NMFS or the State**, the effects of Alternative 3 on fish and shellfish resources are the same as alternative 2 and are therefore insignificant**.

Under Alternative 4, commercial fishing on any species would be prohibited, except that a crab fishery would be allowed but managed under the federal BSAI crab FMP. Under Alternative 4, the Council would continue to manage all fisheries in the Arctic Management Area, including crab fisheries, and would prohibit commercial fishing on all species except for crab. Under this alternative, then, the BSAI crab FMP would be the guiding policy for crab management in the Chukchi Sea up to the northern limit of the crab FMP (the latitude of Point Hope). Should crab fisheries develop in the future north of Point Hope, the Arctic FMP would be the regulatory policy for such fisheries. Thus, the BSAI crab FMP would not be amended under Alternative 4. Since no fishery on any of these species currently occurs in the Arctic EEZ, there would be no impacts on fish species of the prohibition. Because all fisheries would be managed either by the NMFS or the State, **the effects of Alternative 4 on fish and shellfish resources are the same as alternative 2 and are therefore insignificant**.

4.7 Impacts of the Options on Fish

Either Option 1 or 2 or a combination of the features of Options 1 and 2 must be chosen under Alternative 2, 3, or 4 to meet the MSA required provisions for an FMP to (1) assess and specify the present and probable future condition of, and the maximum sustainable yield and optimum yield from, the fishery and

(2) specify objective and measurable criteria for identifying when the fishery to which the plan applies is overfished or when overfishing is occurring. These procedures described under theses option are the focus of this analysis as no fisheries are expected to open under the Alternatives analyzed, except potentially the small Kotzebue Sound crab fishery. The stock assessment and specifications process under either option would be conducted every three years unless new information indicates a shorter time interval.

Option 1: Specify maximum sustainable yield (MSY), status determination criteria (both maximum fishing mortality threshold (MFMT) and minimum stock size threshold (MSST)), optimum yield (OY), annual catch limits (ACL), and annual catch target (ACT) for the fisheries that the plan is intended to manage. Managed fisheries are those identified as having a non-negligible probability of developing within the foreseeable future.

Option 2: Create 4 categories of FMP species, identify species in each category, and create a process for moving species from the ecosystem component (EC) category to the Target Species category. Categorize all species of Arctic finfish and shellfish as EC species or prohibited species. EC and prohibited species are not considered managed fisheries under the FMP and do not require specification of reference points such as MSY, OY, and status determination criteria, therefore no reference points are provided in this option. Reference points would be developed for a species to move it into the Target Species category.

The discussion of Options 1 and 2 reflects the following assumptions.

- Alternatives 2, 3, and 4 would adopt a new multispecies FMP for the Arctic Management Area that would close all federal waters in the Arctic Management Area to commercial fishing for all fish species, except salmonids, whitefish, Dolly Varden char, Pacific halibut, or Pacific herring.

- The Council has stated its intent to not disrupt or prohibit any local or small-scale fisheries in the Arctic Management Area, and thus it is likely the Council will adopt a preferred alternative that would specifically exempt from federal management the red king crab fishery in the Chukchi Sea. The fishery that would be exempted would be the fishery of the size and geographic scope of the historic red king crab fishery in the eastern Chukchi Sea.

- The Arctic FMP will specify the process under which the Council would consider fishery development in the future. Essentially, that process would be a planning effort that the Council would initiate to collect the information that the Council would need to determine the efficacy of establishing regulations to allow prosecution of a fishery.

- Conservation and management measures contained in the FMP would apply exclusively to domestic fishing activities. The FMP would not authorize foreign harvesting or processing of any fish resource in the Arctic Management Area.

Options 1 and 2 present administrative methods for achieving the same results as intended by Alternatives 2, 3, and 4 analyzed in this EA: to prohibit commercial fishing. Because these options describe an administrative process for scientific assessment that results in prohibiting commercial fishing in the Arctic, the effects of these options on the environment and on management resources will be the same. Either option 1 or option 2 may be selected with Alternatives 2, 3, and 4 and would produce the same results. The effects of the options are analyzed under Alternatives 2, 3, and 4. Additionally, both options would require an FMP amendment to authorize a fishery and the FMP amendment would need to comply with the MSA and would require a NEPA analysis of the specific measures proposed and alternatives to those measures.

4.7.1 Data Sources and Abundance Estimates

The Arctic FMP will be based on the best available information. The following is a summary of the information analyzed to develop Option 1 and Option 2 for management of Arctic fisheries.

In 2008, data were scarce for estimating the abundance and biomass of Arctic fishes. Since the 1950s, several exploratory surveys have been conducted in the Chukchi and Beaufort Seas. Of these, data for only two were available for analysis in the databases maintained by the Resource Assessment and Conservation Engineering division of the Alaska Fisheries Science Center (AFSC). In 1976, a bottom-trawl survey of the southeastern Chukchi Sea was conducted by the Northwest and Alaska Fisheries Center (Wolotira et al. 1977; Figure 4-3). In 1990 and 1991, a multidisciplinary study of the northeastern Chukchi Sea was conducted by the School of Fisheries and Ocean Sciences of the University of Alaska Fairbanks (Barber et al. 1994) that included a comprehensive bottom-trawl survey (Barber et al. 1997; Figure 4-3). Both of these studies used the same gear, a NMFS standard 83-112 survey otter trawl with a 25.2 m head rope and a 34.1 m footrope. The 1990 and 1991 surveys employed electronic net mensuration gear to obtain data on actual net width.

The 1990 survey was used to produce biomass estimates for the analysis in this FMP for three reasons: 1) it had the widest spatial coverage and greatest amount of available data of any of the surveys; 2) it was more recent than the 1976 survey; 3) the availability of data on net width provided more accurate estimates. Data from 1976 and 1991 are presented below to provide a description of temporal and spatial variability in the Alaskan Arctic. The Chukchi and Beaufort Seas are very different oceanographically as well as biologically, so the two areas were treated separately for this analysis. Because no usable survey data were available for the Beaufort Sea, this analysis is for the Chukchi Sea only. A NMFS exploratory survey was conducted in the Beaufort Sea in August 2008 and data from that study will be incorporated into this FMP as they become available.

4.7.1.1 Biomass estimates for the Chukchi Sea

Catch-per-unit-effort (CPUE) for each station of the survey was calculated by the swept-area method. The catch weight for each species in each haul was divided by the area swept during the haul (distance hauled X measured net width) to produce an estimate of kg/km^2. Values for all hauls within the analysis area were averaged to produce an area-wide CPUE estimate for each species. This mean value was multiplied by the total analysis area of the Chukchi to produce an estimate of total biomass.

Only part of the Alaskan Chukchi Sea area was included in this analysis. Fishing is likely to occur only on the continental shelf and upper continental slope, and is unlikely in very shallow nearshore areas. Therefore, the analysis area was limited to waters where bottom depths ranged from 20 to 500 m (Figure 4-3). The analysis area was also bounded by Bering Strait and the U.S. borders with Russia and Canada. Bathymetry data from the International Bathymetry Chart of the Arctic Ocean and an Albers Equal Area projection were used in this analysis. The total analysis area for the Chukchi and Beaufort Seas was 257,329 km^2. Although a precise boundary between the two seas is difficult to establish, the Beaufort section of this area was approximately 15% of the total. To obtain the area of the Chukchi section, the total area was multiplied by 0.85 to yield an analysis area of 218,730 km^2.

4.7.1.2 Temporal variability: 1990 vs. 1991

Eight of the stations sampled in 1990 were sampled again in 1991, using the same gear (Figure 4-3). Biomass data from the 1991 study were not available for analysis; however relative abundance data for these eight stations were obtained from the literature (Barber et al. 1997). The density (number of fish/km^2) for the eight stations was averaged to produce annual estimates of relative abundance for a subset of species (Table 4-2). The comparison between 1990 and 1991 suggests there is substantial interannual variability in fish abundance. Most of the listed species were more abundant in 1990, and several species caught in 1990 were not observed in 1991. Three species were more abundant in 1991. Only warty sculpin abundance was similar between years.

4.7.1.3 Temporal and spatial variability: 1976 vs. 1990

Biomass data were available from the 1976 survey and were used to compare biomass of species groups between 1976 and 1990. The fishing gear used in both surveys was the same (Wolotira et al. 1977), but the 1976 survey did not provide measurements of actual net width. The average net width in the 1990 survey (15.276 m) was used to calculate CPUE for the 1976 survey. The two surveys did not cover the same area: the 1976 survey focused on the southeastern Chukchi, while the 1990 survey covered the northeastern Chukchi (Figure 4-3). Species groups for commercial crabs (snow, red king, and blue king), molluscs, and shrimps were analyzed as well as the major fish species groups.

As in the interannual comparison, biomass estimates varied considerably between the two surveys (Table 4-3). The biomass of most species groups was greater in 1990, as was the total fish biomass. There was no spatial overlap between the two surveys. As a result, it is difficult to know whether the differences in the biomass estimates between the two years are a result of temporal or spatial variability. It is likely that the differences are a result of both, which underscores the difficulty of estimating species biomass for this region.

4.7.1.4 Chukchi Sea snow crab size composition and comparative abundance

It should be noted that snow (*Chionoecetes opilio*) crabs in Arctic Alaska appear to be much smaller than snow crabs in the Bering Sea. During the 1991 survey of the northeastern Chukchi Sea (Barber et al. 1994; see Figure 4-3 for station location), snow crab carapace width varied with latitude. Carapace width of females averaged 35 mm and 45 mm at two stations in the southern part of the survey area, and 33 mm at the survey's northernmost station. Mean carapace width data were not available for males, but the mode of male carapace width was 50 mm in the south and 45 mm in the north. No males were observed larger than 85 mm and very few were larger than 75 mm.

Paul et al. (1997) reported additional data from the same surveys reported by Barber et al. (1994). They noted the average carapace width of gravid female opilio crab from the Chukchi Sea was 46 mm (smallest was 34 mm) and that all male opilio crab 35 mm or greater had spermatophores.

Additional information on opilio crab maturity in the Arctic is available in Jewett (1981). Jewett compared maturity characteristics of Chukchi Sea opilio crab collected during the Outer Continental Shelf Environmental Assessment Program and opilio crab from the Bering Sea, the Gulf of St. Lawrence, the Sea of Japan, and other locations. Jewett (1981) reported the smallest mature opilio crab from the Chukchi Sea was 40.3 mm carapace width, and average size at maturity was the same as that for females from the Gulf of St. Lawrence – about 50 mm. He noted that size at maturity for crab from Korean waters was 63 mm, from the Sea of Japan was 50-55 mm, and from the Gulf of Alaska was approximately

80 mm. In terms of overall size, Jewett (1981) reported that the largest Chukchi Sea female opilio size class was about 15 mm smaller than the largest size class from the Bering Sea.

Fair and Nelson (1999) collected opilio crab in their 1998 surveys of the Chukchi Sea. While relatively abundant, the crab were almost entirely immature females and sublegal males.

NMFS bottom trawl surveys of a segment of the continental shelf and slope in the Beaufort Sea (155˚ to 152˚ W) in 2008 collected opilio crab with carapace widths from 55 to 119 mm, with the average 80.5 mm (L. Logerwell, pers. com.). Of the live invertebrates captured, opilio crab were second most abundant by weight and comprised about 10% of the biomass. While it appears that these Beaufort Sea opilio crabs were on average larger than opilio collected in the Chukchi Sea, the size at maturity of the Beaufort Sea crab is unknown.

The above information suggests that opilio crab from the Arctic reach maturity, but may mature at smaller size than crabs in more southerly latitudes. The data also suggest that while biomass of opilio crab may be fairly high, it is questionable if this would support a viable fishery, given many factors that may constrain a fishery. The importance of opilio crab as prey for marine mammals may be a constraint to commercial development; for example, Frost and Lowry (1983) reported that opilio crab are important components in the diet of bearded seals. Also, most of the Arctic opilio crab may be smaller than the minimum size limit for retention of male snow crab in the Bering Sea fishery (78 mm) and well below the minimum size preferred by the snow crab market (101 mm; Turnock and Rugolo 2008). Distance from processing facilities and markets could also constrain fishery development; cost of fuel and time to travel to/from the Arctic could limit or render or hinder unfeasible any fishery development.

The area swept biomass from a 1990 survey in the Chukchi Sea resulted in a biomass estimate of 147,196 t for snow crab (section 4.7.2.2). In comparison, the eastern Bering Sea total mature biomass from 2008 surveys is 509.4 million lbs or 254,700 tons (Turnock and Rugolo, 2008). Table 8-1 also shows a comparison of biomass in 1991 between the Chukchi Sea and eastern Bering Sea biomass with the Chukchi Sea having approximately one third the density of crabs compared to the Beirng Sea. The eastern Bering Sea model for biomass estimates showed a peak in the 1990s so the comparison of a 1990 Chukchi survey to a 2007 Bering Sea survey during the snow crab rebuilding process is not likely a meaningful comparison of current biomass conditions in the Chukchi and Bering Seas.

4.7.1.5 Forage fish species

The Council's intent is to prohibit commercial fisheries in the Arctic Management Area, including particularly forage fish species. The Council explicitly included this measure in its motion to initiate development of an Arctic FMP and the alternatives to be considered in the analysis. Forage fish are prey for other marine ecosystem fauna including other fish, birds, and marine mammals. Alternatives 2, 3 and 4, and options discussed in the next sections (4.7.2 and 4.7.3) include the prohibition on fishing for forage species, either explicitly (as described in 4.7.2.4) or implicitly in section 4.7.3.1. Many of the species listed as Ecosystem Component species are considered prey for other fauna.

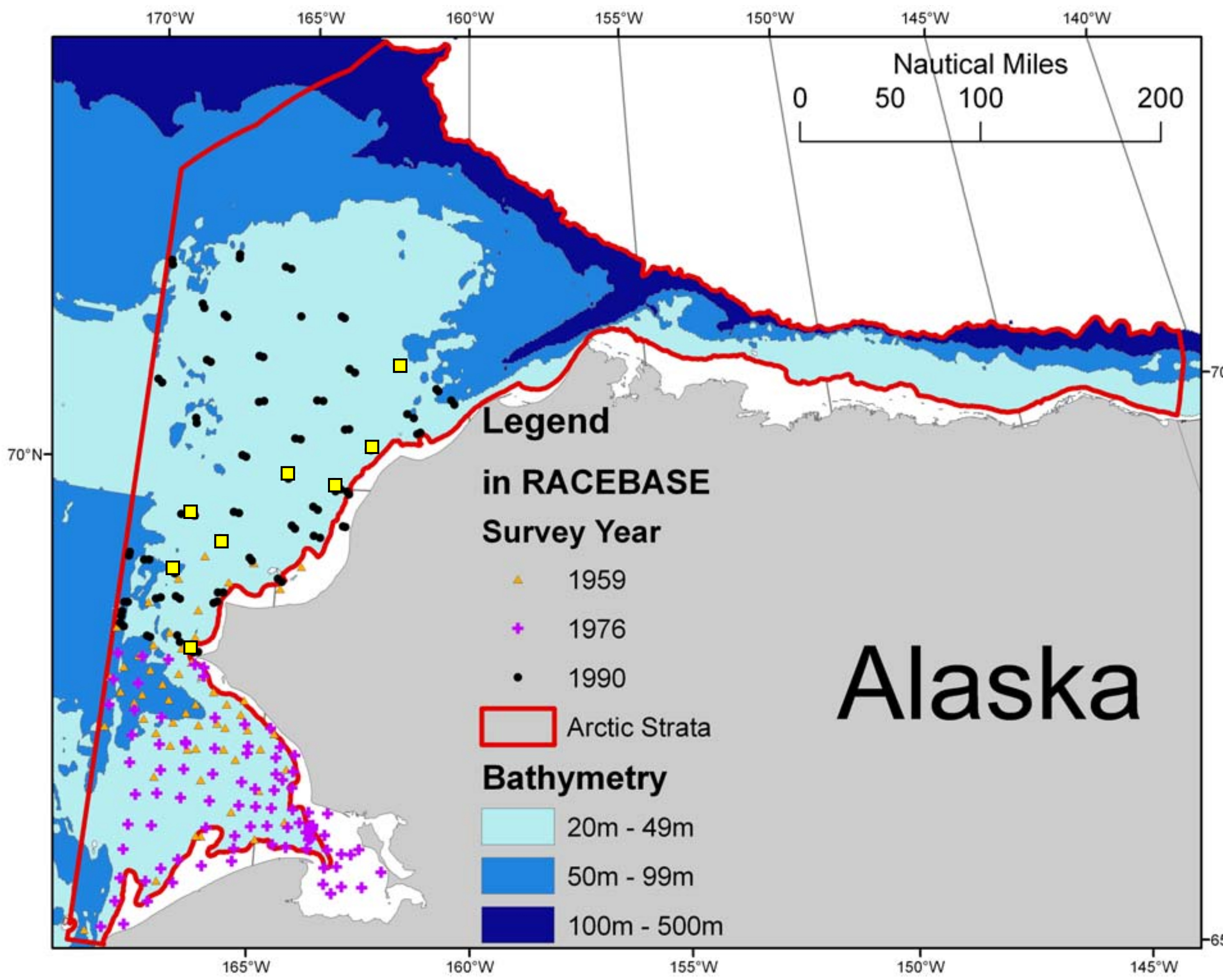

Figure 4-3 **Map of the Alaskan Arctic indicating analysis area, bathymetry, and locations of survey stations. Yellow boxes indicate stations sampled in both 1990 and 1991.**

Table 4-2 Comparison of fish density (number of fish/km^2) in the Chukchi Sea between 1990 and 1991. Ratio 91/90 is the ratio produced when the 1991 values are divided by the 1990 values.

	density (# of fish/km^2)		
	1990	1991	ratio 91/90
Arctic cod	21,301	4,646	22%
Arctic staghorn sculpin	364	803	221%
warty sculpin	317	313	99%
miscellaneous sculpins	241	8	3%
Bering flounder	208	21	10%
marbled eelpout	201	27	13%
wattled eelpout	139	25	18%
Pacific herring	137	0	0%
Pacific cod	125	0	0%
ribbed sculpin	64	83	130%
slender eelblenny	58	97	166%
yellowfin sole	50	0	0%
antlered sculpin	9	242	2722%

Table 4-3 Biomass estimates for species groups in the 1976 and 1990 surveys. Biomass is the total biomass for the Chukchi Sea analysis area described above. Catch of molluscs was not reported to species level in 1990, while it was possible to apportion the 1976 mollusc catch data to snails or bivalves. Snow crab dominated the commercial crab group in both years.

species group	biomass (mt)	
	1976	1990
commercial crabs	47,004	147,905
eelpouts	1,219	4,946
flatfishes	11,269	4,107
gadids	8,642	70,849
greenlings	0	9
herrings	13,159	2,874
lumpsuckers	0	29
molluscs		69,600
(snails)	37,271	
(bivalves)	813	
salmon	41	0
sand lances	30	0
poachers	378	252
pricklebacks	317	269
sculpins	3,087	15,030
shrimps	4,022	6,264
smelts	4,191	272
snailfishes	1,604	557
total biomass of fishes	43,937	99,194

4.7.2 Option 1 Conservation and Management Measures

Option 1 begins by identifying those fisheries with non-negligible probability of developing within the foreseeable future, and treats these as the fisheries that the plan is intended to manage. The fisheries for snow crab (*Chionoecetes opilio*), Arctic cod, and saffron cod are thereby identified as the subject of the FMP. If unanticipated fisheries develop in the future, Option 1 requires that the plan be amended to incorporate them. The alternative then proceeds to specify maximum sustainable yield (MSY), status determination criteria (both maximum fishing mortality threshold (MFMT) and minimum stock size threshold (MSST)), optimum yield (OY), annual catch limits (ACL), and annual catch target (ACT) for the three managed fisheries. The OY specification is the result of a series of analyses in which possible reductions from MSY are examined, considering a variety of socioeconomic factors such as uncertainty, non-consumptive value, and costs, and ecological factors such as protection of keystone species. The result of these analyses is that OY is specified for each of the three fisheries as an annual *de minimis* catch, sufficient only to account for bycatch in subsistence fisheries for other species. However, Option 1 also contains a provision to the effect that, if new scientific information becomes available suggesting that the conditions estimated or assumed in the process of making this specification are no longer valid, a new analysis should be conducted. Because OY is virtually zero for every fishery with a non-negligible probability of developing within the foreseeable future, Option 1 protects all species in the ecosystem, even though it applies to the fisheries for only three target species.

4.7.2.1 Identification of FMP fisheries

There are currently no significant commercial fisheries for groundfish or crab in the Arctic management area. Under Option 1, the FMP would apply to any fishery with non-negligible probability of developing as a significant commercial enterprise within the foreseeable future. In the event that a future fishery develops for some stock not covered by the FMP, the plan should be amended as soon as possible.

The algorithm for identifying the set of fisheries to which the plan currently applies consisted of the following steps:

1. From the most recent Economic SAFE Report (e.g. the 2007 Economic SAFE), tabulate ex-vessel price per pound from the years 2002-2006 for the following groups: pollock, Pacific cod, flatfish, rockfish, and sablefish. Convert these to metric units (dollars/kg).
2. From the most recent surveys (e.g. 2007 EBS shelf bottom trawl survey), tabulate mean CPUE (kg/ha) for each species in the above groups.
3. Calculate mean "revenue per unit effort" (RPUE) for each species encountered by the EBS survey that is also a member of one of the groups identified in Step 1 as (dollars/kg)×(kg/ha), where the average group-specific price from 2002-2006 is used as the estimator of price.
4. Sort the RPUE series obtained in Step 3; determine the lowest RPUE associated with any target fishery (about $3/ha in 2007), which is identified as the "cutoff" RPUE. This should not be taken to imply that an actual commercial vessel could operate profitably at such a rate or that an actual commercial vessel would locate its fishing activities independently of target species density (as the survey does); the minimum RPUE obtained here is simply a relative value.
5. Assess the CPUE for the Arctic. In this example the 1990 Arctic survey was used. The 1990 survey obtained catches of 119 "species" (some of these are true species, others include multiple true species, and a few are not even living organisms). If the list is restricted to species that are included in the BSAI groundfish or crab FMPs, the number of species observed in the 1990 Arctic survey drops to 52.
6. Account for species at the "tails" of their distribution. For example, of the 52 species identified in Step 5 using the 1990 survey, several may be at the tails of their respective geographic distributions; that is, they may just be minor components of populations already managed under the BSAI groundfish or crab FMPs. To focus on species that might actually have self-sustaining populations in the Arctic, eliminate all species that were observed in fewer than 10% (<8) of the hauls and have total biomass estimates of less than 1,000 t. This cuts the list of species down to 22.
7. For each of the 22 species identified in Step 6, assume that the true mean CPUE is equal to the upper 95% confidence interval of the mean (to err on the side of inclusion). Then, for each species compute the "breakeven" price needed to achieve the cutoff RPUE value (in this example the 2007 the cutoff RPUE value was $3/ha). Then, select all species with breakeven prices less than the highest price ever observed for any groundfish. For this example the period 2002-2006 was used (again, to err on the side of inclusion). In this example, this cut the list of species down to 4: snow crab (*Chionoecetes opilio*), Arctic cod (*Boreogadus saida*), saffron cod (*Eleginus gracilis*), and unidentified *Myoxocephalus* sculpins.
8. Of the species identified in Step 7, eliminate any for which markets appear to be nonexistent.
    a. Snow crab are taken in large numbers in the adjoining EBS and are a prized commercial species in that region, so they are not eliminated by this criterion.

b. Arctic cod and saffron cod are not significant commercial species in the adjoining EBS, but this may be due largely to the fact that they are not abundant in that region. According to FishBase (Froese and Pauly 2008), both of these species are the targets of commercial fisheries in other parts of the world, so they are not eliminated by this criterion.
c. Sculpins are not significant commercial species in the adjoining EBS, even though they are abundant in that region. With respect to the genus *Myoxocephalus* in particular, of the 17 species listed in FishBase (Froese and Pauly 2008), only two (*M. polyacanthocephalus* and *M. stelleri*) are reported as having any commercial importance whatsoever. Therefore, unidentified *Myoxocephalus* sculpins are eliminated by this criterion.

The result of the above algorithm is that the fisheries for snow crab, Arctic cod, and saffron cod are identified as those to which the plan applies.

4.7.2.2 Specification of Maximum Sustainable Yield

MSY Control Rule

The MSY control rule for these fisheries is of the "constant fishing mortality rate" form. That is, MSY for each fishery will be calculated as though the respective stock were exploited at a constant instantaneous fishing mortality rate.

Methods

In the simple dynamic pool model of Thompson (1992, using different notation), equilibrium biomass B is given by the equation

$$B(F|r) = \left[\left(\frac{h}{M+F}\right)\left(1+\frac{1}{(M+F)d}\right)\right]^{1/r} ,$$

where F is the instantaneous fishing mortality rate, M is the instantaneous natural mortality rate, d is the difference between the age of maturity and the age intercept of the linear weight-at-age equation, h is the scale parameter in Cushing's (1971) stock-recruitment relationship (with recruitment measured in units of biomass), and $0 \le r \le 1$ is the amount of resilience implied by the stock-recruitment relationship (equal to 1 minus the exponent).

The ratio of equilibrium biomass to equilibrium unfished biomass is given by

$$Bratio(F|r) = \left[\left(\frac{M}{M+F}\right)^2\left(\frac{(M+F)d+1}{(M+F)d}\right)\right]^{1/r} .$$

Equilibrium (sustainable) yield is just the product of F and equilibrium biomass:

$$Y(F \mid r) = F\,B(F \mid r) \quad .$$

Likewise, the ratio of equilibrium yield to equilibrium unfished biomass is given by

$$Yratio(F \mid r) = F\,Bratio(F \mid r) \quad .$$

Equilibrium yield is maximized by fishing at the following rate:

$$F_{MSY}(r) = \left(\frac{M}{2(1-r)}\right)\left(1 - \frac{2-r}{M\,d} + \sqrt{\left(\frac{2-r}{M\,d}\right)^2 + \frac{4-6r}{M\,d} + 1}\right) - M \quad .$$

If it is assumed that the area-swept biomass estimate from the 1990 survey represents equilibrium unfished biomass B_0, an estimate of the MSY stock size B_{MSY} can be obtained as

$$B_{MSY} = Bratio(F_{MSY}(r) \mid r)\,B_0 \quad ,$$

and an estimate of MSY can be obtained as

$$MSY = Yratio(F_{MSY}(r) \mid r)\,B_0 \quad .$$

Application of the above equations requires an estimate of the resilience *r*. Typically, this parameter (or its analogue, depending on the assumed form of the stock-recruitment relationship) is very difficult to estimate in a stock assessment. In the case where no stock assessment even exists, it is necessary to assume a value on the basis of theory. As noted by Thompson (1993), in order for F_{MSY} and its commonly suggested proxies *M*, $F_{0.1}$, and $F_{35\%}$ all to be equal, a necessary (but not sufficient) condition is that *r* take the value 5/7 (≈0.714). Therefore, the value 5/7 will be taken as the point estimate of *r* for each species in the specification of MSY.

MSY for Qualifying Species

Snow crab: As implied by Turnock and Rugolo (2008, p. 40), the age at maturity for snow crab likely ranges between 7 and 9 years. The age at maturity will be estimated here as the midpoint of that range (8 years). Turnock and Rugolo also list 0.23 as the value for *M*. Together with the default estimate of *r* (5/7), and assuming that the age intercept of the linear weight-at-age equation is zero, these values give an F_{MSY} estimate of 0.36, a B_{MSY}/B_0 of 0.193, and an MSY/B_0 ratio of 0.069. The area-swept biomass estimate from the 1990 Arctic survey is 147,196 t, giving B_{MSY}=28,409 t and MSY=10,157 t.

Arctic cod: FishBase (Froese and Pauly 2008) reports that the age at maturity for Arctic cod likely ranges between 2 and 5 years. The age at maturity will be estimated here as the midpoint of that range (3.5 years). FishBase also lists a value of 0.22 for the Brody growth parameter *K* and a value of 7 years for maximum age. Using Jensen's (1996) Equation 7, an age of maturity equal to 3.5 years corresponds to an *M* of 0.47, while Jensen's Equation 8 implies an *M* of 0.33. Using Hoenig's (1983) equation, a maximum age of 7 corresponds to an *M* of 0.62. Taking the average of these three estimates (0.47, 0.33, 0.62) gives an *M* of 0.47, which is the estimate that will be used here. Together with the default estimate of *r* (5/7), and assuming that the age intercept of the linear weight-at-age equation is zero, these values give an F_{MSY}

estimate of 0.70, a B_{MSY}/B_0 of 0.196, and an MSY/B_0 ratio of 0.136. The area-swept biomass estimate from the 1990 Arctic survey is 60,042 t, giving B_{MSY}=11,768 t and MSY=8,166 t.

Saffron cod: FishBase (Froese and Pauly 2008) reports that the age at maturity for saffron cod likely ranges between 2 and 3 years. The age at maturity will be estimated here as the midpoint of that range (2.5 years). FishBase also lists a value of 7 years for maximum age. Using Jensen's (1996) Equation 7, an age of maturity equal to 2.5 years corresponds to an *M* of 0.66. Using Hoenig's (1983) equation, a maximum age of 7 corresponds to an *M* of 0.30. (Need to check with Grant, should the maximum age be 15 or 7 here?) Taking the average of these two estimates (0.66, 0.30) gives an *M* of 0.48, which is the estimate that will be used here. Together with the default estimate of *r* (5/7), and assuming that the age intercept of the linear weight-at-age equation is zero, these values give an F_{MSY} estimate of 0.62, a B_{MSY}/B_0 of 0.207, and an MSY/B_0 ratio of 0.128. The area-swept biomass estimate from the 1990 Arctic survey is 10,195 t, giving B_{MSY}=2,110 t and MSY=1,305 t.

The main reference points derived above for the three stocks are summarized below:

Stock	F_{MSY}	B_{MSY}	MSY
Snow crab	0.36	28,409 t	10,157 t
Arctic cod	0.70	11,768 t	8,166 t
Saffron cod	0.62	2,110 t	1,305 t

4.7.2.3 Specification of Status Determination Criteria

The National Standard Guidelines require specification of two status determination criteria: the maximum fishing mortality threshold (MFMT) and the minimum stock size threshold (MSST).

Maximum Fishing Mortality Threshold

The National Standard Guidelines state the following in paragraph (2)(d)(i): "The fishing mortality threshold may be expressed either as a single number or as a function of spawning biomass or other measure of productive capacity. The fishing mortality threshold must not exceed the fishing mortality rate or level associated with the relevant MSY control rule. Exceeding the fishing mortality threshold for a period of 1 year or more constitutes overfishing."

The MFMT for these fisheries is specified as F_{MSY}, the MSY control rule. If a future stock assessment results in an improved estimate of F_{MSY}, as determined by the Scientific and Statistical Committee, the improved estimate will replace the F_{MSY} value listed in the FMP. The overfishing limit for each fishery is specified as the catch that would result from fishing at the MFMT.

Minimum Stock Size Threshold

The National Standard Guidelines state the following in paragraph (2)(d)(ii): "The stock size threshold should be expressed in terms of spawning biomass or other measure of productive capacity. To the extent possible, the stock size threshold should equal whichever of the following is greater: one-half the MSY stock size, or the minimum stock size at which rebuilding to the MSY level would be expected to occur within 10 years if the stock or stock complex were exploited at the maximum fishing mortality threshold specified under paragraph (d)(2)(i) of this section. Should the actual size of the stock or stock complex in a given year fall below this threshold, the stock or stock complex is considered overfished."

Because no stock assessments have been conducted for the target stocks, it is impossible to determine the range of stock sizes over which rebuilding to B_{MSY} would be expected to occur within 10 years under an F_{MSY} exploitation strategy. In the absence of information indicating that such a rebuilding rate would be expected for any stock size below B_{MSY}, the MSST for these fisheries is therefore specified as B_{MSY}. If a future stock assessment results in an improved estimate of B_{MSY}, as determined by the Scientific and Statistical Committee, the improved estimate will replace the B_{MSY} value listed in the FMP. Also, if a future stock assessment enables estimation of rebuilding rates under an F_{MSY} exploitation strategy, then the MSST would be reduced according to the National Standard Guidelines definition.

4.7.2.4 Specification of Optimum Yield

The MSA states that optimum yield is to be specified "on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor." According to the National Standard Guidelines, OY is supposed to be specified by analysis, as described in §600.310(f)(6). Among other things, this section of the guidelines states, "The choice of a particular OY must be carefully defined and documented to show that the OY selected will produce the greatest benefit to the Nation." The following subsections analyze possible reductions from MSY as prescribed by relevant socio-economic and ecological factors; doing so one at a time to begin with, then in combination.

Reductions from MSY prescribed by relevant socio-economic factors: Uncertainty

Methods

Decision theory can be used to compute the appropriate reduction from MSY resulting from consideration of uncertainty. This requires specification of a utility function. One of the simplest and most widely used utility functions is the "constant relative risk aversion" form (Pratt 1964, Arrow 1965), which will be assumed here. Given this functional form, it is also necessary to specify a value for the risk aversion coefficient. A value of unity will be assumed here. Finally, it is necessary to specify a measure of the nominal wealth accruing to society from the fishery. It will be assumed here that the nominal wealth accruing to society from the fishery is proportional to the equilibrium yield. Given these specifications, the decision-theoretic objective is to maximize the geometric mean of equilibrium yield.

It will also be assumed that the values of parameters M and d are known and that parameter r is a random variable, in which case geometric mean equilibrium yield is given by

$$Y_G(F) = Y(F \mid r_H) \quad ,$$

where r_H is the harmonic mean of r.

Geometric mean equilibrium yield is maximized by fishing at the constant rate $F_{MSY}(r_H)$. Similarly, the geometric mean of the ratio between equilibrium yield and equilibrium unfished biomass is given by

$$Yratio_G(F) = Yratio(F \mid r_H) \quad .$$

It will also be assumed that the area-swept biomass estimate from the 1990 survey represents equilibrium unfished biomass and that this estimate is lognormally distributed with

$$\sigma_B = \sqrt{\ln\left(1 + \frac{\text{var}(CPUE)}{\text{mean}(CPUE)^2 N}\right)} \quad .$$

Given the above, OY can be estimated as

$$OY = Yratio_G(F_{MSY}(r_H) \mid r_H) B_0 \exp\left(-\frac{\sigma_B{}^2}{2}\right) \quad .$$

Application of the above equation requires an estimate of the harmonic mean of the resilience *r*. Given that no assessments have been conducted of the stocks targeted by the fisheries to which the plan applies, statistical estimates of this quantity (e.g., from a Bayesian posterior distribution) are not available. Therefore, it is necessary to use informed judgment to arrive at an estimate. Given the default value of 5/7 used in the estimation of MSY and the general lack of stock-specific information, it is reasonable to assume a logit-normal distribution for *r* with μ_r=ln(5/2) and σ_r=1. This distribution has a median value of 5/7 (the point estimate used in the MSY specifications), a coefficient of variation close to 0.27, and a harmonic mean close to 0.60.

If the distribution of *r* is logit-normal with a given median, no finite value of σ_r can reduce OY to zero. However, this result does not hold across all distributional forms. For example, if the distribution of *r* is beta with a given arithmetic mean, it is possible to find a coefficient of variation large enough that OY is reduced to zero.

Results

Snow crab: Together with the default distribution assumed for *r*, the parameters listed in the MSY section imply an OY/B_0 ratio of 0.046. The estimate of σ_B from the 1990 Arctic survey is 0.166, which, together with the biomass point estimate of 147,196 t, implies a geometric mean value for B_0 of 145,171 t. Considering the effects of uncertainty, then, OY would be 6,678 t, a reduction of 34% from MSY.

Arctic cod: Together with the default distribution assumed for *r*, the parameters listed in the MSY section imply an OY/B_0 ratio of 0.065. The estimate of σ_B from the 1990 Arctic survey is 0.192, which, together with the biomass point estimate of 60,042 t, implies a geometric mean value for B_0 of 58,944 t. Considering the effects of uncertainty, then, OY would be 3,831 t, a reduction of 53% from MSY.

Saffron cod: Together with the default distribution assumed for *r*, the parameters listed in the MSY section imply an OY/B_0 ratio of 0.064. The estimate of σ_B from the 1990 Arctic survey is 0.702, which, together with the biomass point estimate of 10,195 t, implies a geometric mean value for B_0 of 7,970 t. Considering the effects of uncertainty, then, OY would be 510 t, a reduction of 61% from MSY.

Reductions from MSY prescribed by relevant socio-economic factors: Non-consumptive value

Methods

In addition to the benefits derived from the consumptive uses of a stock, it is possible for society to derive value from non-consumptive uses. For example, society might prefer a higher biomass to a lower biomass irrespective of the use of that biomass to generate fishery yields. Non-consumptive values can be combined with consumptive values to generate a measure of equilibrium total gross value V as follows:

$$V(F|r) = B(F|r)(p_B + F\,p_Y) \quad ,$$

where p_B is the "price" per unit of biomass associated with non-consumptive use and p_Y is the price per unit of yield associated with consumptive uses.

The fishing mortality rate that maximizes sustainable value is given by

$$F_{MSV}(r) = \left(\frac{M}{2(1-r)}\right)\left((1-u) - \frac{2-r}{M\,d} + \sqrt{\left(\frac{2-r}{M\,d}\right)^2 + \left(\frac{4-6r}{M\,d}\right)(1-u) + (1-u)^2}\right) - M \quad ,$$

where $u = p_B/(M \times p_Y)$. Note that this expression is identical to the equation for F_{MSY}, except that the quantity 1 is replaced by the quantity $1-u$ in three places.

It is theoretically possible for u to be sufficiently high that the optimal fishing mortality rate (and thus OY) is zero. This value is given by

$$u_0 = \left(\frac{M\,d + 1}{M\,d + 2}\right) r \quad .$$

Results

There are no data on the value of p_B for any of the qualifying fisheries that would be covered by the plan under Option 1. However, available information from other fisheries indicates that p_B is likely to be very small. Based on the parameter values given in the section on MSY, the ratio of p_B to p_Y at which OY is reduced to zero for each of the three fisheries is as follows:

Snow crab:	0.12
Arctic cod:	0.24
Saffron cod:	0.24

It is very unlikely that the ratio of p_B to p_Y comes anywhere close to the above values for any of the three fisheries covered by the plan. The available information pertaining to non-consumptive value therefore does not support a reduction from MSY for any of the three fisheries.

Reductions from MSY prescribed by relevant socio-economic factors: Costs

Methods

Costs of fishing can be viewed as including a fixed component, which is incurred at any level of fishing, and a variable component, which changes proportionally with the level of fishing. Equilibrium net wealth W can then be written as follows:

$$W(F|r) = B(F|r)F\,p_Y - c_F - F\,c_V \quad ,$$

where c_F is the instantaneous fixed cost rate and c_V is the instantaneous variable cost rate.

The fishing mortality rate that maximizes sustainable net wealth has no closed-form solution.

It is possible for fixed cost rate or the variable cost rate (or both) to be sufficiently high that the optimal fishing mortality rate is zero. In particular, if c_F>MSY×p_Y or if c_V>B_0×p_Y, the optimal fishing mortality rate, and thus OY, will be zero. It should be noted that these are sufficient, but not necessary, conditions for a zero OY.

Results

No significant commercial fishery currently exists for any of the three stocks to which the plan applies. This implies that the expected costs of fishing outweigh the expected revenues. These costs may include fuel use in remote locations, distance to processing facilities, very small CPUE in comparison to other fishing locations, lack of knowledge of the good fishing locations, and small fish or crab size. Because any significant level of commercial effort evidently results in a net loss, the available information pertaining to costs would appear to prescribe something close to a 100% reduction from MSY for each of the three fisheries so long as current cost and revenue structures remain unchanged.

Reductions from MSY prescribed by relevant ecological factors

Methods

The MSFCMA requires that the specification of optimum yield take "into account the protection of marine ecosystems." Arctic cod is identified as a keystone species which needs to remain close to carrying capacity in order for the marine ecosystem to retain its present structure. No other keystone species are identified. Therefore, the OY for each of the three fisheries needs to be set at a level that limits impacts on Arctic cod to negligible levels. Available data pertaining to likely catches of Arctic cod in each of the three fisheries can be examined to determine if the respective fishery would be expected to have anything more than a negligible impact on the Arctic cod stock.

Results

Snow crab: Because snow crab are exclusively fished with pot gear, the relative catch rates of snow crab and Arctic cod from the 1990 Arctic survey are probably not a good indicator of the likely incidental catch rate in a future Arctic snow crab fishery. Therefore, the best available data on potential incidental catch rates in a future Arctic snow crab fishery come from the Bering Sea snow crab fishery. Incidental catch rates for gadids in that fishery are typically on the order of 0.5% (individual gadids caught per individual snow crab caught), which could reasonably be interpreted as a negligible value. Snow crab is also a prey species for several marine mammals that are either petitioned or currently under review for ESA listing. The removal of prey species may increase stress on these marine mammal species and may affect the predator/prey relationship in the Arctic. It is difficult to quantify the amount of MSY reduction to provide for this factor considering the variety of food these marine mammals consume. Until more information is known, it is not possible to quantify a reduction of MSY based on the relevant ecological factors in the snow crab fishery.

Arctic cod: By definition, any directed fishery for Arctic cod would have non-negligible impacts on the Arctic cod stock. Therefore, the relevant ecological factors prescribe something close to a 100% reduction from MSY in the Arctic cod fishery.

Saffron cod: In the 1990 Arctic survey, if the station-specific data are sorted in order of decreasing saffron cod CPUE and consideration is limited to the upper quartile (to approximate a fishery targeting on saffron cod), the median incidental catch rate of Arctic cod is just over 5 kg per kg of saffron cod. In other words, the best scientific information available indicates that a target fishery for saffron cod would likely take about five tons of Arctic cod for every ton of saffron cod, which could not reasonably be interpreted as a negligible value. Therefore, the relevant ecological factors prescribe something close to a 100% reduction from MSY in the saffron cod fishery.

Conclusion: Reductions from MSY prescribed by all relevant factors

The reductions from MSY resulting from the above analyses are summarized below:

Fishery	Uncertainty	Non-consumptive value	Costs	Ecosystem
Snow crab	34%	~0%	~100%	~0%
Arctic cod	53%	~0%	~100%	~100%
Saffron cod	61%	~0%	~100%	~100%

Interactions between the various factors were not considered in the analyses summarized in the above table, which could be problematic were it not for the fact that one factor (costs) prescribes something close to a 100% reduction from MSY for all three fisheries, and another factor (ecosystem) prescribes something close to a 100% for all but the snow crab fishery. On the basis of these analyses, then, OY is specified as an annual *de minimis* catch, sufficient only to account for bycatch in subsistence fisheries for other species. In the event that new scientific information becomes available suggesting that the conditions estimated or assumed in the process of making this specification are no longer valid, a new analysis should be conducted as soon as possible.

4.7.2.5 Specification of ACL and ACT

Given the specification of OY as an annual *de minimis* catch sufficient only to account for bycatch in subsistence fisheries for other species, it is appropriate to set the "annual catch target" equal to zero. The "annual catch limit" is an additional reference point that does not have major significance for a fishery with an OY approaching zero. To avoid proliferation of superfluous reference points, the annual catch limit for these fisheries is set equal to the overfishing limit.

4.7.3 Option 2 Conservation and Management Measures

Option 2 begins by making species, rather than fisheries, the subject of the FMP. All species of Arctic finfish and marine invertebrates would be included in the FMP. However, no fisheries are identified in the FMP. Instead, the species are included in the FMP by virtue of being members of an "ecosystem component." The ecosystem component (EC) concept was introduced in the proposed rule for revising the National Standard 1 guidelines. According to the proposed rule (§600.310(d)(5)), EC species are not considered part of the fishery(ies) managed by an FMP, and they do not require specification of reference points such as MSY and OY, although a Council should consider measures to minimize bycatch thereof. Option 2 FMP would not apply to any fisheries initially and contains a detailed procedure whereby the FMP could be amended to apply to one or more fisheries in the future. Option 2 does not specify the MSY, OY, or status determination criteria for EC species or prohibited species. Option 2 prescribes a tier system for setting the overfishing levels based on available information for the Target Species. Other reference points would be developed for a Target Species in parallel with the definitions in the BSAI and GOA groundfish FMPs. Option 2 provides three approaches for a system-level MSY. When information becomes available, the MSY could be specified at a species specific level rather than the system-level described in this analysis.

Species covered by this option include all Arctic finfish and marine invertebrates above a trophic level of approximately three. A trophic level of three indicates that these species are two steps removed from primary producers such a phytoplankton. While acknowledging that this is an arbitrary criterion, species that satisfy it are, in general, species than can be surveyed at least somewhat effectively using commonly-used survey methods, such as trawl and acoustic surveys, and are species that are vulnerable to fishing gear commonly used in other Alaska marine ecosystems. Taxa of marine invertebrates that would be excluded are hermit crabs, jellies, sea stars, sea cucumbers, and other benthic invertebrates. While every species is important, this option focuses on species that are "manageable," i.e., those species potentially susceptible to direct or indirect fishing impacts, whose abundance trends can be effectively monitored, and which would be responsive to the management tools at the command of the Council.

4.7.3.1 Identification of FMP Species

Option 2 would establish four categories of species or species groups (Table 4-4), but initially would only populate two of those categories: a prohibited species category for species managed by non-federal agencies, and an ecosystem component category for all other species. Other categories are established for use in the future if or when fisheries develop in the Arctic. A key feature of this alternative is an explicit and formal procedure for transferring a species from the ecosystem component category to the target species category. The four categories of species are the following:

1. Prohibited Species – are those species and species groups, the catch of which must be avoided while fishing, and which must be returned to sea with a minimum of injury except when their retention is authorized by other applicable law. The prohibited species category would include all species whose primary management is the responsibility of a non-federal agency.
2. Target species – are those species that support either a single species or mixed species target fishery. Status determination criteria are required for these species.
3. Bycatch species – are those species or species groups that are caught in non-negligible quantities while conducting a fishery for the target species. Such stocks could be subject to overfishing, or becoming overfished, without conservation and management measures. Bycatch of these species is monitored in-season and managed with maximum allowable impact restrictions that could be either a cap on the amount of bycatch or rate of bycatch.
4. Ecosystem component species – are those species and species groups which are not taken in any target fishery.

Table 4-4 Initial assignment to species to species categories

	Finfish	Marine Invertebrates
Prohibited Species	Pacific halibut Pacific herring Pacific salmon Dolly Varden char Whitefishes	Red king crab
Target Species	None	None
Bycatch species	None	None
Ecosystem Component Species	Arctic cod Saffron cod Yellowfin sole Alaska plaice Other Pleuronectids (flounders, plaice, dabs, turbot, sole) Walleye pollock Other gadids Pacific ocean perch Capelin Rainbow smelt Eulachon Pacific sand lance Skates Sharks Pholidae (gunnels) Stichaedae (pricklebacks) Zoarcidae (eelpouts) Liparidae (snailfishes) Cyclopteridae (lumpsuckers) Agonidae (poachers) Cottidae (sculpins) Myctophidae (lanterfishes) Gasterosteridae (sticklebacks) Hexagrammidae (greenling)	Cephalopods Blue king crab Tanner crab (C. opilio) Scallops

4.7.3.2 Criteria for Initiating a Target Fishery

Until information is available to develop a sustainable fisheries management program, the Council prohibits commercial fisheries in the Arctic Management Area. A small red king crab fishery may have previously occurred in a localized area of the southeastern Chukchi Sea, as described in Appendix A; the Council exempts management of this red king crab fishery in this FMP and defers management of this fishery to the State of Alaska.

The Council will consider the following criteria for opening a new fishery:

A. The Council will initially require a plan for a new fishery that will ensure resource conservation, minimize impacts on other users of the area, complies with the Magnuson-Stevens Act and its National Standards, complies with other applicable laws and orders, and provides net positive economic benefits.

B. Any proposed fishing in the Arctic would be organized into one or more target fisheries. In most cases, the target would be a single species, though there may be situations where designating several species as a mixed species target may be more appropriate. Establishing a target fishery may require that the species be transferred from the ecosystem component category to the target species category.

C. The Council will consider designating a new target fishery in the Arctic Management Area upon receiving a petition from the public, or a recommendation from NMFS or the State of Alaska. The Council will initiate a planning process to evaluate information in the petition and other information concerning the proposed target fishery. The Council will require a fishery development analysis to ensure the best available science is used to move a species from unfished status to full fishery development. This analysis could be included in any NEPA and economic analysis required to support FMP amendments. The fishery development analysis will contain the following information:
:

- A review of the life history of the target species
- A review of available information on any historic harvest of the species, commercial, sport or subsistence
- An analysis of customary and traditional subsistence use patterns and evaluation of impacts on existing users
- Initial estimates of stock abundance (B_0) and productivity (M) sufficiently reliable to apply a Tier 5 control rule
- Evaluation of the vulnerability (susceptibility and productivity) of species that will be caught as bycatch in the target fishery.
- Evaluation of potential direct and indirect impacts on endangered species
- Evaluation of ecosystem/trophic level effects
- Evaluation of potential impacts on essential fish habitat, including biogenic habitat
- A plan for inseason monitoring of the proposed fishery
- A plan for collecting fishery and survey data sufficient for a Tier 3 assessment of the target species within a defined period
- Identification of specific management goals and objectives during the transition from unexploited stock to exploited resource
- Descriptions of proposed fishery management measures and justification for each
- Proposed regulations to implement the management approach

D. The analysis described above will be reviewed by the Council, and if appropriate the Council will initiate an environmental review consistent with NEPA and MSA and proceed through the process of amending this Arctic FMP, including appropriate initial review, public review, and final review and rulemaking and completion of the FMP amendment process as specified in the MSA and NOAA guidelines.

E. The Council may authorize the proposed fishery consistent with measures specified in the proposed FMP amendment and adopt additional measures it believes are necessary for stock conservation, fishery sustainability, and allocation considerations.

F. The Council may require onboard observers on fishing vessels, shoreside processing facilities, or at harvest sites if non-vessel platforms (i.e., ice) are used for harvesting. The Council also may require additional research associated with the new fishery, other monitoring programs, recordkeeping and reporting requirements, and periodic review of the fishery's performance relative to requirements of the MSA and other applicable law.

4.7.3.3 Specification of Status Determination Criteria

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. For groundfish species in the Target Species category, this maximum allowable rate would be prescribed through a set of five tiers which are listed in section 4.7.3.3.1 in descending order of preference, corresponding to descending order of information availability. A similar tier process for crab species follows in section 4.7.3.3.2. The Council's Scientific and Statistical Committee (SSC) will have final authority for determining whether a given item of information is "reliable" for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. The tier process for harvest specifications may be use with either Option 1 or Option 2.

4.7.3.3.1 Groundfish Tiers

For tier (1), a "pdf" refers to a probability density function. For tiers 1 and 2, if a reliable pdf of biomass at MSY (BMSY) is available, the preferred point estimate of BMSY is the geometric mean of its pdf. For tiers 1 to 5, if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers 1 to 3, the coefficient α is set at a default value of 0.05. This default value was established by applying the 10 percent rule suggested by Rosenberg et al. (1994) to the ½ BMSY reference point. However, the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers 2 to 4, a designation of the form "FX%" refers to the fishing mortality (F) associated with an equilibrium level of spawning per recruit equal to X% of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view spawning per recruit calculations based on a knife-edge maturity assumption as reliable. For tier 3, the term B40% refers to the long-term average biomass that would be expected under average recruitment and F=F40%.
Tier 1 Information available: Reliable point estimates of B and BMSY and reliable pdf of FMSY .

1a) Stock status: B/BMSY > 1
- FOFL = m_A , the arithmetic mean of the pdf
- FABC ≤ m_H , the harmonic mean of the pdf

1b) Stock status: a < B/BMSY ≤ 1
- FOFL = m_A × (B/BMSY - a)/(1 - a)
- FABC ≤ m_H × (B/BMSY - a)/(1 - a)

1c) Stock status: B/BMSY ≤ a
- FOFL = 0
- FABC = 0

Tier 2 Information available: Reliable point estimates of B, BMSY , FMSY , F35% , and F40% .

2a) Stock status: B/BMSY > 1
- FOFL = FMSY
- FABC ≤ FMSY × (F40% /F35%)

2b) Stock status: a < B/BMSY # 1
- FOFL = FMSY × (B/BMSY - a)/(1 - a)
- FABC ≤ FMSY × (F40% /F35%)× (B/BMSY - a)/(1 - a)

2c) Stock status: B/BMSY ≤ a
- FOFL = 0
- FABC = 0

Tier 3 Information available: Reliable point estimates of B, B40% , F35% , and F40% .

3a) Stock status: B/B40% > 1
FOFL = F35%
FABC ≤ F40%
3b) Stock status: a < B/B40% ≤ 1
FOFL = F35% × (B/B40% - a)/(1 - a)
FABC ≤ F40% × (B/B40% - a)/(1 - a)
3c) Stock status: B/B40% ≤ a
FOFL = 0
FABC = 0

Tier 4 Information available: Reliable point estimates of B, F35% , and F40% .
FOFL = F35%
FABC ≤ F40%

Tier 5 Information available: Reliable point estimates of B and natural mortality rate M.
FOFL = M
FABC ≤ 0.75 × M.

4.7.3.3.2 Crab Tiers

The following process would be used for crab specifications, as provided for in Amendment 24 to the Crab FMP, approved June 6, 2008.

Status determination criteria for crab stocks are annually calculated using a five-tier system that accommodates varying levels of uncertainty of information. The five-tier system incorporates new scientific information and provides a mechanism to continually improve the status determination criteria as new information becomes available. Under the five-tier system, overfishing and overfished criterion are annually formulated and assessed to determine the status of the crab stocks and whether (1) overfishing is occurring or the rate or level of fishing mortality for a stock or stock complex is approaching overfishing, and (2) a stock or stock complex is overfished or a stock or stock complex is approaching an overfished condition.

Overfishing is determined by comparing the overfishing level (OFL), as calculated in the five-tier system for the crab fishing year, with the catch estimates for that crab fishing year. For the previous crab fishing year, NMFS will determine whether overfishing occurred by comparing the previous year's OFL with the catch from the previous crab fishing year. This catch includes all fishery removals, including retained catch and discard losses, for those stocks where non-target fishery removal data are available. Discard losses are determined by multiplying the appropriate handling mortality rate by observer estimates of bycatch discards. For stocks where only retained catch information is available, the OFL will be set for and compared to the retained catch.

NMFS will determine whether a stock is in an overfished condition by comparing annual biomass estimates to the established MSST, defined as ½ B_{MSY}. For stocks where MSST (or proxies) are defined, if the biomass drops below the MSST (or proxy thereof) then the stock is considered to be overfished. MSSTs or proxies are set for stocks in Tiers 1-4. For Tier 5 stocks, it is not possible to set an MSST because there are no reliable estimates of biomass.

If overfishing occurred or the stock is overfished, section 304(e)(3)(A) of the Magnuson-Stevens Act, as amended, requires the Council to immediately end overfishing and rebuild affected stocks.

Annually, the Council, Scientific and Statistical Committee, and Crab Plan Team will review (1) the stock assessment documents, (2) the OFLs and total allowable catches or guideline harvest levels for the upcoming crab fishing year, (3) NMFS's determination of whether overfishing occurred in the previous crab fishing year, and (4) NMFS's determination of whether any stocks are overfished.

Five-Tier System

The OFL for each stock is annually estimated for the upcoming crab fishing year using the five-tier system, detailed in Table 4-5 and Table 4-6. First, a stock is assigned to one of the five tiers based on the availability of information for that stock and model parameter choices are made. Tier assignments and model parameter choices are recommended through the Crab Plan Team process to the Council's Scientific and Statistical Committee. The Council's Scientific and Statistical Committee will recommend tier assignments, stock assessment and model structure, and parameter choices, including whether information is "reliable," for the assessment authors to use for calculating the OFLs based on the five-tier system.

For Tiers 1 through 4, once a stock is assigned to a tier, the stock status level is determined based on recent survey data and assessment models, as available. The stock status level determines the equation used in calculating the F_{OFL}. Three levels of stock status are specified and denoted by "a," "b," and "c" (see Table 4-5). The F_{MSY} control rule reduces the F_{OFL} as biomass declines by stock status level. At stock status level "a," current stock biomass exceeds the B_{MSY}. For stocks in status level "b," current biomass is less than B_{MSY} but greater than a level specified as the "critical biomass threshold" (β).

Lastly, in stock status level "c," current biomass is below β * (B_{MSY} or a proxy for B_{MSY}). At stock status level "c," directed fishing is prohibited and an F_{OFL} at or below F_{MSY} would be determined for all other sources of fishing mortality in the development of the rebuilding plan. The Council will develop a rebuilding plan once a stock level falls below the MSST. The estimation of B_{msy}/B_0 is equal to the fraction of unfished biomass at which fishery thresholds are typically set to close crab fisheries because of concerns about stock status.

For Tiers 1 through 3, the coefficient α is set at a default value of 0.1, and β set at a default value of 0.25, with the understanding that the Scientific and Statistical Committee may recommend different values for a specific stock or stock complex as merited by the best available scientific information.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}.

In Tier 5, the OFL is specified in terms of an average catch value over an historical time period, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information.

OFLs will be calculated by applying the F_{OFL} and using the most recent abundance estimates. The Crab Plan Team will review stock assessment documents, the most recent abundance estimates, and the proposed OFLs. The Alaska Fisheries Science Center will set the OFLs consistent with this FMP and forward OFLs for each stock to the State of Alaska prior to its setting the total allowable catch or guideline harvest level for that stock's upcoming crab fishing season.

Tiers 1 through 3

For Tiers 1 through 3, reliable estimates of B, B_{MSY}, and F_{MSY}, or their respective proxy values, are available. Tiers 1 and 2 are for stocks with a reliable estimate of the spawner/recruit relationship, thereby enabling the estimation of the limit reference points B_{MSY} and F_{MSY}.

Tier 1 is for stocks with assessment models in which the probability density function (pdf) of F_{MSY} is estimated.
Tier 2 is for stocks with assessment models in which a reliable point estimate, but not the pdf, of F_{MSY} is made.
Tier 3 is for stocks where reliable estimates of the spawner/recruit relationship are not available, but proxies for F_{MSY} and B_{MSY} can be estimated.

For Tier 3 stocks, maturity and other essential life-history information are available to estimate proxy limit reference points. For Tier 3, a designation of the form "F_X" refers to the fishing mortality rate associated with an equilibrium level of fertilized egg production (or its proxy) per recruit equal to X% of the equilibrium level in the absence of any fishing.

The OFL calculation accounts for all losses to the stock not attributable to natural mortality. The OFL is the total catch limit comprised of three catch components: (1) non-directed fishery discard losses; (2) directed fishery discard losses; and (3) directed fishery retained catch. To determine the discard losses, the handling mortality rate is multiplied by bycatch discards in each fishery. Overfishing would occur if, in any year, the sum of all three catch components exceeds the OFL.

Tier 4

Tier 4 is for stocks where essential life-history, recruitment information, and understanding are lacking. Therefore, it is not possible to estimate the spawner-recruit relationship. However, there is sufficient information for simulation modeling that captures the essential population dynamics of the stock as well as the performance of the fisheries. The simulation modeling approach employed in the derivation of the annual OFLs captures the historical performance of the fisheries as seen in observer data from the early 1990s to present and thus borrows information from other stocks as necessary to estimate biological parameters such as γ.

In Tier 4, a default value of natural mortality rate (M) or an M proxy, and a scalar, γ, are used in the calculation of the F_{OFL}. Explicit to Tier 4 are reliable estimates of current survey biomass and the instantaneous M. The proxy B_{MSY} is the average biomass over a specified time period, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information. A scalar, γ, is multiplied by M to estimate the F_{OFL} for stocks at status levels a and b, and γ is allowed to be less than or greater than unity. Use of the scalar γ is intended to allow adjustments in the overfishing definitions to account for differences in biomass measures. A default value of γ is set at 1.0, with the understanding that the Council's Scientific and Statistical Committee may recommend a different value for a specific stock or stock complex as merited by the best available scientific information.

If the information necessary to determine total catch OFLs is not available for a Tier 4 stock, then the OFL is determined for retained catch. In the future, as information improves, data would be available for some stocks to allow the formulation and use of selectivity curves for the discard fisheries (directed and non-directed losses) as well as the directed fishery (retained catch) in the models. The resulting OFL from this approach, therefore, would be the total catch OFL.

Tier 5

Tier 5 stocks have no reliable estimates of biomass or M and only historical data of retained catch is available. For Tier 5 stocks, the historical performance of the fishery is used to set OFLs in terms of retained catch. The OFL represents the average retained catch from a time period determined to be representative of the production potential of the stock. The time period selected for computing the average catch, hence the OFL, would be based on the best scientific information available and provide the appropriate risk aversion for stock conservation and utilization goals. In Tier 5, the OFL is specified in terms of an average catch value over a time period determined to be representative of the production potential of the stock, unless the Scientific and Statistical Committee recommends an alternative value based on the best available scientific information.

For most Tier 5 stocks, only retained catch information is available so the OFL will be estimated for the retained catch portion only, with the corresponding overfishing comparison on the retained catch only. In the future, as information improves, the OFL calculation could include discard losses, at which point the OFL would be applied to the retained catch plus the discard losses from directed and non-directed fisheries.

Table 4-5 Five-Tier System for setting overfishing limits for crab stocks. The tiers are listed in descending order of information availability. Table 4-6 contains a guide for understanding the five-tier system.

Information available	Tier	Stock status level	F_{OFL}
B, B_{MSY}, F_{MSY}, and pdf of F_{MSY}	1	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = \mu_A$ =arithmetic mean of the pdf
		b. $\beta < \frac{B}{B_{msy}} \leq 1$	$F_{OFL} = \mu_A \frac{B/B_{msy} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{msy}} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$ †
B, B_{MSY}, F_{MSY}	2	a. $\frac{B}{B_{msy}} > 1$	$F_{OFL} = F_{msy}$
		b. $\beta < \frac{B}{B_{msy}} \leq 1$	$F_{OFL} = F_{msy} \frac{B/B_{msy} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{msy}} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$ †
B, $F_{35\%}^*$, $B_{35\%}^*$	3	a. $\frac{B}{B_{35\%*}} > 1$	$F_{OFL} = F_{35\%}*$
		b. $\beta < \frac{B}{B_{35\%}*} \leq 1$	$F_{OFL} = F^*_{35\%} \frac{\frac{B}{B^*_{35\%}} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{35\%}*} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$ †
B, M, $B_{msy^{prox}}$	4	a. $\frac{B}{B_{msy^{prox}}} > 1$	$F_{OFL} = \gamma M$
		b. $\beta < \frac{B}{B_{msy^{prox}}} \leq 1$	$F_{OFL} = \gamma M \frac{B/B_{msy^{prox}} - \alpha}{1-\alpha}$
		c. $\frac{B}{B_{msy^{prox}}} \leq \beta$	*Directed fishery F = 0* $F_{OFL} \leq F_{MSY}$ †
Stocks with no reliable estimates of biomass or M.	5		OFL = average catch from a time period to be determined, unless the SSC recommends an alternative value based on the best available scientific information.

*35% is the default value unless the SSC recommends a different value based on the best available scientific information.
† An $F_{OFL} \leq F_{MSY}$ will be determined in the development of the rebuilding plan for that stock.

Table 4-6 A guide for understanding the five-tier system.

- F_{OFL} — the instantaneous fishing mortality (F) from the directed fishery that is used in the calculation of the overfishing limit (OFL). F_{OFL} is determined as a function of:
  - F_{MSY} — the instantaneous F that will produce MSY at the MSY-producing biomass
    - A proxy of F_{MSY} may be used; e.g., $F_{x\%}$, the instantaneous F that results in x% of the equilibrium spawning per recruit relative to the unfished value
  - B — a measure of the productive capacity of the stock, such as spawning biomass or fertilized egg production.
    - A proxy of B may be used; e.g., mature male biomass
  - B_{MSY} — the value of B at the MSY-producing level
    - A proxy of B_{MSY} may be used; e.g., mature male biomass at the MSY-producing level
  - β — a parameter with restriction that $0 \leq \beta < 1$.
  - α — a parameter with restriction that $0 \leq \alpha \leq \beta$.
- The maximum value of F_{OFL} is F_{MSY}. $F_{OFL} = F_{MSY}$ when $B > B_{MSY}$.
- F_{OFL} decreases linearly from F_{MSY} to $F_{MSY} \cdot (\beta-\alpha)/(1-\alpha)$ as B decreases from B_{MSY} to $\beta \cdot B_{MSY}$
- When $B \leq \beta \cdot B_{MSY}$, F = 0 for the directed fishery and $F_{OFL} \leq F_{MSY}$ for the non-directed fisheries, which will be determined in the development of the rebuilding plan.
- The parameter, β, determines the threshold level of B at or below which directed fishing is prohibited.
- The parameter, α, determines the value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$ and the rate at which F_{OFL} decreases with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$.
  - Larger values of α result in a smaller value of F_{OFL} when B decreases to $\beta \cdot B_{MSY}$.
  - Larger values of α result in F_{OFL} decreasing at a higher rate with decreasing values of B when $\beta \cdot B_{MSY} < B \leq B_{MSY}$.

4.7.3.4 Specification of Maximum Sustainable Yield and Optimum Yield

This section considers methods to estimate the MSY that could be produced in aggregate by Arctic finfish and invertebrates. As has been noted elsewhere, MSY is a theoretical concept, and our treatment of MSY in this section is perhaps more theoretical than usual. Conceptually, such an aggregate harvest might be taken by a reduction fishery that attempts to maximize the yield of undifferentiated biomass. While such a fishery is not likely, a system-level estimate of MSY is useful to provide a general sense of the magnitude of potential fishery yields in comparison of other ecosystems. MSY could be specified at the species level when enough information becomes available.

The MSA states that optimum yield is to be specified "on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor." According to the National Standard Guidelines, OY is supposed to be specified by analysis, as described in §600.310(f)(6). Among other things, this section of the guidelines states, "The choice of a particular OY must be carefully defined and documented to show that the OY selected will produce the greatest benefit to the Nation." OY would be developed for a species in the Target Species category along with the other biological reference points.

These methods to estimate MSY are simple and inexact, and thus likely to produce estimates that are correct only to an order of magnitude. However, similar approaches were applied historically in North Pacific (Alverson and Pereyra 1969), and provided useful guidance for fisheries development. An advantage of trying several methods is that differing results can provide an indication of their uncertainty.

There are several important caveats to consider when applying these methods. First, these methods provide a point estimate of MSY, while the Arctic ecosystem is likely to be highly dynamic. Second, the Arctic is changing rapidly, and an estimate of MSY using historical data may not be representative of present or future conditions. Both of these considerations highlight the need for an ongoing monitoring program for key Arctic species and oceanographic conditions, and to re-evaluate ecosystem productivity on a continuing basis.

Three approaches were considered to estimate a system-level MSY and they are described below.

B_0 approach to estimate MSY

The approximation developed by Alverson and Pereyra (1969), $MSY = 0.5 * M * B_0$, has been widely applied in data-poor situations as a rough guide for potential yield (Beddington and Kirkwoood, 2005). The deviation is loosely based on the Shaefer model, where $B_{MSY} = 1/2\ B_0$, and dynamic pool models, where $F_{MSY} = M$ is often a reasonable approximation. Thompson (1992) demonstrated that these two assumptions were inconsistent for dynamic pool models under fairly general conditions. Since biomass levels between 30% and 40% of unfished stock size are widely used proxies for BMSY, a simple modification to the original equation was used for MSY calculations, $MSY = 0.35 * M * B_0$. When applying this equation, total biomass estimates from exploratory surveys in the Arctic were used as an estimate of B_0, and the median natural mortality rate for assessed groundfish stocks in the Bering Sea/Aleutian Islands was used for M (conveniently, this happened to be 0.2). Given that the appropriate value of M is highly uncertain, results were reported for higher and lower values of M (0.1 and 0.3) to provide contrast.

Bottom-up approach

Annual estimates of primary production in each ecosystem were used to estimate the potential fish production by assuming certain trophic transfer efficiencies. Iverson (1990) gives several equations for converting annual primary production in grams of carbon (C) or nitrogen (N) per square meter into annual fish production (wet weight per square meter). Here, we assumed that fish production was at trophic level 3.5 (the same assumption used in Iverson 1990). Estimates of primary productivity in the Arctic have wide ranges due to the extreme seasonality of production combined with high variability in conditions between years. However, the contrast between the areas remains clear despite these wide ranges: the Chukchi Sea (including the Russian portion) has a range of 20 to greater than 400 grams of carbon produced per square meter annually (gC/m^2y), while the Beaufort Sea (including the Canadian portion) has a narrower range of 30-70 gC/m^2y (Carmack et al. 2006). This compares with the Eastern Bering Sea estimate ranging from less than 75 gC/m^2y on the inner shelf to over 275 gC/m^2y on the shelf break (Aydin and Mueter 2007, Springer et al. 1996), and to the Gulf of Alaska shelf estimate of 300 gC/m^2y (Sambrotto and Lorenzen 1987). Iverson's (1990) equations were used to convert both the low and high ends of the range of primary production (PP) values given for each system to low and high estimates of annual fish production in metric tons as scaled to the area of each system (Table 4-7Table 4-7).

Estimates of annual fish production for the Bering Sea shelf and the Gulf of Alaska derived by this method appear higher than the estimates of annual surplus production estimated by Mueter and Megrey (2006), which were 2.5 million metric tons in the Bering Sea and 330,000 t in the Gulf of Alaska. Part of this discrepancy may arise from using the high PP estimates in the comparison, if this level of PP is not available in every year. Estimates in Mueter and Megrey (2006) also considered primarily currently fished species, and not all species at trophic level 3.5, which would include unfished forage species in those systems. Nevertheless, this is one caveat; the production estimates here do not account for commercial value or lack thereof.

Iverson (1990) suggests that the average fish catch is about 25% of total fish production for some ecosystems. Examination of this calculation based on a yield per recruit model for Alaskan ecosystems suggest that 25% would be a reasonable MSY estimate for these regions.

There are several other important caveats to this analysis.

First, we note that these equations area based on regression relationships for the conversion of phytoplankton C to N derived from systems between 15 and 65 degrees N, so may not be appropriate to the high-latitude Chukchi and Beaufort Seas. In addition, the equations cannot accommodate PP values lower than about 40 gC/m^2y, so values of 0 were included at the lower end of the primary production scale for the Arctic systems.

Second, conversion of primary production to fish biomass may not be direct in shallow Arctic seas with strong benthic-pelagic coupling as observed in the Chukchi Sea (Grebmeier et al. 1988, Grebmeier and McRoy 1989, Dunton et al. 1989, Dunton et al. 2005). Benthic clams and amphipods are important groups channeling the relatively high benthic production observed in the Chukchi Sea to birds and mammals, specifically walruses, bearded seals, and gray whales (Moore et al. 2000, Coyle et al. 2007, Dehn et al. 2007, Bluhm and Gradinger 2008). The limited available trawl survey data reviewed above suggest that the high benthic and primary productivity observed in the Chukchi Sea may not indicate similarly high fish biomass as is observed in the Bering Sea. Some authors suggest that the close coupling of primary production with benthic invertebrate biomass results from short food chains and little grazing in the pelagic zone (Dunton et al. 1989), thus leaving little energy for high fish biomass, but considerable energy for large benthic foraging mammals.

Third, in the Beaufort Sea, the total annual fish production estimated here corresponds closely to the estimated fish consumption of vertebrate predators in that ecosystem. Frost and Lowry (1984) estimated the consumption for the most common marine mammals and birds in the pelagic food web of the Alaskan Beaufort shelf, and included Arctic cod as both forage for these predators and as a predator on zooplankton. An estimated 123,000 tons of Arctic cod were required to feed late 1970's populations of Belugas, ringed seals, marine birds, and Arctic cod themselves in the Beaufort Sea. Belugas and ringed seals in particular were dependent on Arctic cod for a majority of their consumption, and birds for half their consumption. Fishery development in the Beaufort Sea will need to consider carefully the tradeoffs between potential benefits of the fishery and maintaining marine mammal and seabirds at existing levels.

Table 4-7 Primary production (PP, in gC/m^{2}y), area (km^2), and potential fish production (P, in t/y) in ecosystems off Alaska. Areas are as reported by A.Greig, AFSC, for the Chukchi and Beaufort Sea shelves off Alaska, and in Aydin et al. 2007 for the Eastern Bering Sea and Gulf of Alaska. The low and the high fish production estimates for the Eastern Bering Sea are derived from primary productivity estimates for the inner shelf and the outer shelf respectively.

Ecosystem	Low PP gC/m^{2}y	High PP gC/m^{2}y	Area km^2	Low Fish P t/y	High Fish P t/y	Low Proxy MSY (t)	High Proxy MSY (t)
Chuckchi	20	400	281,729	0	7,792,640	0	1,948,160
Beaufort	30	70	38,599	0	124,642		31,161
Bering Sea	75	275	495,218	1,842,213	11,565,817	460,553	2,891,454
Gulf of Alaska		300	291,840	Not Available	7,532,208	Not Available	1,883,042

Comparative approach to estimate MSY

Estimates of total (benthic + pelagic) fish density are available for the Barents Sea, a well-studied and fully exploited ecosystem. Even though the Barents Sea is an Arctic ecosystem, its productivity is strongly influenced by flux from North Atlantic. It is unlikely that the Chukchi and the Beaufort Seas are more productive than the Barents Sea. To obtain MSY estimates, it was assumed 1) current estimates of fish density in the Barents Sea as estimated by an ecosystem model were close to BMSY, 2) that BMSY fish densities in the Chukchi and Beaufort sea were the same as, one-half, or one-tenth the density in the Barents Sea, and 3) that FMSY = M = 0.2 was a reasonable proxy for FMSY.

Summary of MSY Calculations for Alternative 2

The three MSY calculations for Option 2 shown in Table 4-8 indicate the system-level MSY for the Chuckchi Sea could range from 0 t to 1,948,160 t. The wide range suggests that none of these methods should be considered reliable estimates of system wide MSY for fishery management. The three approaches illustrate the range of fishery potential and its associated uncertainty and methods that could be applied when fish stocks are moved into the target category.

Table 4-8 Summary of MSY estimates for the Arctic

	Chukchi Sea	**Beaufort Sea**	**Total**
Area (20 – 500m)	**218,730 km^2**	**38,599 km^2**	**257,329 km^2**
MSY estimation method			
Bottom-up approach low PP	0 t	0 t	0 t
Bottom-up approach high PP	1,948,160 t	31,161 t	1,979,321 t
MSY = 0.35 * M *B_0 (M = 0.1)	8,600 t	Not available	
MSY = 0.35 * M *B_0 (M = 0.2)	17,300 t	Not available	
MSY = 0.35 * M *B_0 (M = 0.3)	25,900 t	Not available	
Comparative (same as Barents Sea biomass density)	596,500 t	105,300 t	701,800 t
Comparative (0.5 Barents Sea biomass density)	298,300 t	52,600 t	350,900 t
Comparative (0.1 Barents Sea biomass density)	59,700 t	10,500 t	70,200 t

4.8 Cumulative Effects on Fish and Shellfish Resources

Past, present, and future cumulative effects on fish and shellfish resources of the Arctic Management Region are limited because of the undeveloped nature of this region. Past activities that affect fish and shellfish resources include the very limited crab commercial and fish and crab subsistence harvest activities that occurred in the Arctic Management Area, as described in this chapter and the continued subsistence use of fish and shellfish resources. Though the available biomass to support sustainable fishing activities is uncertain, based on historical use, the continued use of subsistence fish and shellfish resources is likely small enough to not affect the sustainability of the stock. Future subsistence harvests of fish and shellfish resources are expected to continue at a similar level to current harvests and are not expected to affect stock sustainability or to affect the spatial or temporal distribution or prey availability for the fish and shellfish stocks.

Past, present, and future commercial and subsistence harvest of marine mammals may also affect the fish and shellfish resources of the Arctic Management Region. The removal of marine mammals would reduce the predator pressures on fish and shellfish stocks, until the abundance levels of predators and prey shift to a new equilibrium. Commercial harvest of whale species is a past action that may have lingering effects on the fish and shellfish resources as some whale stocks in the Arctic have not recovered to their pre-whaling abundance levels. More information on whale prey species and abundance is in Chapter 7. The continued subsistence harvest of bowhead whales and other marine mammals is not likely to have any discernable future effects on fish and shellfish stocks due to the low level of harvest in comparison to the size of the marine mammal stocks (Table 7-3).

Other past, present, and future actions that may affect fish and shellfish resources are oil and gas development in the Arctic Management Area. Concerns include the effects of seismic surveys on fish and the release of pollution and drilling muds and cuttings during exploration activities. Seismic airgun use has been documented to affect fish species in a way that reduces catch rates over 20 miles away for hours, if not days, after the use of the gun. (Enges et al. 1993; Lokkeborg, S. and Soldal, A.V. 1993; and Skalski et al. 1992). The release of pollution that may result in fish and shellfish mortality or at lower levels may affect the ability of fish and shellfish to reproduce or perform other important life activities such as foraging or evading predators. Chronic or acute pollution events are likely to have a spatial effect that diminishes with distance from the source and may affect the spatial distribution of any contacted fish stocks. A large oil spill is very unlikely during reasonably foreseeable oil and gas exploration drilling projects in the Arctic Ocean off Alaska (section 3.2). There is a low likelihood of a large oil spill during present and reasonably foreseeable future oil and gas development activities due to the limited number of developments. While an oil spill is unlikely during the oil and gas activities considered reasonably foreseeable for our analysis of cumulative effects, the MMS EIS (2007) determined that in the event of a large oil spill, significant cumulative effects were likely to occur for marine resources, including fish and shellfish resources.[20] The impacts of a large oil spill, if such a spill occurs, will be significant regardless of the alternative chosen for this action. If commercial fishing were to occur in the vicinity of oil and gas production facilities in the Beaufort Sea under Alternative 1, it is possible that such activity could slightly increase the probability of an oil spill, by, for example, creating a risk of fishing vessels' anchors being dragged across pipelines (Bercha 2006).

[20] The significance criteria employed by the MMS EIS (2007) differs from that used herein. Any effects to fish and shellfish resources deemed significant under the criteria employed by the MMS EIS (i.e., an adverse impact that results in a change in distribution or a decline in abundance requiring three or more generations for the affected population to recover to its former status) would likely qualify as significant under the criteria employed in this EA.

Because they prohibit fishing activities in the vicinity of existing and reasonably foreseeable production facilities, Alternatives 2, 3, and 4 would not increase the likelihood of a large oil spill, nor would they add to the effect on fish and shellfish resources which would occur in the event of a large oil spill. Due to the remote probability that a large oil spill may occur, and the fact that Alternatives 2, 3, & 4 do not contribute to the risk to fish and shellfish resources, in assessing the significance of potential cumulative impacts, we discount the effects of an oil spill by its low probability of occurrence.

With the potential increase in transportation and oil and gas development, there is increased risk of introduction of invasive species into the Arctic environment. Invasive species could be released in ballast water from ships, carried on ship haul fouling communities, or brought in on drilling rigs that had been used in waters other than the Arctic. Invasive species may also be carried into the Arctic Ocean by currents and rising ocean temperatures and sea ice retreat may allow the colonization by invasive species that otherwise would not have been able to survive in the Arctic. Invasive species could potentially compete with or prey on Arctic marine fish or shellfish species, which may impact mortality and spatial distribution of Arctic fish and shellfish species. Unfortunately, no baseline or monitoring program exists to establish the current assemblage of Arctic species, so that the introduction of an invasive species could be discovered. The significance of this affect would depend on the ability of the invasive species to survive and reproduce in the Arctic environment and its use of Arctic fish or shellfish species. We are not aware at this time of any potential invasive species introduced into the Arctic that may colonize the Arctic region and adversely affect current populations of Arctic fish and shellfish.

The direct and indirect impacts of Alternatives 2, 3, and 4 are primarily protective of fish and shellfish resources by prohibiting fishing activities in the Arctic Management Area until information is available to sustainably manage a fishery. The direct and indirect effects of Alternatives 2, 3, and 4 when added to the impacts of past, present, and reasonably foreseeable future activities analyzed in this section are likely to be insignificant for fish and shellfish resources. Any potential adverse effects identified under the cumulative effects are reduced by the beneficial effects of Alternatives 2, 3, and 4. None of the cumulative effects of Alternatives 2, 3, and 4 is expected to result in significant effects that jeopardize the ability of any fish or shellfish stock to sustain itself. Alternative 1 has the potential to allow for significant impacts on fish and shellfish resources through uncontrolled harvest, and, therefore, may also result in potentially significant cumulative impacts.

Chapter 5 Essential Fish Habitat and Habitat

5.1 Essential Fish Habitat

EFH is defined in the Magnuson-Stevens Act as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of EFH: “waters” includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species’ full life cycle.

Federal regulations specify the following requirements for EFH descriptions in FMPs:

> FMPs must describe and identify EFH in text that clearly states the habitats or habitat types determined to be EFH for each life stage of the managed species. FMPs should explain the physical, biological, and chemical characteristics of EFH and, if known, how these characteristics influence the use of EFH by the species/life stage. FMPs must identify the specific geographic location or extent of habitats described as EFH. FMPs must include maps of the geographic locations of EFH or the geographic boundaries within which EFH for each species and life stage is found....[also] FMPs must demonstrate that the best scientific information available was used in the description and identification of EFH, consistent with national standard 2 (50 CFR 600.815).

The Arctic FMP would describe Arctic EFH for each species by life stage as a general distribution using the best scientific information available. Appendix III contains the EFH information proposed for the Arctic FMP.

Fish survey and observer data are not available to analyze Arctic EFH, as was used for the other Alaska FMPs. The information available for almost all species is primarily broad geographic distributions based on specific samples from surveys and fisheries, which have not been linked with habitat characteristics. Furthermore, our ability to precisely define the habitat (and its location) of each life stage of each managed species in terms of its oceanographic (temperature, salinity, nutrient, current), trophic (presence of food, absence of predators), and physical (depth, substrate, latitude, and longitude) characteristics is very limited. Consequently, the information is restricted primarily to their position in the water column (e.g., demersal, pelagic), broad biogeographic and bathymetric areas (e.g., 100-200 m zone), and occasional references to known bottom type associations.

Identification of EFH for some species includes historical range information. Traditional knowledge and sampling data have indicated that fish distributions may contract and expand due to a variety of factors including, but not limited to, temperature changes, current patterns, changes in population size, and changes in predator and prey distribution.

The Magnuson-Stevens Act emphasizes the need to protect fish habitat. Under the law, FMPs must describe and identify EFH, minimize to the extent practicable the adverse effects of fishing on EFH, and identify other actions to encourage the conservation and enhancement of EFH.

Once EFH is identified, federal agencies must consult with NMFS regarding any action that may adversely affect EFH. As part of such consultation the federal action agency must prepare an EFH assessment that describes the action, analyzes the effects of the action on EFH and the managed species, provides the federal agency's conclusions regarding the effects of the action on EFH, and proposes any applicable mitigation (50 CFR 600.920(e). An EFH assessment may incorporate by reference other relevant environmental assessment documents, such as a Biological Assessment, a NEPA document, or another EFH assessment prepared for a similar action. The Magnuson-Stevens Act also requires NMFS to provide conservation recommendations to federal and state agencies for any actions that would adversely affect EFH.

5.2 Habitat

Fishing presents a potential for damage or removal of fragile biota within each area used by fish as habitat and the potential for reduction of habitat complexity, benthic biodiversity, and habitat suitability. Habitat complexity is a function of the structural components of the living and nonliving substrate and could be affected by a potential reduction in benthic diversity from long-lasting changes to the species mix. Many factors contribute to the intensity of these effects, including the type of gear used, the type of bottom, the frequency and intensity of natural disturbance cycles, history of fishing in an area and recovery rates of habitat features. This process is presented in more detail in section 3.2 of the HAPC EA (NMFS 2006a), as well as Section 3.4.3 of the EFH EIS (NMFS 2005). In the Arctic, benthic habitats have not experienced previous fishing effort but may face potential impacts from fishing in the future due to global warming and potential trends of fish stocks to migrate into northern waters.

The Arctic bottom habitat, described in section 8.1.1, has a mix of substrates, defined in part by the continental shelf, continental break, and deep-water basins. Each of the substrates by depth zone may experience different effects. The Chukchi Sea contains a broad shallow shelf similar to the Bering Sea, and the Beaufort Sea has a narrow coastal shelf that lies adjacent to a deep water basin.

5.3 The Boulder Patch

In the 1970s, marine researchers discovered anomalous seafloor sites in relatively shallow waters in Stefansson Sound in the central Alaskan Beaufort Sea. Characterized by patches of rocks, pebbles, and boulders, these provide substrate for a rich flora, including extensive kelp beds (summarized in Streever and Wilson 2001). This rocky area and its associated growth of marine life was subsequently designated the "Boulder Patch" and, although boulders (1-2 m in diameter) constitute some of the substrate, the rocky substrate is more in the pebble to cobble size (1-10 cm) range. Extensive studies and monitoring of the Boulder Patch have occurred along with development of oil and gas resources in Arctic Alaska, providing the opportunity for research and publication of results over the past two decades.

The Boulder Patch is a benthic community comprised of several species of red and brown algae, a diverse assortment of invertebrates from several taxonomic phyla, and an associated small fish community (Dunton et al. 1982, Martin and Gallaway 1994, Dunton and Schonberg 2000). The most common kelp species is *Laminaria solidungula*, with sponges and cnidarians, along with a pink soft coral, the most conspicuous invertebrates. The mapped area of the Boulder Patch extends up to 20 km offshore the Sagavanirktok River delta; small "patches" or individual boulders likely supporting similar marine communities are reported to occur both east and west of this area but have not been mapped. Given the nature of seasonal ice conditions (freezing bottom fast in water up to two meters deep) and the limits of light penetration, the Boulder Patch community is likely restricted to narrow and relatively shallow environments.

The dominant plant in the Boulder Patch, *Laminaria solidungula*, stores carbon during the short summer months when sufficient light is available, but then in the absence of photosynthesis it completes up to

90% of its growth in the dark winter months using stored carbon (Dunton 1985, Dunton and Schell 1986). Kelp production in Arctic waters may contribute considerably to overall primary production in this marine ecosystem (Dunton and Dayton 1995).

5.4 Northern Bering Sea Research Area

NMFS recently implemented Amendment 89 to the BSAI groundfish FMP that implements new conservation measures that close to commercial nonpelagic trawl fishing most areas north of Nunivak Island in the northern Bering Sea (Figure 5-1) (73 FR 43362, July 25, 2008). This closure includes the St. Lawrence Island Habitat Conservation Area and the Northern Bering Sea Research Area. The Council intends to prevent habitat impacts that might be associated with nonpelagic trawl gear that may be used to harvest commercial fish stocks that may change distribution due to climate change. The Council intends to develop a research plan over the next two years, and until that time the Northern Bering Sea Research Area will be closed to nonpelagic trawling. Under the research plan, experimental fishing with nonpelagic trawl gear could occur in this area under exempted fishing permits to study the effect of this gear on the bottom.

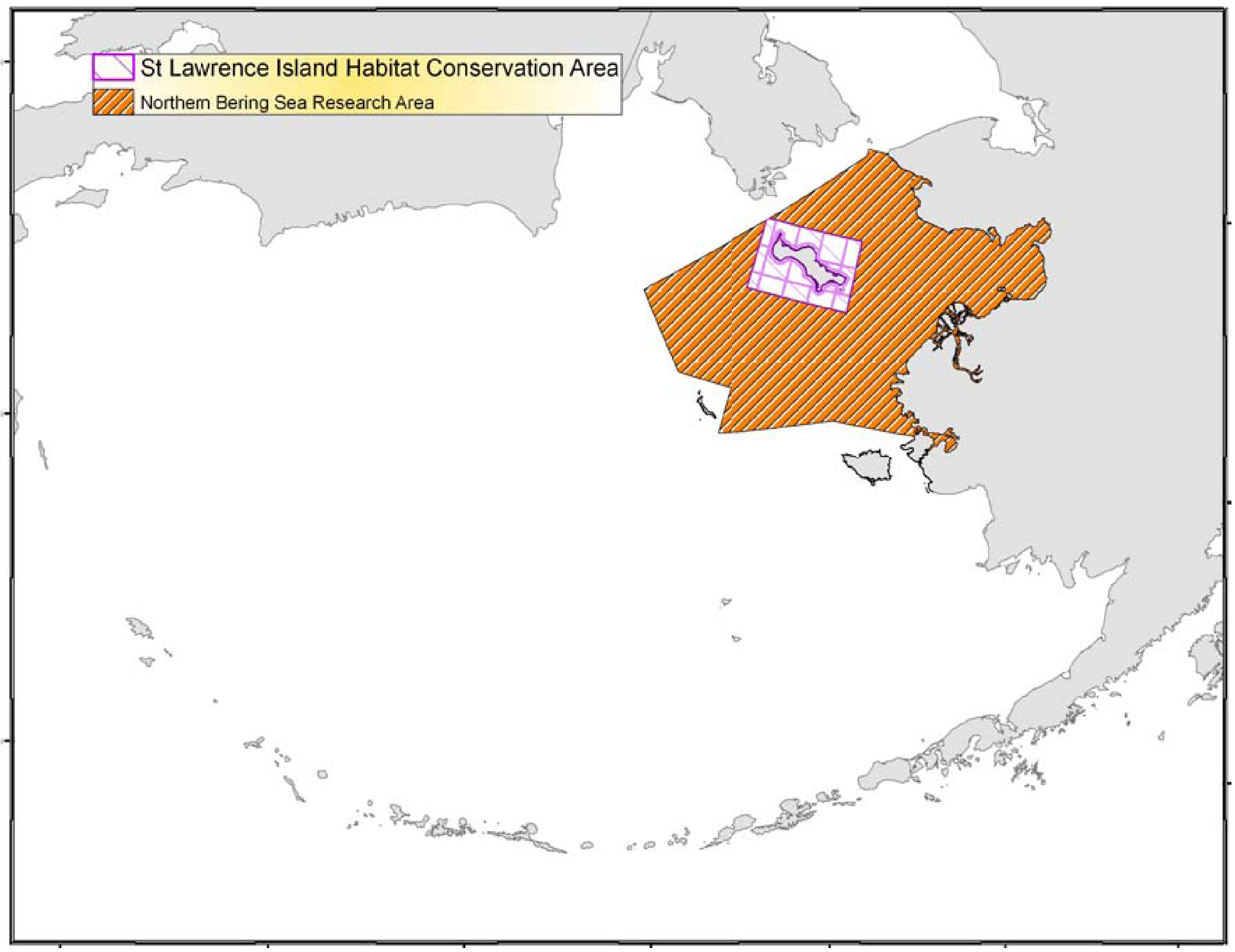

Figure 5-1 Northern Bering Sea Research Area and St. Lawrence Habitat Conservation Area

The closure of the Northern Bering Sea Research Area will protect bottom habitat to the benefit of those Arctic species that move through the Bering Strait and depend on bottom habitat in the Bering Sea during some part of their lives.

5.5 Effects of the Alternatives on Habitat

An Alaska-based fishery impacts assessment model analyzes the effect of fishing gears on habitats, including fragile biota. This model is described in Appendix B of the EFH EIS (NMFS 2005). Different types of fishing gear have different types of impact on bottom habitat, with trawling having more potential for impacts than fishing with pot or hook and line gear. The effects depend on the organisms and bottom material contacted by the gear as well as by the manner in which the gear contacts the bottom. Based on the information available to date, the predominant direct effects caused by nonpelagic trawling include smoothing of sediments, moving and turning of rocks and boulders, resuspension and mixing of sediments, removal of seagrasses, damage to corals, and damage or removal of epibenthic organisms (Auster et al. 1996, Heifetz 1997, Hutchings 1990, ICES 1973, Lindeboom and de Groot 1998, McConnaughey et al. 2000). Trawls affect the seafloor through contact of the doors and sweeps, footropes and footrope gear, and the net sweeping along the seafloor (Goudey and Loverich 1987). Trawl doors leave furrows in the sediments that vary in depth and width depending on the shoe size, door weight, and seabed composition. The footropes and net can disrupt benthic biota and dislodge rocks. Larger seafloor features or biota are more vulnerable to fishing contact, and larger diameter, lighter footropes may reduce damage to some epifauna and infauna (Moran and Stephenson 2000).

Each alternative was rated by significance criteria for any effect on marine benthic habitat (NMFS 2008). The significance criteria are outlined in Table 5-1 and are grouped into four categories:

1. Mortality and damage to living habitat species: Damage to or removal of benthic biota (such as seapens/whips, anemones, soft corals, and sponges) by direct contact with fishing gear;
2. Modification of non-living substrate by direct contact with fishing gear (non-living substrates such as sand, mud, gravel, rock, and shell);
3. Modification of the community structure in terms of benthic biodiversity;
4. Modification of habitat suitability to support healthy fish populations.

Each of the criteria was assessed qualitatively, due to the lack of existing habitat data. Specifically, the second category, "modifications to nonliving substrate by gear" is somewhat hypothetical, as problems have been identified in assessing impacts for fishing gears. The third category identifies effects from fishing that may result in a change in the biodiversity within the habitat area. Intense or high frequency fishing activities within a relatively small area may result in a change in diversity by removing resident species and by attracting opportunistic fish species that feed on injured or uncovered marine organisms disturbed in the wake of a tow.

Specific impacts to habitat from different management regimes are very difficult to predict. The ability to predict the potential effects on benthic habitat from mitigation measures that change the geographical and seasonal patterns of fishing depends on having detailed information regarding habitat features, life histories of living substrates, the natural disturbance regime, and the effects of fishing with various gears at different levels of intensity on different habitat types.

Several simplifying assumptions were made:

1. Disturbances, such as fishing, in sensitive habitats may add additional stress on areas with slow recovery times and fragile, sessile marine organisms. Some natural disturbances occur on the Arctic shelf in shallow areas.
2. Closing areas to disturbances benefits benthic habitat.
3. Disruption of non-living structure, such as gravel and sand, may alter habitat for species.
4. If more area is restricted or closed to fishing, fewer alterations and disturbances to marine habitat from fishing are expected. Conversely, increasing the fishing effort in an area will place additional stress on benthic habitat.

The reference points against which the criteria are applied are the current size and quality of marine benthic habitat in the Arctic region.

Table 5-1 Criteria used to determine significance of effects on habitat.

Effect	Criteria			
	Significantly Negative (-)	**Insignificant (I)**	**Significantly Positive (+)**	**Unknown (U)**
Habitat complexity: Mortality and damage to living habitat species	Substantial increase in mortality and damage; long-term irreversible impacts to living habitat species.	Likely not to substantially change mortality or damage to living habitat species.	Substantial decrease in mortality or damage to living habitat species.	Information, magnitude and/or direction of effects are unknown.
Habitat complexity: (non-living substrates such as gravel sand and shell hash)	Substantial increase in the rate of removal or damage of non-living substrates.	Likely not to substantially change alteration or damage non-living substrates.	Substantial decrease in the rate of removal or damage of non-living substrates.	Information, magnitude and/or direction of effects are unknown.
Benthic biodiversity	Substantial decrease in community structure from baseline.	Likely not to substantially change community structure.	Substantial increase in community structure from baseline.	Information, magnitude and/or direction of effects are unknown.
Habitat suitability	Substantial decrease in habitat suitability over time.	Likely not to substantially change habitat suitability over time.	Substantial increase in habitat suitability over time.	Information, magnitude and/or direction of effects are unknown.

<u>Alternative 1: Status Quo</u>

Under Alternative 1, no commercial fisheries currently occur in the Arctic Management Area, except for the small red king crab fishery in the Kotzebue area. Red king crab is usually harvested by pot gear, which has a very limited impact on benthic habitat compared to mobile bottom contact gear like trawl or dredge gear. Under current conditions there is likely no discernable effect of the small crab fishery on bottom habitat. However, Alternative 1 does not prevent uncontrolled commercial fishing by vessels that are not licensed by the State. Due to the potential movement of certain fish stocks north (walleye pollock and yellowfin sole) and the use of trawl gear to harvest these species, Alternative 1 does not prevent potential effects on habitat. The use of trawl gear in sensitive areas could reduce habitat complexity by damaging living and non-living substrates, reduce benthic biodiversity by killing bottom dwelling species that are susceptible to trawl gear, and reduce habitat suitability over time by the effects on the substrate and the species that live there. Locations like the Boulder Patch, described in section 5.3, may be particularly susceptible to potential damage if this area supports commercial quantities of fish that may be harvested by trawl gear. The potential effects would depend on the location of the fishery, the level of participation, and the gear type used. For these reasons, **Alternative 1 has the potential to allow**

significant negative impacts to habitat complexity, benthic biodiversity and habitat suitability and therefore may result in significantly negative impacts on habitat.

Alternatives 2, 3, and 4

In terms of analyzing the effects on habitat, Alternatives 2, 3, and 4 differ only in how the Arctic crab fishery is managed, whether in the Arctic FMP or not. In Alternative 2, the entire crab fishery of the Arctic Management Area would be managed in the Arctic FMP, which would prohibit any fishery. Alternative 2 would therefore be the most protective to habitat as no commercial fishing would be allowed in the Arctic Management Area. Alternatives 3 and 4 would allow the limited red king crab fishery in the Kotzebue area, whether managed by the State or jointly between state and federal agencies. The impacts under these alternatives would be the same as Alternative 2 except for the potential for a very slight impact on habitat in Kotzebue where pots are used to harvest the red king crab. Because the scope of this fishery is intended to be limited to historical amounts, any impact is likely not discernable because of the very limited historical size of this fishery. Overall, Alternatives 2, 3, and 4 are more protective to habitat than Alternative 1 by preventing the occurrence of uncontrolled commercial fishing in the Arctic Management Area. **Because Alternatives 2, 3, and 4 would not change the current conditions of habitat present in the Arctic Management Area, including no changes to habitat complexity, benthic diversity, and habitat suitability, the impacts of Alternatives 2, 3, and 4 on habitat are insignificant.**

5.6 Cumulative Effects on Habitat

Past, present, and future effects on habitat in the Arctic Management Area are primarily related to development activities. Oil and gas development may disturb bottom habitat during the installation of pipelines, platforms, and coastal facilities that support coastal and off shore oil and gas development and exploration. In addition, release of pollutants during oil and gas exploration may increase mortality, reduce living habitat complexity, diversity and suitability for organisms sensitive to the pollution. A large oil spill is likely to result in significant impacts on bottom habitat (MMS 2007) and would be significant regardless of the direct and indirect effects of the alternatives. But, the likelihood of a large spill during exploration activities appears to be remote (section 3.2).

Increases in transportation due to retreating ice may result in the development of additional harbors in the Arctic Management Area, which currently contains only one harbor in the Kotzebue area. Placement of a harbor will result in the disturbance of bottom habitat which may support fish species. The level of the impact would depend on the size of the harbor, the substrate, and the organisms dependent on the substrate. Due to the remoteness of the Arctic Management Area, few additional harbors are likely to be developed, and the impact would be localized, so that overall the features of the bottom habitat of the Arctic Management Area would not be likely to substantially change.

Coastal development may impact bottom habitat near villages that are affected by coastal erosion. The placement of erosion control devices may disturb nearshore benthic habitat but may also protect the same habitat in the future by preventing the deposition of sediments from the shoreline to the intertidal and subintertidal areas.

The potential introduction of invasive species with the increase in transportation and oil and gas exploration (section 3.2) may impact the biological structure of bottom habitat if the invasive species is a bottom dwelling species that effectively competes with or preys on indigenous structure forming biota. In addition the habitat diversity could be changed if the invasive species displaces the current bottom dwelling species. The significance of this cumulative effect would depend on the invasive species introduced and where such species fit into the ecological benthic system.

In addition, release of pollutants during oil and gas exploration may increase mortality, reduce living habitat complexity, diversity and sustatianability for organisms sensitive to the pollution. A large oil spill is very unlikely during reasonably foreseeable oil and gas exploration in the Arctic Ocean off Alaska. There is a low likelihood of a large oil spill during present and reasonably foreseeable future oil and gas development activities. While an oil spill is unlikely during the oil and gas activities considered reasonable foreseeable for our analysis of cumulative effects, if such a spill occurs, it is likely to result in significant impacts on bottom habitat (MMS 2007)[21]. These impacts would be significant regarless of the alternative chosen for this action. If commercial fishing were to coccur in the vicinity of oil and gas prduciton facilities in the Bearufort Sea under Alternative 1, it is possible that such activity could slightly increase the probability of an oil spill.

Because they prohibit fishing activities in the vicinity of existing and reasonably foreseeable production facilities, Alternatives 2, 3, and 4 would not increase the likelihood of a large oil spill, nor would they add any incremental impact to the effect on bottom habitat which would occur in the event of a large oil spill. Due to the remote probability that a large oil spill may occur, and the fact that Alternatives 2, 3, and 4 do not contribute to the risk to bottom habitat, in assessing the significance of potential cumulative impacts, we discount the effects of an oil spill by its low probability of occurrence.

The direct and indirect impacts of Alternatives 2, 3, and 4 are primarily protective of bottom habitat and essential fish habitat by establishing a method to prevent fishing activities in the Arctic Management Area and therefore preventing fishing impacts on bottom habitat. The direct and indirect effects of Alternatives 2, 3, and 4 when added to the impacts of past, present, and reasonably foreseeable future activities analyzed in this section are likely to be insignificant for essential fish habitat and bottom habitat. Any potential adverse effects identified under the cumulative effects are reduced by the beneficial effects of Alternatives 2, 3, and 4. **None of the cumulative effects of Alternatives 2, 3, and 4 is expected to result in significant effects that substantially changes or damage living and non-living habitat structure, or substantially change the benthic biodiversity or habitat suitability. Uncontrolled fishing under Alternative 1 has the potential to allow for significant impacts on essential fish habitat and bottom habitat, and therefore, may also result in potentially cumulative significant impacts.**

[21] The significance criteria employed by the MMS EIS (2007) differs from that used herein. Any effects to habitat deemed significant under the criteria employed by the MMS EIS (i.e., an adverse impact to bottom habitat that results in a change in distribution or a decline in abundance requiring three or more generations for the affected population to recover to its former status) would likely qualify as significant under the criteria emplyed in this EA.

Chapter 6 Birds in the Arctic Management Area

6.1 Introduction

Thirty-eight species of seabirds breed in Alaska, with approximately 1,800 seabird colonies ranging in size from a few pairs to 3.5 million birds. Breeding populations are estimated to contain 36 million individual birds in the Bering Sea alone, and total Alaska population size (including subadults and nonbreeders) is estimated to be approximately 30% higher. Five additional species that breed elsewhere but occur in Alaskan waters during the summer months contribute another 30 million birds.

Many of these species occur in substantial numbers in the Alaskan Arctic, with millions arriving to nest in habitats adjacent to the Chukchi and Beaufort Seas. Although only a few species remain through the winter, birds are abundant in the region during the period from May to early September.

The FWS Beringian Seabird Colony Catalog (2004) lists the location, population size, and species composition for each seabird colony based on the most recent information available from opportunistic surveys of colonies and from historical information at some locations (Stephensen, pers. com.). This catalog lists colonies in the Alaska Arctic that include large numbers of cormorants, murres, eiders, puffins, auklets, black-legged kittiwakes, and gulls (Figure 6-1).

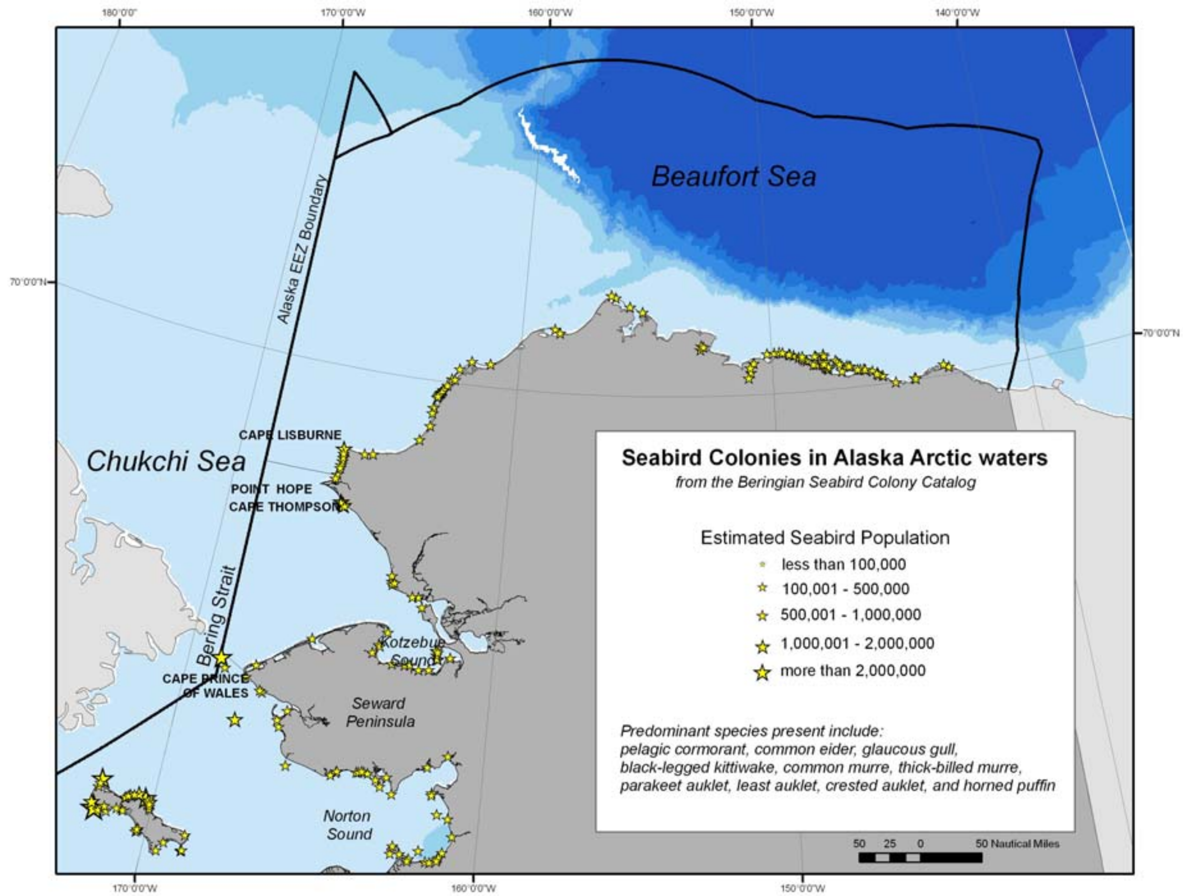

Figure 6-1 Seabird Colonies in Alaska Arctic Waters

6.2 Species descriptions and general distribution

According to Johnson and Herter (1989), at least 10 million individuals of over 120 species of terrestrial and aquatic birds migrate through the Beaufort Sea area, which the authors define as the Alaskan and Canadian Beaufort Sea from Barrow to Victoria Island and northward to Ellesmere Island in the Canadian High Arctic. Most arrive by early June each year to breed, nest, molt and fledge young on the terrestrial landscape. Arrival and nesting is tied to melting of snow and ice; most young birds have fledged by late July to early August and leave shortly thereafter. Some migrate long distances to and from this region, such as the arctic tern, white-rumped sandpiper, red phalarope, northern wheatear, yellow wagtail, and short-tailed shearwater. Some arrive in great abundance, such as the lesser snow goose, long-tailed duck, and red-breasted merganser and also many species of eiders, scaups, scoters, geese, swans, and other ducks. Shorebirds and other tundra-nesting birds also occur in large numbers throughout the tundra and wetlands of Alaska's North Slope. Loons and tundra swans are some of the species that leave the region late in the fall, and Johnson and Herter (1989) state that only a few species remain in this region from October to April, including black guillemots, common ravens, and snowy owls, and in some sheltered areas rock and willow ptarmigan, gyrfalcons, and hoary redpolls.

Bird densities in the pelagic waters of the Beaufort Sea are the lowest of any marine areas adjacent to Alaska (Divoky 1984), probably because of the extensive ice cover almost year-round and low production of forage items. Divoky (1984) reported higher densities of seabirds in the western Beaufort Sea versus areas to the east, suggesting that input of warmer subarctic water from the Bering Sea and through the Chukchi Sea may result in more productive feeding conditions. However, he also reported that, overall, pelagic seabird densities in the Beaufort Sea are very low compared with other areas of Alaska.

The marine environment is characterized by generally open water conditions from July to September or October, with varying amounts of open-water distance between the shoreline and the offshore permanent ice pack. In some years hundreds of miles of open water may occur, while in other years the ice pack remains within only miles of the coast, or the region may even be ice-bound throughout the summer, leaving little foraging area for marine birds. Winter sea ice is characterized by intermittent cracks, leads, and polynyas in the offshore areas, while the coastal zone and lagoons are generally frozen to the bottom or near bottom, with a shear zone of rumpled and broken ice at the interface between the moving ice pack and shorefast ice.

In mid to late May, deltas of larger rivers start to open, providing the earliest available unfrozen water habitat for arriving waterfowl and other birds (Johnson and Herter 1989). As the spring season progresses through May and June, coastal ice melts and cracks, gradually opening the coastal Beaufort and Chukchi Seas to arriving waterfowl and shorebirds, and larger rivers may outflow onto the shorefast ice many kilometers offshore. Overflow from the Mackenzie River in the Yukon Territory may extend over 50 km offshore (Johnson and Herter 1989).

Marine waters from the Bering Sea that are transported through Bering Strait and into the Chukchi Sea may account for the higher productivity in the Chukchi. The extensive productivity of the Chukchi Sea marine environment for seabirds, shorebirds, and coastal or cliff nesting birds provides important seasonal habitat for crested auklet, Steller's eider, common and thick-billed murre, black-legged kittiwake, spectacled eider, northern fulmar, and short-tailed shearwater. Seabird colonies along the Chukchi Sea coast near Point Hope provide nesting habitat for over 400,000 seabirds annually (Swartz 1966), and the U.S. Fish & Wildlife Service's Alaska Maritime National Wildlife Refuge attempts to annually survey these colonies. Nine species regularly breed in this area including the pelagic cormorant, glaucous gull, black-legged kittiwake, thick-billed and common murre, black and pigeon guillemot, and horned and tufted puffin (Swartz 1966). These species feed in adjacent Chukchi Sea waters.

The Alaska Maritime National Wildlife Refuge encompasses seabird colonies at Cape Lisburne in the Chukchi Sea, and annual monitoring efforts document use of these areas by selected species. In the Alaskan Arctic, the Cape Lisburne colony is the only refuge lands where this monitoring effort occurs. At this nesting site, the predominant species is the Black-legged Kittiwake; population trends show increasing abundance as of surveys conducted in 2005, but productivity (number of birds fledged per nest) was low based on a very short duration survey in 2005 (Dragoo et al. 2008).

Watson and Divoky (1972) surveyed the eastern Chukchi Sea in fall 1970. They observed several species offshore, many of which were likely migrating to southern latitudes for winter. These included Arctic and red-throated loons, primarily in the Barrow area and most within 40 miles of the coast. A few northern fulmars (Bering Strait area only) and slender-billed shearwaters were also observed in the Chukchi Sea, and only two pelagic cormorants were observed, south of Cape Prince of Wales. Long-tailed ducks were very common in flocks up to several thousand. Flocks of common, king, and spectacled eiders were also observed, most of which were females. Many other species were observed, including murres, jaegers, various gulls (glaucous, Ross's, herring, ivory, and Sabine's gulls), guillemots, crested and parakeet auklets, and black-legged kittiwakes. Watson and Divoky (1972) also reported that ice was a major factor affecting the locations of birds, with some species present more often along the pack ice edge (guillemots), while others were more prevalent associated with open water (gulls). They noted that ice may provide resting habitat for some species.

Watson and Divoky (1972) concluded that, in the fall, Chukchi Sea marine waters are used by large numbers of migrating seabirds, eiders, shorebirds, and other species, including a "significant fraction" of the world's population of Ross's gull. This area also may be an important feeding area for migrating species.

Piatt et al (1991) studied seabird distribution in the southern Chukchi Sea, near Cape Thompson, in relation to pelagic fish density and nutrient distribution from Alaska coastal currents. They found kittiwakes, shearwaters, and murres to be the most abundant and widely distributed species in late summer.

Northern fulmar do occur in the Chukchi Sea area but few have been observed past the Barrow area in the western Beaufort Sea (Figure 6-2). Surveys in the Chukchi Sea indicate that short-tailed shearwaters occur up to the Barrow area, and are uncommon visitors to the Beaufort Sea region (Johnson and Herter 1989). The breeding area for the pelagic cormorant includes areas of the southern Chukchi Sea, and it is only a casual visitor in the western Beaufort Sea (Johnson and Herter 1989).

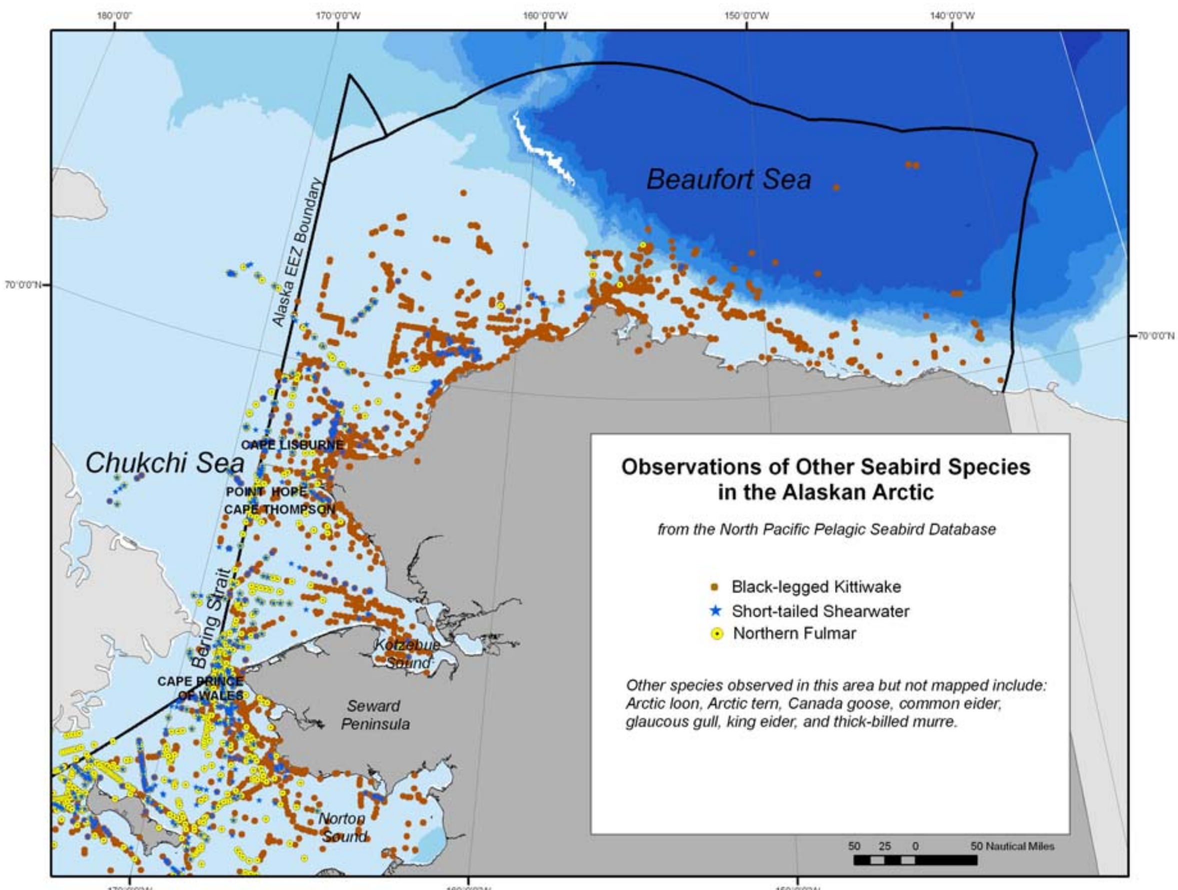

Figure 6-2 Observations of Other Seabird Species in Alaskan Arctic Waters

The Alaskan Arctic hosts several species of gull, although few overwinter in the region. The Ross's gull occurs in the Chukchi Sea and western portions of the Beaufort Sea; it occurs in this area primarily in the fall; it has been reported to be generally abundant in the Point Barrow area. Johnson and Herter (1989) report that a fairly large proportion of the world's population of Ross's gull visits the Alaskan Arctic annually. Surveys by the USFWS in 2007 showed Ross's gulls primarily around and north of Barrow and not in other areas surveyed in the Chukchi and Beaufort Seas (Kathy Kuletz, USFWS, unpublished data). The glaucous gull is very common throughout the open water season and occurs throughout the Chukchi and Beaufort Seas. The NPPSD indicates centers of concentration are around the Barrow area and offshore the central Alaskan Beaufort Sea, with this distribution possibly due to more sampling in these areas. Black-legged kittiwakes are also common in the region, increasing in abundance in pelagic areas as the sea ice retreats northward each summer. The NPPSD shows black-legged kittiwake centers of abundance at Cape Lisburne and just west of Barrow in the Chukchi Sea and just east of Barrow through the central portions of the Alaskan Beaufort Sea (Figure 6-2). Johnson and Herter (1989) report that the Sabine's gull and ivory gull are migrants to the Beaufort Sea but are uncommon.

Arctic terns are fairly common, migrating to breed in the Alaskan Arctic. Most common in coastal areas, the arctic tern breeds across the entire northern Arctic region, then migrates south to winter in subantarctic and antarctic waters (Johnson and Herter 1989). Nesting areas include coastal beaches and barrier islands; the NPPSD shows concentrations of arctic terns centered in the Barrow area with relatively greater numbers from Barrow to Wainwright and just east of Barrow. Boekelheide (1976) studied Arctic terns in the Barrow area, particularly on Cooper Island along Elson Lagoon east of Point Barrow, noting that they nest in colonies near areas where sea ice persists throughout the nesting season, early June through late July. Adults fed on Arctic cod and marine invertebrates when sea ice conditions permitted offshore foraging. Boekelheide (1976) reported that adults fed their chicks Arctic cod and other organisms, with Arctic cod a preferred prey item.

Common, king, spectacled, and Steller's eiders occur along the coasts of the Arctic region, with the common and king eiders the most abundant. King eiders concentrate in spring along the coast to nest, and some move offshore as well. The common eider is closely tied to marine habitat. It winters in the ice in polynyas and leads, feeding on mollusks and crustaceans from the sea floor, and migrates in the spring to Arctic coastal areas to nest.

A colony of nesting thick-billed murres at Cape Lisburne frequently feed in nearshore areas near Barrow, and individual birds have also been observed in offshore Beaufort Sea waters (Johnson and Herter 1989). Black guillemots have increased in abundance in the Beaufort Sea in the last few decades, and nest along the coast during summer months. Hundreds nest on Cooper Island where manmade nesting structures have been placed; Cooper Island now has the largest colony in Alaska (Johnson and Herter 1989). The NPPSD shows black guillemots are most abundant offshore in the eastern Chukchi Sea region. This species has been intensively studied on Cooper Island, and studies relating climate change to black guillemot production show that adults feed on demersal fishes during the nesting season. Birds in the Cooper Island colony feed chicks primarily on Arctic cod (Harter 2007). Black guillemots remain in the Arctic during winter; Johnson and Herter (1989) noted that these birds may migrate out of the Beaufort Sea area, but overwinter in the Chukchi or Bering Sea areas.

Parakeet auklets, crested auklets, and least auklets occur in the Chukchi Sea, but rarely in the Beaufort Sea according to Johnson and Herter (1989). The NPPSD shows parakeet auklets are abundant in the Bering Strait region and the central Chukchi Sea; the least auklet is not as abundant in the Chukchi but increases in abundance south of Bering Strait into the central Bering Sea; and crested auklets are similarly not abundant in the Chukchi Sea but are more abundant south of Bering Strait. Johnson and Herter (1989) report that Least Auklets nest on islands in the Bering Strait area and Crested Auklets may move into the Chukchi in the fall in large numbers. Tufted and horned puffins are rare in the Beaufort Sea; both may nest at coastal sites in the Chukchi Sea. Pelagic surveys show that horned puffins occur in the southern Chukchi Sea with higher abundance in the Bering Strait area (NPPSD).

Recent surveys (fall 2007) conducted by the FWS for "species of interest" showed that abundance of bird species was relatively high in the northern Bering Sea (particularly eiders, guillemots, loons, and dovekies) but abundance declined through the Bering Strait area. Further north, Ross's gulls, Kittlitz's murrelets, dovekie, and eiders were observed in relatively large numbers near and offshore from Point Barrow. Eiders were also present in the Prudhoe Bay area and offshore from Cape Lisburne. Shearwaters and auklets were observed through Bering Strait and northward in the offshore Chukchi Sea to approximately the latitude of Point Lay. A few shearwaters were observed offshore and northwest of Point Barrow and southward from areas offshore of Cape Lisburne to outer Kotzebue Sound during late September to mid October.

The Pomarine Jaeger is common in the Arctic, with higher densities reported from the Wainwright area in the Chukchi Sea eastward through the Barrow area to the Prudhoe Bay area (NPPSD). This species nests along the Arctic coast, and may occur offshore, but is commonly observed in nearshore areas during migrations in spring and fall.

Other common birds inhabiting the Alaskan Arctic include Tundra Swans, Black Brant, and Lesser Snow Geese, all of which are primarily terrestrial, feeding in fresh waters or brackish river delta areas and do not occur offshore. Shorebirds occur in the hundreds of thousands and include plovers, tattlers, sandpipers, godwits, turnstones, phalaropes, stints, the Killdeer, the Dunlin, and many others. Arctic Alaskan shorebirds prey primarily on larval and adult insects (Troy 2000) and do not use offshore pelagic marine waters. The Long-tailed Duck (Oldsquaw) is abundant in the Arctic coastal region, but generally only occupies brackish water lagoons after fledging and prior to migration south in the fall.

6.3 Birds with Conservation Status

Short-tailed Albatross

The short-tailed albatross (Phoebastria albatrus) is listed as endangered under the ESA and by the State of Alaska (65 FR 46643). While it is possible this species may occasionally travel into the Chukchi Sea, no records are available that indicate the species' use of Arctic waters. No critical habitat has been designated for the short-tailed albatross in the US, since the population growth rate does not appear to be limited by marine habitat loss (NMFS 2004a). Because short-tailed albatrosses rarely, if ever, use the waters in this action area, they are not analyzed further in this document.

Spectacled eider

The spectacled eider (Somateria fischeri) is a threatened species under the ESA and also listed as a species of special concern in Alaska. An estimated 7,370 spectacled eiders occupied the Arctic Coastal Plain of Alaska in June 2001. About 2% of the estimated 363,000 world population (MMS 2002) nest in wet tundra near ponds on the Arctic coasts of Alaska and the Russian Federation and on the coast of the Yukon-Kuskokwim (Y-K) Delta in Alaska. Nesting pairs arrive together each spring, but the males leave after egg incubation begins. In late summer, the females and young join the males at sea (ADF&G, 2001b). The only known wintering area of spectacled eiders lies south of St. Lawrence Island in the Bering Sea. In March 2008, observers on a research cruise in this area reported a very large aggregation of spectacled eiders in this area estimated to be 300,000 to 350,000 individuals (K. Kuletz, pers. comm..).

Because few eiders are observed in marine areas along the Beaufort coast in spring, a majority may migrate to the nesting areas overland from the Chukchi Sea (MMS 2002). Spectacled eiders have declined dramatically in Alaska since the 1960s (ADF&G 2001). Causes for this decline are not known but may include some combination of reduced food supplies, pollution, overharvest, lead shot poisoning, increased predation, and other causes (ADF&G 2001b).

The breeding population on the North Slope is currently the largest breeding population of spectacled eiders in North America. The most recent population estimate is approximately 4,744 pairs (Larned et al., 1999). However, this breeding area is nearly nine times the size of the Y-K Delta breeding area. Consequently, the density of spectacled eiders on the North Slope is about one quarter that on the Y-K Delta (Larned and Balogh, 1997; USFWS, 1996; 66 FR 9146). Based on USFWS survey data, the Spectacled eider breeding population on the North Slope does not show a significant decline throughout most of the 1990s. In February 2001, USFWS designated critical habitat on the Y-K Delta, in Norton Sound, Ledyard Bay, and the waters between St. Lawrence and St. Matthew Islands (66 FR 9146). The Ledyard Bay critical habitat area is within this study area and is shown in Figure 6-3.

During winter, spectacled eiders feed predominantly on clams; birds dive up to 70 m to capture clams off the sea floor (Jim Lovvorn, pers. comm.). In summer during the breeding season, spectacled eiders feed on invertebrates and vegetation from coastal tundra ponds along the Alaskan Arctic coastal area. Currently, research on spectacled sider nutrition is continuing at the Alaska Sea Life Center focusing on nutrient allocation to egg production to help understand reproductive energetics in this species (Federer and Hollmen 2008).

Steller's eider

The Steller’s eider (Polysticta stelleri) is a threatened species under the ESA and an Alaska species of special concern. Steller's eiders are diving ducks that feed on mussels in marine waters during the winter and insect larvae in freshwater ponds during the breeding season of spring and summer. Their current breeding range includes the arctic coastal plain in northern Alaska and northern coastal areas of the Russian Federation, where they nest on the tundra near small ponds (ADF&G, 2001c). In winter, most of the world's population of Steller’s eiders ranges throughout the Alaska Peninsula and eastern Aleutian Islands. Aerial surveys provide the only currently available means of objectively estimating Steller’s eider population size in northern Alaska. Population size point estimates based on annual waterfowl breeding pair surveys from 1989 to 2000 ranged from 176 to 2,543 (Mallek, 2002). These observations indicated that hundreds or low thousands of Steller’s eiders occur on the Arctic Coastal Plain. These surveys do not demonstrate a significant population trend from 1989 to 2000.

The current world population estimate is 150,000 to 200,000 birds, but the population is thought to have declined by as much as 50% between the 1960s and 1980s. When the Alaska breeding population of the Steller’s eider was listed as threatened, the factors causing the decline were unknown. Factors identified as potential causes of decline in the final rule listing the population as threatened (62 FR 31748) included predation, hunting, ingestion of spent lead shot in wetlands, and changes in the marine environment that could affect Steller’s eider food or other resources. Since listing, other potential threats, such as exposure to oil or other contaminants near fish processing facilities in southwest Alaska, have been identified, but the causes of decline and obstacles to recovery remain poorly understood (USFWS, 2002a). In February 2001, USFWS designated critical habitat for the Alaska-breeding population of Steller's eiders in one terrestrial and four marine areas: Y-K Delta, Kuskokwim Shoals, Seal Islands, Nelson Lagoon (including Nelson Lagoon and portions of Port Moller and Herendeen Bay), and Izembek Lagoon (66 FR 8849). None of these designated areas is in the study area for this analysis; however, Steller’s eiders have been observed throughout the area (Figure 6-3).

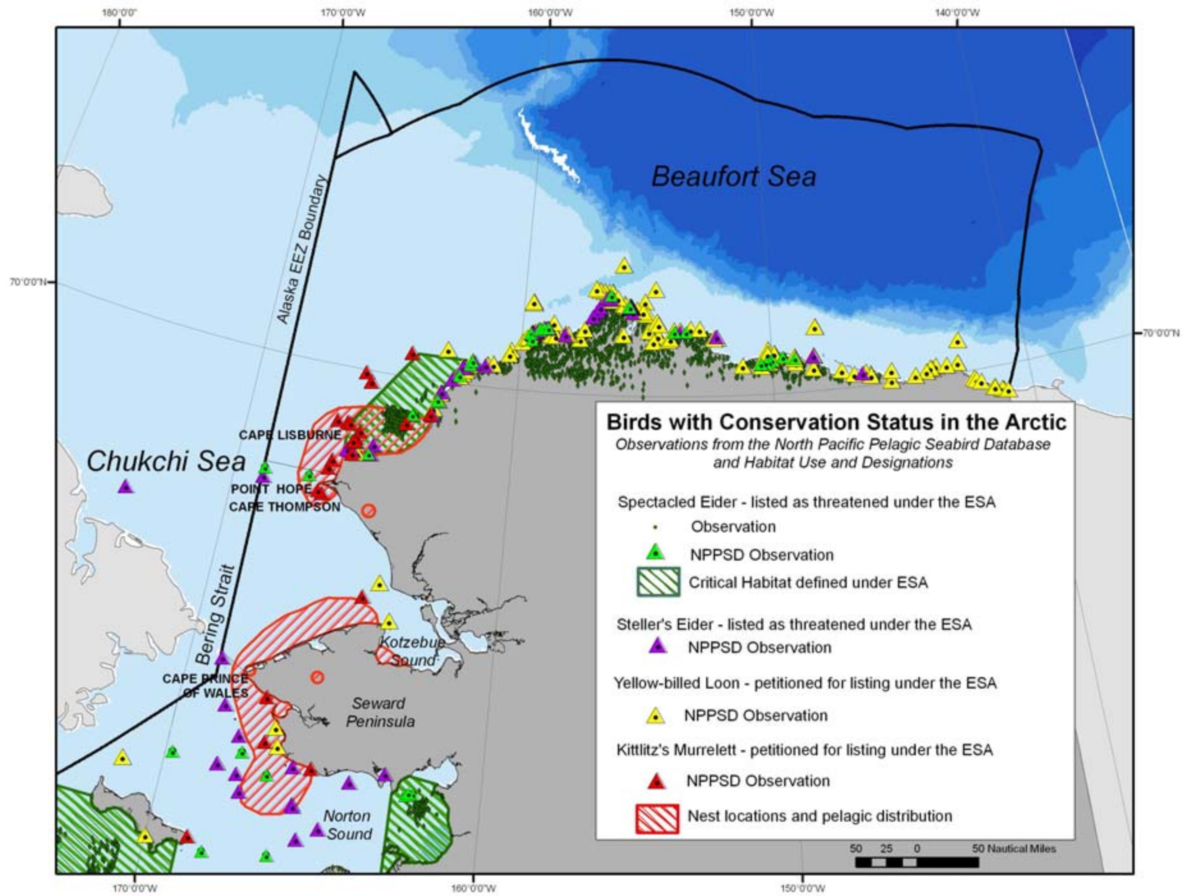

Figure 6-3 Birds with Conservation Status in the Arctic

Yellow-billed loon

Yellow-billed loons breed abundantly in the Alaska tundra on the North Slope all summer, in association with large permanent fish-bearing lakes greater than two meters deep. The single largest concentration based on 1998-2001 aerial survey data was slightly east of Barrow, between the Meade and Ikpikpuk Rivers. They are believed to be long-lived and dependent upon high annual adult survival to maintain current population size. The total Alaska population is estimated at between 3,700 and 4,900. There has been no discernible population trend, but due to limitations of current surveys and available information, researchers are not confident of being able to detect even significant declines in the breeding population. In 1993, researchers estimated a breeding population of 680 on the Seward Peninsula, in addition to yellow-billed loons' use of the North Slope.

Most of the summer breeding habitat of the yellow-billed loon is available for oil and gas leasing and development. Yellow-billed loons are threatened by destruction of habitat, introduced predators, disturbance, and pollutants from oil and gas exploration and development. Human disturbance at up to one mile away can cause behavioral changes in yellow-billed loons such as leaving eggs or chicks unattended. Some Native subsistence harvest of yellow-billed loons may occur, as well as incidental mortality to this loon from subsistence gill nets.

FWS received a petition from the Center for Biological Diversity in 2004 to list the yellow-billed loon as endangered or threatened throughout its range or as a distinct population segment and to designate critical habitat once listed. After a positive 90-day finding, the FWS initiated a status review, and is now under court order to release a 12-month finding on listing or not listing the species by February 15, 2009.

In 2006, the BLM, FWS, and other agencies developed a conservation agreement for yellow-billed loons. This agreement strives to (1) implement specific actions to protect yellow-billed loons and their breeding habitats from impacts associated with human activities; (2) monitor populations in Alaska; (3) monitor and reduce (if necessary) subsistence impacts; and (4) conduct further research.

Kittlitz's murrelet

Kittlitz's murrelet is a small diving seabird that forages in shallow waters for capelin, Pacific sandlance, zooplankton and other invertebrates. It feeds near glaciers, icebergs, and outflows of glacial streams, sometimes nesting up to 45 miles inland on rugged mountains near glaciers. They nest on the ground, and not in colonies; thus, less is known about their breeding behaviors. The entire North American population and most of the world's population inhabit Alaskan coastal waters discontinuously from Point Lay south to northern portions of Southeast Alaska. In 2007, U.S. Fish & Wildlife Surveys found relatively high densities of Kittlitz’s murrelets off Pt Barrow in late September (K. Kuletz, pers. comm.).

Kittlitz's murrelet is a relatively rare seabird. Most recent population estimates indicate that it has the smallest population of any seabird considered a regular breeder in Alaska (9,000 to 25,000 birds). This species appears to have undergone significant population declines in several of its core population centers: Prince William Sound (up to 84%), Malaspina Forelands (up to 75%), Kenai Fjords (up to 83%), and Glacier Bay. Causes for the declines are not well known, but likely include habitat loss or degradation, increased adult and juvenile mortality, and low recruitment. FWS believes that glacial retreat and oceanic regime shifts are the factors that are most likely causing population-level declines in this species. On May 4, 2004, the FWS (2004) gave the Kittlitz's murrelet (Brachyramphus brevirostris) a low ESA-listing priority because it has no imminent, high magnitude threats (50 CFR Part 17 Volume 69, Number 86). However, the listing priority was elevated from 5 to 2 in 2007 in recognition that climate change will have a more immediate effect on this species than previously believed and because of more evidence of declining population trends.

The FWS has conducted surveys for Kittlitz's murrelet in the Alaska Maritime National Wildlife Refuge over the past few years (FWS, 2006). These surveys have revealed populations at Attu, Atka, Unalaska, and Adak. Intensive surveys in 2006 found an additional 10 nests in the mountains of Agattu. Bird biologists will now be able to study the species’ breeding biology for the first time.

6.4 Impacts of Alternatives on Birds

The impacts of groundfish fisheries on seabirds are difficult to predict due to the lack of information on many aspects of seabird ecology. A summary of known information, both general and species-specific, can be found in Section 3.7 of the PSEIS (NMFS 2004). An analysis of the programmatic level preferred alternative for management of BSAI groundfish fisheries is in Section 4.9.7 of that document. Section 9 of the Alaska Groundfish Harvest Specifications EIS has a more recent analysis of the impact of the groundfish fisheries on prey availability, incidental take, and benthic habitat (NMFS 2007a).

As noted in the PSEIS, seabird life history includes low reproductive rates, low adult mortality rates, long life span, and delayed sexual maturity. These traits make seabird populations extremely sensitive to changes in adult survival and less sensitive to fluctuations in reproductive effort. The problem with attributing population changes to specific impacts is that, because seabirds are long-lived animals, it may take years or decades before relatively small changes in survival rates result in observable impacts on the breeding population. Moloney et al (1994) estimated a 5- to 10-year lag time in detecting a breeding population decline from modeled hook-and-line incidental take of juvenile wandering albatross, and a 30- to 50-year population stabilization period after conservation measures are put in place.

Interactions between birds and commercial fisheries may occur in the form of incidental take, reduced prey availability, and habitat disturbance. Since all of the alternatives under consideration would close most or all commercial fisheries in the Arctic Management Area, none of the alternatives would significantly impact birds.

In the future, if the Council determines that commercial fishing should be allowed, then the impacts of those fisheries would be evaluated with respect to impacts on the following indicators of seabird resource health:

Take

Seabirds can be killed and injured when they are attracted to baited hooks as these are being set and become entangled in the line or caught on the hooks. They are taken when they are attracted to trawling operations, perhaps by the presence of offal discards from fishing operations. They may become entangled in the cables connecting the trawl or the trawl sonar to the vessel, or in the trawl mesh. Seabirds may also be taken when they collide with, or strike, the fishing vessels themselves at night. Hook-and-line and trawl gear account for most seabird take; pot gear and gill nets account for very little. Indirect takes may occur if seabirds ingest and become entangled in marine plastics, become oiled during oil spills caused by marine accidents, or their colonies are preyed upon by invasive mammals introduced by accident (the Norway rat is a particular concern).

Prey availability

Fisheries may reduce, or disperse, the biomass of prey species available to seabird populations. Vessel activity may also displace or interfere with normal seabird foraging. This may be a particular concern when both birds and vessel are attracted by particular “hot spots” such as sites of upwelling, fronts, and shelf breaks. Vessels may also create seabird feeding opportunities by the discard of fish or fish processing wastes (offal).

Habitat disturbance

Fishing gear may disturb bottom habitat used by bottom-feeding seabirds and thus reduce available prey. Bottom trawl gear is the primary source of concern for an indirect impact through benthic habitat disturbance. Also, disturbance associated with the presence of human activity can cause birds to abandon eggs and chicks, particularly in the case of the yellow-billed loon.

Table 6-1 contains the significance criteria for analyzing the effects of the proposed action on seabirds. These criteria are from the 2006-2007 groundfish harvest specifications EA/FRFA (NMFS 2005). These criteria are applicable to this action because this analysis and the harvest specifications analysis both analyze the effects of groundfish fisheries on seabirds.

Table 6-1 Criteria used to determine significance of impacts on seabirds.

	Incidental take	Prey availability	Disturbance of habitat
Insignificant	No substantive change in bycatch of seabirds during the operation of fishing gear.	No substantive change in forage available to seabird populations.	No substantive change in gear impact on benthic habitat used by seabirds for foraging.
Adverse impact	Non-zero take of seabirds by fishing gear.	Reduction in forage fish populations, or the availability of forage fish, to seabird populations.	Gear contact with benthic habitat used by benthic feeding seabirds reduces amount or availability of prey.
Beneficial impact	No beneficial impact can be identified.	Availability of offal from fishing operations or plants may provide additional, readily accessible, sources of food. Removal of large predatory fish may leave more forage foe birds.	No beneficial impact can be identified.
Significantly adverse impact	Trawl and hook-and-line take levels increase substantially from the baseline level, or level of take is likely to have population level impact on species.	Food availability decreased substantially from baseline such that seabird population level survival or reproduction success is likely to decrease.	Impact to benthic habitat decreases seabird prey base substantially from baseline such that seabird population level survival or reproductive success is likely to decrease.
Significantly beneficial impact	No threshold can be identified.	Food availability increased substantially from baseline such that seabird population level survival or reproduction success is likely to increase.	No threshold can be identified.
Unknown impacts	Insufficient information available on take rates or population levels.	Insufficient information available on abundance of key prey species or the scope of fishery impacts on prey.	Insufficient information available on the scope or mechanism of benthic habitat impacts on food web.

For this analysis, seabirds have been grouped as follows:

• Species listed under the ESA as endangered or threatened and candidate species for listing: spectacled eiders, Steller's eiders, Kittlitz's murrelet, and yellow-billed loon.

• Species at high risk of fisheries interaction: gulls, shearwaters, and northern fulmars

• Other seabird species: murres, kittiwakes, gulls, auklets, puffins, cormorants, jaegers, terns, guillemots, murrelets, storm-petrels, and others.

The table below lists potential fishery interactions with these seabird groups.

Group	Species	Potential fisheries interactions
ESA-listed and candidate species	Spectacled eider	No observed takes Disturbance of feeding habitat, vessel collisions
ESA-listed and candidate species	Steller's eider	No observed takes Disturbance of feeding habitat, vessel collisions
ESA-listed and candidate species	Kittletz's murrelet	No observed takes Disturbance in forage areas, takes in gillnets
ESA-listed and candidate species	Yellow-billed loon	Takes in commercial and subsistence gillnet fisheries Disturbance in nesting habitat
Species at high risk of fisheries interactions	Gulls, shearwaters, and northern fulmars	Takes in BSAI hook-and-line Takes in BSAI trawl
Other seabirds	Alcids (auklets, murres, puffins, murrelets)	Small numbers of takes in BSAI hook-and-line Small numbers of takes in BSAI trawl

Incidental Takes

Estimated incidental take of birds recovered in the nets from trawling operations in the BSAI is approximately 855 birds per year (NMFS 2007a). Gull, shearwaters and fulmars make up 78 percent of the average annual trawl incidental catch for Alaska waters (NMFS 2007a). Additional bird mortality may occur by striking the trawl warps and third wire cables. This cable-strike mortality is unknown and is not included in any take estimates as these birds do not show up in any observer samples. The estimated takes of gulls, fulmars and shearwaters in the entire groundfish fishery are very small portions of these species populations (NMFS 2007a).

No Kittlitz's murrelets were specifically reported taken in the observed groundfish fisheries between 1993 and 2001 (PSEIS 2004) and no estimates are presented by AFSC (2006). While Kittlitz's murrelets have been observed in areas where fisheries occur, incidental take by the groundfish fisheries is unlikely because of the murrelet's foraging techniques, diet composition, and the fact that they do not follow or congregate around fishing vessels (K. Rivera, NMFS, pers. comm.) (FWS 2006).

The level of fishing effort may be an indication of the potential take of seabird species. Because the overall amount of harvest in the nonpelagic trawl fishery is not expected to change under the alternatives and options, the amount of incidental take of seabird species in the nonpelagic trawl fisheries is expected to be the same as status quo. Because the impact of incidental take is not expected to change under the alternatives and options, the effect of the alternatives and options on the incidental take of seabirds is insignificant.

Alternative 1 (Status quo)

Incidental take: If one or more commercial fisheries developed in the Arctic planning area, this could lead to an increase in the amount of incidental take of seabirds. The degree of any increase in incidental take would depend on the type of gear used by the fisheries that develop and the spatial and temporal distribution of effort in the fisheries. While the precise degree of such potential impacts is uncertain, given available information on the level of take in the BSAI trawl and hook and line fisheries, unless a commercial fishery developed and concentrated its effort in the Ledyard Bay critical habitat area, it is unlikely that incidental take would rise to a level of significance.

Prey availability and benthic habitat: If a fishery develops that targets arctic cod or other species that are important prey for seabirds, the fishery could adversely affect prey availability. Whether this effect would rise to a level of significance would depend on the abundance and reproductive rate of targeted species, the amount of fishing effort involved and the amount of biomass removed by the fishery.

A fishery that uses bottom trawl gear may adversely affect benthic habitat that supports prey resources for eiders and other benthic feeders, even if it does not target a prey resource for these birds. The use of bottom trawl gear in the Ledyard Bay critical habitat area would be of particular concern, as such activity may adversely affect benthic habitat that supports prey resources for spectacled eiders. Whether these effects would rise to a level of significance would depend on the abundance, distribution and reproductive rate of the targeted species and affected non-target species, relative to the amount of biomass removed by the fishery.

While the Council acknowledges considerable uncertainty regarding the type, location, and intensity of potentially unregulated fisheries that may emerge in the Arctic planning area, in our judgment it is unlikely that the effects of such fisheries on prey availability and benthic habitat of seabirds would rise to a level of significance.

Alternative 2: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait.

The potential for incidental takes during Arctic region fishing activities would be eliminated under this alternative. Because commercial fishing is not occurring now in the Arctic except for the very small crab fishery, no substantial change in the occurrence of incidental takes would be expected under this alternative. Therefore, Alternative 2 would have no effect on the incidental take of seabirds.

Alternative 3: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred would be exempt from the Arctic FMP.

Alternative 4: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop FMP to terminate its geographic coverage at Bering Strait. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

The effects of Alternatives 3 and 4 on incidental take of seabirds in the Arctic region are the same as Alternative 1. Both alternatives would allow for the continuation of a small crab fishery which is highly unlikely to affect seabird species which rarely overwinter in the Arctic. Alternative 3 and 4 would be more protective than Alternative 1 by preventing the development of other commercial fisheries. Because no substantial change overall in the occurrence of incidental takes is expected, the effects of incidental takes from Alternatives 3 and 4 on Arctic seabirds are insignificant.

Prey Availability and Benthic Habitat

Seabird diet information is scant, but available information suggests the importance of several fish species in the diets of Arctic seabirds. Dragoo et al. (2008) report that in 2005 at the Cape Lisburne nesting site in the Chukchi Sea, Black-legged kittiwakes primarily fed on small fish including Pacific sand lance, sculpins, gadids, and cod, including Arctic cod. Divoky (1984) reported that Arctic cod are the main prey of birds that feed in pelagic areas. Swartz (1966) reported that Arctic cod was a prominent element in the diets of thick-billed murres (45%), common murres (77%), black-legged kittiwakes (54%), and glaucous gulls (20%).

Divoky (1984) summarized feeding information on Beaufort Sea seabirds based on surveys conducted aboard an icebreaker. Surface-feeding species included phalaropes, jaegers, gulls, kittiwakes, and terns, and diving species included loons, eiders, long-tailed ducks, shearwaters, murres, and guillemots. Diving species were almost absent in more pelagic environments except in the western Beaufort where diving species were more abundant, probably due to observations of large numbers of one species, short-tailed shearwaters. Other species of diving seabirds observed regularly in offshore waters were black guillemots and thick-billed murres. Surface-feeding seabirds seen commonly offshore were the glaucous gull, and less frequently the black-legged kittiwake, jaegers, and other gulls. Arctic cod were an important element in the diets of nearly all seabirds that feed in Beaufort Sea waters.

Watson and Divoky (1972) reported some diet information based on surveys of the eastern Chukchi Sea in fall 1970. Primary prey items for ducks are pelagic crustaceans and small fish, mainly Arctic cod. Arctic cod were in the diets of Ross's, glaucous, ivory and herring gulls; common murres; black guillemots; and black-legged kittiwakes. They reported that fish are generally important to loons (which prey at the surface and midwater depths), jaegers (piracy), gulls (generally surface feeders), and large alcids (surface to midwater diving).

Frost and Lowry (1984) summarized food habits data for seabirds, marine mammals, and fish based on collections from the mid to late 1970s. Diet composition reported in Table 6-2 (percent of total diet) is for marine birds in the Beaufort Sea.

Table 6-2 Seabird Food Sources Percentages in the Beaufort Sea

Species /Group	Copepods	Euphausiids	Hyperiid amphipods	Arctic cod	Other
Black-legged Kittiwake		2	1	90	7
Glaucous Gull		9	1	50	40
Ivory Gull		10		80	10
Ross' Gull		40		40	20
Sabine's Gull	13	10		10	67
Arctic Tern		18	2	40	40
Jaegers				40	60
Black Guillemot				80	20
Thick-billed Murre		2	2	90	6
Loons				50	50
Phalaropes	90				10

Frost and Lowry (1984) evaluated seabird diets based on estimated annual consumption of major prey items. They estimated that 44% of seabird diets are comprised of Arctic cod. Other prey items were hyperiid amphipods, euphausiids, copepods, and other species. Forest and Lowry (1984) noted competitive interactions among seabirds, marine mammals, and fishes in that each group may prey on organisms that are also important to certain species in other groups, noting particularly the competition between ringed seals and Arctic cod for amphipods, which are important in the diets of many seabird species.

Divoky (1984) also studied the importance of Arctic cod in the diets of seabirds in the Beaufort Sea, noting that Arctic cod represented 64% by weight and 20% by weight of the diets of pelagic and nearshore seabirds, respectively. Welch et al. (1993) reported on the distribution of Arctic cod schools in the Canadian Arctic, noting that these schools of cod are preyed on intensely by seabirds and marine mammals.

Descriptions of the effects of prey abundance and availability on seabirds may be found in Section 3.7.1 of the PSEIS (NMFS 2004) and in section 9 of the Alaska Groundfish Harvest Specifications EIS (NMFS 2007a). Detailed conclusions or predictions cannot be made regarding the effects of forage fish bycatch on seabird populations or colonies. However, the present understanding is that fisheries management measures affecting abundance and availability of forage fish or other prey species could affect seabird populations (NMFS 2001; NMFS 2004), although commercial fisheries do not greatly compete directly with seabirds. There is no directed commercial fishery for those species that compose the forage fish management group, and seabirds typically target juvenile stages rather than adults for those target species where there is an overlap between seabirds and commercial fisheries. Most of the forage fish bycatch in Alaska groundfish fisheries is smelt taken in the BSAI pollock fishery.

The Alaska Groundfish Harvest Specifications EIS found that the potential impact of the entire groundfish fisheries on seabird prey availability was limited due to little or no overlap between the fisheries and foraging seabirds based on either prey size, dispersed foraging locations or different prey (NMFS 2007a). The majority of bird groups feed in vast areas of the oceans, are either plankton feeders or surface or mid-water fish feeders and are not likely to have their prey availability affected by non-pelagic trawl fisheries. The possible exception is seaducks that depend on benthic habitat. These include Steller's eiders, scoters, cormorants, and guillemots.

Spectacled eiders use the open leads of ice in the winter in the critical habitat area to aggregate and to feed on benthic organisms. These ducks dive 40-70 m to eat clams (exclusively Nuculana radiata) in the winter critical habitat area (Lovvorn et al 2003). In the fall and summer, the birds are more dispersed (Greg Balogh, USFWS, pers. comm.), and vessels are likely to encounter the dispersed population only in October before the sea ice develops. Direct disturbance of the eiders are unlikely because of their dispersed presence in locations of fishing in a limited time of the year.

The important feature of the winter critical habitat area is the presence of clams available to foraging spectacle eiders (Greg Balogh, USFWS, pers. comm.). Because non-pelagic trawl gear contacts the bottom, non-pelagic trawl gear in the critical habitat may have an impact on spectacled eider prey. These impacts on prey could come from uncovering the clams or from exposing the clams to the abundant predators (starfish and crabs) occurring in the area (Lovvorn, U of Wyoming, per. comm. February 2007). This potential loss of clam abundance may not be a problem for the eiders if the loss occurs in an area that is not under an ice lead used by the eiders. The location of ice leads depends on the winds which are quite variable. The potential for reduced foraging success is increased if the ice leads occur throughout critical habitat, the clams are evenly distributed, and fishing activity is evenly distributed. Ledyard Bay in the Chukchi Sea is critical habitat for molting spectacled eiders and is likely used July through October. Non-pelagic trawling in this area could have the same concerns as described above for spectacled eiders and other seabirds that may use this location and depend on bottom habitat for prey (Steller's eiders per Figure 6-3).

Alternative 1 Status quo

Currently, no commercial fishing is occurring in the Arctic region and therefore no competition for prey species with seabirds is occurring. Alternative 1 does not prevent commercial fishing for those vessels that are not registered by the State; and therefore, the potential exists that competition for target species between the fisheries and seabirds could occur. Particularly, if a fishery for Arctic cod were to develop, according to the diet information presented above, there could be considerable competition for this species, depending on the fishing effort involved.

An impact on prey can also be indirect. A fishery that uses bottom trawl gear may affect benthic habitat that supports prey resources for eiders and other benthic feeders even though the fishery may be targeting a species that is not a prey resource for these birds.

Because competition is not likely occurring currently or in the future, no substantial change in seabird prey availability is expected. Therefore, the effects of Alternative 1 on prey availability are insignificant under current conditions. Alternative 1 has the potential to result in significant adverse effects on seabird prey and habitat if unregulated fishing activity resulted in the removal of prey species or damage to habitat that caused population changes in seabird species. Considering the likely target species for a commercial fishery are arctic cod and saffron cod which are keystone forage species in the Arctic environment, unregulated fishing on these species make the potential for significant impacts more likely.

Alternative 2: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait.

The potential for competition for prey species between fisheries and seabirds would be eliminated under this alternative. Alternative 2 would prevent any fishing from occurring and therefore no competition for prey resources or disruption of feeding habitat would occur.

Alternative 3: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred would be exempt from the Arctic FMP.

Alternative 4: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop FMP to terminate its geographic coverage at Bering Strait. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

The effects of Alternatives 3 and 4 on the potential competition for prey species are the same as Alternative 1. Both alternatives would allow for the continuation of a small crab fishery which has potential to compete with those birds that use benthic prey in the same area as the crab fishery. Alternatives 3 and 4 would be more protective than Alternative 1 by preventing commercial fishing. Because no substantial change overall in the harvest of prey species is expected compared to the status quo, the effects on seabirds' prey availability under Alternatives 3 and 4 are insignificant. No affects on ESA-listed seabird species or designated critical habitat are expexted from Alternatives 2, 3, and 4. These alternatives prevent fishing in the Arctic Management Area except for the small red king crab fishery in the Kotzebue area which is outside of any critical habitat and is not likely to incidentally take any seabirds, is not likely to compete with any ESA-listed species for prey and is not likely to affect bottom habitat supporting ESA-listed species prey.

6.5 Cumulative Effects

Activities beyond commercial fishing that may affect seabird resources in the arctic include oil and gas exploration and development, subsistence harvest, and general disturbance from human presence. Given the prominence of the Alaskan Arctic region as important breeding and nesting habitat for a diverse and abundant bird assemblage, more national and international attention is being paid to the seasonal use of this region and the nature of human activities that occurs there, including existing and future oil and gas exploration and development, mining, shipping assessments (PAME Working Group 2007), scientific research, and homeland security. The National Audubon Society lists four regions in the Chukchi Sea as "Important Bird Areas", including the Bering Strait, Cape Lisburne and Cape Thompson, Ledyard Bay, and central/eastern offshore Chukchi Sea areas (Audubon Alaska 2004). Audubon Alaska (2005) recently published the Alaska Watchlist which lists the Arctic as a bird conservation region for several species of loon, eiders, other waterfowl, and shorebirds. The USFWS conducted surveys in the Arctic region in 2007, and will continue to monitor seabird colonies at Cape Lisburne as part of management of the Alaska Coastal Maritime Wildlife Refuge; heightened interest in bird monitoring is partly due to anticipated oil and gas exploration and development in the Chukchi Sea. And NOAA/NMFS recently completed fish surveys in the Beaufort Sea in 2008. Funded by MMS, these surveys included opportunistic seabird observations as part of the scheduled scientific research. The most frequently observed birds, from highest to lowest, were Arctic tern, black-legged kittiwake, phalaropes, unidentified shorebirds, Glaucous gull, terns, murres, unidentified gulls, parasitic jaeger, unidentified jaeger, Sabine's gull, thick-billed murre, surf scoter, and unidentified loons.[22]

There is currently a 20-count total subsistence take allowance of yellow-billed loons in the North Slope region if the birds are inadvertantly caught in gill nets. Historically yellow-billed loons have been hunted for subsistence purposes, but they are not currently on the list of "open" species in Alaska.

If additional Arctic seabird species (Kittlitz's murrelet and yellow-billed loon are candidate species) are listed under the Endangered Species Act, any future fisheries would have to be prosecuted in a way to minimize impacts to those species.

Release of pollutants during oil and gas exploration may increase seabird mortality, affect prey availability and disturb habitat necessary for foraging, resting, migration, and reproduction. A large oil spill is very unlikely during reasonably foreseeable oil and gas exploration in the Arctic Ocean off Alaska. There is a low likelihood of a large oil spill during present and reasonably foreseeable future oil and gas development activities. While an oil spill is unlikely during the oil and gas activities considered reasonable foreseeable for our analysis of cumulative effects, if such a spill occurs, it is likely to result in significant impacts on seabirds (MMS 2007)[23]. Effects could include direct oiling and mortality of birds and fouling of prey and habitats. These impacts would be significant regarless of the alternative chosen for this action. If commercial fishing were to coccur in the vicinity of oil and gas prduction facilities in the Bearufort Sea under Alternative 1, it is possible that such activity could slightly increase the probability of an oil spill.

Because they prohibit fishing activities in the vicinity of existing and reasonably foreseeable production facilities, Alternatives 2, 3, and 4 would not increase the likelihood of a large oil spill, nor would they add any incremental impact to the effect on seabirds which would occur in the event of a large oil spill. Due to the remote probability that a large oil spill may occur, and the fact that Alternatives 2, 3, and 4 do not contribute to the risk to seabirds, in assessing the significance of potential cumulative impacts, we discount the effects of an oil spill by its low probability of occurrence.

The direct and indirect impacts of Alternatives 2, 3, and 4 are primarily protective of seabirds by establishing a method to prevent fishing activities in the Arctic Management Area and therefore preventing fishing impacts on seabirds. The direct and indirect effects of Alternatives 2, 3, and 4 when added to the impacts of past, present, and reasonably foreseeable future activities analyzed in this section are likely to be insignificant for seabirds. Any potential adverse effects identified under the cumulative effects are reduced by the beneficial effects of Alternatives 2, 3, and 4. **None of the cumulative effects of Alternatives 2, 3, and 4 is expected to result in significant effects that substantially increase bird mortality, substantially reduce prey availability or substantially impact habitat to result in population level effects. Uncontrolled fishing under Alternative 1 has the potential to allow for significant impacts on seabirds, and therefore, may also result in potentially cumulative significant impacts.**

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[22] www.afsc.noaa.gov/REFM/Stocks/fit/Beaufort.php

[23] The significance criteria employed by the MMS EIS (2007) differs from that used herein. Any effects to seabirds deemed significant under the criteria employed by the MMS EIS (i.e., an adverse impact to seabird that results in a change in distribution or a decline in abundance requiring three or more generations for the affected population to recover to its former status) would likely qualify as significant under the criteria emplyed in this EA.

Chapter 7 Marine Mammals in the Arctic Management Area

The Arctic is known for its indigenous, and sometimes migratory, marine mammal populations. The Chukchi and Beaufort Seas are characterized by lower diversity of animals but, for some species, high abundance. Fifteen marine mammal species are present in the Arctic Management Area; bowhead whales, gray whales, beluga whales, narwhals, minke whales, killer whales, fin whales, humpback whales, spotted seals, bearded seals, ribbon seals, ringed seals, Pacific walrus, polar bears, and harbor porpoise. Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf (Lowry et al. 1982). Many of these marine mammal species rely on fish for a portion of their diets, and some information on marine mammal diets was presented in an earlier chapter on fish (Chapter 4). Later in this chapter (7) a summary of marine mammal diet information is presentedin Table 7-4. Chapter 8 also discusses fish and other prey organisms for marine mammals in the context of energy flow through the Arctic ecosystem.

7.1 Arctic Region Marine Mammal Status

The most recent marine mammal stock assessment reports (SARs) for nearly all species in the Arctic were completed in 2007 based on 2002 through 2006 data (Angliss and Outlaw 2008). Arctic marine mammals under USFWS jurisdiction, Pacific walrus and polar bears, were assessed in 2002 (Angliss and Outlaw 2008). All of the marine mammals that occur in the Arctic also occur in the Bering Sea, except narwhal; which are believed to occur solely in Arctic waters. The effects of fishing on marine mammals occurring in the Bering Sea are described in two environmental impact statements (EISs); the Programmatic EIS for the Alaska Groundfish Fisheries provides a detailed analysis of the potential effects of fishing activities on marine mammals (NMFS 2004a); and the Alaska Groundfish Harvest Specifications EIS provides recent information on the effects of the groundfish fisheries on marine mammals including a detailed description of the status of ESA Section 7 consultations (Section 8.2 of NMFS 2007a). For Bering Sea marine mammals, ESA Section 7 consultation has been completed for all ESA-listed marine mammals (NMFS 2000 and NMFS 2001). NMFS is currently consulting on the effects of the groundfish fisheries on humpback whales (NMFS 2006b). A draft biological opinion on the groundfish fishery in the Bering Sea and Aleutian Islands management area (BSAI) and Gulf of Alaska (GOA) is expected to be available in fall 2009.

The information from the programmatic and harvest specifications EISs (NMFS 2004a and 2007a) and from the marine mammal stock assessments (Angliss and Outlaw 2008) is incorporated by reference. Few surveys of marine mammals have occurred in the Chukchi Sea until recently. These recent surveys have provided new information regarding species distribution, including new observations of narwhal in the Beaufort and Chukchi Seas. Based on this new information, a stock assessment is planned for narwhals in 2009. The following is a summary of the status and distribution of each marine mammal species that may occur in the Beaufort or Chukchi Seas. Diet information for each marine mammal is summarized in Table 7-4.

7.1.1 Bowhead Whales

The Western Arctic stock of bowhead whales (*Balaena mysticetus*) occurs in the Bering, Chukchi, and Beaufort Seas. The bowhead whale seasonally inhabits the Chukchi and Beaufort Seas. Bowheads travel into the Arctic from the Bering Sea during spring (May/June) and inhabit the eastern Beaufort Sea during summer, primarily in the Amundsen Gulf south of Banks Island; they return south and then westward along the Alaskan Beaufort Sea coast to the Chukotka Peninsula, then southward into the Bering Sea in fall (September/October).

Bowhead whales are distributed in seasonally ice-covered waters of the Arctic and near-Arctic, generally north of 54°N and south of 75°N in the Western Arctic Basin (Moore and Reeves, 1993). For management purposes, five bowhead whale stocks are currently recognized by the IWC (IWC, 1992). These stocks occur in the Okhotsk Sea (Russian waters), Davis Strait and Hudson Bay (Greenland and Canadian waters), in the eastern North Atlantic (the Spitsbergen stock near Svalbard) and in the Bering-Chukchi-Beaufort Seas (Figure 7-1). The latter is the Western Arctic stock, the largest remnant population and only stock found in U. S. waters (Rugh et al. 2003).

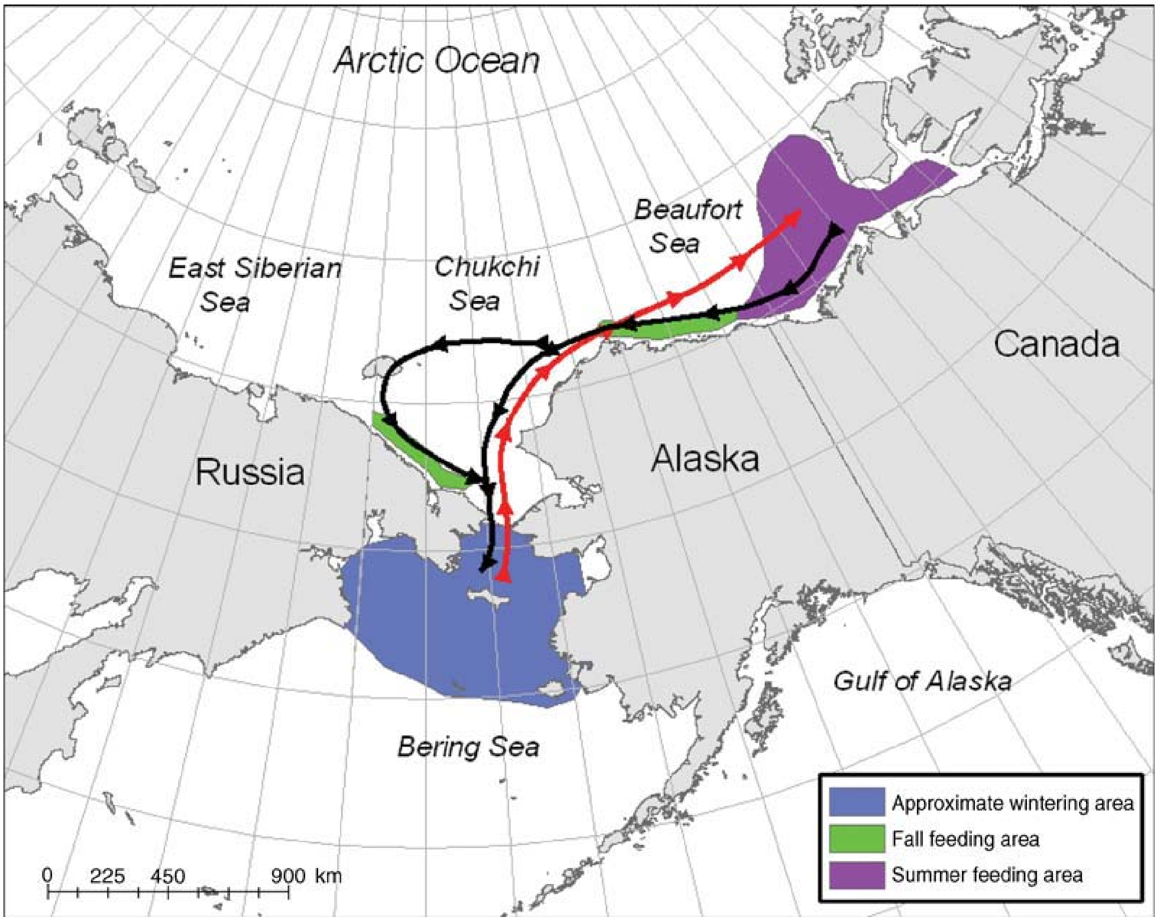

Figure 7-1 Migration of Bowhead Whales Western Arctic Stock (Moore and Laidre 2006). Red line with arrows shows spring migration north and east; black line with arrows shows autumn migration west and south.

All stocks of bowhead whales were severely depleted during intense commercial whaling prior to the twentieth century, and most of these stocks have not shown significant evidence of recovery even though a century has passed since commercial whaling stopped (Woodby and Botkin 1993). Only the Western Arctic stock has recovered significantly (Zeh et al. 1993). In order to assess the size of this stock, NMFS began a study of abundance in 1976 by conducting visual counts of whales during the spring while they were migrating past ice-based sites north of Point Barrow, Alaska (Krogman 1980). These counts are corrected for whales missed by the observers, in particular through the use of acoustic arrays that detect the location of vocalizing whales (Zeh et al. 1993 and George et al. 2004a). These counts continue to be the primary source of abundance information for this stock (George et al. 2004a). The current abundance estimate for the Western Arctic stock is 10,545 animals (Zeh and Punt 2004), between 46% and 101% of the estimated abundance of 10,400-23,000 animals prior to the onset of commercial whaling in the mid-19th century (Woodby and Botkin 1993; see also Bockstoce et al. 2005). Some analyses suggest the population may be approaching carrying capacity, although there is no sign of slowing in the population growth rate (Brandon and Wade 2006).

The Western Arctic stock of bowhead whales remains listed as endangered under the Endangered Species Act (ESA). Because of the ESA listing, the stock is classified as a depleted and a strategic stock under the Marine Mammal Protection Act (MMPA). However, the Western Arctic bowhead whale population is healthy and growing under a managed subsistence hunt and may be approaching historic abundance levels. NMFS will use criteria developed for the recovery of large whales in general (Angliss et al. 2002) and bowhead whales in particular (Shelden et al. 2001) in the next five-year ESA status review to determine if a change in listing status is needed (Gerber et al. 2007).

Starting in 2007, the National Marine Mammal Laboratory (NMML) began conducting a five-year study of bowhead whale feeding ecology (http://www.afsc.noaa.gov/Quarterly/jfm2008/divrptsNMML1.htm). This study focuses on late summer oceanography and prey densities relative to whale distribution over continental shelf waters within 100 miles north and east of Point Barrow, Alaska. Aerial surveys and acoustic monitoring provide information on the spatial and temporal distribution of bowhead whales in the study area. Oceanographic sampling helps identify sources of zooplankton prey available to whales on the shelf and the association of this prey with physical characteristics (hydrography, currents, etc.) that may affect mechanisms of plankton aggregation. Prey distribution will be better understood by examining temporal and spatial scales of the hydrographic and velocity fields in the study area, particularly relative to frontal features. Results of this research program may help explain increased occurrences of bowheads feeding in the western Beaufort Sea (in U.S. waters), well west of the typical summer feeding aggregations in Canadian waters of the Beaufort Sea.

7.1.2 Gray whale

Gray whales (*Eschrichtius robustus*) occur in the coastal and shallow water areas of both the eastern and western reaches of the North Pacific Ocean, as well as the Bering, Chukchi, and Beaufort Seas. Two stocks are recognized: the western Pacific or Korean stock (listed as endangered under the ESA) and the eastern North Pacific stock (removed from the ESA in 1994, Rugh et al. 1999). Only the eastern North Pacific stock is found in the Bering Sea/Aleutian Islands, Gulf of Alaska, and Arctic Management Area. This population migrates annually along the coast of North America from summer feeding areas in the Bering, Chukchi, and Beaufort Seas to winter grounds in sheltered waters along the Baja Peninsula (Rice and Wolman 1971).

The eastern North Pacific gray whale population has made a remarkable recovery since commercial whaling caused its depletion in the early 1900s. Gray whales were listed as endangered under the ESA on June 2, 1970 (35 FR 8495). On November 9, 1984, following a comprehensive evaluation of their status, NMFS concluded that this population should be listed as threatened, instead of endangered, under the ESA (49 FR 44774). However, no further action was taken until June 27, 1991 when a subsequent review was completed and made available to the public on 1991 (56 FR 29471). The latter review showed the best available abundance estimate (in 1987/88) was 21,296 whales with an average annual rate of increase of 3.29% (Buckland et al. 1993). Calculations indicated that this population was approaching carrying capacity (Reilly 1992). Therefore, on November 22, 1991 (56 FR 58869), NMFS proposed that this population be removed from the list of endangered and threatened wildlife under the ESA. And on January 7, 1993, NMFS published a final notice of determination (58 FR 3121) that this population should be removed from the list because the population had recovered to near its estimated original population size and was neither in danger of extinction throughout all or a significant portion of its range, nor likely to again become endangered within the foreseeable future. On June 16, 1994 (59 FR 31094), the eastern North Pacific gray whale population was formally removed from the list of endangered and threatened wildlife under the ESA.

The most recent abundance estimate of 20,110 is based on counts made during the 2006/2007 southbound migration (Rugh et al. 2008). This estimate is similar to abundance estimates made in 2000/01 and 2001/02 during the southbound migrations. Analyses of data from previous counts resulted in abundance estimates of 29,758 for 1997/98, 19,448 for 2000/01, and 18,178 for 2001/02 (Rugh et al. 2005). Most of these surveys started in mid-December and ran until mid-February; however, the 2001 southbound migration continued for another three weeks, and so the systematic counts were extended until March 5, 2001. In 2002, migration timing returned to normal with the southward migration ending in mid-February (Rugh et al. 2005).

Although the estimates show that migrating gray whales seemed to be decreasing between 1997/98 and 2001/02, this decline in abundance appears to be temporary and related to an unexplained gray whale mortality event that occurred in 1999 and 2000. The population is estimated to currently be at 99% to 100% of carrying capacity (Wade and Perryman 2002). However, it is impossible to determine how much of the decrease in the estimates is due to a real decline in the population and how much is sampling error in the estimate. Evidence that the decline is temporary comes from stranding data (Norman et al. 2000, Gulland et al. 2002, and Gulland et al. 2005), calf production data (Perryman et al. 2002 and 2004), and a change in body condition of whales during the southward migration (LeBoeuf et al. 2000). The abundance estimate for 2006/07 is consistent with estimates from 2000/01 and 2001/02, which further supports the idea that this stock may have reached carrying capacity (Rugh et al. 2008).

7.1.3 Beluga whales

Beluga whales (*Delphinapterus leucas*) are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere (Gurevich 1980), and some stocks are closely associated with open leads and polynyas (nonlinear openings in the sea ice) in ice-covered regions (Hazard 1988). Depending on season and region, beluga whales may occur in both offshore and coastal Alaskan waters, with concentrations in areas now designated as separate stocks: Bristol Bay, eastern Bering Sea, eastern Chukchi Sea, and Beaufort Sea (Angliss and Outlaw 2005). A stock also occurs in Cook Inlet but this stock is not likely to range into the Arctic Management Area. Most beluga whales from these summering areas are assumed to overwinter in the Bering Sea, but few data exist to support this conclusion (O'Corry-Crowe et al. 1997).

The population abundance estimate for the Bristol Bay stock is 1,888 animals, 18,142 animals in the eastern Bering Sea stock, 3,710 animals in the eastern Chukchi Seastock, and 39,258 animals in the Beaufort Sea stock (Angliss and Outlaw 2005). The draft 2008 SARs estimate the Bristol Bay stock at 2,877 animals (Robyn Angliss, NMML personal communication September 3, 2008). Current population trends for the Beaufort Sea and eastern Bering Sea stocks are unknown (Angliss and Outlaw 2005). The annual subsistence take by Alaska Natives between 1999-2003 averaged 53 animals per year from the Beaufort Sea stock, 65 animals per year from the eastern Chukchi sea stock, 209 animals per year from the eastern Bering Sea stock, and 19 animals per year from the Bristol Bay stock. The amounts of subsistence harvest on these stocks are expected to be slightly less for each of these stocks according to the draft 2008 SARs (Robyn Angliss, NMML, personal communication, September 3, 2008). These estimates may be negatively biased because of unreliable estimates of struck and loss rates during subsistence hunts. The Alaska Beluga Whale Committee monitors the subsistence harvest of beluga whales (Angliss and Outlaw 2005).

7.1.4 Minke whale

Minke whales (*Balaenoptera acutorostrata*) are distributed worldwide. Sightings in Alaskan waters range from Point Barrow, Alaska, in the Chukchi Sea, through the Bering Sea and Bristol Bay, and in coastal and offshore waters of the Gulf of Alaska (Leatherwood et al. 1982, Mizroch 1992, and NMFS Platform of Opportunity data 1997). Few data are available on migratory behavior and apparent "home ranges" of the Alaska stock of minke whales (e.g., Dorsey et al. 1990). Results of the surveys in 1999 and 2000 provide provisional abundance estimates of 810 and 1,003 minke whales in the central-eastern and southeastern Bering Sea, respectively (Moore et al. 2002). However, this covers only a small portion of the Alaska stock's range. Seabird surveys around the Pribilof Islands indicated an increase in local abundance of minke whales between 1975-78 and 1987-89 (Baretta and Hunt 1994). Current abundance estimates are not available. No data exist on trends in abundance in Alaskan waters (Angliss and Outlaw 2007).

7.1.5 Killer whale

Killer whales (*Orcinus orca*) have been observed in all oceans and seas of the world (Leatherwood et al. 1982) and are found throughout Alaska waters from the Chukchi Sea to southeast Alaska (Braham and Dahlheim 1982). Although reported in tropical and offshore waters, killer whales are more prevalent in colder waters of both hemispheres, with greatest abundances found within 800 km of major continents (Mitchell 1975). Seasonal movements in polar regions may be influenced by ice cover and in other areas primarily by availability of food. Multiple stocks of killer whales occur in Alaska waters. An estimated 1,123 killer whales belong to the eastern North Pacific Alaska resident stock (Angliss and Outlaw 2005). Population trends for the entire stock are currently unknown (Angliss and Outlaw 2007). Transient killer whales certainly occur in the Bering Sea and may also occur in the Arctic, and are the only known predators of bowhead whales (Angliss and Outlaw 2005).

7.1.6 Fin Whale

Fin whales (*Balaenoptera physalus*) are listed as endangered under the ESA and as depleted under the MMPA. Fin whales are large, fast-swimming baleen whales (Reeves, Silber, and Payne 1998). From April to October, fin whales inhabit temperate and subarctic waters throughout the North Pacific including the Gulf of Alaska, Bering Sea, and the southern and central eastern[24] Chukchi Sea. Their known current summer feeding habitat includes the southern portion, especially the southwestern portion, of the Chukchi Sea along the Asian coast. This species' current use of parts of its range probably is modified due to serious population reduction during commercial hunting. Data indicate they do not typically occur in the northeast Chukchi Sea, but distribution of this species may change with a reduction in sea ice. There is no reliable information about trends in abundance, and reliable estimates of current or historical abundance are not available for the entire Northeast Pacific fin whale stock. Population estimates from the 1970s for the entire North Pacific range from 14,620 to 18,630 animals (Ohsumi and Wada 1974). The draft 2008 SARs state that a provisional estimate of fin whales west of Kenai Peninsula is 5,700 whales (minimum est.), and the NMFS Southwest Fisheries Science Center is conducting genetic studies on fin whales throughout the North Pacific to determine stock structure (Robyn Angliss, NMML, personal communication, September 3, 2008).

[24] A fin whale was sighted in the central eastern portion of the Chukchi Sea on July 2, 2008. http://www.afsc.noaa.gov/nmml/cetacean/bwasp/index.php

7.1.7 Humpback whale

Humpback whales (*Megaptera novaeangliae*) are listed as endangered under the ESA and as depleted under the MMPA. The northern Bering Sea, Bering Strait, and southern Chukchi Sea along the Chukchi Peninsula were considered the northern extreme of the range of the humpback whale, except for a sighting of an adult and calf in waters 87 km east of Pt. Barrow in August 2007 (Hashagen et al. 2008). The occurrence of humpback whales in the Beaufort Sea may be related to warmer water temperatures (Hashagen et al. 2008). Their known current summer feeding habitat includes the southern portion, especially the southwestern portion, of the Chukchi Sea. Historically, large numbers of humpbacks were seen feeding near Cape Dezhnev. Humpback whale use of portions of their range also has been influenced by their severe population reduction due to historic commercial hunting. No reliable estimates exist for the abundance of humpback whales in feeding areas for this stock because surveys of the known feeding grounds are incomplete, and because not all feeding areas are known (Angliss and Outlaw 2008). The Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific report indicates that a substantial recovery for humpbacks in the North Pacific (est. 20,000 animals) has occurred since the end of commercial whaling (http://www.cascadiaresearch.org/SPLASH/SPLASH-contract-Report-May08.pdf).

7.1.8 Harbor Porpoise

Harbor porpoises (*Phocoena phocoena*) are found in the eastern North Pacific Ocean from Point Barrow, along the Alaskan coast, and down the west coast of North America to Point Conception, California (Gaskin 1984, Suydam and George 1992, and Dahlheim et al. 2000). They occur primarily in coastal waters, but are also found where the shelf extends offshore (Gaskin 1984 and Dahlheim et al. 2000). In 1999, aerial surveys conducted in Bristol Bay resulted in an abundance estimate of 47,356 for this portion of the Bering Sea. The draft 2008 SARs estimate abundance in Bristol Bay at 48,215 animals (Robyn Angliss, NMML, personal communication, September 3, 2008). Currently, there is no reliable information on population trends (Angliss and Outlaw 2008). The draft 2008 SARs includes information on subsistence hunters using nets off Barrow to take harbor porpoise (Robyn Angliss, NMML, personal communication, September 3, 2008). Harbor porpoise occur primarily in coastal waters of the Chukchi Sea (Figure 29 in Angliss and Outlaw 2008).

7.1.9 Narwhal

Narwhal (*Monodon monoceros*) are distributed in Arctic waters and recently have been sighted in the Beaufort and Chukchi Seas during a NMFS survey (Robyn Angliss, NMML, personal communication, September 3, 2008). Because no stock assessment is currently available for this species, the following information is from the American Cetacean Society (http://www.acsonline.org/factpack/Narwhal.htm). The narwhal is a deep-water cetacean, and has been known to dive to 1,200 feet. They feed in deep bays and inlets on Arctic cod, squid, flatfish, pelagic shrimp, and cephalopods. During the fall migration, narwhals move offshore where they are not exposed to the risk of being trapped in near shore ice. Current population estimates in the Northwest Atlantic region are thought to be around 50,000, and worldwide estimates are not available. Over 1,000 narwhals are harvested each year between Canada and Greenland, which harvests are thought to be above a sustainable level.

7.1.10 Ice Seals

The term "ice seals" refers collectively to a group of seal species that are entirely dependent on ice for portions of their life cycle. The ice seals include the ribbon, spotted, bearded, and ringed seals. In December 2007, NMFS was petitioned by the Center for Biological Diversity (CBD) to list ribbon seals as endangered or threatened under the ESA (CBD 2007). This petition is based on the dependence of this species on sea ice and the loss of sea ice due to global climate change. The petition presents information on (1) global warming which is resulting in the rapid melt of the seals' sea-ice habitat; (2) high harvest levels allowed by the Russian Federation; (3) current oil and gas development; (4) rising contaminant levels in the Arctic; and (5) bycatch mortality and competition for prey resources from commercial fisheries. NMFS determined that the petition presents substantial information that a listing may be warranted and has started a status review of the species to determine whether listing is warranted (73 FR 16617, March 28, 2008). A decision on whether listing is warranted is due in December 2008. On May 28, 2008, the CBD petitioned NMFS to list ringed, bearded, and spotted seals under the ESA due to threats to the species from global warming, high harvest levels allowed by the Russian Federation, oil and gas exploration and development, rising contaminant levels in the Arctic, and bycatch mortality and competition for prey resources from commercial fisheries (CBD 2008a). NMFS has initiated the status review for ringed, bearded, and spotted seals with comments due by November 3, 2008 (73 FR 51615, September 4, 2008). A decision on whether listing is warranted is due May 2009.

7.1.10.1 Spotted Seal

Spotted seals (*Phoca largha*) are distributed along the continental shelf of the Beaufort, Chukchi, Bering, and Okhotsk Seas south to the northern Yellow Sea and western Sea of Japan (Shaughnessy and Fay 1977). Of eight known breeding areas, three occur in the Bering Sea. Satellite tagging studies indicate that spotted seals summering along the Chukchi Sea coast migrate south in October and pass through Bering Strait in November (Lowry et al. 1998), moving south into the Bering Sea with the ice edge through December (Lowry et al. 2000). Preferred habitat for spotted seals in Alaska during January-April is the transition zone of pack ice between the southern fringe of ice and the heavier southward-drifting pack ice (Burns et al. 1981 and Lowry et al. 2000). Pups are born in the pack ice during March-April; during April-May, spotted seals inhabit the southern margin of the ice edge (Braham et al. 1984), and move to coastal habitats after the ice retreats (Fay 1974 and Shaughnessy and Fay 1977). During August-October, spotted seals inhabit coastal and estuarine habitats in the northern Bering and Chukchi Sea (Braham et al. 1984 and Lowry et al. 2000). Availability of food and freedom from disturbance seem to be important criteria for selection of coastal haulout sites (Lowry 1982). Preliminary tagging study results from April through July 2007 show the tagged spotted seals mostly occur in the Bering Sea, as shown in Figure 7-2 (Boveng et al. 2008).

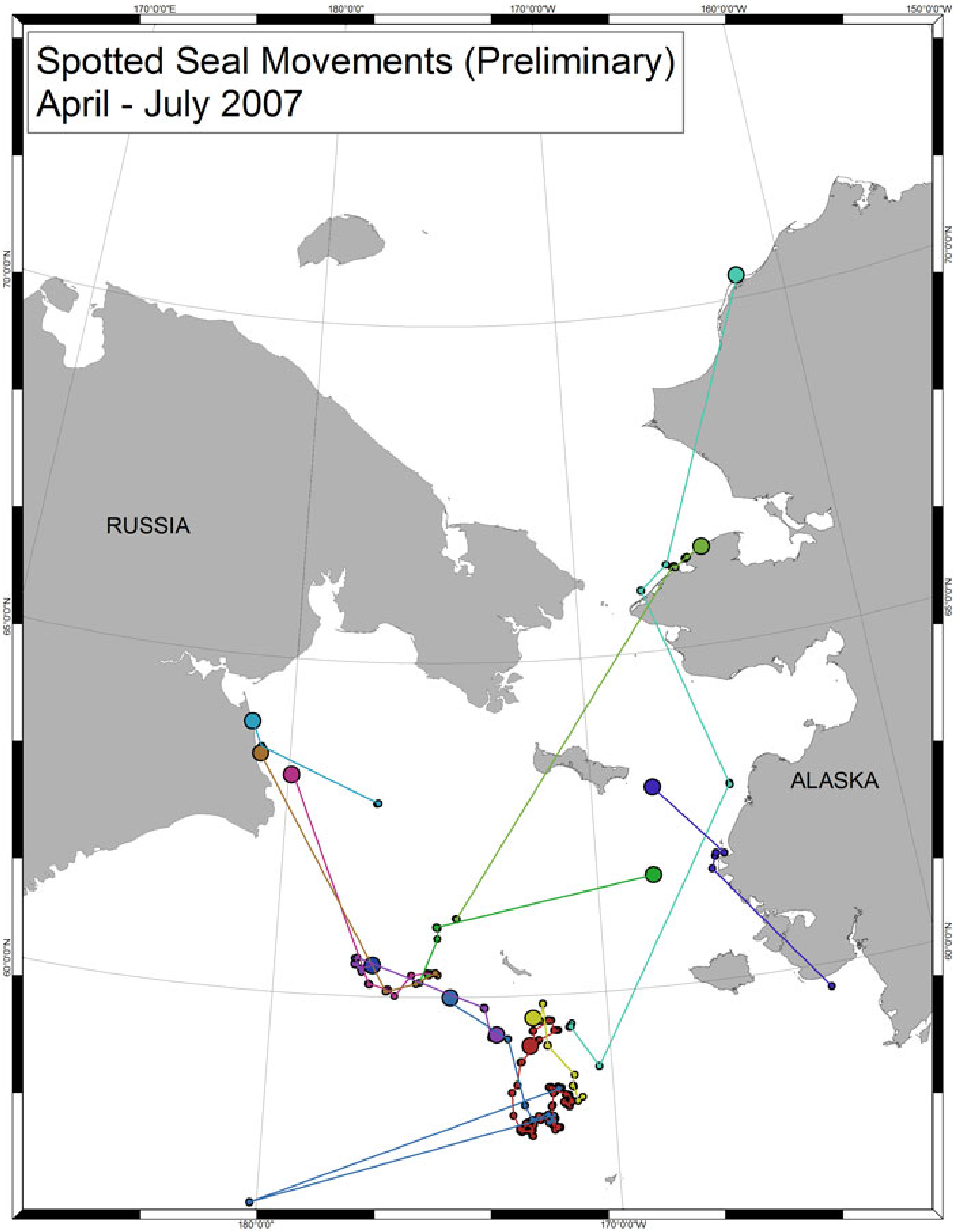

Figure 7-2 Telemetry Data Results for Spotted Seals (Boveng et al. 2008).

A reliable estimate of spotted seal population abundance, abundance trends, and stock structure is currently not available (Rugh et al. 1997; Angliss and Outlaw 2007). Burns (1973) estimated 200,000 to 250,000 animals in the Bering Sea stock, including Russian waters, based on the distribution of "family" groups (mother and pup, with attending male) on ice during the mating season. However, comprehensive systematic surveys were not conducted to obtain these estimates. Spotted seals are an important species for Alaskan subsistence hunters, primarily in Bering Strait and Yukon-Kuskokwim regions, with estimated annual harvests ranging from 850-3,600 seals taken during 1966-1976 (Lowry 1984). From September 1985 to June 1986, the combined harvest from five Alaska villages was 986 animals (Quakenbush 1988).

7.1.10.2 Bearded Seal

Bearded seals (*Erignathus barbatus*) are circumpolar in their distribution, extending from the Arctic Ocean south to Hokkaido in the western Pacific. In Alaskan waters, bearded seals occur on the continental shelves of the Bering, Chukchi, and Beaufort Seas (Burns 1981a, Johnson et al. 1966, and Ognev 1935). The majority of bearded seals move south with the seasonally advancing sea ice in winter (Burns 1967). Pups are born in the pack ice from March through mid-May (Burns 1967). In summer, many of the seals that winter in the Bering Sea move north through Bering Strait during April - June, and are distributed along the ice edge in the Chukchi Sea during the summer (Burns 1967 and 1981a). Some seals, particularly juveniles, may spend the summer in open-water areas of the Bering and Chukchi seas (Burns 1981a).

In 2004 through 2006, grants from the U. S. Fish and Wildlife Service to the Native Village of Kotzebue supported tagging studies and integration of local and traditional knowledge to understand the distribution and habits of bearded seals occurring in Kotzebue Sound. Maps of the movements of bearded seal tagged in Kotzebue Sound are available from http://kotzebueira.org/current_projects.html. NMML and ADF&G also participated in tagging ringed and spotted seals as they were captured incidentally to the bearded seals.

Reliable estimates of abundance, abundance trends, and stock structure are not available. Early estimates of the Bering-Chukchi Sea stock range from 250,000 to 300,000 animals (Popov 1976, Burns 1981a, and Burns et al. 1981).

7.1.10.3 Ribbon Seal

Ribbon seals (*Phoca fasciata*) inhabit the North Pacific Ocean and adjacent fringes of the Arctic Ocean, most commonly in the Okhotsk and Bering Seas (Burns 1981b). During the breeding season, ribbon seals are found only in the pack ice of the Okhotsk and Bering Seas (Kelly 1988a). In Alaska waters, ribbon seals are found in the open sea, on the pack ice, and only rarely on shorefast ice (Kelly 1988a). Ribbon seals in Alaska range northward from Bristol Bay in the Bering Sea into the Chukchi and western Beaufort Seas (Burns 1970 and 1981b, Braham et al. 1984, and Moore and Barrowclough 1984), inhabiting the northern part of the Bering Sea ice front from late March to early May (Burns 1970 and 1981b, and Braham et al. 1984), and moving north with the receding ice edge in May to mid-July (Shustov 1965, Tikhomirov 1966, Burns 1970 and 1981b, and Burns et al. 1981a). Ribbon seals usually haul out on thick pack ice (Shustov 1965, Tikhomirov 1966, Burns 1981b, and Burns et al. 1981a) and only rarely on shorefast ice (Bailey 1928). In April, they have been found throughout the ice front but most abundantly over deep water south of the continental shelf (Braham et al. 1984). As the sea ice recedes in May-June, two major rafted remnants of the pack ice remain: the Alaskan massif (from Bering Strait to eastern St. Lawrence Island and south to Nunivak Island) and the Anadyr massif (from the Gulf of Anadyr toward St. Matthew Island); ribbon seals are thought to be associated with the Anadyr massif (Burns et al. 1981b). Little is known of the distribution of ribbon seals after the ice recedes from the

Bering Sea (Kelly 1988a); they are presumed to be solitary and pelagic in summer and autumn but their distribution is unknown (Burns 1981b). Many ribbon seals may migrate north to the Chukchi Sea during the summer (Kelly 1988a), while others may remain pelagic in the Bering Sea, near the edge of the continental shelf (Burns 1970 and 1981b). Single ribbon seals have been observed during the summer (June-August) within 84 miles of the Pribilof Islands (Burns 1981b), near Cordova, Alaska (Burns 1981b) and south of the Aleutian Islands (Stewart and Everett 1983). Preliminary tagging study results from April through July 2007, show that the tagged ribbon seals occur primarily in the Bering Sea but also occasionally range into the Chukchi Seas, as shown in Figure 7-3 (Boveng et al. 2008).

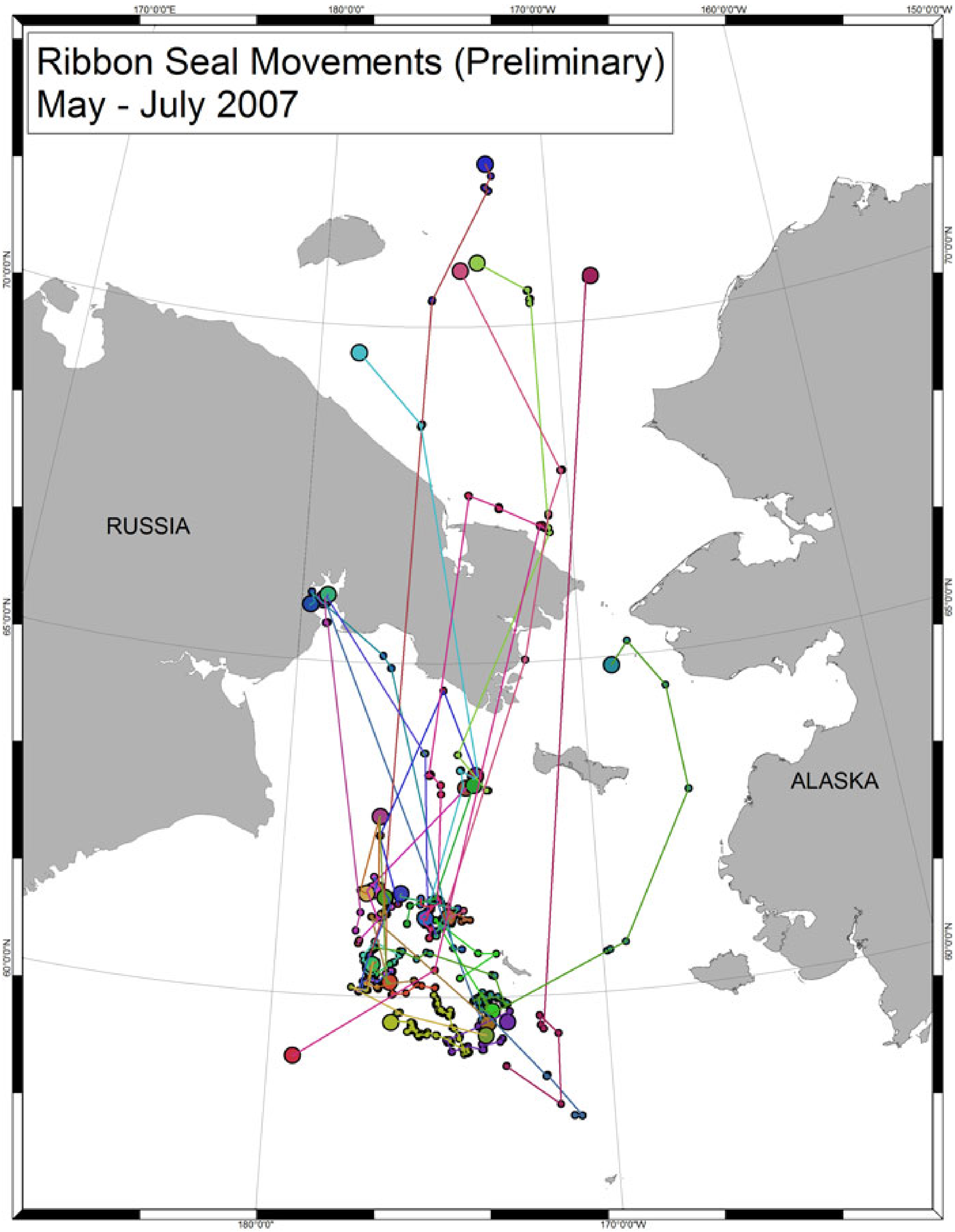

Figure 7-3 Telemetry Data Results for Ribbon Seals (Boveng et al. 2008).

A reliable estimate of abundance, abundance trends, and stock structure for the Alaska stock of ribbon seals is currently not available (Angliss and Outlaw 2008). The worldwide population of ribbon seals was estimated at 240,000 in the mid-1970s, with an estimate of 90,000 to 100,000 in the Bering Sea (Burns 1981b).

7.1.10.4 Ringed seal

Ringed seals (*Phoca hispida*) are found throughout the arctic in areas of seasonal sea ice, as well as in areas covered by the permanent polar ice cap (McLaren 1958, Smith 1987, Kelly 1988b, Ramsay and Farley 1997, and Reeves 1998). In the North Pacific Ocean, they are found in the Bering Sea and range as far south as the seas of Okhotsk and Japan. Most ringed seals overwinter, breed, give birth, and nurse their young within the shorefast sea ice (McLaren 1958 and Smith and Stirling 1975), although some breeding seals (and pups) have been observed in pack ice (Finley et al. 1983). In the Chukchi and Beaufort seas, ringed seals haul out in highest densities in shorefast ice during the May-June molting season, immediately following the March-April pupping season (Johnson et al. 1966, Burns and Harbo 1972, and Frost et al. 1988, 1997, 1998, and 1999). Little is known about the distribution of ringed seals during the "open water" season, July-October, but ringed seals have been seen both hauled out on pack ice and foraging in open water some distance away from the nearest sea ice (Smith 1987). Ringed seals migrate north and south with the retreat and advance of the sea ice edge, but some seals in areas of seasonal shorefast sea ice may be sedentary (Burns 1970, Smith 1987, Heide-Jørgensen et al. 1992, Kapel et al. 1998, and Teilmann et al. 1999). In addition to ice-associated migrations, ringed seals can also travel long distances east or west, particularly young seals (Smith 1987 and Kapel et al. 1998).

A reliable estimate of abundance, abundance trends, and stock structure for the Alaska stock of ringed seals is currently not available (Angliss and Outlaw 2007). Crude estimates of population in Alaskan waters include 1-1.5 million (Frost 1985) or 3.3-3.6 million, based on aerial surveys conducted in 1985, 1986, and 1987 (Frost et al. 1988). Surveys conducted in the Beaufort Sea in the 1990s (Frost et al. 2002) and the eastern Chukchi Sea in 1999 and 2000 (Bengtson et al. 2005) resulted in a total of approximately 249,000 seals (Angliss and Outlaw 2005). This is a minimum population estimate because it does not include much of the geographic range of the stock, and the estimate for the Alaska Beaufort Sea has not been corrected for the number of ringed seals not hauled out at the time of the surveys.

7.1.11 Pacific Walrus

The Pacific walrus (*Odobenus rosmarus*) occurs primarily in the shelf waters of the Bering and Chukchi Seas (Allen 1880 and Smirnov 1929). Most of the population congregates during the summer in the southern edge of the Chukchi Sea pack ice between Long Strait, Wrangell Island, and Point Barrow (Fay et al. 1984). The remainder of the population, primarily adult males, stays in the Bering Sea during summer (Brooks 1954, Burns 1965, Fay 1955, Fay 1982, and Fay et al. 1984). Females and sub-adult males migrate toward Bering Strait in the autumn when the pack ice begins to re-form (Fay and Stoker 1982). Walrus use terrestrial haulout sites when suitable haulout sites on ice are unavailable. The major haulout sites are located along the northern, eastern, and southern coasts of the Chukchi Peninsula, on islands in Bering Strait, on the Punuk Islands, on Round Island in Bristol Bay (Lentfer 1988), and at Cape Seniavan on the north side of the Alaska Peninsula. Although walrus are capable of deep diving (greater than 250 meters (Born et al. 2005), they usually feed in waters less than 80 meters deep over the continental shelf where their prey are more abundant and easier to obtain than in deeper waters (Fay and Burns 1988 and Jay et al. 2001).

The current size and trend of the Pacific walrus population is unknown (Gorbics et al. 1998). The total initial estimate of 270,000 to 290,000 animals in 1980 was later adjusted to about 250,000 (Fay et al. 1984 and Fedoseev 1984). A reliable estimate of current population size is not available. A new range-wide count is expected by late 2008. Between 1975 and 1990, aerial surveys by the U.S. and Russia produced population size estimates from approximately 201,000 to 234,000 individuals (Angliss and Outlaw 2007). On February 7, 2008, the Center for Biological Diversity petitioned the U. S. Fish and Wildlife Service (USFWS) to list Pacific walrus under the ESA because of the impact of global warming in the sea ice habitat (CBD 2008b). As of August 2008, the USFWS had not evaluated the petition (Joel Garlich-Miller, USFWS, personal communication, August 28, 2008).

7.1.12 Polar bear

Polar bears (*Ursus maritimus*) are circumpolar in their distribution in the northern hemisphere. Two stocks occur in Alaska: the Chukchi/Bering Seas stock and the southern Beaufort Sea stock. Polar bear movements are extensive, and individual activity areas are enormous. Prior to the twentieth century, when Alaska's polar bears were hunted primarily by Alaskan Natives, both stocks probably existed near carrying capacity. The size of the Beaufort Sea stock appeared to decline substantially in the late 1960s and early 1970s due to excessive harvest rates when sport hunting was legal. Similar declines could have occurred in the Chukchi Sea, although data are unavailable to test that assumption. Since passage of the MMPA, harvest rates have declined. The Chukchi stock population trend can not be determined at this time (72 FR 1064, January 9, 2007). The Northern Beaufort Sea population appears to be stable but the Southern Beaufort population appears to be declining (72 FR 1064, January 9, 2007). Polar bear stocks in Alaska have no direct interaction with commercial fisheries activity (Angliss and Outlaw 2005).

The 1991-2000 mean U.S. harvest from the Chukchi/Bering Sea stock was 44.8 animals per year. Development of a management agreement for this stock between Native representatives of Alaska and the Russian Federation, and the United States and Russian governments, is ongoing. In 1997, a Cooperative Agreement was developed between the USFWS and the Alaska Nanuuq Commission to facilitate local participation in activities related to the conservation and management of polar bears pursuant to Section 119 of the MMPA (Angliss and Outlaw 2005). The 1995-2000 mean U.S. harvest from the Beaufort Sea stock was 32.2 animals per year. A management agreement between Canadian Inuit and Alaskan Inupiat of the North Slope has been in place since 1998. Since initiation of this local user agreement, the combined Alaska/Canada mean harvest from this stock has been 55.1 animals per year, which is less than an annual allocation guideline of 81 and PBR level of 95 animals per year (Angliss and Outlaw 2005).

On May 15, 2008, the USFWS listed polar bears as threatened under the Endangered Species Act (73 FR 28212). The reason for the listing is that polar bear's sea ice habitat is declining throughout the species' range, that this decline is expected to continue for the foreseeable future, and that this loss threatens the species throughout all of its range. According to the USFWS listing notice (73 FR 28212, May 15, 2008), the Chukchi Sea population is estimated to comprise 2,000 animals, based on extrapolation of aerial den surveys (2002). Status and trend cannot yet be determined for this population. The Southern Beaufort Sea population comprises 1,500 animals, based on a recent population inventory (2006). The predicted trend is declining (Aars et al. 2006, p.33), and the status is designated as reduced.

7.2 Impacts of Alternatives on Marine Mammals

Interactions between marine mammals and commercial fisheries may occur due to overlap in important marine mammal prey and the size and species of fish that are harvested in the fisheries, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities. Because very limited commercial fishing has occurred under the status quo (small king crab fishery) and the other alternatives provide for the same or less potential for fishing, none of the alternatives is expected to result in much fishing activity interaction with marine mammals.

The impacts of commercial fishing on marine mammals are analyzed by addressing these questions:

(1) Would the proposed fishery result in direct interactions with marine mammals (incidental take and entanglement in marine debris)?

(2) Would the proposed fishery disturb or remove prey species at levels or in areas that could compromise foraging success of marine mammals (harvest of prey species)?
(3) Would the proposed fishery modify marine mammal behavior (disturbance) by either sound or presence of fishing activities?

This analysis determines (a) whether takings, prey competition, or disturbance are possible with any potential new fisheries, and (b) if they are possible, what relative level of impact might be likely from the effect.

Table 7-1 contains significance criteria for analyzing the effects of the alternatives on marine mammals. These criteria are from the 2006-2007 groundfish harvest specifications EA/FRFA (NMFS 2006c). Criteria for insignificant impacts were included to describe impacts that may not reach a level of significance. These criteria are applicable to this action because this analysis and the harvest specifications analysis both analyze the effects of fisheries on marine mammals and the types of fisheries and marine mammals would likely be similar in the Bering Sea and the Arctic region. The 2006-2007 EA/FRFA provided the latest ideas on determining the significance of effects on marine mammals based on similar information that is available for this EA/RIR/IRFA. No new information is available for determining the significance of an impact on marine mammals.

Table 7-1 Criteria for Determining Significance of Impacts to Marine Mammals.

	Incidental take and entanglement in marine debris	Harvest of prey species	Disturbance
Adverse impact	Mammals are taken incidentally to fishing operations, or become entangled in marine debris	Fisheries reduce the availability of marine mammal prey.	Fishing operations disturb marine mammals
Beneficial impact	There is no beneficial impact.	There are no beneficial impacts.	There is no beneficial impact.
Insignificant impact	No substantial change in incidental take by fishing operations, or in entanglement in marine debris	No substantial change in competition for marine mammal prey species by the fishery.	No substantial change in disturbance of mammals.
Significantly adverse impact	Incidental take is more than potential biological removal (PBR) or is considered major in relation to estimated population when PBR is undefined.	Competition for prey species likely to constrain foraging success of marine mammal species causing population decline.	Disturbance of mammals such that population is likely to decrease.
Significantly beneficial impact	Not applicable	Not applicable	Not applicable
Unknown impact	Insufficient information available on take rates	Insufficient information as to what constitutes important prey species or spatial and temporal overlap with the fisheries	Insufficient information as to what constitutes disturbance.

Table 7-2 provides a list of marine mammals that occur in the Arctic and may have some impact from fishing activities. These impacts could be disturbance, competition for prey species, or incidental takes by fishing vessels or entanglement in fishing gear. NMFS has no records of beluga whales, narwhals, and polar bears being taken incidentally in the groundfish, crab and scallop fisheries. But these species may occur in the same location as fishing activities, and, therefore, should be further examined for potential impacts from disturbance by fishing activities, competition for prey (for belugas and narwhals) or entanglement by discarded gear.

Climate change may increase the potential effects of fishing activities on marine mammals. The warming of the Arctic may increase the potential for new fisheries development which could result in additional interaction with marine mammals. These interactions could result in increased incidental takes, increased competition for prey resources and increased disturbance. The level of effects would depend on the nature of the fishery and the marine mammal species. Climate change may also increase the adverse effects on marine mammals regardless of whether a fishery is occurring by changes in habitat and prey availability from the warming climate, increasing stress that could be compounded by effects from fisheries.

Table 7-2 Arctic Marine Mammals and Observed Groundfish, Crab and Scallop Fisheries Interactions. Except as noted, incidental take information is from the List of Fisheries (LOF) for 2008 and draft LOF for 2009 (FR 72 66048, November 27, 2007; and 73 FR 33760, June 13, 2008).

Species	Stock	Observed Groundfish, Crab, and Scallop Fisheries Interaction
Cetaceans		
Bowhead whale	Western Arctic	Fishing line scarring and gear entanglement, including crab pots
Fin whale	Northeast Pacific	GOA pollock trawl
Humpback whale	Western N. Pacific	BSAI pollock trawl Bering Sea sablefish pot
Gray whale	Eastern N. Pacific	CA spiny lobster, coonstripe shrimp, finfish, rock crab, tanner crab pot or trap CA and OR Dungeness crab pot
Minke whale	Alaska	BSAI pollock trawl
Beluga whale	Beaufort Sea Eastern Chukchi Sea Eastern Bering Sea Bristol Bay	
Killer whale	GOA and BSAI transient	BSAI flatfish trawl BSAI pollock trawl BSAI Pacific cod longline BSAI Greenland turbot longline AK/WA/OR/CA commercial passenger fishing vessel* * *
Harbor porpoise	Bering Sea	BSAI flatfish trawl
Pinnipeds		
Pacific walrus	Alaska	BSAI flatfish trawl
Bearded seal	Alaska	BSAI flatfish trawl BSAI pollock trawl**
Spotted seal	Alaska	BSAI flatfish trawl BSAI pollock trawl
Ringed seal	Alaska	BSAI pollock trawl*
Ribbon seal	Alaska	BSAI pollock trawl BSAI Pacific cod longline
Carnivora		
Polar bear	Chukchi/Bering Sea Southern Beaufort Sea	

*Robyn Angliss, National Marine Mammal Laboratory, personal communication 4/28/08

** Guinevere Lewis, National Marine Mammal Laboratory, personal communication, 4/28/08. Bearded seals were observed taken in the pollock fishery in 2006, and this information has not yet been added to the List of Fisheries

* * * Killer whale unknown stock

7.2.1 Incidental takes and entanglement

Table 7-3 provides the list of marine mammals that may occur in the Arctic Ocean and that experience human caused mortality, including fishing mortality. The fishing mortality can be compared to the potential biological removal (PBR) and the total mean annual human-caused mortality. The PBR is the the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. For nearly all stocks, the annual mortality due to fishing activities is well below either the PBR or the total annual human caused mortality for stocks that PBR can not be determined. The exception is minke whales for which PBR is not determined, and all of the human-caused mortality is from fishing activities.

Table 7-3 Estimated Mean Annual Mortality of Marine Mammals from Observed Fisheries Compared to the Total Mean Annual Human-Caused Mortality and Potential Biological Removal. Mean annual mortality is expressed in number of animals and includes both incidental takes and entanglements. The averages are from several years of data, as available. The years chosen for averaging vary by species. Mean annual mortality levels in observed commercial fisheries were estimated by Perez (2007); inclusion of information from sources other than observer program is specified in Angliss and Outlaw (2008).

Arctic Marine Mammal Species and Stock	Mean annual mortality from fisheries	Total mean annual human-caused mortality *	PBR
Pacific walrus***	1.2	5,794	Undetermined
Bearded seal***	0.68	6,789	Undetermined
Spotted seal***	0.88	5,266	Undetermined
Ringed seal***	0.71	9,568	Undetermined
Ribbon seal***	0.8	194	Undetermined
Harbor porpoise, Bering Sea	0.35	0.35	Undetermined****
**Polar bear Chukchi/Bering Sea	0	65	Undetermined
**Polar bear S. Beaufort Sea	0	52	88
Killer whale, GOA, BSAI transient	0.4	0.4	3.1
**Humpback whale, Western North Pacific	0.2	0.2	1.3
Minke whale, Alaska	0.32	0.3	Undetermined
**Fin whale, Northeast Pacific	0	0	11.4
**Bowhead whale	0.2	46	95
Beluga whale (Beaufort Stock)	0	152	324
Beluga whale (Eastern Chukchi stock)	0	65	74
Gray whale	6.7	130	417

* Does not include research mortality. Other human-caused mortality is predominantly subsistence harvests for seals, walrus, beluga whales, polar bears, gray whales, and bowhead whales.
** ESA-listed stock
*** Currently under review for listing under the ESA
**** Abundance estimates are greater than 8 years old, and therefore the PBR will be undetermined for 2008. (Robyn Angliss, NMML, personal communication, September 3, 2008)

The BSAI flatfish trawl fishery has the largest number of marine mammals species observed incidentally taken (Table 7-2), followed by pollock trawl, longline, and pot fisheries. Killer whales, harbor porpoise, Pacific walrus, spotted seals, ringed seals and bearded seals have been observed taken in the BSAI flatfish trawl fishery. All of the ice seals, humpback, killer, minke and fin whales have been observed taken in the Alaska pollock trawl fishery. Humpback, bowhead, and gray whales have been observed entangled in pot gear. Killer whales and ribbon seals have been observed taken with longline gear.

The Environmental Impact Statement for subsistence bowhead whaling has recent information on the potential fishing activity threats to bowhead whales (NMFS 2008). Section 3.2.7 of that EIS describes information available on the potential interactions between bowhead whales and fishing vessels, based on scarring and gear entanglements recorded during subsistence hunting and strandings. Approximately 20 entanglement events have been recorded, including two crab pot entanglements.

Alternative 1 *(Status quo)*

No groundfish fishing currently occurs in the Chukchi and Beaufort Seas; and therefore, no effects are expected from incidental takes and entanglement from groundfish fishing gear used in the Arctic region on Arctic marine mammals. Because there are no groundfish fishing restrictions in the Chukchi and Beaufort Seas for vessels not registered with the State of Alaska, the potential exists that a commercial fishery could develop. The gear type used would depend on the target species. Based on observed marine mammal takes in Alaska fisheries (Table 7-2), the use of trawl gear would present a risk of incidental takes and entanglement to all marine mammals, except gray, beluga, and bowhead whales and polar bears. Longline gear may present a risk to killer whales and ribbon seals.

A very small commercial crab fishery has occurred in the southeastern Chukchi Sea under the status quo. Based on observed fisheries mortality (Table 7-2), marine mammals potentially impacted by pot gear are bowhead whales, humpback whales, and gray whales. This crab fishery has been prosecuted during a time period when sea ice allowed access to the fishing area by snow machine. Because it is unlikely whales would be present in an area with sea ice sufficient to support a snow machine, it is unlikely there would be any interaction between the gear and whales during the pot fishery. The potential remains, however, for whales to become entangled in lost or abandoned pot gear.

Based on the amount of incidental takes observed in the very large BSAI fisheries (2 million mt of groundfish) and the potential small size of any Arctic fishery, it is likely that commercial fishing in the Chukchi and Beaufort Seas would result in incidental takes and entanglement of marine mammals at much smaller levels than in the BSAI. The mortality impact of the BSAI fisheries on the marine mammal stocks is very small. Because there are no indications of the development of commercial groundfish fisheries in the Arctic Ocean under the status quo and the historical crab fishery is very limited, the overall amount of incidental takes and entanglements of marine mammals under Alternative 1 is likely to remain unchanged. Currently no substantial change overall in the occurrence of incidental takes and entanglement in fishing gear in the Arctic is expected; and therefore, the effects of incidental takes and entanglement from Alternative 1 on marine mammals are currently insignificant. Because Alternative 1 allows for unregulated fishing activities, the potential for incidental takes by fishing activities, especially unobserved fishing, may be significant for one or more marine mammal species, depending on the species and the fishery.

Alternative 2: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait.

The potential for incidental takes during Arctic region fishing activities and entanglement by fishing gear of marine mammals would be eliminated under this alternative. Alternative 2 would be more protective to bowhead, humpback, and gray whales than Alternative 1, which provides for a small crab fishery. Because commercial fishing is not occurring now in the Arctic except for the very small crab fishery, no substantial change in the occurrence of incidental takes or entanglement would be expected under this alternative. Therefore, Alternative 2 would have no effect on the incidental take and entanglement of any marine mammals.

Alternative 3: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred would be exempt from the Arctic FMP.

Alternative 4: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop FMP to terminate its geographic coverage at Bering Strait. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

The effects of Alternatives 3 and 4 on the incidental take and entanglement of marine mammals in the Arctic region are the same as Alternative 1 under current conditions. Both alternatives would allow for the continuation of a small crab fishery which has potential to impact bowhead, humpback, and gray whales if they were to encounter the gear. Alternative 3 and 4 would be more protective than Alternative 1 by preventing the development of other commercial fisheries. Because no substantial change overall in the occurrence of incidental takes and entanglement in fishing gear is expected, the effects of incidental takes and entanglement from Alternatives 3 and 4 on Arctic region marine mammals are insignificant. Alternative 3 and 4 allow for the small red king crab fishery near Kotzebue which may result in gear entanglement for whale species passing through the fishing ground. The prosecution of this fishery under Alternative 3 would be a state action not subject to Section 7 consultation under the ESA. Prosecution of the red king crab fishery under Alternative 4 would require amendment to the crab FMP to provide for this fishery, which is a federal action requiring compliance with ESA and potential section 7 consultation.

7.2.2 Harvest of Prey Species

Table 7-4 provides a listing of Arctic marine mammals and prey of each species. Most marine mammals eat fish, zooplankton, and invertebrates while a few marine mammal species eat primarily other marine mammals (transient killer whale and polar bear).

Table 7-4 Arctic Region Marine Mammal Prey

Species	Prey
Bowhead whale	Zooplankton in the Chukchi Sea and Beaufort Sea
Fin whale	Zooplankton, squid, fish (herring, cod, capelin, and pollock), and cephalopods
Humpback whale	Zooplankton, schooling fish (pollock, herring, capelin, saffron cod, sand lance, Arctic cod, and salmon species)
Gray whale	Benthic invertebrates
Minke whale	Pelagic schooling fish (herring and pollock)
Beluga whale	Primarily Arctic cod in Beaufort and northern Chukchi Seas, variety of benthic and pelagic fish and invertebrates in southern Chukchi.
Killer whale (transient)	Marine mammals
Harbor porpoise	Fish (Pacific herring, smelt, eelpout, pollock, Pacific sand lance, and gadids) and cephalopods
Narwhal	Arctic cod, squid, flatfish, pelagic shrimp, and cephalopods
Pacific walrus	Benthic invertebrates (primarily mollusks), occasionally seals and birds
Bearded seal	Primarily crab, shrimp, and mollusks; some fish (Arctic cod, saffron cod, sculpin, and pollock)
Spotted seal	Primarily pelagic and nearshore fish (pollock and salmon), occasionally cephalopods and crustaceans
Ringed seal	Primarily Arctic cod, saffron cod, herring and smelt in fall in winter and fish and fish and crustaceans in summer and spring
Ribbon seal	Arctic and saffron cods, pollock, capelin, eelpouts, sculpin and flatfish, crustaceans and celphalopods
Polar bear	Ringed and bearded seals, walrus, and beluga whales

Sources: NOAA 1988, NMFS 2004a, Nemoto 1959, Tomilin 1957, Gearin et al. 1994, Lowry et al. 1980a, Walker et al. 1998, Lee and Schell 1999, and Kawamura 1980

Transient killer whales and polar bears depend primarily on marine mammals and are not likely to directly compete with fisheries for prey resources. Male Pacific walrus also occasionally eat seals, but the proportion of seals in the diet is not known (Fay 1985). Removals of fish or destruction of fish habitat could potentially result in a decrease in populations of marine mammals known to be prey species of killer whales, walrus, and polar bears. Thus, a decrease in prey species could indirectly impact killer whales, walrus, and polar bears.

Most of the baleen whales (bowhead, minke, humpback, gray, and fin) are primarily dependent on zooplankton or benthic invertebrates that are not likely to be targeted fishery species. No competition for prey resources between bowhead and gray whales and fisheries is likely, but some competition may occur for fin and humpback whales. The potential for competition between fisheries and baleen whales is greatest for minke whales, which feed primarily on pelagic schooling fish.

Beluga whales and harbor porpoises eat a variety of prey species, including fish and invertebrates. Their varied diet decreases the potential for effects from competitions for prey with the fisheries.

Pacific walrus, gray whales, and bearded seals are heavily dependent on benthic invertebrates for prey resources. Fishing activities that disturb the benthos may impact the availability of prey for Pacific walrus, gray whales, and bearded seals. Bottom trawling has the greatest potential for impacts on the benthos followed by pelagic trawling. The impact would depend on the substrate and the organisms present. Bearded seals also eat fish, providing additional opportunity to find prey resources and reducing the potential for effects from competition with fisheries.

Alternative 1 Status quo

Currently, no commercial fishing is occurring in the Arctic region, and therefore no competition for prey species with marine mammals is occurring. The only possible exception is the small historical king crab fishery. If ice seals or walrus were to forage in the same location as this crab fishery, there may be the potential for prey competition, but the size of the fishery and timing makes this doubtful. A description of the potential effects of the Bering Sea and Aleutian Islands King and Tanner crab fisheries on bearded seals is in sections 4.3.2 and 4.9.4 of the Final EIS for Bering Sea and Aleutian Islands Crab Fisheries (NMFS 2004b). Crab fishery competition would be limited to seasonally ice-covered areas on the continental shelf, based on scientific information that bearded seals are strongly associated with sea ice and shallow waters. In addition, the potential effects of this fishery on bearded seals is mitigated by the snow crab harvest strategy that only allows removals of approximately 20 percent of legal-sized males and prohibits harvest of females. Based on this information, the Crab EIS concluded that the effects of these crab fisheries on bearded seals are insignificant.

Alternative 1 does not prevent commercial fishing for those vessels that are not registered by the State; and therefore, the potential exists for competition for target species between the fisheries and marine mammals. Any effects would depend on the species targeted, amounts harvested, locations of harvests, seasons, and the marine mammals' use and dependence on the target species. For example, minke whales depend primarily on schooling pelagic species. With the changing environment in the Arctic, some marine mammals may find it difficult to find prey as prey distributions shift, and fishing on any of these prey species may compound effect on marine mammals as they attempt to forage. A pollock fishery in the Arctic may have more of a potential for competition with minke whales than it would with bowhead whales, which eat primarily zooplankton. An impact on prey can also be indirect. A fishery that uses bottom trawl gear may impact benthic habitat that supports prey resources for walrus and bearded seals, even though the fishery may be targeting a species that is not a prey resource for these mammals.

It is unlikely that any competition for prey species currently exists between marine mammals and the limited king crab fishery because of the size of the fishery, the location, and the timing. There is no indication at this time that a commercial fishery for target species would occur at a magnitude that would impact marine mammal prey resources. Because competition is not likely occurring currently, no substantial change in the amount of harvest of prey species is expected for marine mammals at this time. Therefore, the effects of Alternative 1 on the harvest of prey species are currently insignificant. Because Alternative 1 allows for unregulated fishing, it is possible that significant impacts on marine mammals prey could occur in the future, depending on the species harvested and the dependence of the marine mammal on that species for prey.

Alternative 2: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait.

The potential for competition for prey species between fisheries and marine mammals would be eliminated under this alternative. Alternative 2 would prevent any fishing from occurring and therefore no competition for prey resources would occur. Preventing commercial fishing would be most beneficial to species that eat fish that may be targeted in a fishery (fin, humpback, beluga, minke whales; harbor porpoise; and ice seals). Preventing a crab fishery may be more protective to walrus and ice seals than Alternative 1, if these species depend on crabs in the same location as the crab fishery. Because Alternative 2 would eliminate commercial fishing, Alternative 2 would have no effects on marine mammals from the harvest of prey species.

Alternative 3: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred would be exempt from the Arctic FMP.

Alternative 4: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop FMP to terminate its geographic coverage at Bering Strait. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

The effects of Alternatives 3 and 4 on the potential competition for prey species are the same as Alternative 1. Both alternatives would allow for the continuation of a small crab fishery which has potential to compete with those mammals that use benthic prey in the same area as the crab fishery. Alternatives 3 and 4 would be more protective than Alternative 1 by preventing commercial fishing. Because no substantial change overall in the harvest of prey species is expected compared to the status quo, the effects on marine mammals from the harvest of prey species under Alternatives 3 and 4 are insignificant. Alternative 3 and 4 allow for the small red king crab fishery near Kotzebue which may result in prey competition for those marine mammals that may feed in the area of the fishing. The prosecution of this fishery under Alternative 3 would be a state action not subject to Section 7 consultation under the ESA. Prosecution of the red king crab fishery under Alternative 4 would require amendment to the crab FMP to provide for this fishery, which is a federal action requiring compliance with ESA and potential section 7 consultation.

7.2.3 Disturbance of Marine Mammals

Fishing activities can cause disturbances of marine mammals by disrupting foraging, resting, or reproductive behavior. These disturbances could be caused by the presence of fishing vessels or the sound emitted by fishing activities.

Fishing Activity Presence

Table 7-5 shows where Arctic marine mammals are likely to be present during the year in the Beaufort and Chukchi Seas. This information is summarized from the status and distribution descriptions in this chapter. If the timing of a marine mammal's presence in the Beaufort or Chukchi Sea is known, that information is provided in the third column of the table. Disturbance by the presence of fishing vessels will depend on whether the animal is in the location during the fishing activities. Many of the mammals are dependent on the ice pack or ice edge environment for foraging, resting, and reproduction (e. g., ice seals and walrus). These ice environments may not be good locations for fishing activities, lessening the potential for disturbance from the presence of fishing vessels. Most of the marine mammals use the waters of the Chukchi and Beaufort during the summer when fishing activities are most likely to occur after ice retreat. Fishing activities in the Beaufort Sea are not likely to disturb fin, humpback, minke, and killer whales, harbor porpoise, and Pacific walrus as these species are not likely to occur in the Beaufort Sea. Any fishing in the Chukchi Sea could potentially disturb any of the Arctic marine mammals.

Table 7-5 Location of Arctic marine mammals during the year in the Beaufort and Chukchi Seas

Species	Location	Time
Bowhead whale	Beaufort and Chukchi Seas	summer
Fin whale	Southern and Eastern Chukchi	April - October
Humpback whale	Southern Chukchi and Beaufort Sea	summer
Gray whale	Chukchi and Beaufort Seas	summer
Minke whale	Chukchi Sea	
Beluga whale	E. Chukchi and Beaufort Seas	
Killer whale (transient)	Chukchi Sea	
Harbor porpoise	Coastal Chukchi Sea	
Narwhal	Beaufort and Chukchi Seas	
Pacific walrus	Chukchi Sea	summer
Bearded seal	Chukchi and Beaufort Seas	summer
Spotted seal	Coastal Beaufort and Chukchi Seas	summer (Figure 7-2)
Ringed seal	Chukchi and Beaufort Seas	summer
Ribbon seal	Pelagic Chukchi and Beaufort Seas	summer (Figure 7-3)
Polar bear	Chukchi and Beaufort Sea	

Walrus are sensitive to human disturbance when using haulouts on land. In March 2007, a stampeding incident on the Russian coast of the Bering Strait resulted in an estimated 4,000 walrus being killed out of a local group of about 20,000 animals (http://seattletimes.nwsource.com/html/nationworld/2004073403_webwalrus14.html). Walrus can be stampeded by the appearance of a hunter or low flying airplane, and it is possible that a vessel passing close to a haulout may also create such a response.

Spotted seals select coastal haulouts in areas free of disturbances (Lowry 1982). Fishing activities near a haulout may prevent spotted seals from using the site. Spotted seals appear to prefer coastal habitats along with harbor porpoise and may experience disturbance from fisheries that are prosecuted near shore.

Bowhead whale presence in this region would likely partly overlap any commercial fishing activity. The bowhead is an ESA endangered species, and potential impacts from fisheries would raise ESA issues. Bowhead whales are very important in the subsistence economy and sociocultural environment of nearly all coastal villages along the Chukchi and Beaufort Sea coasts; any commercial fishery interference with or disturbance of bowhead whales, or perception of interference or disturbance, would be a major issue to resolve.

Polar bears are a conspicuous resident of the Arctic, and the public has become more concerned over their fate given the apparent warming trends in polar regions. Polar bears require sea ice in their annual cycle of denning, hunting, and general survival. Reductions in sea ice may impact polar bears and reduce their population size. While it is unclear how commercial fishing activities may impact polar bears, disturbance may exacerbate the effects of the shrinking habitat.

Fishing Activity Sounds

The following information is from the biological opinion prepared by NMFS for the Liberty Oil Production Island Project (NMFS 2002).

Sound is transmitted efficiently through water. Hydrophones often detect underwater sounds created by ships and other human activities many kilometers away, far beyond the distances where human activities are detectable by senses other than hearing. Sound transmission from noise-producing sources is affected by a variety of things, including water depth, salinity, temperature, frequency composition of the sound, ice cover, bottom type, and bottom contour. In general terms, sound travels farther in deep water than it does in shallow water. Sound transmission in shallow water is highly variable, because it is strongly influenced by the acoustic properties of the bottom material, bottom roughness, and surface conditions. Ice cover also affects sound propagation. Smooth annual ice cover may enhance sound propagation compared to open-water conditions. However, as ice cracks and roughness increases, sound transmission generally becomes poorer than in open water of equivalent depth. The roughness of the under-ice surface becomes more significant than bottom properties in influencing sound-transmission loss (Richardson and Malme 1993).

Marine mammals use calls to communicate and probably listen to natural sounds to obtain information important for detection of open water, navigation, and predator avoidance. Baleen whale hearing has not been studied directly. There are no specific data on sensitivity, frequency or intensity discrimination, or localization (Richardson et al., 1995). For each species, the frequency range of reasonably acute hearing in baleen whales likely includes the frequency range of their calls. Most baleen whale sounds are concentrated at frequencies less than 1 kilohertz, but sounds up to 8 kilohertz are not uncommon (Richardson et al., 1995). Most calls emitted by bowheads are in the frequency range of 50-400 Hertz, with a few extending to 1,200 Hertz. The frequency range in songs can approach 4000 Hertz (Richardson et al., 1995). Based on indirect evidence, at least some baleen whales are quite sensitive to frequencies below 1 kilohertz but can hear sounds up to a considerably higher but unknown frequency. Most of the manmade sounds that elicited reactions by baleen whales were at frequencies below 1 kilohertz (Richardson et al., 1995). Some or all baleen whales may hear sounds at frequencies well below those detectable by humans. Even if the range of sensitive hearing does not extend below 20-50 Hertz, whales may hear strong infrasounds at considerably lower frequencies. Based on work with other marine mammals, if hearing sensitivity is good at 50 Hertz, strong infrasounds at 5 Hertz might be detected (Richardson et al., 1995).

Bowheads have extremely sensitive hearing. For example, they are capable of detecting sounds of icebreaker operations at a range of up to 31 miles (50 km) (Richardson 1996). Bowhead whales use sound for identifying pathways for migration and for communication with other bowhead whales (NMFS 2002). Communications among bowhead whales during migration and in response to danger also has been observed to alter migration patterns (A. Brower in USDOI, MMS, 1986:49; T. Napageak in USDOI, MMS, 1995:13).

Species that depend on sound for foraging activities, navigation, and communication may be disturbed by fishing activity sounds. These include the toothed (beluga, harbor porpoise, and killer whales) and baleen (humpback, fin, bowhead, gray, and minke whales) cetaceans. Killer whales, beluga, and harbor porpoise use echolocation for foraging and other important activities (http://www.nmfs.noaa.gov/pr/pdfs/health/sonar_fact_sheet.pdf). Bowhead whales and other marine mammals, including bearded and ringed seals, have been extensively monitored in the Prudhoe Bay oil field area and are known to be sensitive to sounds emitted from vessels, barge and vessel deck machinery, propeller rotation and cavitation, winches, and other equipment noises from tug and barge, seismic survey vessel, and other vessels (NMFS 2002). Fishing vessels and their operations may emit similar types of sounds that could have effects on bowhead whales, seals, or other marine mammals. Hydroacoustic technology may be used to locate fish for either research or harvest and may impact marine mammals in the location where this technology is used and could be heard by marine mammals. Based on research supported by the Alaska Whale Foundation, humpback whales may have some ability to adjust their vocalizations to effectively communicate where vessel noise occurs (Hanser 2005). This ability may also be present in other marine mammals highly dependent on vocalizations.

Alternative 1 *(Status quo)*

No groundfish fishing is currently occurring in the Chukchi and Beaufort Seas; and therefore, fishing activities under Alternative 1 are not expected to have disturbance effects on marine mammals. Because there are no groundfish fishing restrictions in the Chukchi and Beaufort Seas for vessels not registered with the State of Alaska, a commercial fishery of unregistered vessels could potentially develop. The location of the fishing activity would depend on the target species. Nearshore fisheries would be more likely to result in disturbances for those marine mammals that use near shore habitat (walrus, harbor porpoises, and spotted seals). Pelagic fisheries may occur in areas used by marine mammals that depend on pelagic species (e. g. ribbon seals and minke whales), and may cause disturbance to these marine mammals.

A very small commercial crab fishery has occurred in the southeastern Chukchi Sea under the status quo. It is very unlikely that this fishery would cause any disturbance of marine mammals because the crab fishery has been prosecuted during a time period when sea ice allowed access to the fishing area by snow machine, and marine mammals are not likely to be present at that time.

Based on the amount of interaction between the very large BSAI fisheries (2 million mt of groundfish) and the potential small size of any Arctic fishery, it is likely that commercial fishing in the Chukchi and Beaufort Seas would result in disturbance of marine mammals at much smaller levels than in the BSAI. The amount of disturbance will depend on the marine mammal species, timing and location of the fishery. Because there are no indications of the development of commercial groundfish fisheries in the Arctic Ocean under the status quo and the historical crab fishery is very limited, the overall amount of disturbance of marine mammals under Alternative 1 is likely to remain unchanged. Because no substantial change overall in the disturbance of marine mammals is currently expected, the effects of disturbance by fishing activities on marine mammals under Alternative 1 are currently insignificant.

Because Alternative 1 allows for unregulated fishing, it is possible that significant disturbance of marine mammals could occur in the future, depending on the marine mammals species and the fishery.

Alternative 2: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait.

The potential for disturbance of marine mammals by fishing activities would be eliminated under this alternative. Alternative 2 would be more protective to marine mammals than Alternative 1 by preventing any commercial fishing. Alternative 2 would have no effects on the disturbance of marine mammals.

Alternative 3: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has historically occurred would be exempt from the Arctic FMP.

Alternative 4: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the scallop FMP to terminate its geographic coverage at Bering Strait. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

The effects of Alternatives 3 and 4 on the disturbance of marine mammals are the same as the current effects of Alternative 1. Both alternatives would allow for the continuation of a small crab fishery which is not likely to have a disturbance effect on marine mammals. Alternatives 3 and 4 prevent the potential for commercial fisheries to develop and are therefore more protective of marine mammals from potential disturbance than Alternative 1. Because no substantial change overall in the disturbance of marine mammals is expected compared to the status quo, the effects of disturbance from fishing activities on marine mammals under Alternatives 3 and 4 are insignificant. Alternative 3 and 4 allow for the small red king crab fishery near Kotzebue which may result in disturbance for marine mammals that may be present during fishing activities. Because the fishery is likely to be no more than 2 to 4 participants for a short period of time during the year, any disturbance is likely insignificant. The prosecution of this fishery under Alternative 3 would be a state action not subject to Section 7 consultation under the ESA. Prosecution of the red king crab fishery under Alternative 4 would require amendment to the crab FMP to provide for this fishery, which is a federal action requiring compliance with ESA and potential section 7 consultation.

7.3 Cumulative Effects

The following actions may have a continuing, additive, and meaningful relationship to the effects of the alternatives on marine mammals. Some of these actions are broadly based on the potential changes to the fisheries management and human reaction to the changing Arctic environment that may result in impacts on marine mammals. These actions are described in detail in Chapter 3.

Oil, Gas and Mineral Development

Mineral Management Services Oil and Gas Lease Sales in the Arctic Region

NMFS completed a biological opinion (biop) on Mineral Management Services oil and gas lease sales in the Arctic region. The biop was released on July 14, 2008 and is available at http://www.fakr.noaa.gov/protectedresources/whales/bowhead/biop0708.pdf. This opinion considers the potential effects of oil and gas leasing and exploration on bowhead, humpback, and fin whales. The bowhead whale is most likely to be affected by oil and gas leasing and exploration, and this species is likely more sensitive to noise and disturbance than are humpback and fin whales. The biop concluded that oil and gas exploration could result in considerable increase in noise and disturbance in the spring, summer, and autumn range of the Western Arctic bowhead whales, and to summering fin and humpback whales. Oil and gas leasing and exploration are likely to adversely affect these whales due to vessel operations, marine geophysical (seismic) exploration, aircraft traffic, and drilling noises from various structures. The probability of a large oil spill is remote during exploration, but spill probabilities may be significant during latter phases. After reviewing the current status of the bowhead, fin, and humpback whales occurring in the Arctic, the environmental baseline for the action area, the proposed action, and the cumulative effects, NMFS concluded that individual whales within the action area may be adversely affected, but that oil and gas leasing and exploration are not likely to jeopardize the continued existence of these whale species. As discussed in 7.2.3, bowhead whales are particularly sensitive to sound in their environment and the EIS for the seismic survey program in the Arctic concluded that significant effects could occur for bowhead whales (MMS 2006)

It is likely that past, present and future oil, gas and mineral development activities in the Arctic may affect marine mammals by disturbance (including disturbance of prey resources during seismic activity) or potential contamination of the water and food sources through release of oil, drilling muds, and cuttings into the environment. The effects are likely to be localized. Narwhal habitat in the Canadian and Greenland Arctic is being mined and drilled, and there are concerns about heavy metal levels in narwhal tissues (ACS 2008). This concern for narwhals may increase as they expand their range into the Chukchi and Beaufort Seas and encounter oil, gas, and mineral development activities. It is likely that this concern may be true for other marine mammals that depend on the same prey resources as narwhals, such as Arctic cod. As these activities are permitted, additional environmental analyses will be required and will give a better description of the potential impact of the activity on marine mammals, specific to the location and type of development activity.

Air breathing marine mammals are inhaling air from just a couple of inches above the surface, where toxic fumes from oil spills are highest in concentration.[25] Studie from the Exxon Valdez spill showed that it is not just the coating of oil that kills the marine mammals, it is the fumes. Evidence for this was acute mortalities, low recovery of captured sea otters, lesions in the brains of seals and delayed mortality from lung damage. The predicted recovery of marine mammals in the Arctic from the effects of an oil spill are likely greater than those identified by MMS (2007) (1 to 5 years) due to the extreme climate of the Arctic and the stress from reduced sea ice for those animals dependent on ice for habitat.

Release of pollutants during oil and gas exploration may increase marine mammal mortality, affect prey availability and disturb habitat necessary for foraging, resting, migration, and reproduction. A large oil spill is very unlikely during reasonably foreseeable oil and gas exploration in the Arctic Ocean off Alaska. There is a low likelihood of a large oil spill during present and reasonably foreseeable future oil and gas development activities. While an oil spill is unlikely during the oil and gas activities considered reasonable foreseeable for our analysis of cumulative effects, if such a spill occurs, it is likely to result in significant impacts on marine mammals (MMS 2007)[26]. Effects could include direct oiling and mortality

[25] Jeep Rice, Alaska Fisheries Science Center, Auke Bay Lab, personal communication, Oct. 28, 2008.
[26] The significance criteria employed by the MMS EIS (2007) differs from that used herein. Any effects to marine mammals deemed significant under the criteria employed by the MMS EIS (i.e., an adverse impact to marine mammals that results in a change in distribution or a decline in abundance requiring three or more generations for the affected population to recover to its former status) would likely qualify as significant under the criteria emplyed in this EA.

of marine mammal and fouling of prey and habitats. These impacts would be significant regarless of the alternative chosen for this action. If commercial fishing were to coccur in the vicinity of oil and gas prduction facilities in the Bearufort Sea under Alternative 1, it is possible that such activity could slightly increase the probability of an oil spill.

Because they prohibit fishing activities in the vicinity of existing and reasonably foreseeable production facilities, Alternatives 2, 3, and 4 would not increase the likelihood of a large oil spill, nor would they add any incremental impact to the effect on marine mammals which would occur in the event of a large oil spill. Due to the remote probability that a large oil spill may occur, and the fact that Alternatives 2, 3, and 4 do not contribute to the risk to marine mammals, in assessing the significance of potential cumulative impacts, we discount the effects of an oil spill by its low probability of occurrence.

The direct and indirect impacts of Alternatives 2, 3, and 4 are primarily protective of marine mammals by establishing a method to prevent fishing activities in the Arctic Management Area and therefore preventing fishing impacts on marine mammals. The direct and indirect effects of Alternatives 2, 3, and 4 when added to the impacts of past, present, and reasonably foreseeable future activities analyzed in this section are likely to be insignificant for marine mammals. Any potential adverse effects identified under the cumulative effects are reduced by the beneficial effects of Alternatives 2, 3, and 4. **None of the cumulative effects of Alternatives 2, 3, and 4 is expected to result in significant effects that substantially increase marine mammals mortality, substantially reduce prey availability or substantially impact habitat to result in population level effects. Uncontrolled fishing under Alternative 1 has the potential to allow for significant impacts on marine mammals, and therefore, may also result in potentially cumulative significant impacts.**

Transportation and Shipping

Transportation and shipping activities in the Arctic are limited to the ice free period between June and October. Future transportation and shipping are likely to increase as sea ice retreats with warming temperatures. Traffic in this area includes traffic supporting development and tourism and shipping of goods from Europe or the Eastern U.S. to East Asia. Current and future vessel traffic may disturb marine mammals, may result in ship strikes, and may result in pollution discharge into the environment. As traffic increases, these potential effects on marine mammals could also increase if the marine mammals are not able to avoid the areas of traffic. This could be more important for those animals that are particularly sensitive to human activities, such as walrus and bowhead whales.

Introduction of Invasive Species

With the potential increase in shipping and oil and gas development, the potential for introduction of invasive species increases. Invasive species could compete with marine mammal prey, such as an invasive mollusk replacing the indigenous mollusk that walruses feed on. The effect on marine mammals would depend on the ability of the invasive species to compete in the Arctic environment and whether the marine mammals could obtain a similar amount of nutrition from the invasive species as from the indigenous prey. More baseline information would be needed to determine if invasive species are present or being introduced as Arctic activities increase in the future.

Commercial Whaling

Past commercial whaling had a significant impact on the population of bowhead and humpback whales occurring in the Arctic region. Even though a large portion of the population for each of these species was harvested, some recovery has occurred for the western Arctic stock of bowhead whales since commercial whaling has been banned. The Western North Pacific stock of humpback whale abundance continues to be a small fraction of prewhaling abundance estimates (Angliss and Outlaw 2007). The western North Pacific and Okhotsk stock of minke whales is estimated at 25,000 animals (http://www.iwcoffice.org/conservation/permits.htm#recent). From 2001 through 2006, Japan harvested approximately 100 fin whales per year in the North Pacific under scientific research permits (http://www.iwcoffice.org/_documents/table_permit.htm). Continued management of commercial whaling activities by the International Whaling Commission and the avoidance of harvesting less abundant whales by Norway, Japan, and Iceland will provide protection to whale species that occur in the Arctic management area and allow the potential for continued recovery from historical whaling.

Ecosystem-sensitive management

Increased attention to ecosystem-sensitive management is likely to lead to more consideration for the impact of the fisheries on marine mammals and more efforts to ensure the ecosystem structure that marine mammals depend on is maintained, including prey availability. Increasing the potential for observers collecting information on marine mammals and fisheries interaction, and any take reduction plans, may lead to less incidental take and interaction with the fisheries, thus reducing the adverse effects of the fisheries on marine mammals.

Changes in the status of species listed under the ESA, the addition of new listed species or critical habitat, and results of future ESA Section 7 consultations may require modifications to any future fishing practices to reduce the impacts of these fisheries on listed species and critical habitat. Listing the ice seals and Pacific walrus and designating critical habitat would require ESA Section 7 formal consultation for any future fisheries that may adversely affect either the species or designated critical habitat. The consultation would identify any protection measures needed for the future fisheries to prevent jeopardy of extinction or adverse modification or destruction of critical habitat. This potential future action is likely to increase protection for ice seals and Pacific walrus.

The ongoing research efforts described in the Reasonable Forseeable Future Actions section of Chapter 3 are likely to improve our understanding of the Arctic marine ecosystem and how fisheries may impact marine mammals. NMFS is conducting or participating in Arctic marine research projects summarized in Chapter 3, which include understanding the ecosystems and possibly developing fisheries, and surveying fish stocks to support the development of stock assessments. These projects will allow NMFS to better understand the potential impacts of commercial fisheries on the Arctic marine ecosystem, including potential impacts on marine mammals. The results of the research will be useful in managing any future fisheries with ecosystem considerations and is likely to result in reducing potential effects on marine mammals.

Traditional management tools

The cumulative impact of the annual harvest specifications for the BSAI groundfish fisheries in combination with future harvest specifications may have lasting effects on marine mammals that use both the Bering Sea and Arctic Ocean. However, as long as future incidental takes remain at or below the PBR or remain a very small portion of total human-caused mortality, the stocks will still be able to reach or maintain their optimal sustainable population or are not likely to experience population declines related to fishing activities. Additionally, since future TACs will be set with existing or enhanced protection measures, it is reasonable to assume that the effects of the fishery on the harvest of prey species and disturbance will likely decrease in future years. Improved monitoring and enforcement through the use of technology would improve the effectiveness of existing and future protection measures by ensuring the fleet complies with the protection measures. For instance, the Nunivak Island, Etolin Strait, and

Kuskokwim Bay habitat conservation area is closed to bottom trawling (73 FR 43362, July 25, 2008). This closure protects bottom habitat that supports clams used by Pacific walrus for foraging.

Actions by other Federal, State, and International Agencies

State management of the salmon fisheries of Alaska will continue into the future, and a limited chum salmon fishery has occurred in Kotzebue Sound (section 8.5.8). Harvest of salmon may compete with marine mammals that occur in the Kotzebue Sound and depend on the salmon resources, such as spotted seals and humpback whales. The State's first priority for management is to meet spawning escapement goals to sustain salmon resources for future generations. Subsistence use is the highest priority use under both state and federal law. Surplus fish beyond escapement needs and subsistence use are made available for other uses, such as commercial and recreational harvests. The State carefully monitors the status of salmon stocks returning to Alaska streams and controls fishing pressure on these stocks. Even though prey availability is not accounted for in the setting of salmon harvest levels, the management of salmon stocks effectively maintains healthy populations of salmon where possible and may provide sufficient prey availability to marine mammals.

Incidental takes of Arctic marine mammals occur in the state-managed set and drift gillnet and purse seine salmon fisheries (72 FR 66048, November 27, 2007 and 73 FR 33760, June 13, 2008). Arctic marine mammal species taken in the state-managed fisheries and the BSAI groundfish fisheries are listed in Table 7-6. Mortality estimates in the second column are calculated based on annual averages of mortality (1999 to 2003 for gray whales, 1990 to 1993 for spotted seals, and 1990 to 2001 for harbor porpoises) (Angliss and Outlaw 2008 and Angliss and Lodge 2003).

Table 7-6 Arctic Marine Mammals Taken in State-Managed and Federal BSAI Fisheries

Arctic Marine Mammal Stocks Taken in State Managed and Federal BSAI Groundfish Fishery	State Fisheries Mean Annual Mortality*	State Fisheries Incidentally Killing or injuring Arctic Marine Mammals
Gray whale	0.5 (purse seine)	Bristol Bay salmon drift and set gillnet, and purse seine
Spotted seal	1.5 (drift gillnet)	Bristol Bay salmon drift and set gillnet,
Harbor porpoise	0.5 (AK Peninsula/Aleutian Islands set gillnet)	Ak Peninsula/Aleutian Islands salmon set gillnet, AK Kuskokwim, Yukon, Norton Sound and Kotzebue salmon gillnet

Source: Angliss and Outlaw 2008, Angliss and Lodge 2003, LOF for 2008 (72 FR 66048, November 27, 2007) and proposed LOF for 2009 (73 FR 33760, June 13, 2008)

The state fishery mortality estimate for gray whales listed in Table 7-6 is included in the total mean annual human caused mortality in Table 7-3. The combination of the incidental takes in the federal fishery with takes in the state-managed fisheries for gray whale and harbor porpoise is well below the PBR and a small portion of the total mean annual human-caused mortality. The combination of federal and state fishery mortality for spotted seals is well below the total human caused mortality. It is not likely that any current or future state fishery would greatly increase the overall incidental takes of these marine mammals to the extent that either the PBR is exceeded or the proportion of fishery mortality in the total mean annual human caused mortality is greatly changed.

Private actions

Subsistence harvest is the primary source of direct mortality for many species of Arctic marine mammals. Current levels of subsistence harvests, reflected in column 3 of
Table 7-3, are controlled only for bowhead whales, polar bear, and beluga whales. Subsistence harvest information is collected for other marine mammals and considered in the stock assessment reports. Amounts of subsistence harvests of marine mammals may increase in the future if population levels increase with more development in the Arctic region.

Other factors that may impact marine mammals include continued commercial fishing; non-fishing commercial, recreational, and military vessel traffic in Alaskan waters; and tourism and population growth that may impact the coastal zone. Little is known about the impacts of these activities on marine mammals in the Arctic region. However, Alaska's coasts are currently relatively lightly developed, compared to coastal regions elsewhere. Despite the likelihood of localized impacts, the overall impact of these activities on marine mammal populations is expected to be modest.

Conclusions

Oil, gas, and mineral development and increased shipping activity, including increased potential for introducing invasive species, have the potential to adversely impact marine mammals in the Arctic, but these impacts are likely to be localized and not expected to result in stock level effects. The continuing fishing activity and continued subsistence harvest are potentially the most important sources of additional annual adverse impacts on marine mammals that range from the Bering Sea into the Arctic management area. Both of these activities are monitored and are not expected to increase beyond the PBRs for most marine mammals or to greatly increase the total annual human caused mortality. The extent of the fishery impacts would depend on the size of the fisheries, the protection measures in place, and the level of interactions between the fisheries and marine mammals. However, a number of factors will tend to reduce the impacts of fishing activity on marine mammals in the future, most importantly ecosystem management. Ecosystem-sensitive management and institutionalization of ecosystem considerations into fisheries governance are likely to increase our understanding of marine mammal populations and interactions with fisheries. The effects of actions of other federal, state, and international agencies are likely to be less important when compared to the direct interaction of the commercial fisheries, subsistence harvests, and marine mammals.

Under current conditions, the potential direct and indirect impacts from Alternatives 1, 3, and 4 are very limited (for incidental takes and harvest of prey resources) to nonexistent (for disturbance) due to only a very small historical king crab fishery and no other present or future fisheries being allowed. Therefore the past, present, and reasonably foreseeable future actions in combination with the direct and indirect impacts of Alternatives 1, 3, and 4 are not likely to result in significant impacts on Arctic marine mammals. If conditions change to support unregulated fishing under Alternative 1, the potential direct and indirect adverse effects of unregulated fishing may combine with the effects of oil and gas exploration and development and increase shipping activities to result in cumulative significant effects on marine mammals. Because Alternative 2 prohibits fishing, no direct or indirect effects on marine mammals are expected and therefore no cumulative effects are expected.

Chapter 8 Arctic Ecosystem

Commercial fisheries may impact ecological relationships between components of the ecosystem such as predator/prey relationships, energy flow and balance, and biological diversity. Other chapters of this EA/RIR/IRFA also discuss ecosystem issues and evaluate the impacts of the alternatives on a wide range of ecosystem components (target and other fish species categories, seabirds, and marine mammals). This section looks at ecosystem issues from a somewhat different perspective. It is concerned with the potential for overall ecosystem impacts from commercial fishing, rather than the impacts on specific resource components.

8.1 Ecosystem description

In this section, we describe the Arctic ecosystems within US waters off Alaska in general terms. Because there is less information for these ecosystems than for other ecosystems currently under Council management (e.g. the Eastern Bering Sea, Gulf of Alaska, and Aleutian Islands) we are unable to provide a quantitative description of ecological relationships in the Arctic, including a detailed food web, at this time. Nevertheless, we do provide a qualitative description of important relationships in these ecosystems.

In the following four subsections, we describe 1) large scale physical forcing in the Arctic and how it affects the Alaskan Arctic ecosystems (the Beaufort/Canada Basin and Chukchi Seas); 2) how this unique physical environment shapes biological relationships in the Alaskan Arctic; 3) the human ties to the seasonal/biological cycle; and 4) some observed changes in the Arctic ecosystem and potential future changes under climate change. Finally, we provide some preliminary recommendations with respect to predicted impacts of the four alternatives on the Arctic ecosystems.

8.1.1 Physical ecosystem characteristics

The physical characteristics of Alaskan Arctic ecosystems arise from the larger context of their geography within the landbound Arctic region above 66.33 degrees North latitude, which include the extreme seasonality of sunlight (full sun 24 hours in summer, full darkness 24 hours in winter) and the presence of sea ice. Seasonally, winter darkness is associated with extreme cold and relatively calm weather, while light summers are cool, damp, and foggy, with more frequent rain and snow than winter.

The Arctic Ocean itself is the world's smallest ocean at just over 14 million square km (a figure which includes the Barents, but not the Bering Sea, and represents an area approximately 1.5 times the size of the U.S.). The Arctic Ocean has limited exchange with the global ocean because it is surrounded by land masses with relatively shallow continental shelves less than 500 m deep along its entire margin. This unique "mediterranean" sea is therefore strongly affected by land influences, including freshwater runoff (10% of worldwide runoff into 3% of total oceanic area) and the high pressure atmospheric systems and extreme cold associated with continental land masses, both of which contribute to ice formation. Another significant input into the Arctic Ocean arrives through the Bering Strait in the form of cool, low salinity Bering Sea water, which affects ecological dynamics in the Alaskan Arctic. However, 75% of the exchange between oceans occurs in the eastern Arctic with the Atlantic, with warm, high salinity water incoming and cold, lower salinity water outgoing through Fram Strait (Codispoti et al.1991, Niebauer 1991, CIA World Factbook 2008).

In addition to land and freshwater runoff, the presence of sea ice alters the structure of the ocean environment in the arctic. Ice covers the Arctic Ocean for much of the year, but it advances and retreats seasonally over the continental shelves. The wide continental shelves in the Arctic Ocean represent between one third and one half of its total area, much larger than for any other ocean basin. These wide shelves interacting with seasonal ice advance and retreat, shape the water column properties in the Arctic Ocean and help maintain the more permanent ice cover found in the central basin. In turn, the advancing and retreating ice edge on the continental shelves is vitally important to the ecology of the coastal waters.

There are two forms of ice in the Arctic: multi-year or perennial ice, which is more than three meters thick and drifts throughout the central basin, and annually formed ice which is thinner (approximately 1 to 2 meters) and covers much more area over the continental shelves, where it is formed in nearshore areas by freshwater runoff and cold winds from land. Perennial ice tends to follow the general atmospheric circulation in the Arctic, moving clockwise in the Beaufort Sea for several years (westward along the northern Alaskan coast) and then joining a large general eastward flow of ice across the pole and towards the exit to the Atlantic at Fram Strait five to six years later. Perennial ice cover at the pole is maintained year-round by the stratification of the Arctic Ocean, which separates warm, salty Atlantic water deep below cooler, fresher continental shelf-derived water. Annual ice on the continental shelves forms seasonally and takes the form of bottom or land fast ice nearshore and floating ice offshore. This ice may be blown into the central basin to contribute to perennial ice, or may melt the following summer, depending on the circulation patterns in the Arctic each year.

Ice alters physical relationships on both the continental shelves and in the deep basin by altering tides, currents, mixing, and upwelling, as well as light absorption and reflection. The cycle of ice formation and retention is important to the resident and migratory inhabitants of the Arctic, and has very different patterns depending on the Arctic region (Carmack et al. 2006, Codispoti et al. 1991, Jones et al. 1991, Prinsenberg and Ingram 1991, Rigor et al. 2002).

In the Alaskan Arctic, there are three basic geographic regions, each with different ecology: two continental shelf regions, the Chukchi and Beaufort Seas, and the deep offshore region of the Beaufort Sea called the Canada Basin (Figure 1-1). We emphasize physical and ecological features of the shelf ecosystems, and not the deep basin in this description, because shelf ecosystems in general are where most fisheries take place worldwide.

The wide, shallow Chukchi shelf is classified as an "inflow" shelf to the Arctic Ocean, because Bering Sea water flowing through from the Pacific influences its characteristics, while the adjacent narrow Beaufort shelf is classified as an "interior" shelf, most influenced by river inputs (Carmack et al. 2006). The Chukchi and Beaufort Seas are very different physically and therefore ecologically, with differences extending to each of the major habitats in each area, including the nearshore, shelf, slope, and basin, the pelagic and benthic zones, and the ice associated habitats. The Alaskan portion of the Chukchi shelf is wide and shallow (58 m on average), similar to the Bering Sea, while the Alaskan portion of the Beaufort shelf is narrow and moderately shallow (80 m on average), dropping off steeply to the deep Canada Basin. The width of the Beaufort Sea shelf is similar to that seen in the northeastern Gulf of Alaska, but it is shallower, with barrier islands and large river deltas lining the coast (Norton and Weller 1984). Similar to the Gulf of Alaska shelf, dynamics on the Beaufort Sea shelf are affected by processes offshore in the deep basin, especially by currents there.

Although the Chukchi and Beaufort shelves are adjacent, the major currents affecting each come from opposite directions, with the exception of the Alaska Coastal Current which flows northward along the Alaskan coast of the Chukchi and continues eastward along the nearshore portions of the Alaskan Beaufort shelf (Figure 8-1; Grebmeier et al. 2006a, Woodgate et al. 2005, Aagaard 1984). Offshore, Bering Sea water generally flows northward through the Chukchi Sea from the Bering Strait, while surface flows along the outer Beaufort shelf are to the west due to the circulation of the Beaufort Gyre. Incoming waters to the Chukchi Sea from the Bering Sea are nutrient rich, especially along the Russian

Coast from the Gulf of Anadyr, contributing to extremely high biological productivity in the Russian Chukchi Sea and high productivity on the Alaskan side. The incoming Alaska Coastal water is lower in both salinity and nutrients than the Bering Sea water. Some nutrients are transported around Point Barrow to the Beaufort Sea shelf in combined Bering Sea / Alaska Coastal water, and other nutrients are supplied by rivers, but in general nutrient supply to the Beaufort Sea as a whole is lower due to the dilution effect of low nutrient Atlantic origin water arriving from the north across the Arctic Ocean (McLaughlin et al. 2005). In addition to nutrients, northern Bering Sea waters transport plankton and larvae that replenish or supplement i*n situ* production in the Chukchi and Beaufort Seas.

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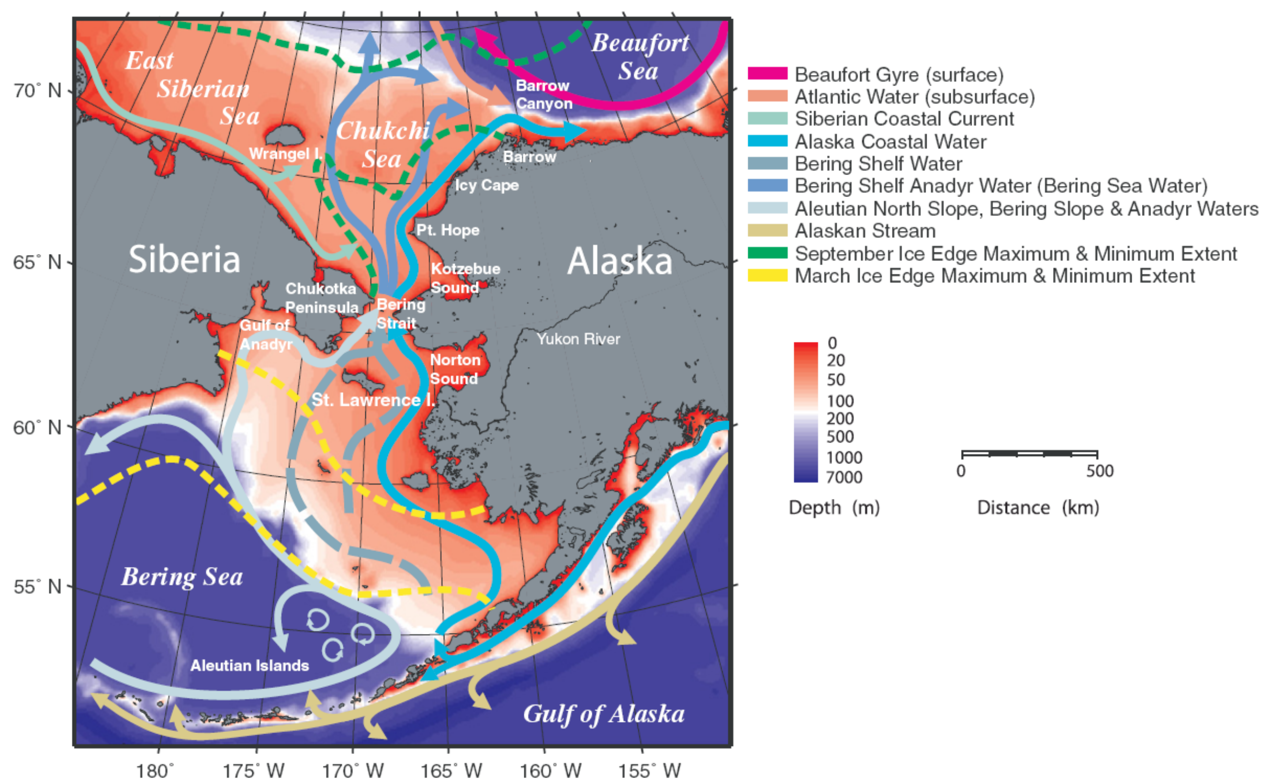

Figure 8-1 Major currents in the Alaskan Arctic region (Grebmeier et al. 2006a)

Seasonal ice formation and retreat occur by different processes in the Chukchi and Beaufort seas, in general due to the physical differences described above. The Chukchi Sea can vary from full ice cover to full open water annually, with full ice cover typically extending for 6 months, approximately December to June (Woodgate et al. 2005). Ice cover lasts 9-10 months in the Beaufort Sea, from October through July (Norton and Weller 1984). Over the shallower Chukchi shelf, annual ice from local freezing and thawing is most common. The Beaufort Sea shelf can be affected by perennial ice from the central Arctic following the circulation of the Beaufort Gyre along the shelf break, as well as annual ice formed locally over the shelf. In both areas, remnants of annual landfast ice may remain near the coast during summer even if offshore ice is gone. There are often recurrent areas of open water (polynyas) during winter and spring along the Alaskan Chukchi coast and in the Beaufort Sea, which both alter physical characteristics by forming dense water (Carmack et al. 2006), and represent important areas of biological productivity during seasons with daylight, and therefore habitats for foraging birds and marine mammals (Stirling 1997). Ice cover's impact on biological production results in seasonal differences in water masses flowing out of the Chukchi and into the Beaufort Sea/Canada Basin. In summer, water leaving the Chukchi shelf is relatively warmer, fresher, and depleted in nutrients but enriched in oxygen; the opposite occurs in the winter (Carmack et al. 2006, McLaughlin et al. 2005). These seasonal differences alter the eastward flowing current connecting the Chukchi and Beaufort Seas (Pickart 2004), thus changing the potential for biological production seasonally.

8.1.2 Biological ecosystem characteristics

In general, Arctic ecosystems are expected to have lower biological productivity than lower latitude ecosystems due to seasonal darkness and cold. However, there is considerable variability between Arctic systems. The physical characteristics of the Chukchi and Beaufort Seas described above lead to the distinctive ecological characteristics of each system. Overall, the combination of more time with open water and far higher nutrient inputs into the Chukchi Sea relative to the Beaufort Sea generates much higher biological productivity in the Chukchi.

Estimates of primary productivity in the Arctic have wide ranges due to the extreme seasonality of production combined with high variability in conditions between years. However, the contrast between the areas remains clear despite these wide ranges: the Chukchi Sea (including the Russian portion) has a range of 20 to greater than 400 grams of carbon produced per square meter annually (gC/m^2y), while the Beaufort Sea (including the Canadian portion) has a narrower range of 30-70 gC/m^2y (Carmack et al. 2006). This compares with the Eastern Bering Sea estimate ranging from less than 75 gC/m^2y on the inner shelf to over 275 gC/m^2y on the shelf break (Aydin and Mueter 2007, Springer et al. 1996), and to the Gulf of Alaska shelf estimate of 300 gC/m^2y (Sambrotto and Lorenzen 1987).

Overall biological production is partitioned spatially and seasonally in the Alaskan Arctic ecosystems. Spatially, there is a clear longitudinal gradient in both benthic and primary production, with highest benthic biomass and chlorophyll observed in the Russian Chukchi Sea and progressively lower biomass observed to east towards the Alaskan coast (with the exception of the highly productive Hanna Shoal) and into the Beaufort Sea (Figure 8-2and Figure 8-3; from Dunton et al. 2005). Seasons and the associated ice cover lead to an annual productivity/migratory cycle driven by high production during ice free seasons and characterized by short food chains and animals with high lipid storage capacity and content at all trophic levels (Grebmeier et al. 2006a, Weslawski et al. 2006).

Interannual variability in primary production is high due to variability in the timing and extent of ice retreat and reformation (Wang et al. 2005). Migratory marine mammals and birds forage in the Arctic in certain areas and at certain times according to the distribution of ice, bathymetric and other physical features (Moore et al. 2000). Here we describe a generalized seasonal productivity cycle, linking benthic and pelagic primary production, secondary production, and higher trophic level production in habitats defined by ice and bathymetry: the ice undersurface, the ice edge, open water, and shallow nearshore benthic habitats. In some areas such as Simpson Lagoon on the edge of the Beaufort Sea, annual primary production may be locally high and may contribute to offshore systems because some zooplankton and fish migrate inshore to feed seasonally, returning offshore as the lagoon freezes (Craig at al. 1984). Additional benthic primary production by macroalgae is limited to shallow nearshore areas and has been best described on the Alaskan Beaufort shelf, where boulder-kelp communities prevail (Dunton 1985, Dunton and Schell 1986, Dunton and Dayton 1995). While there are potentially important linkages between some nearshore habitats and the larger offshore ecosystems, we focus below on the open shelf habitats responsible for the bulk of productivity and comparable to others under current fishery management plans, then discuss fish, macroinvertebrates, and food webs in the Alaskan Arctic.

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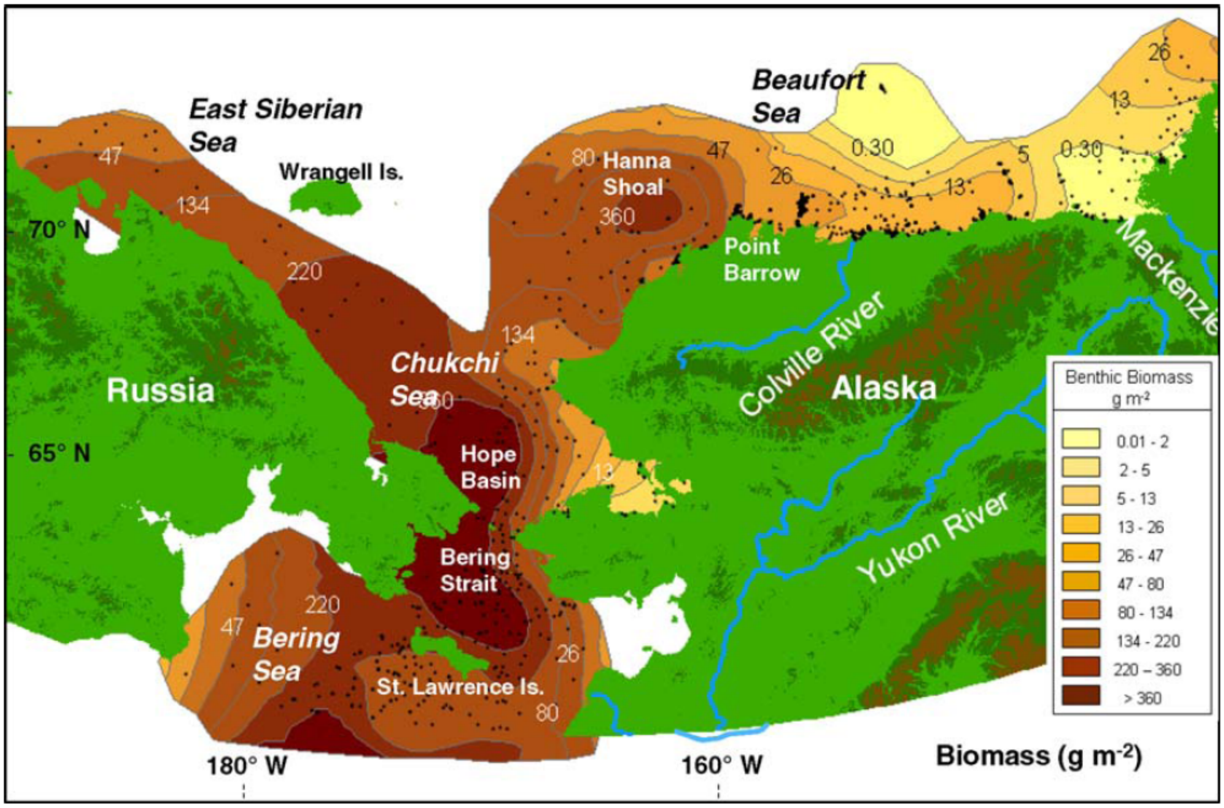

Figure 8-2 Distribution of benthic animal biomass in the Alaskan Arctic region (Dunton et al. 2005)

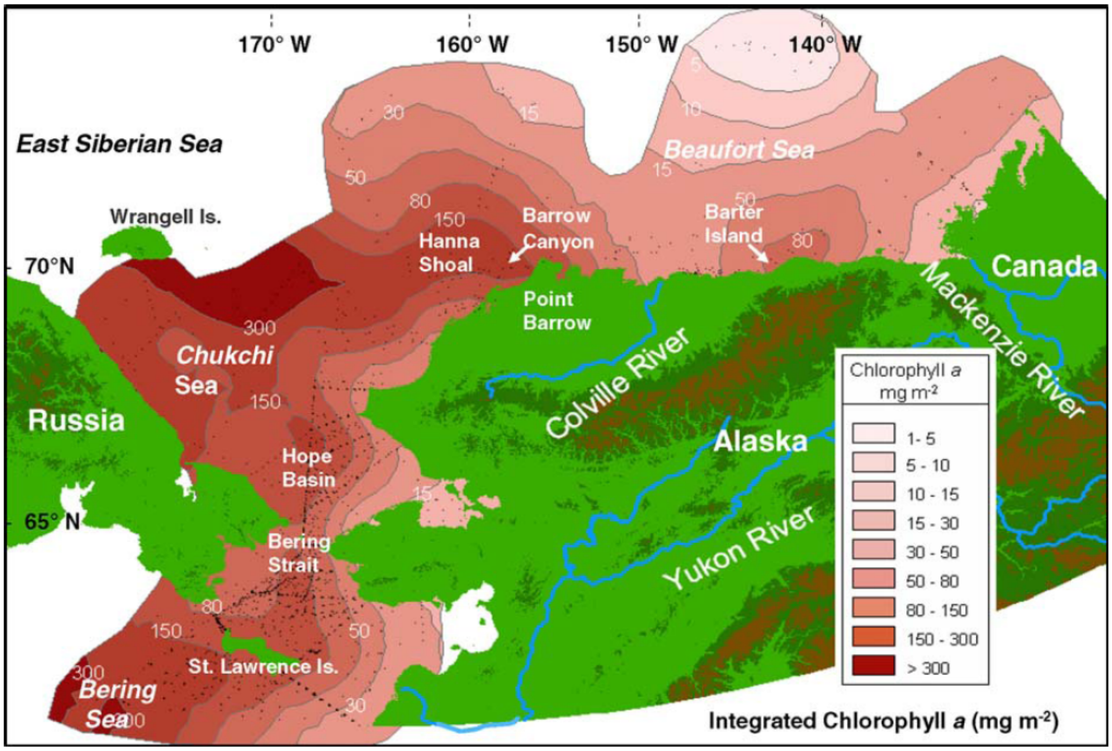

Figure 8-3 Distribution of Chlorophyll a (primary production) in the Alaskan Arctic region (Dunton et al. 2005)

Algae growing on the undersurface of the ice itself has a relatively small contribution to overall primary production in the ecosystem (4% of total production in the Chukchi and 5-10% in the Beaufort Sea; Carmack et al. 2006), but may represent a critically important forage concentration for grazers during late winter and early spring when there is little other primary production, forming an "upside-down benthos" for overwintering invertebrates (Conover and Huntley 1991). All life stages of certain amphipod and copepod species are associated with perennial ice, suggesting an ice-specific community exists in addition to open water zooplankton species feeding opportunistically on ice algae. In addition, turbellarians and nematodes are part of these perennial ice communities (Gradinger et al. 2005). Densities of these invertebrates can be locally high, in turn attracting foraging fish, most commonly the Arctic cod, *Boreogadus saida* (Gulliksen and Lonne 1991). However, most observations of Arctic cod and other larger animals are associated with the extremely productive (and more easily studied) ice edge habitat.

The ice edge habitat occurs seasonally in different areas as ice melts and moves to form cracks, leads, and polynyas in winter and spring, and eventually areas of fully open water in the summer. During light seasons, primary production is enhanced at the ice edge because fresher water from melting ice mixes with the nutrient rich water below to create a shallow, well-lit layer of nutrient rich water where large phytoplankton (diatoms) bloom at high rates relative to the surrounding water and ice (Niebauer 1991, Hill and Cota 2005, Hill et al. 2005).

The ultimate fate of this high primary production depends on the ecosystem. For example, in the subarctic Bering Sea, ice edge bloom production is thought to sink to the bottom to enhance benthic production because pelagic zooplankton grow slowly and are less effective at grazing in cold water, thus they do not transfer the energy to other pelagic consumers (Mueter et al. 2006, Niebauer 1991). However, zooplankton species endemic to colder Arctic waters depend on this ice edge bloom (as well as ice algae, Conover and Huntley 1991) and there are clearly foraging predators associated with the ice edge habitat wherever it occurs, including open water zooplankton, Arctic cod, marine mammals (especially Beluga whales and ringed seals), and seabirds (murres and fulmars; Bradstreet and Cross 1982, Gulliksen and Lonne 1991, Moore et al. 2000, Gradinger and Bluhm 2004). In particular, Arctic cod fed on both ice-associated invertebrates and open water copepods and amphipods in ice edge habitats in the Canadian high Arctic, and were in turn fed on by five of six studied birds and mammals (Bradstreet and Cross 1982), suggesting that the link between ice edge primary production and pelagic zooplankton, fish, and apex predator production may be stronger in Arctic ecosystems than in the subarctic Bering Sea. The ice edge bloom on interior shelves like the Alaskan Beaufort shelf may account for half of the annual primary production (Carmack et al. 2006). Even in high Arctic areas, some of the ice edge bloom may sink to the benthos, enhancing benthic production; however, benthic biomass is relatively low on the Beaufort Sea shelf where ice edge blooms are most important (Dunton et al. 2005). There is close coupling between high benthic biomass and primary production in the Chukchi Sea, due to high primary production in nutrient rich open waters during its longer ice-free season (Grebmeier et al. 1988, Grebmeier and McRoy 1989, Dunton et al. 2005).

As open water habitat expands during the late spring (in the Chukchi Sea) and the summer (in the Beaufort Sea), different processes foster primary production away from the ice and determine its ultimate fate, depending on nutrient availability, habitat depth, and other physical features. While primary production is limited by the availability of sunlight early in the season and under the ice, in open waters later in the season there is plenty of light but primary production is limited by the availability of nutrients. Therefore, the generally high nutrient inputs into the well-mixed Chukchi Sea through the Bering Strait sustain a high level of primary production throughout the summer open water season, but these nutrients are depleted in water transported to "downstream" regions in the Beaufort Sea shelf and Canada Basin. Productivity is further limited by stratification of these deeper water columns, where intermittent mixing produces intermittent blooms (Dunton et al. 2005, Carmack et al. 2006). On the Beaufort shelf, years that had the lowest ice cover generally had higher primary productivity measurements (Horner 1984). In certain areas of the Chukchi and Beaufort shelves, bathymetric features encouraging upwelling of deeper nutrient rich layers are associated with higher overall primary productivity, especially around Beaufort Canyon in the far eastern Chukchi Sea (Hill and Cota 2005).

In the south central Chukchi Sea, recurrent oceanographic fronts enhance primary and benthic productivity, attracting aggregations of gray whales (Bluhm et al. 2007). Similarly, oceanographic fronts in the Beaufort Sea concentrate pelagic phytoplankton and their grazers, copepods and euphausids, attracting foraging bowhead whales (Moore et al. 2000). The shelf break and canyon habitats of both the Chukchi and Beaufort seas are also areas of enhanced primary and secondary production where high densities of foraging birds and mammals are observed during the open water season (Harwood et al. 2005).

Fish associations with these Arctic bathymetric and oceanographic features have received little study to date, although Arctic cod, one of the most common fish, feeds on similar zooplankton as bowhead whales (Frost and Lowry 1984). In the subarctic Bering Sea, open water phytoplankton blooms are thought to enhance pelagic fish (especially pollock) production at the expense of benthic production, via increased zooplankton grazing and production in the warmer open waters during early summer (Hunt et al. 2002, Mueter et al. 2006). Different mechanisms may operate on the Beaufort shelf, which appears more dependent on ice edge blooms yet has both a well developed pelagic food web (Frost and Lowry 1984, see below) and an observed decoupling of pelagic and benthic productivity (Dunton et al. 2006). The Chukchi shelf, in contrast, clearly has high benthic production directly coupled with high primary production in the open water column (Grebmeier et al. 1988, Grebmeier and McRoy 1989, Dunton et al. 1989, Dunton et al. 2005). The close coupling of high primary to high benthic productivity in the Chukchi provides the rich northern foraging grounds for migrating gray whales and other benthic feeders during the open water season (Coyle et al. 2007, Moore et al. 2000). However, the connections between primary and benthic production and fish production in the Alaskan Arctic remain less clear.

The fish and epifaunal invertebrates of the Alaskan Arctic are known mostly from the summer season open water habitat, where it is possible to use trawl survey sampling gear. In August-September of 1976-1977, 19 species of fish were found on the combined eastern Chukchi and western Beaufort Sea shelves off Alaska (Frost and Lowry 1983). The three most common species (by numbers, biomass was not reported) were Arctic cod, Canadian eelpout (*Lycodes polaris*), and twohorn sculpins (*Icelus bicornis*). Compared with the fish fauna of the eastern Bering Sea, Aleutian Islands, and Gulf of Alaska, these most common fish were small (maximum size of 18 cm for Arctic cod, 24 cm for eelpouts, and 7 cm for sculpins). Brittle stars and crinoids were the most abundant invertebrates at most stations, often accounting for 75% or more of total trawl biomass. Larger crabs included Arctic lyre crab (*Hyas coarctatus)* and snow crab (*Chionoecetes opilio*), which were roughly equal in maximum size at 7.5 cm carapace length; however most crabs were smaller and given the size distribution observed, the number of mature individuals was expected to be low for snow crab (Frost and Lowry 1983).

In an August-September 1990-1991 study restricted to the Chukchi Sea, 66 species of fish were found (Barber et al. 1997). Arctic cod was also the most common fish in this study, followed by saffron cod (*Eleginus gracilis)*; these two species combined accounted for 69% of fish biomass over the two year study. Sculpins in the genus *Myoxocephalus* were next most common. The distribution and abundance of fish between the two years studies differed widely, with much higher biomass overall recorded in 1990 and higher biomass in the southern portion of the study area in that year. No spatial trends were observed in 1991. Of 8 stations sampled in both years, little consistency was found in species biomass or composition in the same locations over time (Barber et al. 1997). Further analysis of the dataset from the Alaskan Chukchi shelf in 1990 revealed a similarly high ratio of invertebrates to fish as was found in the 1976-1977 study of Frost and Lowry (1983), with invertebrates accounting for more than 90% of total identified biomass. The top biomass invertebrate groups in 1990 were tunicates, sea stars, sea cucumbers and other echinoderms, jellyfish, snow crabs, and sponges. Snow crab biomass was more than double that recorded for Arctic cod in 1990 (data summarized by A. Greig, AFSC). Compared with 1991 trawl survey estimates of biomass in the eastern Bering Sea, the Chukchi shelf had lower fish and invertebrate biomass density overall, with the exception of tunicates, sponges, non-pandalid shrimp and small sculpins (Table 8-1, Figure 8-4).

A survey is currently (August-September 2008) underway on the Alaskan Beaufort Sea shelf to update biomass estimates for the fish and invertebrate fauna there so that further comparisons with other managed Alaskan ecosystems will be possible in the future.

Table 8-1 Biomass estimates in metric tons for Chukchi Sea invertebrates and fish from a 1990 trawl survey, summarized by A. Greig (AFSC). Chukchi Density is biomass in tons divided by the estimated area of the Alaskan Chukchi shelf, 218,729 square km. E. Bering Density is tons per square km in the E. Bering Sea (shelf area 495,218 square km as reported in Aydin et al. 2007) for the 1991 bottom trawl survey where the comparable group had biomass estimated. In making these comparisons, we assume that survey selectivity for each group is similar between areas.

Chukchi Group	Rank	Biomass	Chukchi Density	E. Bering Density
All invertebrates			5.028074261	7.482607813
All fish			0.453578989	18.20035613
Tunicates	1	274785	1.256279	0.3545
Sea stars	2	178987	0.818304	2.47136
Urchins dollars cucumbers	3	160230	0.732549	1.11966
Scyphozoid jellies	4	159982	0.731416	
C. Opilio	5	147196	0.67296	1.8667
Sponges	6	114997	0.52575	0.05449
Arctic cod	7	60042	0.274504	
Hermit crabs	8	29223	0.133604	0.889427
Lg. sculpins	9	12531	0.05729	0.54032
Misc crabs	10	11557	0.052837	0.059657
Saffron cod	11	10195	0.04661	
Anemones	12	10167	0.046482	0.10952
Non-Pandalid shrimp	13	6219	0.028432	0.00036
Eelpouts	14	4943	0.022599	0.074322
Bering flounder	15	3898	0.017821	
Herring	16	2874	0.01314	0.067143
Sculpins	17	2502	0.011439	0.006443
Brittle stars	18	2292	0.010479	0.283877
Snails	19	2260	0.010332	0.043351
Misc Crustacean	20	1305	0.005966	
Misc. fish	21	872	0.003987	0.082681
Misc. worms	22	460	0.002103	
W. Pollock	23	413	0.001888	10.30904
Oth pel. smelt	24	238	0.001088	0.003549
Managed Forage	25	252	0.001152	0.000149
P. Cod	26	199	0.00091	1.044407
AK Plaice	27	125	0.000571	1.0684
King crab	28	79	0.000361	0.21821
pandalidae	29	45	0.000206	0.011496
YF Sole	30	38	0.000174	4.83331
Capelin	31	34	0.000155	0.003477
Gr. Turbot	32	23	0.000105	0.02152
Misc. Flatfish	33	23	0.000105	0.145496
Greenlings	34	9	4.11E-05	9.58E-05
Bivalves	35	3	1.37E-05	

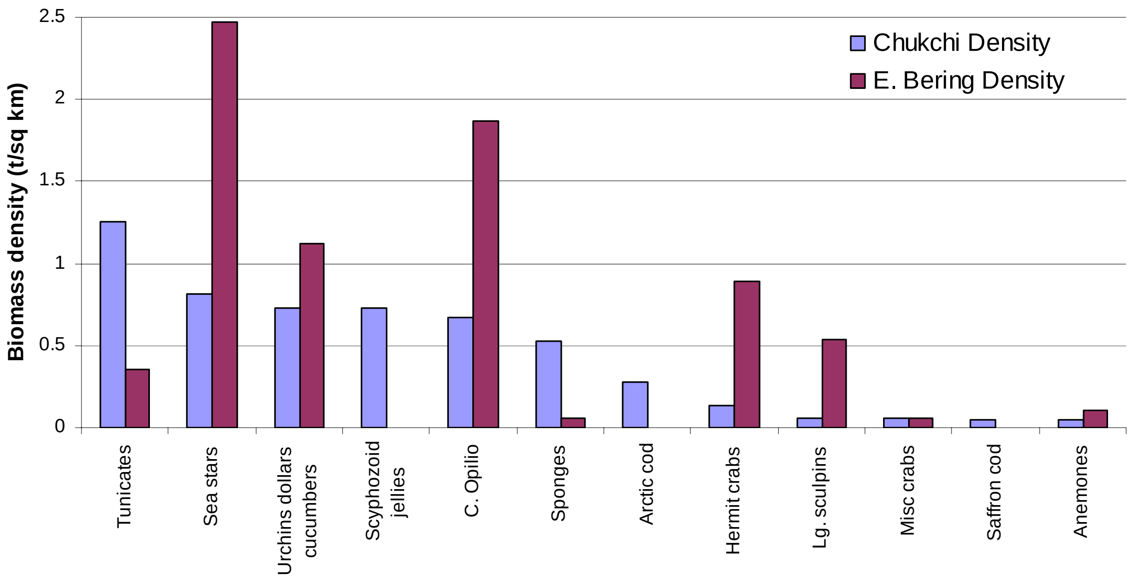

Figure 8-4 Top ranked Chukchi biomass groups compared with EBS biomass for early 1990s

Both the limited available survey data and the more comprehensive Arctic marine mammal and bird literature prominently feature Arctic cod and saffron cod as locally abundant species in the Alaskan Arctic, and as critical components of pelagic food webs. In open water and/or ice edge habitats, Arctic cod are a key link converting the production of small animals (pelagic zooplankton and ice-associated small invertebrates) into useful forage for large animals (birds and mammals; Welch et al. 1993). Multiple predator diets (Beluga whales, ringed seals, ribbon seals, spotted seals, black-legged kittiwakes, glaucous gulls, ivory gulls, black guillemots, thick-billed murres, northern fulmars, and loons) are at least 50% Arctic cod in the Beaufort Sea, and over 90% Arctic cod in certain seasons and areas, especially during winter for foraging seals (Frost and Lowry 1984, Divoky 1984, Welch et al. 1993, Dehn et al. 2007, Bluhm and Gradinger 2008).

Frost and Lowry (1984) estimated the consumption requirements for the most common marine mammals and birds in the pelagic food web of the Alaskan Beaufort shelf, and included Arctic cod as both forage for these predators and as a predator on zooplankton. An estimated 123,000 tons of Arctic cod were required to feed the Belugas, ringed seals, marine birds, and Arctic cod themselves in the Beaufort Sea. Belugas and ringed seals in particular were dependent on Arctic cod for a majority of their consumption, and birds for half their consumption requirements. A total of 2,000,000 metric tons of forage (copepods, euphausiids, pelagic amphipods, Arctic cod, and other prey) was required for all predators including Arctic cod, of which nearly half was copepods. The authors remarked that the level of zooplankton forage required was likely to be available in years with high primary productivity, but might not be available in low productivity years, suggesting that competition for these resources might occur between predators; specifically, between bowhead whales, ringed seals, and Arctic cod for copepods and euphausiids (Frost and Lowry 1984).

The tight linkages described in this simple food web and potentially complex competitive interactions given environmental variability in primary production (which may vary with ice cover) suggest that adding another competitor (fishery) to this ecosystem could have highly unpredictable effects.

While many marine mammals and birds depend on the pelagic food web described above, others are equally dependent on the benthic food web in the Alaskan Arctic. Benthic clams and amphipods are important groups channeling the relatively high benthic production observed in the Chukchi Sea to birds and mammals, specifically walruses, bearded seals, and gray whales (Moore et al. 2000, Coyle et al. 2007, Dehn et al. 2007, Bluhm and Gradinger 2008). Quantitative consumption estimates similar to those presented above for the pelagic food web in the Beaufort Sea are not available for the benthic predators of the Chukchi (and Beaufort) shelves. Further information and work is necessary to determine the extent to which benthic and pelagic food webs may be linked in the Alaskan Arctic as they are in the Bering Sea, potentially switching between benthic and pelagic pathways (Hunt et al. 2002, Mueter et al. 2006), and/or with potentially strong flow through each pathway to predatory fish dependent on both (Aydin et al. 2007). The limited available trawl survey data reviewed above suggest that the high benthic and primary productivity observed in the Chukchi Sea may not indicate similarly high fish biomass as is observed in the Bering Sea. Some authors suggest that the close coupling of primary production with benthic invertebrate biomass results from short food chains and little grazing in the pelagic zone (Dunton et al. 1989), thus leaving little energy for high fish biomass, but considerable energy for large benthic foraging mammals.

8.1.3 Human ecosystem characteristics[27]

Humans have inhabited the Alaskan Arctic and foraged in its marine ecosystems for thousands of years. Sea level rose to its current level between 4,200 and 4,500 years ago, at which time certain coastal areas were used seasonally for seal hunting and fishing according to archaeological sites along the Alaskan Chukchi coast. At one site (Cape Krusenstern), whaling clearly took place between 1400 and 1300 B.C., and in this same location primarily ringed seal and bearded seal bones were found in a layer dating from 0-1000 A.D. (Anderson 1984, Savinetsky et al. 2004). Off Point Barrow, whaling again took place starting around 1000 A.D. after an apparent 500 year gap; people living on this coast also hunted seals, birds, caribou, and fish and eventually lived in relatively large settlements at Point Hope and Barrow. Whaling gave way to fishing at Cape Krusenstern after 1400 A.D., apparently due to the absence of whales. While mammal and bird populations fluctuated substantially over this time period according to archaeological remains, these fluctuations appeared more driven by environmental variability than by human exploitation (Savinetsky et al. 2004). Coastal settlements and subsistence patterns remained relatively steady up until contact between the resident people and whaling ships from the east coast of the U.S. in the late 1800s (Anderson 1984).

The only large scale commercial fishery that has taken place in the Alaskan Arctic was for whales. Bowhead whales were discovered in the Bering Sea by the "Yankee whalers" around 1850 as a replacement for the dwindling Pacific right whales (Bockstoce 1978). The bowheads were heavily exploited by the Yankee whalers and were eventually pursued all the way up to their final summer refuge, feeding grounds in the Mackenzie River delta of the Beaufort Sea. During this hunt, the population of Pacific walrus was also reduced to a quarter its original size; idle whalers hunted the walrus for ivory while they waited for ice to break up or for bowheads to migrate by (Haycox 2002). Bowhead whaling eventually ended due to a combination of economic, social, and environmental forces. First, a directed Civil War attack on the Yankee whaling fleet in which 29 whaling vessels were destroyed and 38 more were captured significantly reduced fleet capacity (Mohr 1977). Then, the discovery of petroleum oil and associated invention of plastics diminished the demand for whale oil to light the lamps of Europe and America. Finally, a bad Arctic ice year (after many between 1871 and 1897) crushed a significant portion of the remaining active whaling vessels. In the end, it cost too much to catch the remaining bowhead whales for the companies to make any money on the products by the beginning of the 20th century (Bockstoce 1978).

[27] Additional discussion of human activity in the action area may be found in Chapter 9 RIR.

Bowhead, gray, and beluga whale hunting are still community mainstays for subsistence in the action area, with hunters sharing catch throughout their communities. However, there are modern concerns with climate change (see below) and contamination of high trophic level animals that are important to human subsistence in this region. The extreme seasonality of production and short food chains, combined with the preferential atmospheric transport of some contaminants to the Arctic may cause long-lived, lipid-rich marine mammals and birds to accumulate toxins that may threaten human health (Alexander 1995. Mallory et al. 2006). Finally, oil exploration represents the other major human activity on the North Slope, which brings both economic enrichment and the potential for contamination of ecosystems if there are spills or other industrial accidents. The North Slope Borough has been active in seeking stricter environmental review of offshore oil exploration in order to preserve the offshore environment (Itta 2008).

8.1.4 The changing Arctic

Certain aspects of the Alaskan Arctic ecosystems described above are changing rapidly; most notably, the physical attributes which drive much of the seasonal habitat availability and resultant primary production. The most obvious change is the continuing decline in summer sea ice cover, which reached a new record minimum in September 2007 (Richter-Menge et al. 2007, Parkinson and Cavalieri 2008, Overland et al. 2008), and which has resulted in the replacement of nearly 30% of the perennial ice which existed in 1979 with annual ice (Carmack et al. 2006). Since perennial ice is generally thicker than annual ice, this suggests that annual ice may be more prone to quicker melting in the summer, both continuing the trend and perhaps increasing the overall variance of ice cover relative to past conditions. The perennial sea ice is also reportedly getting thinner overall, though measurements of ice thickness are more difficult to verify than ice coverage (Rothrock et al. 1999, Winsor 2001, Laxon et al. 2003). This reduction in ice cover is happening much faster than climate change models have predicted (Walsh 2008).

Changes in sea ice have direct effects on biological systems. Human foragers in the Arctic are immediately affected by earlier melts, thinner ice, ice further from shore, and changes in animal migratory patterns (Mallory et al. 2006, Krupnik and Ray 2007). For animals dependent on stable ice near relatively shallow areas as a foraging platform and for reproduction (polar bears, walrus, and ice seals), less ice represents less habitat and is therefore predicted to lead to range alteration, demographic effects, and population declines (Tynan and DeMaster 1997). Despite poor information on the population levels of many Arctic mammal species, this prediction appears to be validated for polar bears, which have associated changes in denning locations and body condition, and for walruses in the Chukchi Sea, where the ice edge retreated to deep water away from the continental shelf, altering distribution, restricting foraging, and resulting in some pup abandonment (Lairdre et al. 2008).

However, not all changes are predicted to have negative impacts. Bowhead whales might benefit from any increased productivity that might be associated with more open water in their current summer foraging habitats (Moore and Laidre 2006). Further, Arctic cod larval survival may increase if there are earlier melts and more open water following their winter spawning season (Fortier et al. 2006). Likewise, earlier ice breakup and more open water may benefit some marine birds (Mallory et al. 2006). However, the pelagic food web interactions described above may complicate the separate predictions for bowhead whales, marine birds, and Arctic cod, given that they may compete for any increased zooplankton production in open water systems.

An example of a more complex whole ecosystem change which may be driven by climate warming is occurring in the Northern Bering Sea, where a shift from strong benthic energy flow to one dominated by pelagic fish has been documented, in part due to range extensions into northern waters (Grebmeier et al. 2006b). Other changes in Arctic ecosystems are less directly attributable to climate change or even increased variability in physical conditions, and still others will be driven by human initiatives. For example, gray whales are now hypothesized to have exceeded their carrying capacity on the northern Bering Sea shelf, perhaps because concentrations of their primary prey, benthic amphipods, have declined (Coyle et al. 2007). While climate change was not implicated in the amphipod decline, any changes to the ecosystem resulting in lower productivity or less benthic pelagic coupling was predicted to exacerbate the decline, potentially affecting gray whales further. Finally, less ice and more open water may lead to increased human activities in the area, including oil exploration, shipping, and commercial fishing.

8.2 Significance analysis

The proposed action could affect the marine ecosystem through spatial removals of fish biomass or alteration of the habitat. Three primary means of measurement of ecosystem change are evaluated here: predator-prey relationships, energy flow and balance, and ecosystem diversity. The criteria used to evaluate the significance of the effects on the ecosystem from the proposed action are provided in Table 8-2 below.[28] The reference point for predator-prey relationships are fishery induced changes outside the natural level of abundance or variability for a prey species relative to predator demands. The reference point for energy flow and balance will be based on bottom gear effort (qualitative measure of unobserved gear mortality particularly on bottom organisms) and a quantitative assessment of trends in retained catch levels over time in the area. The reference point for ecosystem diversity will be a qualitative assessment whether removals of one or more species (target, non-target) effects overall species or functional diversity of the area.

Table 8-2 Significance thresholds for fishery induced effects on ecosystem attributes.

Effect	**Criteria**			
	Significantly Negative (-)	**Insignificant (I)**	**Significantly Positive (+)**	**Unknown (U)**
Predator-prey relationships	A decline outside of the natural level of abundance or variability for a prey species relative to predator demands.	No observed changes outside the natural level of abundance or variability for a prey species relative to predator demands	Increases of abundance or variability for a prey species relative to predator demands	Magnitude and/or direction of effects are unknown
Energy flow and balance:	Long-term changes in system biomass, respiration, production or energy cycling, due to removals.	No observed changes in system biomass, respiration, production or energy cycling, due to removals.	Increases in system biomass, respiration, production or energy cycling, due to removals or lack thereof.	Magnitude and/or direction of effects are unknown
Ecosystem Diversity	Removals from area decreases either species diversity or the functional diversity outside the range of natural variability. Or loss in one or more genetic components of a stock that would cause the stock biomass to fall below minimum biologically acceptable limits	No observed changes outside the natural level for species diversity, functional diversity or genetic components of a stock.	Removals from the area , or lack thereof, increases the species diversity or functional diversity or improves the genetic components of a stock.	Magnitude and/or direction of effects are unknown

[28] The significance criteria used here were adopted from the 2008 EA to evaluate BSAI FMP Amendment 89 Bering Sea Habitat Conservation measures (NMFS 2008)

Table 8-3 below summarizes the significance findings for ecosystem relationships.

Table 8-3 Ecosystem impacts significance analysis.

Issue	Alt 1	Alternatives 2, 3, and 4
Alternative description	Status quo	**Alternative 2**: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait. **Alternative 3**: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has occurred would be exempt from the Arctic FMP. **Alternative 4**: Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.
Predator-prey relationships	This may have a significantly adverse impact. For example, as noted above, Arctic cod is an extremely important forage fish in the action area. A fishery, if one turned to be economically viable, that harvested Arctic cod, or that took large amounts as incidental catch could have an adverse and may have a significantly adverse impact on species that prey on it.	These alternatives are expected to have an insignificant impact on the three categories of ecosystem impacts. Under these alternatives, harvests will initially be equal to zero, and thus similar to harvests in the recent past. Under Alternative 2 any small commercial harvests of crab in Kotzebue Sound will be ended. Prior to any future harvests, NMFS would conduct the appropriate NEPA analysis to determine significance or evaluate any impacts as is currently done for harvest specifications in the GOA and BSAI.
Energy flow and balance	This may have a significantly adverse impact. For example, as noted above, the ecosystem in the action area is subject to considerable year-to-year and seasonal variability which is hard to predict. If a fishery took place it could withdraw much more biomass from a depressed population than that population could sustain.	
Diversity	This impact is unknown. It is certainly possible that a fishery could reduce species or functional diversity in the action area. On the other hand, Arctic cod appears to be a dominant species in the ecosystem. A fishery that reduced the size of the Arctic cod population may create a niche into which other species could expand.	

8.3 Cumulative effects analysis

Section 3.2 of this EA describes past, present and reasonably foreseeable future actions that may have effects on the ecosystem. These actions include oil and gas development, transportation, subsistence and commercial harvests, scientific research and other state, federal and international agency activities. Oil and gas exploration and transportation are likely to result in mortality or disturbance directly or indirectly of species that occur in the ecosystem. For example, vessels engaged in transportation and oil exploration may introduce invasive species that could disrupt the balance of predator and prey relationships and diversity within the ecosystem. Subsistence harvest selectively removes organisms from the ecosystem which may affect diversity and predator-prey relationship, but the historical level of harvest appears to follow natural fluctuations, so no significant cumulative effects are likely from this activity. An oil spill under the ice, which is productive for spring months when translucent light powers primary production by ice algae, would prevent the capture of the sun's energy and result in a direct loss of food calories that are very important to the ecosystem. This effect on this important habitat for Arctic cod, would likely be lethal from the loss of calories, and loss of cover. Arctic cod are arguably the most important fish species in the arctic with their role of transferring energy from lower trophic levels up to higher trophic levels.[29]

Commercial harvests of whales occurring in the Arctic had significant impacts on the diversity and predator prey relationships in the ecosystem by nearly wiping out entire species of whales, but some amount of recovery has occurred.

Scientific research will provide a better understanding of the marine ecosystem which should lead to beneficial impacts through ecosystem based management. The continued management of marine mammals and seabirds in the Arctic by the USFWS may improve the sustainability of these species/populations, especially with the use of the Endangered Species Act to identify and implement conservation measures to protect particularly vulnerable species (e. g., polar bears and Steller's sea eiders). These actions preserve the predator-prey relationships, energy flow and balance, and the diversity of the ecosystem.

Consideration of the cumulative actions described in Section 3.2 of the EA does not change the results of the significance analysis. Alternatives 2 through 4 prevent any fishery from taking place until sufficient research and environmental analyses have been conducted. The direct and indirect effects of Alternatives 2 through 4 on the ecosystem are therefore beneficial overall by protecting the ecosystem from the potential effect of fishing activities. Because efforts are being made through research and resources management to identify and prevent potential adverse effects from various human activities, (oil and gas exploration, transportation and past whaling), the overall cumulative effects are not likely to result in significantly adverse effects on the ecosystem. **The addition of direct and indirect effects of Alternatives 2, 3, and 4 to the cumulative effects described above are likely to result in insignificant impacts.**

Under certain circumstances, a fishery may occur under Alternative 1 and would not be conducted under ecosystem-based management. A fishery, if it occurs, may have significantly adverse impacts for predator-prey relationships and energy flow and balance and unknown impacts on diversity. Key reasonably foreseeable actions, including those associated with oil, gas and mineral development, and transportation and shipping, may create additional stress on fish, fish habitat, and marine mammal resources in the area. These may, for example, reduce carrying capacity, survival rates for different age classes, or reproductive rates for different age classes. Regardless of the future research and management of seabird and marine mammal resources by USFWS and NFMS, the cumulative effects would not change the potential for a fishery, should one occur under Alternative 1, to have potentially adverse and significantly adverse impacts on predator-prey relationships and energy flow, or unknown impacts on diversity. Because ecosystem based management would not be used under Alternative 1, the beneficial effects from the research and resources management would not help to minimize potential adverse effects from the other cumulative effects. **Therefore, the direct and indirect effects of Alternative 1 added to the cumulative effects would result in potentially adverse significant effects on the ecosystem.**

[29] Jeep Rice, Alaska Fisheries Science Center, Auke Bay Lab, personal communication, Oct. 28, 2008.

Chapter 9 Regulatory Impact Review

Climate change in the Arctic means that conditions could become favorable to commercial fishing. The North Pacific Fishery Management Council is considering adopting an Arctic Fishery Management Plan (FMP) to provide a framework within which fishery development could proceed in a way that protects other Arctic resources and ensures that any fishery that may emerge is sustainable.

This Regulatory Impact Review (RIR) describes the economic costs and benefits of the alternatives under consideration by the Council. This analysis is required by Presidential Executive Order 12866 (58 *FR* 51735, September 30, 1993).

9.1 What is a Regulatory Impact Review

The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following statement from the order:

> *In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nonetheless essential to consider. Further, in choosing among alternative regulatory approaches agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.*

E.O. 12866 further requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant." A significant regulatory action is one that is likely to:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, local or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

9.2 Statutory Authority

The Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act) is the primary domestic legislation governing management of the nation's marine fisheries. In 1996, the United States Congress reauthorized the Magnuson-Stevens Act to include, among other things, a new emphasis on the precautionary approach in U.S. fishery management policy. The Magnuson-Stevens Act contains ten national standards, with which all fishery management plans (FMPs) must conform and provides the primary guidance for the management of the federal fisheries.

Under the Magnuson-Stevens Act, the North Pacific Fishery Management Council (Council) is authorized to prepare and submit to the Secretary of Commerce for approval, disapproval or partial approval, an FMP and any necessary amendments for each fishery under its authority that requires conservation and management. The Council conducts public hearings so as to allow all interested persons an opportunity to be heard in the development of FMPs and amendments. (16 U.S.C. 1852(h)).

9.3 Problem Statement

The purpose of the proposed action is to establish federal fisheries management in the Arctic Management Area that complies with the Magnuson-Stevens Act. The action is necessary to prevent commercial fisheries from developing in the Arctic without the required management framework and scientific information on the fish stocks, their characteristics, and the implications of fishing for the stocks and related components of the ecosystem.

9.3.1 OMB Market Failure Analysis

OMB guidelines for preparation of an economic analysis under E.O. 12866 state, in relevant part, that,

> *… in order to establish the need for the proposed action, the analysis should discuss whether the problem constitutes a significant market failure. If the problem does not constitute a market failure, the analysis should provide an alternative demonstration of compelling public need, such as improving governmental processes or addressing distributional concerns. If the proposed action is a result of a statutory or judicial directive, that should be so stated.*

The proposed regulatory action under review in this RIR is proposed in response to the inherent *common property* attributes of the absence of a regulatory framework for fisheries in the Arctic. These attributes, in turn, result in market failure, interfering with society's ability to optimally and efficiently allocate resources among competing users and uses (including "non-use").

The term "*common property*" has a precise technical meaning in economics. A common property resource is one held in common, by all members of a "community" (e.g., all citizens of the United States). As a common asset, private property rights institutions do not appertain, and these assets tend (in the absence of governance) to become sub-optimally managed, imposing uncompensated external costs on society. Because the potential target species of the Arctic Ocean and its Beaufort and Chukchi Seas inherently possess these attributes, under prevailing management rules, the way society regards their stewardship and exploitation is fundamentally different than, say, an asset to which private property rights and institutions apply. For these reasons, private behavior will tend to exploit these public assets at rates, and in ways, that are not socially optimal. That is, when common property is converted to private use, all relevant production costs (including rents to the resource) tend not to be accounted for by the individual user, resulting in imposition of external costs on society. Resolution of this market failure necessitates regulatory intervention.

9.4 Description of the Alternatives

Table 9-1 summarizes the four alternatives under consideration for this action.

Table 9-1 Description of the four alternatives

1	Status quo
2	Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait.
3	Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has occurred would be exempt from the Arctic FMP.
4	Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

Alternative 2 would prohibit commercial fishing in all waters of the EEZ. Alternatives 3 and 4 prohibit all fishing except for the fishery for red king crab that is currently permitted in Kotzebue Sound. Alternative 3 leaves the red king crab in this area out of all FMPs. This permits the state to exercise jurisdiction in the absence of FMP coverage. Alternative 4 defers management to the state within the context of the constraints included in the existing crab FMP.

Table 9-2 summarizes information about the fisheries authorized under the different alternatives, the source of that authority, and the geographic scope of that authority:

Table 9-2 Fisheries Authorized in the Arctic Management Area, by Alternative

Alternative	1	2	3	4
Groundfish Authorized?	No	No	No	No
Groundfish Authority	State regulations	Arctic FMP	Arctic FMP	Arctic FMP
Crab Fishery Authorized?	Yes	No	Yes	Yes
Crab Mgt. Authority	Crab FMP	Arctic FMP	Arctic FMP (with Chukchi red king crab exemption)	Crab FMP
Crab northern boundary	Pt Hope	Bering Strait	Bering Strait	Pt Hope
Notes on Chukchi Sea red king crab fishery management	Open - Crab FMP defers mgt authority to State	Closed	Open – Exempt from Federal mgt. State would manage	Open - Crab FMP defers mgt. authority to State
Scallops Authorized?	Yes	No	No	No
Scallop Authority	Scallop FMP	Arctic FMP	Arctic FMP	Arctic FMP
Scallop northern boundary	Pt Hope	Bering Strait	Bering Strait	Bering Strait

9.5 Social, Cultural, and Economic Background

9.5.1 Political jurisdictions in the action area

The communities in or immediately adjacent to the action area are located within the State of Alaska, the Chukotka Autonomous Okrug of the Russian Federation, and the Yukon, Northwest, and Nunavut Territories of Canada.

The communities within Alaska are located within the Northwest Alaska Borough, the North Slope Borough, or are unorganized communities on the Seward Peninsula. A list of the Alaskan communities in the action area may be found in Table 9.3 (which deals with governments in U.S. communities in the action area), Table 9.4 (which deals with economic conditions in those communities), and Table 9.5 (which provides sources of additional information on these communities).

The residents of the communities in the action area within Alaska are predominantly Alaska Natives. The action area falls within the cultural-linguistic region of the Inupiat.

9.5.2 Northwest Arctic Borough[30]

The Northwest Arctic Borough is the second-largest borough in Alaska, comprising approximately 39,000 square miles along the shores of Kotzebue Sound and the southern Chukchi Sea, and along the Wulik, Noatak, Kobuk, Selawik, Buckland and Kugruk Rivers. The area encompasses about 36,000 sq. miles of land and 5,000 sq. miles of water. The area and key communities are shown in Figure 9-1.

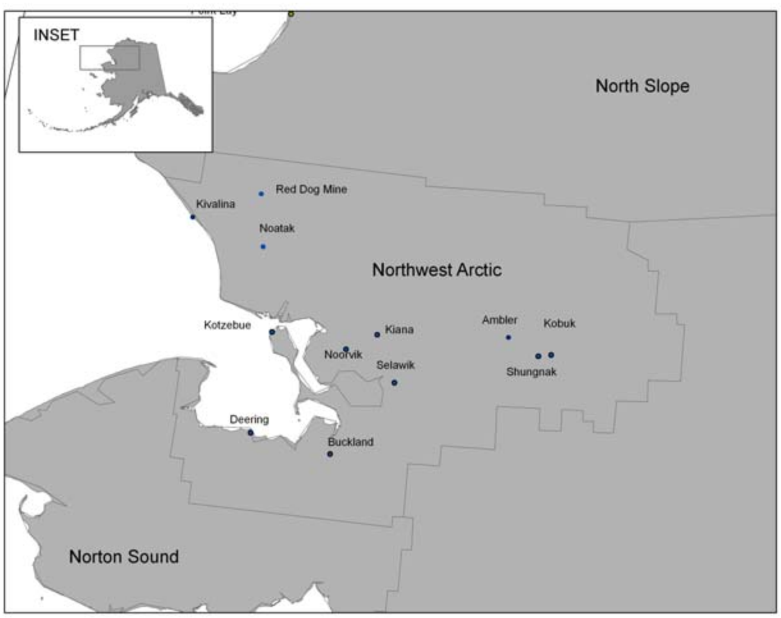

Figure 9-1 Northwest Arctic Borough

[30] This text is adapted with some changes from the Community Database Online of the Alaska Department of Commerce, Community and Economic Development web page on this borough (ADCCED). The discussion of subsistence is based on the Department's Alaska Economic Information System web page.

Kotzebue, the largest town in the Borough (the site is known as "Kikiktagruk" in Inupiat), was a hub for ancient arctic trading routes. The Russians entered Kotzebue Sound in 1818. In 1899 a post office was established in Kotzebue. Most cities in the borough developed as supply stations for Interior gold mining, and were settled around schools and churches. The Borough was incorporated as a First Class Borough in 1986 and became a Home Rule Borough in 1987.

The Borough population is primarily Inupiat Eskimo, and subsistence activities are an important part of the lifestyle. Residents rely on caribou, reindeer, beluga whale, birds, four species of seals, berries, greens, and fish. Section 8.5.9 describes regional subsistence fisheries, and Section 8.5.10 describes regional marine mammal subsistence hunting.

Government, mining, health care, transportation, services and construction contribute to the economy. The Red Dog Mine, 90 miles north of Kotzebue, is the world's largest zinc and lead mine, and provides 370 direct year-round jobs and over a quarter of the borough's wage and salary payroll. The ore is owned by NANA Regional Corporation and leased to Cominco, which owns and operates the mine and shipping facilities. Cominco Alaska, Maniilaq Association, the Northwest Arctic Borough School District, Veco Construction, and Kikiktagruk Inupiat Corp. (KIC) are the borough's largest employers. The smaller communities rely on subsistence food-gathering and Native craft-making; 162 borough residents hold commercial fishing permits.

The City of Kotzebue is the "hub" of northwest Alaska and is the transfer point between ocean and inland shipping. It does not have a natural harbor, and is ice-free for only 3 months each year. Deep draft vessels must anchor 15 miles out, and cargo is lightered to the docking facility. Local barge services provide cargo to area communities. Ralph Wien Memorial Airport supports daily jet service, smaller commercial air travel companies, and air taxis to “bush” areas as well as to Anchorage via Nome.

Subsistence production and consumption is an important part of the Northwest Alaska Borough. Annual average subsistence consumption of 617 pounds provides an estimated 56% of the borough population’s annual caloric intake. Since subsistence consumption varies among the different villages and towns, this percentage also varies. Overall subsistence consumption varies, and the composition of subsistence consumption varies as well, reflecting the availability of commercial sources of food, and the composition of the resource base on which the community draws.

Figure 9-2 shows estimated subsistence harvests for five regional communities. Marine mammals are extremely important components of subsistence consumption for many communities in the region. This dependence varies, and is relatively less important for Noatak, which is further from the coast than the other communities. Non-salmon fish species are important as well. Both resources may be affected by Arctic commercial fisheries.

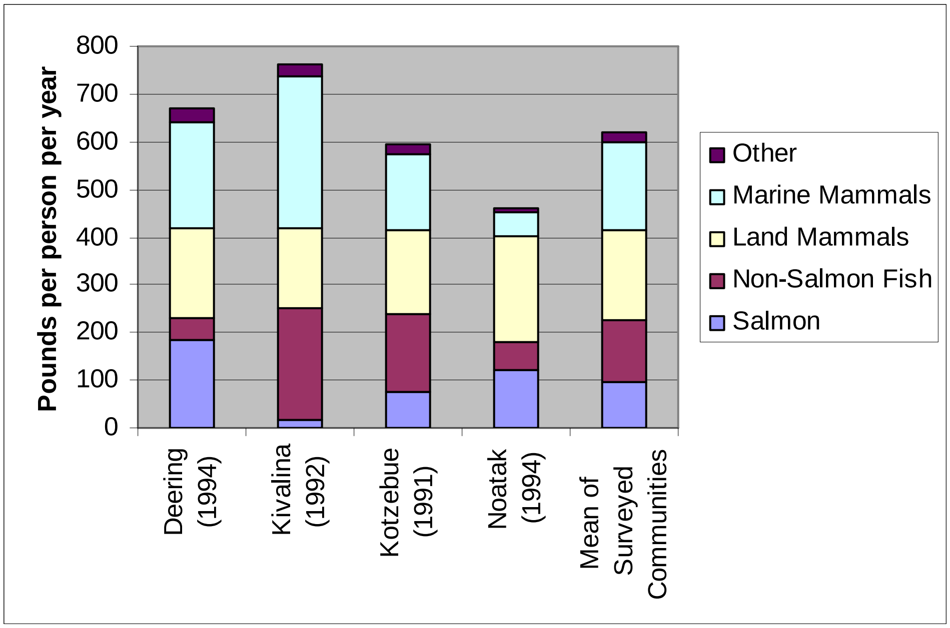

Figure 9-2 Estimates of per capita subsistence harvests in selected Northwest Arctic Borough communities. Source: Alaska Economic Information System accessed at http://www.commerce.state.ak.us/dca/AEIS/AEIS_Home.htm, on August 25, 2008.

The State of Alaska source from which these estimates were obtained notes that "Wild foods, furs, clothing, construction, arts, crafts, furs and other products are traditionally traded among households through extensive, non-commercial, kinship-based networks. Coastal resources such as seal oil, herring and halibut commonly are traded inland, while inland resources such as moose and caribou are traded toward the coast."

9.5.3 The North Slope Borough[31]

The North Slope Borough is the largest borough in Alaska, with over 15% of the State's total land area. It consists primarily of the north and northeastern coast of Alaska along the Chukchi and Beaufort Seas, and includes the Brooks Range, north of the Arctic Circle. The Borough encompasses about 89,000 sq. miles of land and 6,000 sq. miles of water. The area and key communities are shown in Figure 9-3.

[31] This text is adapted with some changes from the Community Database Online of the Alaska Department of Commerce, Community and Economic Development web page on this borough (ADCCED). The discussion of subsistence is based on the Department's Alaska Economic Information System web page.

Figure 9-3 North Slope Borough

Inupiat Eskimos have lived in the region for centuries. Oil exploration in the 1960s led to the development of the huge reserves in Prudhoe Bay and, subsequently, the Trans-Alaska Pipeline in the 1970s. The Borough incorporated in 1972. Today, oil operations support between 4,000 and 5,000 oil company and support service employees in the region. After the passage of the Alaska Native Claims Settlement Act (ANCSA) in 1971, families from Barrow re-settled the abandoned villages of Atqasuk and Nuiqsut.

The majority of permanent residents are Inupiat Eskimos. Traditional marine mammal and caribou hunts and other subsistence practices are an active part of the culture. Section 9.5.7 describes regional subsistence fisheries and Section 9.5.11 describes regional marine mammal subsistence hunting.

The North Slope Borough government is funded by oil tax revenues; it provides public services to all of its communities and is the primary employer of local Native residents. North Slope oil field operations provide employment to over 5,000 non-residents, who rotate in and out of oil work sites from Anchorage, other areas of the state, and the lower 48. Census figures are not indicative of this transient work site population. Ten borough residents hold commercial fishing permits.

Air travel provides the only year-round access, while land transportation provides seasonal access. The Dalton Highway provides road access to Deadhorse/Prudhoe Bay, though it is restricted during winter months. "Cat-trains" are sometimes used to transport freight overland to or from Barrow and/or Deadhorse during the winter.

Subsistence production and consumption are an important part of the North Slope economy. Annual average subsistence consumption of 434 pounds provides an estimated 40% of the borough population's annual caloric intake. Since subsistence consumption varies among the different villages and towns, this percentage also varies. Overall subsistence consumption varies, and the composition of subsistence consumption varies as well, reflecting the availability of commercial sources of food, and the composition of the resource base on which the community draws.

Figure 9-4 shows estimated subsistence harvests for five regional communities. Marine mammals are extremely important components of subsistence consumption in the region, and proportionately more important than in the Northwest Alaska Borough. Non-salmon fish species are important as well. Both resources may be affected by Arctic commercial fisheries.

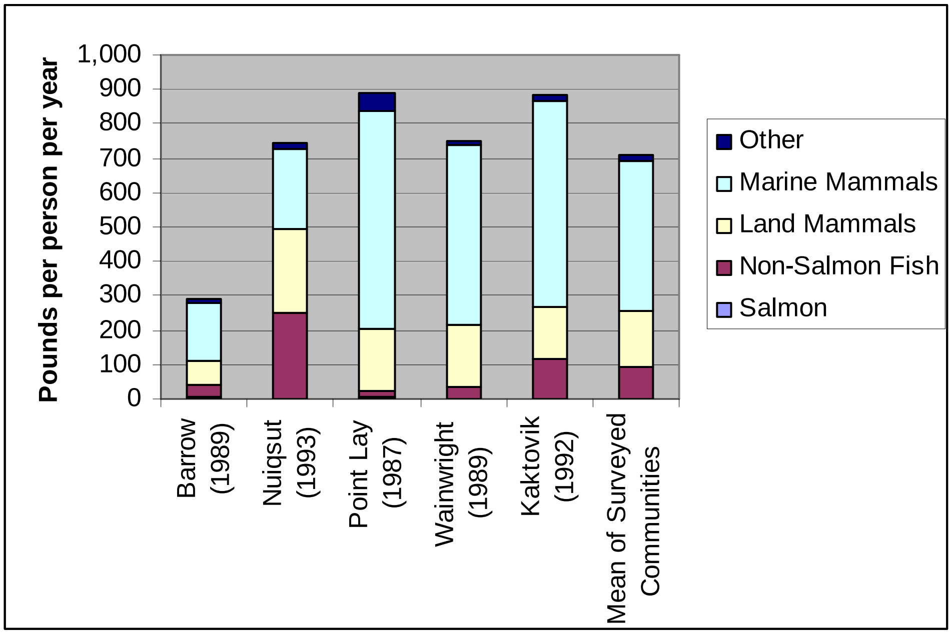

Figure 9-4 Estimates of per capita subsistence harvests in selected North Slope Borough communities and years. Source: Alaska Economic Information System accessed at http://www.commerce.state.ak.us/dca/AEIS/AEIS_Home.htm, on August 25 2008

The State of Alaska source from which these estimates were obtained notes that "Wild foods, furs, clothing, construction, arts, crafts, furs and other products are traditionally traded among households through extensive, non-commercial, kinship-based networks. Coastal resources such as seal oil, herring and halibut commonly are traded inland, while inland resources such as moose and caribou are traded toward the coast."

9.5.4 Bering Strait Communities[32]

Brevig Mission and Teller are located on the Seward Peninsula, just south of Bering Strait. Although they do not border the Chukchi Sea, they have been included here because of their proximity to the action area. Wales is located on the tip of the Seward Peninsula at Cape Prince of Wales, and thus is right on Bering Strait. Diomede is on Little Diomede Island, an island in Bering Strait, only one or two miles from the border with the Russian Federation (Big Diomede Island). Shishmaref is located on a small island just off the north side of the Seward Peninsula, to the east of Wales. There are no other communities between Shishmaref and the western edge of the Northwest Arctic Borough. The area and key communities are shown in Figure 9-5.

[32] Much of the following text is adapted from the Community Database Online of the Alaska Department of Commerce, Community and Economic Development web page on this borough (ADCCED). The discussion of subsistence is based on the Department's Alaska Economic Information System web page.

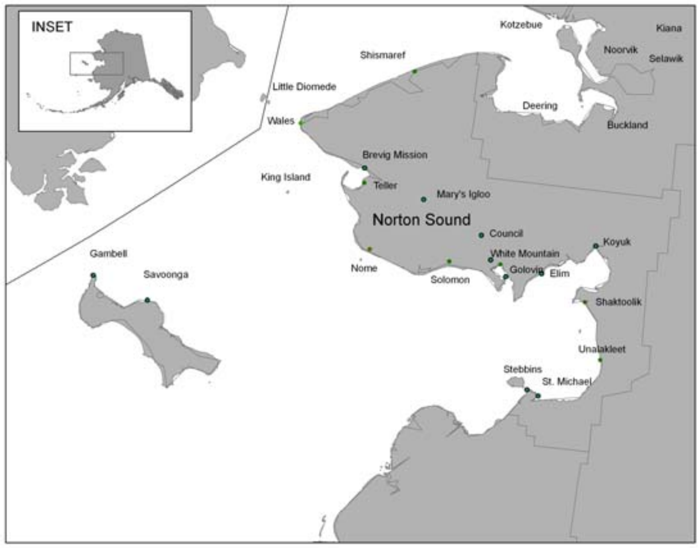

Figure 9-5 Bering Strait Communities

Human occupation in this area goes back at least 5,000 to 6,000 years. Rising sea levels probably cut this area off from Siberia about 6,000 years ago. Historical records of the population in the region begin in the mid-seventeenth century when Russian expansion brought it into contact with Siberian and Chukchi peoples, who were themselves in contact through trading and raiding relationships—with the Inupiat. Early records, largely from the eighteenth century, indicate that, at the time of western contact, "the Eskimos had adapted themselves technically and psychologically to the limitations of man and the universe. They were not experimenting with means to exist in the Arctic… but were living in a well-developed culture where life was far above a mere existence level and was filled with the luxury of the arts, songs, and dancing" (Ray 1975). Ray (1975) characterizes the modern history of the region in five phases: (1) Russian inquiry and exploration, 1650-1778; (2) European exploration, 1778-1833; (3) coastal commerce, 1833-1867; (4) Americans at Bering Strait, 1867-1898; and (5) contemporary life, 1898-1970s (Ray 1975).

These are all predominantly Inupiat communities. Subsistence hunting, fishing, and gathering are very culturally important in these villages. Section 9.5.10 describes regional subsistence fisheries, and Section 9.5.11 describes regional marine mammal subsistence hunting.

The economies of these villages are based on subsistence hunting, fishing and gathering, supplemented by part time work, or the preparation and sale of crafts. Most full time employment is associated with government operations, particularly schools. Diomede, Wales, Teller, and Brevig Mission are all Community Development Quota communities represented by the Norton Sound Economic Development Corporation. Teller, Brevig Mission, Wales, and Shishmaref rely on Seward Peninsula reindeer herds for subsistence use and some commercial use.

All of these communities except Diomede have runways. The runway at Shishmaref is paved. Diomede is accessible by helicopter; in the winter small planes can sometimes land on improvised runways prepared on the ice. Wales lacks a harbor; cargo is delivered by barge and lightered to shore. Shishmaref has an "excellent harbor." Goods must be lightered ashore at Teller. Consideration has been given to developing a harbor at nearby Port Clarence. Brevig Mission and Teller have a seasonal land connection to Nome over a gravel road.

The abandoned community of Ukivok on King Island lies to the south of the action area. In 1964, the King Island community abandoned the village site of Ukivok and moved to Nome. King Islanders remain a distinct community in Nome. Structures continue to exist on the island, although in a state of disrepair. The site is still used as a hunting camp by islanders. King Island remains a site of historical, archeological, and cultural importance. In recent years, ethnographic, ecological and archeological research has been conducted on the island. The National Trust for Historic Preservation included Ukivok on its 2005 list of "The 11 Most Endangered Historic Places."

Subsistence production and consumption are an important part of the Bering Strait Communities. Overall subsistence consumption varies, and the composition of subsistence consumption varies as well, reflecting the availability of commercial sources of food, and the composition of the resource base on which the community draws.

Figure 9-6 shows estimated subsistence harvests for three region communities. Marine mammals are extremely important components of subsistence consumption in the region and may be affected by Arctic commercial fisheries.

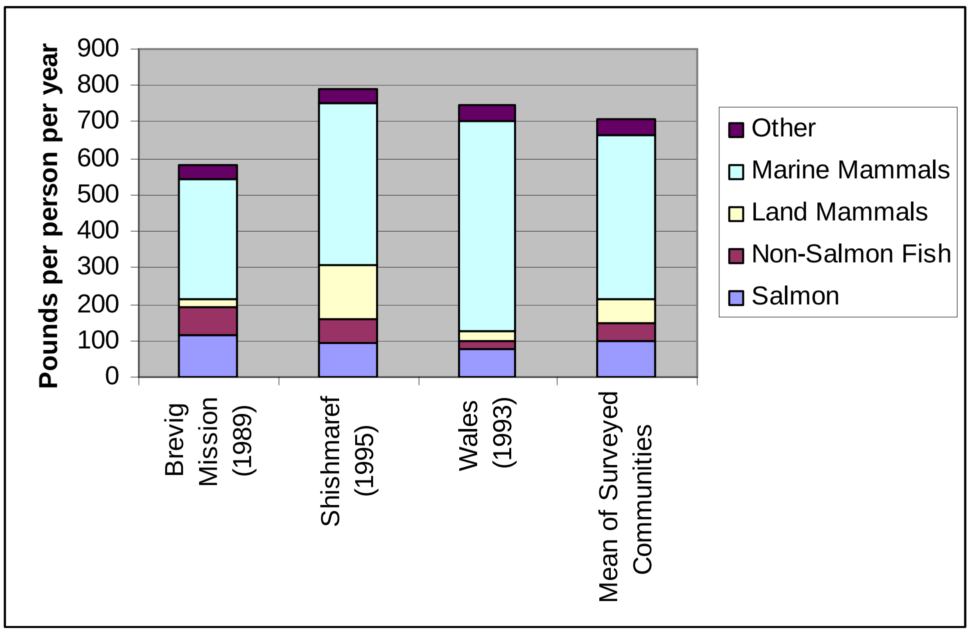

Figure 9-6 Estimates of per capita subsistence harvests in selected Bering Strait Communities and years. Source: Alaska Economic Information System accessed at http://www.commerce.state.ak.us/dca/AEIS/AEIS_Home.htm, on August 25, 2008.

The State of Alaska source from which these estimates were obtained notes that "Wild foods, furs, clothing, construction, arts, crafts, furs and other products are traditionally traded among households through extensive, non-commercial, kinship-based networks. Coastal resources such as seal oil, herring and halibut commonly are traded inland, while inland resources such as moose and caribou are traded toward the coast."

9.5.5 Adjacent Canadian and Russian Federation Communities

The Canadian Beaufort Sea is bordered by the Yukon and Northwest Territories. The Nunavut Territory is nearby. This is the home of the Inuvialuit. The small regional population is concentrated in a few villages and towns. The main communities are Aklavik and Inuvik in the Mackenzie River region, Tuktoyaktuk, with the only port, just to the east of the Mackenzie delta, Paulatuk and Ulukhaktok (formerly Holman), farther to the east on the Amundsen Gulf, and Sachs Harbour on Banks Island, north of the Gulf and to the east of the Beaufort Sea. The population of these communities was about 5,800 in 2006. About 4,300, or almost three-quarters were aboriginal (Ayles, et al.; Bill pers. comm.; NWT).

The Mackenzie River is navigable from June to September as far as the Great Slave Lake, and there is an intermodal port at Hays River from which goods shipped by barge can be transferred to the railroad. Barge traffic down the river is used to supply Canada's Beaufort Sea communities, to supply oil, gas, and defense operations in the region, and to deliver supplies west into Alaska as far as Barrow, and east to Canada's Nunavut Territory.

There are small-scale inshore marine fisheries for Arctic char and Dolly Varden char, and similar fresh water fisheries for cisco and other whitefish species. Most of the harvest is for subsistence purposes. However, there are local inshore commercial fisheries for Arctic char and some of the fresh water species. These are small scale fisheries conducted for a local market. Commercial harvests are small in comparison to subsistence harvests. There is no other commercial fishery. There has been some examination of the potential for development of herring, shellfish, groundfish, and shrimp fisheries. In 2004 and 2006 commercial business did some exploratory work on these species with limited results. Although the parties applied for permits to carry out more exploratory work in 2007, they were not active (Ayles, et al.; Bill pers. comm.).[33]

In the Canadian Beaufort Sea, commercial fisheries management is the responsibility of Fisheries and Oceans Canada (DFO). As part of the implementation of the Inuvialuit Final Agreement[34], the Fisheries Joint Management Committee (FJMC) was established in 1986 by the Minister of Fisheries and Oceans to provide advice to the Inuvialuit and DFO on fishery management and related issues within the Inuvialuit Settlement Region (ISR). The Committee advises the Department on the management of commercial fisheries; it has a greater degree of authority over subsistence fisheries, and over commercial fishing activities that may affect subsistence harvests (Ayles, et al.; Bill pers. comm.).

The Russian Chukchi Sea is bordered by the Chukotka Autonomous Okrug. Two districts within this region border the Sea, the Shmidtovskii District (this is the northwest coast up to and including Wrangell Island) with an estimated 2001 population of about 2,700, and the Chukotskii District with a population of about 4,500 (Gray, Undated).

Anecdotal information indicates that there have been no offshore commercial fisheries in Russia's Chukchi Sea for at least 15 years. There is no catch quota in the Chukchi Sea. Some Russian trawlers may have fished there on an experimental basis for Arctic cod. There is some small scale aboriginal

[33] Personal communication from Kevin Bill, Fisheries Management Biologist – Oil & Gas, Fisheries and Oceans Canada, Inuvik, Northwest Territories. December 11, 2007.

[34] The Inuvialuit Final Agreement (IFA) of 1984 is a modern Land Claim between the Committee for Original Peoples' Entitlement — representing the Inuvialuit of the Inuvialuit Settlement Region — and the Government of Canada — representing the citizens of Canada, and is part of the Canadian Constitution.

fishing, presumably inshore on a subsistence basis, for chum and pink salmon. This analysis has not uncovered references to commercial inshore harvests (Cook, Kochnev, Zgurovsky, pers. comm.).[35]

9.5.6 Overview of Alaskan Communities in the Action Area

Table 9-3 provides summary information on community government, and Table 9-4 provides summary economic information on the individual communities in the action area.

A great deal of excellent descriptive information about the culture and economics of the communities in the action area has been prepared by other federal agencies, and is available on the Internet. Rather than duplicate it here, it has been incorporated by reference. Table 9-5 identifies several useful surveys and provides their internet links.

[35] Cook, Alfred Lee "Bubba". Senior Fisheries Officer Kamchatka/Bering Sea Ecoregion. World Wildlife Fund, Bering Sea Field Office. Anchorage, AK; Kochnev, Anatoly. Wildlife Biologist. Pacific Research Fisheries Center (TINRO) Chukotka Branch, Laboratory of Marine Mammals Study. Anadyr, Chukotka Russia; Konstantin Zgurovsky, Marine Program Coordinator, World Wildlife Fund, Russia.

Table 9-3 Communities in the Action Area: Government

Communities	Location	Incorp_Type	Borough	Reg_Native_Corp	REG_NATIVE_NONPROF	VILLCORP
Teller	Norton Sound (just south of Cape Prince of Wales	2nd Class City	Unorganized	Bering Straits Native Corp.	Kawerak, Incorporated	Teller Native Corporation
Brevig Mission	Norton sound just south of Cape Prince of Wales	2nd Class City	Unorganized	Bering Straits Native Corp.	Kawerak, Incorporated	Brevig Mission Native Corporation
Wales	Cape Pricne of Wales, at tip of Seward Peninsula; borders Chukchi Sea	2nd Class City	Unorganized	Bering Straits Native Corp.	Kawerak, Incorporated	Wales Native Corporation
Shishmaref	Chukchi Sea shore of the Seward Peninsula	2nd Class City	Unorganized	Bering Straits Native Corp.	Kawerak, Incorporated	Shishmaref Native Corporation
Diomede (Inalik)	Island in the Chukchi Sea just north of Bering Strait on the border of the Russian Federation	2nd Class City	Unorganized	Bering Straits Native Corp.	Kawerak, Incorporated	Diomede Native Corporation
Deering	South shore of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Buckland	Up the Buckland River south of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Selawik	In Selawik River drainage to the east of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Noorvik	Kobuk River delta	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Kiana	Up the Kobuk River to the east of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation

Communities	Location	Incorp_Type	Borough	Reg_Native_Corp	REG_NATIVE_NONPROF	VILLCORP
Ambler	Up the Kobuk River to the east of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Shungnak	Up the Kobuk River to the east of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Kobuk	Up the Kobuk River to the east of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Kotzebue	Eastern shore of Kotzebue Sound	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	Kikiktagruk Inupiat Corp.
Noatak	Up the Noatok River to the east of Kotzebue Sound	Unincorporated	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Kivalina	Shore of the Chukchi Sea; Northwest Arctic Borough	2nd Class City	Northwest Arctic Borough	NANA Regional Corporation	Maniilaq Assoc.	NANA Regional Corporation
Point Hope	Shore of the Chukchi Sea; North Slope Borough	2nd Class City	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	Tigara Corporation
Point Lay	Shore of the Chukchi Sea; North Slope Borough	Unincorporated	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	Cully Corporation
Wainwright	Shore of the Chukchi Sea; North Slope Borough	2nd Class City	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	Olgoonik Corporation
Atqasuk	Inland of the Chukchi Sea, southeast of Barrow; North Slope Borough	2nd Class City	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	Atqasuk Corporation
Barrow	Central North Slope; northernmost point in Alaska; North Slope Borough	1st Class City	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	Ukpeagvik Inupiat Corporation

Communities	Location	Incorp_Type	Borough	Reg_Native_Corp	REG_NATIVE_NONPROF	VILLCORP
Nuiqsut	Colville River delta of the Beaufort Sea; North Slope Borough	2nd Class City	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	Kuukpik Corporation
Prudhoe Bay/Deadhorse	Shore and just south of the shore of the Beaufort Sea, delta of the Sagavanirktok River; North Slope Borough	Unincorporated	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	n/a
Kaktovik	Eastern North Slope on the shore of the Beaufort Sea; North Slope Borough	2nd Class City	North Slope Borough	Arctic Slope Regional Corp.	Arctic Slope Native Assoc., Ltd.	Kaktovik Inupiat Corporation
Source: Alaska Department of Commerce, Community, and Economic Development.						

Table 9-4 Communities in the Action Area: Key Economic Characteristics

Communities	Location	Population 2000	Percent Native in 2000	Percent of adults employed in 2000	Percent inpoverty in 2000
Teller	Norton Sound (just south of Cape Prince of Wales	268	93%	64%	38%
Brevig Mission	Norton sound just south of Cape Prince of Wales	276	92%	48%	48%
Wales	Cape Pricne of Wales, at tip of Seward Peninsula; borders Chukchi Sea	152	90%	43%	18%
Shishmaref	Chukchi Sea shore of the Seward Peninsula	562	95%	52%	16%
Diomede (Inalik)	Island in the Chukchi Sea just north of Bering Strait on the border of the Russian Federation	146	94%	49%	35%
Deering	South shore of Kotzebue Sound	136	94%	52%	6%
Buckland	Up the Buckland River south of Kotzebue Sound	406	97%	57%	12%
Selawik	In Selawik River drainage to the east of Kotzebue Sound	772	95%	71%	34%
Noorvik	Kobuk River delta	634	95%	58%	8%
Kiana	Up the Kobuk River to the east of Kotzebue Sound	388	93%	51%	11%
Ambler	Up the Kobuk River to the east of Kotzebue Sound	309	87%	47%	14%
Shungnak	Up the Kobuk River to the east of Kotzebue Sound	256	95%	52%	36%
Kobuk	Up the Kobuk River to the east of Kotzebue Sound	109	94%	55%	27%
Kotzebue	Eastern shore of Kotzebue Sound	3,082	77%	37%	13%

Communities	Location	Population 2000	Percent Native in 2000	Percent of adults employed in 2000	Percent inpoverty in 2000
Noatak	Up the Noatok River to the east of Kotzebue Sound	428	96%	59%	22%
Red Dog Mine	In Northwest Arctic Borough 86 miles north of Kotzebue and 46 miles from the coast of the Chukchi Sea. Associated port on the coast south of Kivalina	32			
Kivalina	Shore of the Chukchi Sea; Northwest Arctic Borough	377	96.6%	65%	26%
Point Hope	Shore of the Chukchi Sea; North Slope Borough	757	90.6%	51%	15%
Russian Chukchi Sea coast (MMS 2007, p 113)	Chukotka Autonomouse Okrug (a province of the Russian Federation) on the eastern shore of the Chukchi Sea	55,245 / 160,000 (2004 / 1989)	~ 19% in 2001	Not estimated	Not estimated
Point Lay	Shore of the Chukchi Sea; North Slope Borough	247	88.3%	30%	7%
Wainwright	Shore of the Chukchi Sea; North Slope Borough	546	93.0%	47%	13%
Atqasuk	Inland of the Chukchi Sea, southeast of Barrow; North Slope Borough	228	94.3%	46%	16%
Barrow	Central North Slope; northernmost point in Alaska; North Slope Borough	4,581	64.0%	35%	9%
Nuiqsut	Colville River delta of the Beaufort Sea; North Slope Borough	433	89.1%	33%	2%
Prudhoe Bay/Deadhorse	Shore and just south of the shore of the Beaufort Sea, delta of the Sagavanirktok River; North Slope Borough	5 (~5,000 temp workers)			
Kaktovik	Eastern North Slope on the shore of the Beaufort Sea; North Slope Borough	293	84.0%	38%	7%

Communities	Location	Population 2000	Percent Native in 2000	Percent of adults employed in 2000	Percent inpoverty in 2000
Canadian Beaufort Sea coast	Lands of Canda's Yukon, Northwest, and Nunavut Territories adjacent to the Beaufort Sea. Five communities, all in the Northwest Territories.	~5,800 (2006)	~ 74% (2006)		
Sources: Alaska Department of Commerce and Community Development.; MMS 2007 (Chukchi lease sales); NMFS community profiles for Prudhoe Bay/Deadhorse. Note: Communities have been listed by geographic location from west to east. Kotzebue vicinity communities include Ambler, Buckland, Deering, Kiana, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, and Shungnak. The Kotzebue grouping has been adapted from MMS 2007.					

Table 9-5 Sources of detailed information on Alaskan action area communities

	Kotzebue Sound and southern Chukchi Sea (Bering Straits and south of Point Hope)	Northern Chukchi Sea (Point Hope to Barrow)	Beaufort Sea (East of Barrow)
History	BLM 2006 provides a good introductory survey of what is known of the prehistory and modern history of the region. See Sections III.B.9 and III.E.2.c	Northern Economics discusses the modern history of the North Slope region, but doesn't provide evidence on prehistoric activity.	Northern Economics discusses the modern history of the North Slope region, but doesn't provide evidence on prehistoric activity.
Local Government	Community profiles for all villages, towns, and cities in the State, in both summary and detailed report forms, are available at the Alaska Department of Commerce and Community Development, Community Database Online	Community profiles for all villages, towns, and cities in the State, in both summary and detailed report forms, are available at the Alaska Department of Commerce and Community Development, Community Database OnlineNorthern Economics discusses local government and local public finance for the North Slope region, with profiles for individual communities from Point Hope to Barrow.	Community profiles for all villages, towns, and cities in the State, in both summary and detailed report forms, are available at the Alaska Department of Commerce and Community Development, Community Database OnlineNorthern Economics discusses local government and local public finance for the North Slope region, with individual profiles Nuiqsut and Kaktovik
Native corporations, non-profits, and tribal governments	The Bureau of Land Management's draft EIS for its Kobuk-Seward Peninsula land management plan provides details in Section III.E.2.c(3)	Northern Economics discusses the roles of the Regional and village corporations, Native non-profit organizations, and tribal governments on the North Slope.	Northern Economics discusses the roles of the Regional and village corporations, Native non-profit organizations, and tribal governments on the North Slope.
State and Federal government		Northern Economics discusses the roles of the State and Federal governments on the North Slope.	Northern Economics discusses the roles of the State and Federal governments on the North Slope.
Economics	The Army Corp or Engineers analysis of the Red Dog Mine's Delong Terminal Project provides information on the economy of the northern Northwest Alaska Borough. The Bureau of Land Management's draft EIS for its Kobuk-Seward Peninsula land management plan provides a broader overview in Section III.E.2	Northern Economics provides an overview of the regional North Slope economy. The National Academy of Science provides a history of oil and gas development on the North Slope.	Northern Economics provides an overview of the regional North Slope economy. The National Academy of Science provides a history of oil and gas development on the North Slope.

Subsistence fishing and marine mammal hunting	The ADF&G Division of Subsistence makes the data sets summarizing the results of surveys of subsistence activity available online through its Community Subsistence Information System. Studies of subsistence activity in the Arctic are also available through the Subsistence website as pdf files). The Minerals Management Service Final EIS for the Chukchi Sea Planning Area provides an overview of subsistence activity in this region. The Army Corp or Engineers analysis of the Red Dog Mine's Delong Terminal Project provides considerable information on subsistence harvests on the Chukchi coast south of Kivalina.	The ADF&G Division of Subsistence makes the data sets summarizing the results of surveys of subsistence activity available online through its Community Subsistence Information System. Studies of subsistence activity in the Arctic are also available through the Subsistence website as pdf files). The Minerals Management Service Final EIS for the Chukchi Sea Planning Area provides an overview of subsistence activity in this region.	The ADF&G Division of Subsistence makes the data sets summarizing the results of surveys of subsistence activity available online through its Community Subsistence Information System. Studies of subsistence activity in the Arctic are also available through the Subsistence website as pdf files). The Minerals Management Service Final EIS for the Beaufort Sea Planning Area provides an overview of subsistence activity in this region.
Sources cited in this table:			
Alaska Department of Commerce, Community, and Economic Development. n.d. Community profile website: http://www.commerce.state.ak.us/dca/commdb/CF_BLOCK.htm.			
Alaska Department of Fish and Game, Division of Subsistence, Community Subsistence Information System: http://www.subsistence.adfg.state.ak.us/CSIS/			
Alaska Department of Fish and Game, Division of Subsistence, Technical Reports on the Arctic: http://www.subsistence.adfg.state.ak.us/geninfo/publctns/subabs.cfm?region=arctic			
U.S. Army Corp of Engineers. Draft EIS. Delong Mountain Terminal Navigation Improvements Project. Chapter 3: http://www.poa.usace.army.mil/en/cw/delong/03%20Section%203%20Affected%20Environment.pdf			
U.S. Bureau of Land Management. 2006. DRAFT Kobuk-Seward Peninsula Resource Management Plan and Environmental Impact Statement. Volume 1: http://www.blm.gov/ak/st/en/prog/planning/ksp/ksp_documents/ksp_draft_rmp_eis.html			
U.S. Minerals Management Service. Final Environmental Impact Statement Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea: http://www.mms.gov/alaska/ref/EIS%20EA/Chukchi_feis_Sale193/feis_193.htm			
U.S. Minerals Management Service. Final Environmental Impact Statement Beaufort Sea Planning Area. Oil and Gas Lease Sales 186, 195, 202: http://www.mms.gov/alaska/ref/EIS%20EA/BeaufortMultiSaleFEIS186_195_202/2003_001vol1.pdf			
National Academy of Science. Cumulative Environmental Effects of Oil and Gas Activities on Alaska's North Slope: http://www.nap.edu/catalog.php?record_id=10639			
Northern Economics. 2006. North Slope Economy, 1965 to 2005. April.: http://www.mms.gov/alaska/reports/2006rpts/2006_020.pdf			

9.5.7 Subsistence in the Inupiat Culture[36]

Subsistence harvests of sea and land mammals, fish, birds, and plants are an important source of food, materials, and to some extent income, for people in the communities in the action area. However, they also play an important cultural role as well.

Traditionally, Inupiat values focused on their close relationship with natural resources, specifically game animals. The Inupiat also had a close relationship to the supernatural with specific beliefs in animal souls and beings who control the movements of animals. Other values included an emphasis on the community, its needs, and its support of other individuals. The Inupiat respect persons who are generous, cooperative, hospitable, humorous, patient, modest, and industrious (Lantis, 1959; Milan, 1964; Chance, 1966, 1990).

Although there have been substantial social, economic, and technological changes in Inupiat lifestyle, subsistence continues to be the central organizing value of Inupiat sociocultural systems. The Inupiat remain socially, economically, and ideologically loyal to their subsistence heritage. Indeed, "most Inupiat still consider themselves primarily hunters and fishermen" (Nelson, 1969). This refrain is voiced repeatedly by the residents of the North Slope (Kruse et al., 1983; ACI, Courtnage, and Braund, 1984; Impact Assessment, Inc., 1990a,b; USDOI, MMS, 1994). Task groups still are organized to hunt, gather, and process subsistence foods. Cooperation in hunting and fishing activities also remains an integral part of Inupiat life, and who one cooperates with is a major component of the definition of significant kin ties (Heinrich, 1963). Large amounts of subsistence foods are shared within the community, and who one gives to and receives from also are major components of what makes up significant kin ties (Heinrich, 1963; ACI, Courtnage, and Braund, 1984).

On the North Slope, "subsistence" is much more than an economic system. The hunt, the sharing of the products of the hunt, and the beliefs surrounding the hunt tie families and communities together connect people to their social and ecological surroundings, link them to their past, and provide meaning for the present. Generous hunters are considered good men, and good hunters often are respected leaders. Good health comes from a diet derived from the subsistence hunt. Young hunters still give their first game to the community elders, and to be generous brings future success. These are some of the essential ways that subsistence and beliefs about subsistence join with sociocultural systems.

Bowhead whale hunting remains at the center of Inupiat spiritual and emotional life; it embodies the values of sharing, association, leadership, kinship, arctic survival, and hunting prowess (see Bockstoce et al., 1979; ACI, Courtnage, and Braund, 1984). Barrow resident Beverly Hugo, testifying at public hearings for MMS' Beaufort Sea Sale 124, summed up Inupiaq cultural values this way:

> …these are values that are real important to us, to me; this is what makes me who I am…the knowledge of the language, our Inupiat language, is a real high one; sharing with others, respect for others…and cooperation; and respect for elders; love for children; hard work; knowledge of our family tree; avoiding conflict; respect for nature; spirituality; humor; our family roles. Hunter success is a big one, and domestic skills, responsibility to our tribe, humility…these are some of the values…that we have…that make us who we are, and these values have coexisted for thousands of years, and they are good values… (USDOI, MMS, 1990b).

The importance of the whale hunt is more than emotional and spiritual. The organization of the crews does much to delineate important social and kin ties within communities and also to define community

[36] The text in this section is based, with little change other than the first and last paragraphs, on the Minerals Management Service Final EIS for the Beaufort Sea Planning Area Oil and Gas Lease Sales 186, 195, 202 in 2003. Section III.C.3.d. (USDOI, MMS, 2003).

leadership patterns. The structured sharing of the whale helps determine social relations both within and between communities (Worl, 1979; ACI, Courtnage, and Braund, 1984; Impact Assessment, Inc., 1990a).

Structured sharing also holds true for caribou hunting, fishing, and other subsistence pursuits. In these communities, the giving of meat to elders does more than feed old people; it bonds giver and receiver, joins them to a living tradition, and draws the community together.

In the 1990s, wild food harvests per person amounted to just over 500 pounds a year in the Arctic (Wolfe, 2000). People in subsistence communities also consume significant amounts of store-bought produce and processed foods. However subsistence consumption remains important. As just discussed, there are cultural reasons for this. Another reason is undoubtedly the high cost of food in rural Alaska. In March 2008, the cost of a standard basket of groceries for a family of four in Barrow was 215% the cost in Anchorage; the cost in Kotzebue was 195% the cost of a basket in Anchorage. Moreover, the traditional high protein and fat Inupiat diet has nutritional advantages (Gadsby 2004). Subsistence foods are also important because there is much sharing of foods locally harvested with relatives living outside the communities in each region (for nutritional as well as traditional/cultural value). In 2000, Wolfe estimated that it would cost from $31 to $53 million to replace Arctic subsistence harvests with purchased food (assuming $3 to $5 per pound) (Wolfe, 2000). However, for various reasons, foods from other sources are imperfect substitutes for subsistence foods (Pedersen, pers. comm.).

Climate change may have an adverse effect on subsistence resources in the Arctic if the warming of the arctic leads to less capacity for the ecosystem to support species used as subsistence resources. A number of important subsistence species have been petitioned for review or are currently under review for listing under the ESA because of climate change diminishing their ice habitat (ice seals and walrus). The potential reduction in these populations could have a substantial impact on the communities that depend on these resources. Section 8.1.4 has a discussion on the changes occurring in the Arctic due to climate change.

9.5.8 Commercial fisheries

Table 9-7 summarizes information on the commercial fisheries in the waters of the action area. There is currently only one small and poorly documented crab fishery in the EEZ north of Bering Strait.

Jurisdiction

Federal Fishery Management Plans provide limited coverage in the action area:

- Gulf of Alaska or the Bering Sea and Aleutian Island Groundfish FMPs and the Scallop FMP do not apply to waters north of Bering Strait.
- The King and Tanner crab FMP applies in the EEZ in the southern Chukchi Sea.
- The Salmon FMP specifically prohibits salmon fishing in an area that includes the waters of the Chukchi and the Beaufort Seas.
- There is no FMP for halibut. The International Pacific Halibut Commission exercises jurisdiction over halibut fishing in defined waters, and it is apparent that these waters (“Convention Waters”) include the Chukchi and Beaufort Seas (see Section 2.2.5).

In the absence of an FMP, the Federal Government may not regulate the actions of fishing operations in the action area. The Federal Government may not issue an exempted fishery permit (EFP) because these allow for harvests that would otherwise be prohibited by an FMP or fishery regulations (50 CFR 600.745).

In the absence of a Federal FMP, the State of Alaska may regulate fishing vessels in the EEZ in the Chukchi and Beaufort Seas under three circumstances:

1. Section 306(a)(3)(A) of the Magnuson-Stevens Act (MSA) provides for state regulation of a fishing vessel outside state boundaries if the vessel is registered with the state and there is no FMP or other applicable federal regulations for the fishery in which the vessel is operating. If there is an FMP, this section also provides for state regulation of fishing outside state boundaries if the State's laws and regulations are consistent with the FMP and applicable federal regulations for the fishery in which the vessel is operating.
2. Section 306(a)(3)(B) of the MSA also provides for state management when an FMP specifically delegates that management authority and the State's laws and regulations are consistent with that FMP.
3. Section 306(a)(3)(C) of the MSA provides for management by the State of Alaska when fishing vessels are not registered under the law of the State of Alaska and operate in a fishery in the EEZ for which there was no FMP in place on August 1, 1996. In this case, if the Council and the Secretary find a legitimate interest of the State in the conservation and management of such a fishery, then the State may regulate fishing until an FMP is approved and implemented.

Section 306(a)(3)(A) of the MSA appears to be applicable in this case, where no FMP currently exists. In the absence of a finding by the Council and Secretary pursuant to 306(a)(3)(C) of the MSA the State of Alaska would have the authority to regulate the actions of its licensed vessels in the Arctic EEZ, but not to regulate the actions of vessels that are not licensed by it. As noted in Section 2.2 of the EA, the Council has made an explicit decision not to issue the finding called for under 306(a)(3)(C).

Under current state statutes, all fishing in any waters of the State or the EEZ is prohibited unless specifically authorized by statute or regulation (AS 16.05.920(a))[1].[37] The State has extended its fishing regulations to cover EEZ waters for all groundfish species not included in a federal FMP or for where a federal FMP delegates authority to the State (5 AAC 28.010). Thus, for groundfish fishing to occur, explicit regulations allowing fishing would need to be promulgated by the Alaska Board of Fisheries.

The State's Chukchi-Beaufort Groundfish Area (Registration Area Y) includes all state waters north of the latitude of Cape Prince of Wales (65E 36N N. lat). At this time state regulations allow groundfish to be taken at any time provided a vessel registers with the state. However, groundfish fisheries in Area Y are generally managed as parallel fisheries. Under parallel fishery management the state adopts the seasons, bycatch and gear types promulgated in adjacent federal waters. In the absence of federal regulations, Area Y groundfish fisheries in the EEZ remain closed. Under current state regulations the State could allow an exploratory fishery under a Commissioner's permit within the three mile limit.

State regulations applicable to king crab (5 AAC 34.010), Tanner crab (5 AAC 35.010), miscellaneous shellfish which includes scallops (5 AAC 38.010), and herring (5 AAC 27.010) also specifically apply to the adjacent waters of the EEZ. State regulations authorize king crab fishing south of Point Hope, and herring fishing in the waters of Kotzebue Sound. While state regulations authorize salmon fishing in the waters of Kotzebue Sound, the Salmon FMP prohibits salmon fishing in federal waters in the action area, and thus prevents the application of state salmon regulations in federal waters. State regulations do not authorize fishing for other species in the action area.

[37] This paragraph, and the remaining paragraphs on jurisdiction, draw heavily on December 2007 personal communications from Kerri Tonkin, Program Coordinator, Alaska Department of Fish and Game, P.O. Box 115526, Juneau.

State fisheries in Kotzebue Sound

The following State of Alaska commercial fisheries in the Chukchi Sea region are centered in Kotzebue Sound (Jim Menard, pers. comm.; ADF&G 2007)[38]:

- Salmon fisheries occur each summer and fall salmon fisheries, targeting chum salmon. A few other species of salmon are harvested incidentally as well as Dolly Varden. The Noatak and Kobuk rivers are the principal salmon habitats in this area. Set net fisheries have taken place in the EEZ (Alaska statistical area 626631, see Figure 9-7). However, salmon fisheries are not regulated by this action.
- There have been intermittent herring sac roe fisheries in the past (although none has occurred since 1996). The ADF&G notes that the fishery occurs late, and that potential fishermen have had trouble finding a buyer. A herring fishery for crab bait, with a market in Nome, operated in the mid-nineties. Interest has been expressed in a herring spawn on kelp fishery.
- There is some evidence of a commercial crab fishery. One small fish ticket was submitted in 2005, but there is no other fish ticket evidence of activity back to 1985 (the size of the harvest cannot be released because of data confidentiality). This catch was reported in a statistical area that falls almost entirely within the State's territorial waters. Subsistence fishermen on Diomede Island have sold some crab in the past and other, primarily subsistence fishermen may have as well. Crab activity is described in more detail below. Parenthetically, sales of other subsistence harvests of other fish species could have taken place in the past but there would be little evidence on this topic.
- There is a commercial sheefish (inconnu) fishery that occurs in Hotham Inlet with a harvest quota of 25,000 pounds, but usually only a few thousand pounds are sold commercially.
- Whitefish fisheries have taken place in the past, primarily in Hotham Inlet and the Selawik River. The ADF&G notes that fish were sold locally for human consumption, dog food, and crab bait.

Red and blue king crab, and *C. opilio* crab are found in the southern Chukchi Sea.

- Norton Sound, and especially the waters to the south of the Seward Peninsula, is an important habitat for red king crab. They also occasionally occur in U.S. waters off of the tip of the Seward Peninsula and along the western side of its north face, and across the entrance to Kotzebue Inlet. They do not appear to occur around Diomede Island.
- Blue king crab are found south of and in Bering Strait. They occur around both King Island and Little Diomede Island. They occasionally occur north of the Strait around the tip of and along the western end of the north face of the Seward Peninsula and across the entrance to Kotzebue Sound. Their range of occasional occurrence is further west than for red king crab.
- *C. opilio* crab may be found in Bering Strait, and through most of the southern Chukchi Sea, as far north as Point Hope (NOAA, 1988).

There appears to be a small scale fishery for red and blue king crab in EEZ waters in the outer part of Kotzebue Sound, however little is known about it. The following discussion summarizes available information.

There is relatively limited information on exploitable biomass. Lean et al. (1992) report "In 1984, several boats explored north of Bering Strait, but failed to find commercial quantities of crab. Catch was about one legal crab per pot lift." The survey area was offshore Rabbit Creek, north of Cape Kruzenstern and

[38] Menard, Jim. Area Management Biologist. Alaska Department of Fish and Game. Personal communication.

south of Red Dog (Lean, pers. comm.)[39]. Lean et al. (1992) also reported that, in 1989, four crab catcher-processor vessels explored waters north of Bering Strait for several days with catch rates approaching one legal crab per pot lift along the coast; the report notes that a "…total of 3,574 pounds of red king crab and 44 pounds of blue king crab were harvested in the Chukchi Sea." A crab pot test fishery was permitted in 2001 under an educational permit. Fishermen were allowed to retain crab for subsistence purposes. One individual sold some of this crab and was prosecuted (Menard, pers. comm.).

Red king crab are sensitive to fresh water. This contributes to an inshore-offshore migration pattern in Kotzebue Sound. The crab appear to migrate inshore during the winter, but in the spring meltwater tends to dilute the nearshore waters and reduce their salinity. This apparently leads the crab to migrate offshore at that time. Thus, winter harvests through the ice are likely to take place within state internal waters, but summer harvests are likely to take place in offshore waters of the EEZ. The most likely location of summer harvests is in a four statistical area block in outer Kotzebue Sound. This area is shown in Figure 9-7 (Lean, pers. comm.).

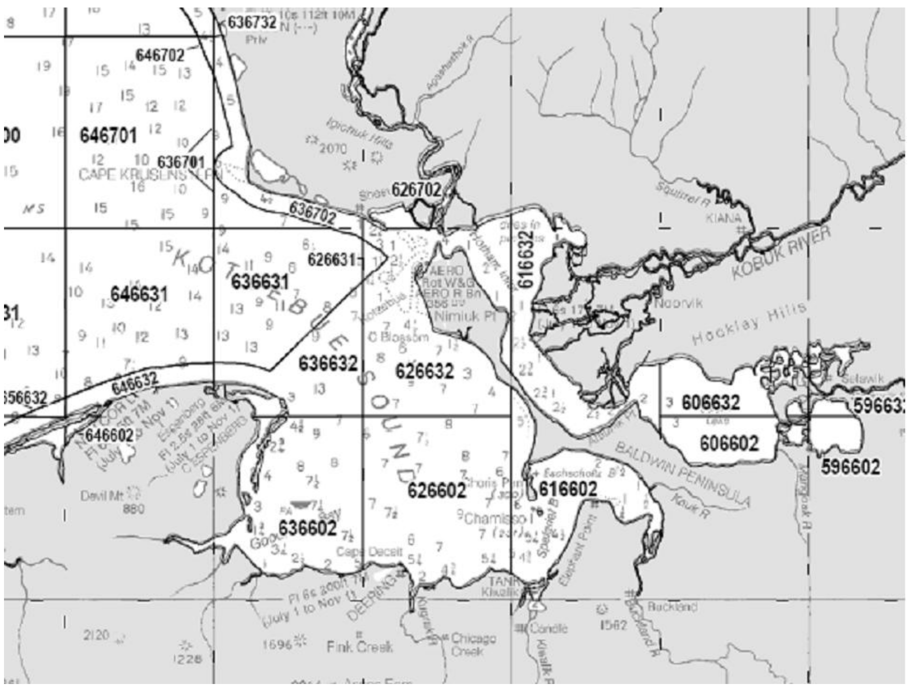

Figure 9-7 State of Alaska Groundfish and Shellfish statistical areas in the vicinity of Kotzebue. Areas 646701, 636701, 646631, and 636631 are the most likely location for summer king crab fishing in the EEZ.

A distinct Kotzebue Sound fishing district including the waters of ADF&G Registration Area Q north of 66° N. lat. was created by the Alaska Board of Fisheries in March 2005.[40] Prior to this the Kotzebue area was included in a district that also included St. Lawrence Island. However, this action was taken to consolidate management boundaries for stocks south of Bering Strait, and create a distinct area in the southern Chukchi in case a crab fishery ever emerged there. The northern boundary of Area Q, at the latitude of Point Hope (68°, 21' N. lat.), is the northern boundary of the Kotzebue District. At the same meeting, the Board changed the start date for commercial fishing from August 1 to June 15. Fishermen may take red and blue male crab (ADF&G, 2005; Lean, pers. comm.).

[39] Lean, Charles. Norton Sound Economic Development Corporation. Nome. Formerly with the Alaska Department of Fish and Game. Personal communications.
[40] This is designated the "Q4" district of the Bering Sea Registration Area Q.

Commercial crab fishing in the region would be conducted under the State of Alaska's K09X interim use permit. Prior to 2005, these authorized harvests from an area that included the St. Lawrence Island; following the Board of Fish action in 2005, these only authorized harvest from the southern Chukchi between Bering Strait and Point Hope. Prior to 2002 no more than one of these was issued in any year; none were issued from 1980 to 1993. In 2002, the year following the test fishery, the number jumped to four, and fluctuated between two and four through 2007. A total of 21 K09X annual interim use permits were issued between 2002 and 2008. Eighteen of these were issued to four residents of Kotzebue (permit data obtained from the Alaska Commercial Fisheries Entry Commission web site; Lean, pers. comm.).

There is little documentary evidence for commercial harvests of red king crab in this area. A review of the State of Alaska's fish ticket data base back to 1985 turned up one crab ticket recording harvest in July 2005 (review conducted by ADF&G staff). The ticket only indicated that a small amount of crab had been landed.[41] Although a complete review of ADF&G management reports has not been done for this analysis, the ADF&G Annual Management Report for 1992 does report a small sale of 16 crab. It is very likely, however, that in this area not all crab landings are recorded on fish tickets. There have been fish ticket compliance problems in this area in the past, notably for sheefish harvests. There may well be compliance problems in the crab fishery as well (Lean, pers. comm.).

Fishery observers believe that king crab are harvested in the EEZ in the outer part of Kotzebue Inlet for subsistence, personal use, and commercial purposes (Menard pers. comm., Lean, pers. comm.; Pungowiyi, pers. comm.). [42] It is possible that some subsistence and personal use harvest may be sold. Although the Diomede Islands fall outside of this fishing area, historically, sales of Diomede subsistence crab in Nome have been documented by the Alaska Division of Subsistence. Thomas reports the distribution of Diomede crab to Nome, Teller, and Wales. He reports, based on field work conducted in 1980 and 1981, that, "One person recalled that in his parent's time, crab was sold to Nome for 25¢ each. He remembered a whole plane load sent to Nome. People from other villages "send" for crab; these people include friends, relatives, and people wanting to buy crab. The shortage of crab in Nome has increased the number of requests for Diomede crab" (Thomas, 1981). This distribution may include fish distributed as gifts, but clearly also includes sales. Similar sales take place now in the Kotzebue area.

Although crab fishing apparently takes place, few individuals have participated in it, and it is characterized as a local, small-vessel fishery operated by small skiffs. The gear used is small crab pots that are locally manufactured by participants in the fishery or purchased from vendors. There are essentially no management costs, since very few participate, and in some years there have been no participants. The only species targeted is the red king crab, although some blue king crab may be present. It is believed that these crabs mature in the southern Chukchi Sea area, possibly seeded by larval crabs that originate in the Bering Sea and are transported through Bering Strait into the Chukchi Sea. Since so few individuals have participated in this fishery, almost no revenues have accrued to individuals. There is some local recreational interest and subsistence use of red king crab, but the extent of participation is very small. Some individuals harvest red king crab through winter ice for personal use (Lean, pers. comm.).

In summary, the baseline for this analysis includes very small scale, poorly documented, and possibly intermittent king crab fishing in the outer waters of Kotzebue Sound. To the extent that this fishery occurs, it takes place in the summer. Any harvests in the winter are likely to be taken within Alaska's internal waters; a winter fishery may be affected, however, by harvest of what are likely the same stocks in the immediately adjacent waters of the EEZ.

[41] While this ticket reported a landing from state internal waters, it may have been in error. July landings are very unlikely to have come from inshore waters. (Lean, pers. comm.)
[42] Pungowiyi, Caleb. Kotzebue. Personal communication.

One commercial fishing operation on the Colville River delta

In the Beaufort Sea, the Helmericks family has operated a small commercial fishery for Arctic cisco, least cisco, and a few broad and humpback whitefish for over 35 years. This fishery occurs annually in October-November in the brackish delta waters of the Colville River (20,000 to 25,000 fish annually). Catch records, and tag recoveries by this operation have provided useful scientific information. These whitefish are marketed locally in the Barrow area and a few are smoked and marketed in Fairbanks. No other documented active marine or freshwater commercial fisheries occur in that area. However, there is potential for miscellaneous fisheries on a case-by-case basis through a Commissioner's permit depending on interest and size of fish stock (Bue, pers. comm.).[43]

Other High Latitude commercial fisheries

As noted, there is small scale inshore fishing in Canada's Beaufort Sea. Exploratory fisheries have recently been conducted in the Canadian portion of the Beaufort Sea. Species of interest include cod, crab, gastropods, and other fishes (Bill, 2005; Bill, pers. comm.). There do not appear to be any commercial fisheries ongoing in the Russian Federation's Chukchi Sea, although some exploratory trawling for Polar cod is said to have occurred (Kochnev, Zgurovsky, pers. comm. via Cook)[44].

Fisheries exist in Arctic Regions in other parts of the world. These include large fisheries in Barents and Norwegian Seas north of Europe, fisheries in the Central North Atlantic off of Greenland and Iceland, and fisheries in the Newfoundland and Labrador Seas off of Northeastern Canada. Table 9-6 summarizes the lists of target species identified by Vilhjálmsson and Hoel et al.[45]

Table 9-6 Key Species Harvested in Arctic Regions

Region	Northeast Alantic – Barents and Norwegian Seas	Central North Atlantic – Iceland and Greenland	Newfoundland and Labrador Seas, Northeastern Canada
Species listed	Capelin, polar cod, Greenland halibut, northern shrimp, herring, Northeast Atlantic cod	Atlantic cod, Greenland halibut, Northern shrimp, herring, capelin, blue whiting, cod, redfish	Atlantic cod, Greenland halibut, capelin, herring, Polar cod, northern shrimp, snow crab
Source: Vilhjálmsson and Hoel et al.			

Vilhjálmsson and Hoel et al reviewed the fisheries in four northern ecoregions. Two of these, Northeast Canada, including Newfoundland and the Labrador area, and the Central North Atlantic, including Iceland and Greenland are described as of a true Arctic type. Two others, the Northeast Atlantic, including the Barents Sea and Norwegian Sea, and the Bering Sea, were described as cold-temperate type because of a greater influence of warmer Atlantic or Pacific waters. (ACIA 2005, page 692). These notes

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[43] Bue, Fred, ADF&G. pers. comm.

[44] Kochev, Anatoly. Wildlife Biologist. Pacific Research Fisheries Center (TINRO) Chukotka Branch, Laboratory of Marine Mammals Study. P.O.Box 29, Anadyr, Chukotka 689000 Russia. Cook, Alfred Lee "Bubba". Senior Fisheries Officer Kamchatka/Bering Sea Ecoregion World Wildlife Fund, Bering Sea Field Office, 406 G Street, Suite 303, Anchorage, AK 99501. Personal communication from Kochev to Cook, December 12, 2007.

[45] The brief discussion of high latitude fisheries that follows is based on Vilhjálmsson and Hoel et al. That source provides a much more detailed description of these fisheries, placing them in their ecological perspective and discussing potential climate change impacts.

will summarize certain findings with respect to the Northeast Canada, Central North Atlantic, and Northeast Atlantic ecoregions.

The Northeast Canada ecoregion includes the waters off of and around Labrador and Newfoundland. Fishing in the region has been dominated by the cod resources of the area. Much of this area is seasonally covered with sea ice to a considerable distance offshore. Normally only the area to the south and southeast of Newfoundland is free of ice in March. (National Snow and Ice Data Center) Interest in the cod fisheries had been a significant factor in North American history. However, these stocks collapsed to very low levels in the early 1990s for reasons that remain unclear. While studies have pointed to the role of overfishing in causing this collapse, the role of environmental factors remains unresolved. There have also been less important regional fisheries for Greenland halibut, capelin, herring, northern shrimp, and snow crab. Polar cod occur in the area but have not been the subject of a targeted fishery.

The Central North Atlantic ecoregion includes the waters of off southern and western Greenland, and the waters around Iceland. This is actually a conflation of two eocregions since the waters around Iceland, and particularly to the south of it, are somewhat warmer. The waters around Greenland are seasonally ice covered to a considerable distance offshore, and are normally covered in March (except for waters to the southwest). The waters around Iceland are normally free of ice year-round. (National Snow and Ice Data Center). Despite the differences in the waters of the two islands, they are treated together here because of interactions between the cod stocks in the two regions (larval drift from Iceland to Greenland and spawning migrations from Greenland to Iceland). Large numbers of species are commercially exploited in the warmer Icelandic waters, fewer in the colder Greenland waters. The authors note that the species in Greenland's waters are typically cold water species such as Greenland halibut, northern shrimp, capelin, and snow crab. Redfish occur but tend to be outside the colder waters and cod can be plentiful at West Greenland in warm periods.

The Northeast Atlantic ecoregion includes the waters of the Norwegian and Barents Seas. This includes the waters off of Norway halfway to the U.K. in the south and out to Jan Mayen land and the Svalbard Islands in the north, and the Barents Sea to the north of Norway and Northeastern Russia as far east as Novaya Zemlya. These waters are not in general seasonally ice covered. There is seasonal ice coverage in the north, around the Svalbard Islands and Franz Josef land, the eastern Barents Sea and the Russian Arctic coast. Waters temperatures in this region are moderated by the northeastward extension of the North Atlantic Drift. Vilhjálmsson and Hoel et al. described these waters as cold-temperate rather than Arctic. Primary species harvested in the region include capelin, Polar cod, Greenland halibut, northern shrimp, herring, and Northeast Atlantic cod.

Table 9-7 Overview of Commercial, Subsistence, and Sport Fishing in the Chukchi and Beaufort Seas off Alaska.

	Groundfish	Shellfish	Salmon	Herring	Other species
Commercial fishing					
Kotzebue Sound/Southern Chukchi Sea	No fish ticket records since 1985.	Small scale poorly documented red king crab fishing in the EEZ in Kotzebue Sound.	Alaska's northernmost commercial fishery is in Kotzebue Sound. Primarily chum salmon, although some Dolly varden and Chinook are taken. Some set netting has occurred in the EEZ.	Intermittent sac roe and food/bait fisheries in Kotzebue Sound. None since 1996. Development hindered by late ice breakup and fishery timing. Interest expressed in spawn on kelp fishery.	Sheefish, primarily for local markets. Non-target Dolly Varden harvests in chum fishery. Whitefish species taken for local markets for human consumption, dog food, and crab bait. Sporadic sales of burbot.
Chukchi Sea north of Point Hope	No fish ticket records since 1985.	No fish ticket records since 1985.	No commercial fisheries. Anecdotal evidence suggests that salmon, including Chinook salmon, are being seen further north in this region.	No commercial fisheries.	No commercial fisheries in this region.
Beaufort Sea	No fish ticket records since 1985.	No fish ticket records since 1985.	No commercial fisheries.	No commercial fisheries.	One commercial fishery - for Arctic and least Cisco, and broad and humpbacked whitefish conducted in the Colville river Delta. Arctic cisco spawn in the Mackenzie River delta and then drift close to shore to the Colville, where they rear. Markets in Barrow and Fairbanks.
Subsistence fishing					
Kotzebue Sound/Southern Chukchi Sea	Some inshore subsistence harvests of starry flounder, yellowfin sole, Arctic flounder, Alaskan plaice, and halibut. These are relatively minor subsistence species.	Small scale poorly documented red king crab fishing in Kotzebue Sound, including in the EEZ.	Chum salmon (and limited amounts of other species) are important, although less so in the southern sound because of limited availability.	Of minor importance	Sheefish, Dolly Varden trout, whitefish species, saffron cod (tomcod) are the primary species. ADF&G notes that other species taken include rainbow smelt, capelin, northern pike, Arctic grayling, and burbot.

	Groundfish	Shellfish	Salmon	Herring	Other species
Chukchi Sea north of Point Hope	Some flounder and cod. But of minor importance.	Some whaling crews may put out crab pots and retrieve small crabs.	Chum, pink, and silver. Salmon are reportedly increasing somewhat in numbers and are of moderate importance.	None	Broad whitefish and other whitefish, salmon, particularly chum salmon, grayling, and Arctic char. Other species are less important.
Beaufort Sea	Arctic cod and flounder, but not very important.	No subsistence harvest.	Chum, pink, and silver salmon are harvested, but rarely. These are not important species here Salmon are reportedly increasing somewhat in numbers.	None.	Dolly Varden are an important species. Other species harvested include Arctic cisco and lake trout.
Sport fishing					
Kotzebue Sound/Southern Chukchi Sea	No sport fishery.	No sport fishery.	Some Chinook harvest likely by persons in guided and unguided float trips on local rivers.	No sport fishery.	Fishing for Arctic grayling, sheefish, and Dolly Varden. World record Dolly was taken on the Wulik near Kivalina. One source of demand is by persons involved in guided and unguided float trips on regional rivers.
Chukchi Sea north of Point Hope	No sport fishery.	No sport fishery.	No sport fishery.	No sport fishery.	No measurable sport fishery.
Beaufort Sea	No sport fishery.	No sport fishery.	No sport fishery	No sport fishery.	Some sport fishing for Dolly Varden, grayling, lake trout and Arctic char in rivers and lakes along the haul road.
Sources: Groundfish and crab fish ticket records were reviewed back to 1985. Banducci et al. Pedersen, Pederson, Lean, Menard, pers. comm.					

9.5.9 Sport fishing

Little sport fishing occurs in marine waters of the region. There is some sport fishing in the Kotzebue Sound area, targeting Dolly Varden and salmon. The northernmost sport fishery in this region occurs near Kivalina, in the Wulik River drainage. The current world record Dolly Varden came from this river (the previous world record came from the nearby Noatak River). Sport fishing demand in this region is generated by local residents and guided and unguided rafting tours of the Kobuk and Noatak Rivers (Scanlon, pers. comm.; ADF&G 2007).

Oilfield workers in the Prudhoe Bay industrial area do some sport fishing, primarily at points where the haul road provides access to the interior rivers and lakes. Fishermen target Dolly Varden and some Arctic grayling.

9.5.10 Subsistence fishing

Subsistence fisheries occur near most coastal villages of the region or at fish camps located various distances from villages. The following sections draw primarily on available subsistence information collected and presented by the ADF&G Division of Subsistence in different formats. However, there is a lack of current comprehensive longitudinal information on this topic. The limited availability of information is not due to low importance of subsistence fishing to residents of the regional communities (in fact, fish as a resource group likely represents a third of the annual subsistence harvests, by weight, in these regions).[46] The limited information is more likely related to the historical lack of issues surrounding the fisheries, and thus to relatively limited research funding (Pedersen, pers. comm.).[47]

Human use of Arctic cod in Alaska's Arctic region is not well documented. Some subsistence use of Arctic cod occurs along the coasts of the Chukchi and Beaufort Seas. George et al. (2007) report that fishing for Arctic cod may occur through the ice with poles and lines. Local Inupiat residents call the Arctic cod *Iqalugaq* (George et al. 2007). Andriiashev (1954) notes that in the mid-20th century, some fishing has occurred for Arctic cod in the White Sea and Barents Sea in spite of the fish's small size, and is used mainly as food for dogs "because of low palatability."

Saffron cod are abundant in the Chukchi Sea, and were the most abundant fish species encountered during trawl surveys in this area in 1998 (Fair and Nelson 1999) in both numbers and estimated biomass. This species occurs in the Beaufort Sea as well, but its distribution and abundance in the Arctic are unknown. Saffron cod are an important forage species used by seals. Called *Uugaq* by the Inupiat, Saffron cod are larger than Arctic cod, growing to 35 cm in length (George et al. 2007). George et al. (2007) report that Saffron cod are an important traditional Native food for coastal residents of the Bering Sea and are also harvested in the Barrow area and eastward to Kaktovik.

Arctic flounder are reported to be fairly common in the Chukchi and Beaufort Seas, occurring in both marine zones and nearshore brackish water lagoons (George et al. 2007) and are called *Nataagnaq* by the local Inupiat. Starry flounder, also called *Nataagnaq* by the Inupiat, occur along the coasts of the Chukchi and Beaufort Seas and upstream in larger rivers.

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[46] Marine mammals depend heavily on fish; thus fish stocks also make a contribution to subsistence indirectly, through subsistence harvests of marine mammals. Marine mammal subsistence is discussed in Section 9.5.10.

[47] Sverre Pedersen. Subsistence Resource Specialist III with the Alaska Department of Fish and Game, Division of Subsistence. 1300 College Road, Fairbanks, AK 99701-1599. Personal Communication January 7, 2008.

George et al. (2007) report that other marine fish species of importance to residents of the Arctic include the capelin or *Panmaksraq*, which have been harvested in the surf along the shore; fourhorn sculpin or *Kanayuq*, which are caught incidentally to other species in under-ice gill nets targeting whitefish and are prized for their livers; and Pacific herring or *Uqsruqtuuq* which are little utilized by local residents. Other marine species that are occasionally reported caught in commercial or subsistence nets or observed washed ashore are pricklebacks, the slender eelblenny, eelpouts, the Bering wolffish and the wolf eel, snailfish, lumpsuckers, the Pacific sand lance, and the Pacific sleeper shark (George et al. 2007).

Kotzebue Sound and the Southern Chukchi Sea[48]

Communities in this region include Brevig Mission, Teller, Inalik on Little Diomede Island, (all just south of Bering Strait), Wales, Shismaref, Deering, Buckland, Selawik, Shungnak, Kobuk, Ambler, Kiana, Noorvik, Kotzebue, Noatak, Kivalina, and the Red Dog Mine. Subsistence harvests take place predominately in inshore coastal waters, and in the lakes and river systems behind the coast.

As noted, king crab has been harvested at Little Diomede Island, and to a limited extent on the outer Seward Peninsula. Some king crab harvests have occurred in the winter, through the ice, near Kivalina north of Shishmaref and near Cape Kruzenstern (Charlie Lean, pers. comm.). Subsistence fishing for salmon is important in this region, particularly along the Noatak and Kobuk Rivers, which have strong chum salmon runs. Subsistence salmon harvests are less important in the southern Kotzebue Sound communities, because of the lesser availability of salmon. Total Kotzebue Sound subsistence harvests may be about 74,000 pounds annually. Subsistence harvests for Pacific herring exist, but are probably small, and are poorly documented. Additional subsistence fisheries exist for sheefish, Dolly Varden, six additional species of whitefish (broad, round, and humpback whitefish, and least, Arctic and Bering cisco), saffron or Tom cod, rainbow smelt, capelin, northern pike, starry flounder, yellowfin sole, Arctic flounder, Alaska plaice, Arctic grayling, burbot, and halibut. Of these species, salmon, whitefish, Dolly Varden, and sheefish are probably the most important (ADF&G, 2005).

Chukchi Sea coast from Point Hope to Barrow[49]

Communities in this region include Point Hope, Point Lay, Wainwright, Atkasuk, and Barrow. The Alaska Department of Fish and Game has surveyed subsistence fish harvests in Point Lay, Wainwright, and Barrow. Subsistence harvests take place predominately in inshore coastal waters, and in the lakes and river systems behind the coast.

In Barrow estimated fish harvests between 1987 and 1989 ranged from 51,062 to 118,471 pounds. Harvests were dominated by broad whitefish (40% to 67% of weight, depending on the year. Grayling was the next most important species, with harvests accounting for from 6% to 15% of total fish harvest, depending on the year. Other species included salmon, humpback whitefish, Arctic cod, Bering cisco, burbot, and least cisco. There were relatively small harvests of smelt, capelin, rainbow smelt, Arctic char, lake trout, pike, and round whitefish.

[48] This section is based on ADF&G 2007.

[49] Subsistence species of importance were identified by examining available survey data for local communities. If more than two years of surveys were available for a community, at least two surveys were examined. Survey data was obtained from the ADF&G Division of Subsistence Community Subsistence Information System (URL: http://www.subsistence.adfg.state.ak.us/CSIS/).

In Wainwright, estimated fish harvests in 1988 and 1989 were 10,085 to 17,385 pounds. Least cisco (38% and 46% of the harvest weight respectively), rainbow smelt (37% and 24%), and grayling (14% and 23%) were the most important species. Small amounts of salmon and other species were also harvested.

In Point Lay, a 1987 survey found a relatively small subsistence harvest of fish, 2,983 pounds. The main components included grayling (60%), Dolly Varden (19%), and chum and pink salmon (14%). Other species harvested included broad whitefish, flounder, and smelt.

Thus, the key species taken in subsistence harvests in the surveyed communities in this northern Chukchi Sea region are broad whitefish, grayling, least cisco, and smelt. Overall statements can mask differences between communities, however. Humpback whitefish doesn't appear important in Point Lay or Wainwright, but it is somewhat more significant in Barrow.

Beaufort Sea[50]

In this analysis, the communities of Nuiqsut and Kaktovik are treated as subsistence communities located on the Beaufort Sea. The Alaska Department of Fish and Game has surveyed subsistence fish harvests in these communities periodically in past years. Subsistence harvests take place predominately in inshore coastal waters, and in the lakes and river systems behind the coast.

Five surveys covered Kaktovik between 1985 and 2002. These showed many changes from year to year. Overall harvests could range widely from 5,970 pounds to 22,952 pounds. In four of the five survey years harvests were between 5,970 and 11,403 pounds. The composition of harvests varied as well. Arctic char were the most important species from 1985 to 1992, accounting for between 67% and 76% of the harvest, depending on the year. The large 22,952 pound harvest was due to a very large harvest of Arctic char that year. Cisco was also important from 1985 to 1992, but not so much afterwards. On the other hand, Dolly varden accounted for the bulk of the harvest in the 2001 and 2002 surveys, but did not appear in the earlier surveys. The small harvests in 2001 and 2002 was probably due to poor weather (Pederson and Linn).

In Nuiqsut, harvests in 1985 and 1993 were 70,609 pounds and 90,490 pounds. The survey in 1993 found that most subsistence fish harvests consisted of broad whitefish (46% by estimated weight) and Arctic cisco (35% by estimated weight). Other species included burbot, grayling, least cisco, Dolly Varden, humpback whitefish, and salmon. Trace amounts of smelt, rainbow smelt, Arctic cod, and lake trout were also harvested. The 1985 survey found subsistence harvests dominated by cisco (42% by estimated weight) and broad whitefish (38% by estimated weight). Other species in 1985 included grayling, Dolly Varden, burbot, humpback whitefish, and salmon. Small amounts of smelt, lake trout, and humpback whitefish were also taken.

Potential for commercial and subsistence interactions

Subsistence fishing takes place in state coastal and inland waters. Very little of it appears to take place in the EEZ. Thus there is little potential for direct interactions between subsistence fishing and commercial fishing. Indirect interaction may occur if anadromous stocks, exploited by subsistence fishermen pass through areas at times when they might be targeted or taken as bycatch by commercial operations, or if commercial operations harvest subsistence species predator or prey, or harvest competitive species that compete with subsistence species for an ecological niche. Potential conflicts for key subsistence fish

[50] Subsistence species of importance were identified by examining available survey data for local communities. If more than two years of surveys were available for a community, at least two surveys were examined. Survey data was obtained from the ADF&G Division of Subsistence Community Subsistence Information System (URL: http://www.subsistence.adfg.state.ak.us/CSIS/).

species are summarized in Table 9-8. Grayling, smelt, least cisco, and Arctic char may also be taken in commercial fisheries that would occur where these species occur but these species appear to have less subsistence importance than those listed in Table 9-8

Table 9-8 Potential for conflict between commercial fishing in the EEZ and key subsistence fish species

Stock	Potential for commercial fishery interaction
Salmon (chum is the most important)	Salmon are anadromous, spending years in salt water. Mid-water trawlers in the Bering Sea currently take chum salmon as bycatch. The potential for interaction is greatest between commercial trawling that might emerge in the southern Chukchi Sea, and subsistence fishing in Kotzebue Sound, and along the coast south of Point Hope.
Dolly Varden	Some stocks of Dolly Varden remain in fresh water, but others are anadromous. Anadromous stocks can enter salt water and travel long distances. Tagged char are often found between 30 to 50 km from their natal streams. Distances as much as 1,000 km have been recorded. Thus this species may enter the waters of the EEZ, and may be subject to direct impacts from fishing operations.
Bering cisco	Bering cisco may leave fresh water systems and enter brackish water along the coast during a part of their life cycle cycle. These are believed to remain close inshore and thus would not be directly affected by fishing activity in the EEZ.
Arctic cisco	Arctic cisco populations on the North Slope are believed to originate in Mackenzie River delta. As young fish they are apparently driven by currents as far west as the Colville River delta where they rear and grow to adulthood. When they reach sexual maturity, they return to the Mackenzie River to spawn. Although some fish stop at the Sagavanirktok River, they typically do not grow to maturity there.
Broad whitefish	May leave fresh waters system and enter brackish water along the coast during a part of their life cycle. These are believed to remain close inshore and thus would not be directly affected by fishing activity in the EEZ.
Whitefish in general	May leave fresh water systems and enter brackish water along the coast during a part of their life cycle. These are believed to remain close inshore and thus would not be directly affected by fishing activity in the EEZ.
Sheefish or inconnu	May leave fresh water systems and enter brackish water along the coast during a part of their life cycle. These are believed to remain close inshore and thus would not be directly affected by fishing activity in the EEZ.

9.5.11 Subsistence harvest of marine mammals

The Native communities in the action area depend on subsistence harvests of marine mammals in many ways, and have long historical and traditional involvement in marine mammal hunts. Marine mammals are an important component of the regional diet, substituting, as noted in the discussion of subsistence fisheries, for foods consumed more commonly in other regions. Mammal parts are used for other purposes as well. Native communities and cultures in the region have been been shaped in many ways (for example, the definition of personal roles, political organization, seasonal round) by marine mammal hunting. There are no identifiable substitutes for the food value of marine mammals, or for their role in sustaining regional communities.

Subsistence species of importance were identified by examining available survey data for local communities within the regions. Data was examined back to the early 1980s if it was available. Survey data was obtained from the ADF&G Division of Subsistence Community Subsistence Information

System (URL: http://www.subsistence.adfg.state.ak.us/CSIS/). In some cases, this meant the use of survey information more than 20 years old.

Chapter 7 describes the marine mammals in the action area, and Section 7.1 analyzes the impacts of the alternatives on marine mammals. As noted in Chapter 7, the climate change occurring in the Arctic region may have impacts on marine mammals as prey distribution may shift with warming waters. This may be of a concern for a number of subsistence marine mammal species including those that are ice dependent, such as the ice seals. It may also be important for walrus that are dependent on resting areas (ice or shore) that are near shallow water locations where their prey is available.

Table 9-9 provides an index of the relative importance of different species in the three regions defined for this action area. The information in the table is a crude measure of the relative importance of the different species: it deals with the weight of subsistence meat and not with other materials that might be obtained from the animal; it doesn't address cultural significance; surveys do not cover all towns in all years and some date back to the 1980s.

Table 9-9 Marine mammals as a percent of subsistence harvest weight; Average percent for surveyed communities and years.

Species	Southern Chukchi	Northern Chukchi	Beaufort Sea
Marine mammals	45%	65%	55%
Polar Bear	1%	1%	1%
Bearded seal	21%	4%	12%
Ribbon seal	0%	0%	0%
Ringed seal	4%	2%	3%
Spotted sea	3%	0%	2%
Steller sea lion	0%	0%	0%
Walrus	8%	14%	11%
Beluga whale	4%	12%	8%
Bowhead whale	4%	31%	75%
Gray whale	0%	0%	0%
not known	0%	0%	0%
Region	Bering Strait to Kivalina	Point Hope to Barrow	Nuiqsut to Kaktovik
Number of year-community combinations included incalculation	11	6	5

Kotzebue Sound and the southern Chukchi Sea

Communities in this region include Brevig Mission, Teller, Inalik on Little Diomede Island, (all just south of Bering Strait), Wales, Shismaref, Deering, Buckland, Selawik, Shungnak, Kobuk, Ambler, Kiana, Noorvik, Kotzebue, Noatak, Kivalina, and the Red Dog Mine. The communities in this region exploit a somewhat wider range of marine mammal resources than are harvested further north. Little survey data on marine mammal harvests is available for inland river communities. Marine mammals will be relatively less important inland compared to land mammals there than on the coast, and the lack of survey information presumably reflects decisions to gather data on the most important issues for the different communities.

The available survey data suggests that, for coastal communities, marine mammal harvests provided between 33% and 78% of total subsistence harvests, by weight, depending on the year and community.

Key species harvested included bearded seal, ringed seal, spotted seal, walrus, beluga whale, and bowhead whale. The weight of beluga whale harvests tended to be greater here than the weight of bowhead whale harvests. Beluga whale harvests tended to be much more important, as a proportion of marine mammal harvests by weight, than they were from Wainwright to the Beaufort Sea. Other species harvested included polar bear, ringed seal and grey whale. The importance of the species varied considerably by community and year.

Chukchi Sea coast from Point Hope to Barrow

Communities in this region include Point Hope, Point Lay, Wainwright, Atkasuk, and Barrow. Marine mammal harvests accounted for between 54% and 72% of total subsistence harvests, in the data that were examined. The data suggest that marine mammals are somewhat more important in the coastal communities here than in communities to the south. Bowhead whales appear to be the most important subsistence resource here, although limited information from Point Lay points to the possible importance of beluga whale there as well. In each community the principal whale species harvested accounted for from 42% to 84% of the annual marine mammal harvest by weight. Other key species are bearded seals and walrus.

Beaufort Sea

In this analysis, the communities of Nuiqsut and Kaktovik are treated as subsistence communities located on the Beaufort Sea. Overall, bowhead whales were by far the most important marine mammal harvest by weight in this region. In four of the five years of survey data available, bowhead whale accounted for from 56% to 94% of the weight of the marine mammal harvest in each community. In Kaktovik, survey data from 1985 does not show a bowhead harvest; the overall Kaktovik marine mammal harvest was very comparatively low that year. Other important species in these communities included the bearded seal and ringed seal. Walrus was important in one year in one community. The Beaufort Sea communities appear to differ from the Chukchi Sea communities in the lesser relative importance of walrus, and the greater relative importance of bowhead whale. Spotted seal and beluga whale did not appear to be important in this region.

Potential for commercial and subsistence interactions

The marine mammals taken by regional subsistence hunters occur in the waters of the EEZ that would be regulated by this action. Chapter 7, which reviews the impacts of this action on marine mammals in the Arctic, describes the potential impacts of the action on mammal populations. Potential interactions evaluated there include injury or death from collision with vessels or entanglement in fishing gear, removal of prey resources at levels or in areas that could compromise the foraging success of marine mammals (either directly by harvesting the food of a marine mammal, or indirectly by harvesting the prey of a marine mammal's own prey or disturbing habitat supporting prey), and disturbing marine mammals and modifying their behavior. The analysis did not find that any of the alternatives would have a significant impact on marine mammals and therefore no significant impacts on the subsistence harvest of marine mammal are likely.

9.5.12 Oil and gas, and mining

The development of oil and gas resources on the North Slope has left a large industrial infrastructure in the region, particularly between Barrow and the western border of the Arctic National Wildlife Refuge. Most of the infrastructure had been constructed by 1988 by which time the Prudhoe Bay and Kuparuk oil fields had been developed. Infrastructure includes: roads; airstrips; waste disposal, saltwater treatment, gas-handling, power generation, storage, maintenance, and residence facilities; pipelines; offshore gravel islands; offshore causeways; and gravel mines, production pads and oil wells. Infrastructure was estimated to cover 17,354 acres in 2001 (Committee, 2003).

There are significant oil and gas exploration and development activities in Alaska's Territorial waters and in Federal waters in the Chukchi and Beaufort Seas. These are described in detail in section 3.2 of the EA, which discusses reasonably foreseeable future actions. The discussion has been placed there to provide context for the discussion of future leasing and exploration activities. This discussion is not repeated here.

The Red Dog Mine in the Northwest Alaska Borough is an open-pit mine producing lead, zinc, and silver. The ores are milled at the site and the concentrates are trucked to a port on the coast south of Kivalina. Here they are transferred to a barge and taken to ships lying four miles offshore for additional transfer. The port is open for about 100 days a year and about 15 ships take deliveries of concentrate each year (Committee, 2003).

9.5.13 Local marine traffic

The navigation season varies somewhat from year to year, and organized historical data is limited (Inman)[51]. The Coast Pilot notes that ice begins to break up in the Bering Strait in June.[52] Breakup is somewhat earlier to the northeast of the Strait in the Kotzebue Sound-Kivalina area, where the Pilot indicates that it takes place in late May. However, north of this area it appears to take place later the further north one travels; breakup is in late June at Point Hope, Point Lay and Wainwright and late July at Barrow (NOAA). Barge traffic from the lower-48 typically leaves Seattle by July 1 and arrives in Barrow by August 1 (ASCG Inc.). At Kaktovik (Barter Island) the easternmost community on Alaska's North Slope, the Coast Pilot says, the ice usually breaks off from shore in late July or early August. However, "After the breakup, ice is present in varying amounts and moves on and off the shore with the winds until mid-September or early October when it freezes up for the winter." (NOAA)

The Pilot indicates that freezeup works its way down the coast in reverse. Mid-September or early October at Kaktovik, early October in Barrow and Wainwright, early November in Point Lay, and mid-November in Point Hope. The Kotzebue Sound-Kivalina tends to freeze up a little earlier: late October. In any event, the Coast Pilot notes that "a southbound vessel should try to clear Bering Strait by early November." (NOAA)

Port facilities in the action area are extremely limited. There are no good natural harbors along the coast from the Bering Strait to the Canadian border. Waters along the coast are generally shallow and communities depend on lightering to and from vessels anchored offshore. For example, the Coast Pilot reports that anchorage at Barrow can be had 1,200 yards from shore, where cargo is lightered from barges to landing craft. The DeLong Mountain Terminal, shore storage and transfer facilities, with a dock extending a short distance offshore, has been constructed for the export of lead, zinc and silver concentrates and the delivery of supplies at the Red Dog Mine. This facility is on the coast about 17 miles south of Kivalina and 65 miles north of Kotzebue. However, even at this facility, shallow waters preclude larger ships from coming close inshore. The concentrates are transferred to a barge at the dock and then transferred to ships four miles off shore. Causeways at Prudhoe Bay provide infrastructure for cargo handling. However, the water near the causeways is shallow, and ocean-going tugs and barges

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[51] Captain Michael D. Inman, Chief, Response Division Seventeenth Coast Guard District. Juneau, Alaska personal communication dated, July 17, 2008.

[52] The discussion in the next two paragraphs is based on a review of the Coast Pilot for this region. The Pilot is retrospective and summarizes past experience; warming Arctic conditions may be changing the character of the ice and extending the length of the open water season in this region.

must anchor offshore and lighter their cargoes to and from the causeways (ASCG, NOAA). There is almost no support infrastructure for medium or deep-draft marine operations from the Bering Strait to the Canadian border. Shoreside support and land and air transportation infrastructure are extremely limited.

There is active small boat traffic in the region as residents travel "to access subsistence hunting, gathering, and fishing areas" or to visit other towns or villages. Towns maintain boat ramps or have undeveloped boat landing areas. (ASCG) The Coast Pilot indicates that protected areas along the coast provide protection for shallow draft vessels. (NOAA).

The resupply of the small communities in the region, and the regional oil operations, is carried out by barge. The Alaska Department of Commerce, Community, and Regional Affairs website notes that Crowley Marine Services, a subsidiary of Crowley Maritime Corporation, has Alaska petroleum operations to communities along the Bering Sea, and the Arctic Coast east to the Canadian border. Twice a month, Lynden Transport Company provides marine/truck freight services to borough communities. (ADCCRA) Bowhead Transportation Company also provides barge access from Seattle (Bowhead). Barge access to the region is also available from Canadian waters to the east. Cargo can be transshipped from rail lines to barges at Hays River on the Great Slave Lake in interior Canada and transported down the Mackenzie River to Tuktoyaktuk on the Beaufort Sea and then shipped from there as far west as Barrow. North Slope deliveries are scheduled for August. (NTC website).

In 2007 nine cruise lines operated roughly 27 large ships in Alaska service and six additional lines operated smaller ships (capacities ranging from 6 to 235 passengers. Most of the tour ships operate in the Inside Passage and the Gulf of Alaska. (http://www.cruisecritic.com/ports/article.cfm?ID=84) Firms do provide cruises into the U.S. Arctic, but it is not yet common. For example the Russian icebreaker Kapitan Khlebnikov has transited Alaska's North Slope on a Northwest Passage cruise, without making landfall in Alaska (Petrie). In 2009, the MV Hanseantic is scheduled to transit the Northwest Passage from Nome to Reykjavik (http://www.hl-cruises.com/redwork/do.php?layoutid=100&node=39712&language=2#).

A workshop on marine transportation in the Arctic (Arctic Marine Transport Workshop, 2004) suggested that increased marine tourism is expected as cruise ships venture further north following the retreat of the ice edge. It is also likely that resource exploration, recovery, and shipping activities will expand into previously inaccessible areas.

9.5.14 Coast Guard in the Arctic[53]

The Coast Guard has the same United States Code Title 10 and Title 14 responsibilities in the Arctic EEZ as elsewhere.

The Coast Guard has no aviation or surface assets permanently stationed in the Arctic region at this time. Coast Guard icebreakers routinely operate in the region, but have predominantly been used in support of scientific research. Marine Inspectors and Investigators working for the Captain of the Port in Anchorage routinely travel to the region to conduct preventive marine safety inspections or post incident investigations. Additionally, District Seventeen is currently reassessing and updating the Aids to Navigation needs along the Western Coast and North Slope of Alaska and into the Arctic.

[53] This section is based on personal communications from Captain Michael D. Inman, Chief, Response Division Seventeenth Coast Guard District. Juneau, Alaska dated January 9, 2008, July 17, 2008.

The principal logistics base for Coast Guard operations in Alaska, including in the Arctic, at present and in the future will be the Coast Guard Integrated Support Command in Kodiak, including its associated infrastructure and tenant facilities. District Seventeen surface and air assets are primarily based in and around the Gulf of Alaska and are routinely on station in the Bering Sea. Additionally, larger cutters, including icebreakers, which patrol in the Bering Sea and which would patrol in the Arctic, are homeported at various locations along the West Coast of the Continental U.S., in Hawaii and in Alaska. The LORAN Station in Port Clarence is the Coast Guard's only permanent physical presence north of Nome. Forward deployments of aircraft to Cold Bay, St. Paul and Nome are common. Air, sea and marine inspection operations in the arctic have periodically to routinely been conducted since the 1960s.

The commencement of oil drilling operations, increased commercial shipping traffic, cruise ship voyages, ecotourism and the establishment of living marine resource conservation measures are all anticipated in the foreseeable future. Coast Guard future asset and patrol requirements in the Arctic are presently being assessed. However, it is fairly clear that with any substantial increase in the above discussed activities in the Arctic, Coast Guard resources will be challenged and further stretched in responding to mission requirements in the Arctic along with those that already exist in the Bering Sea, Aleutian Islands and Gulf of Alaska. Arctic Domain Awareness (ADA) patrols by fixed winged aircraft have commenced and will continue in the near term. Additionally, deployments to the North Slope of Alaska by Coast Guard Cutters, helicopters and small boats are occurring this summer (FY 2008). Marine Safety, Marine Inspection and Aids to Navigation work are expected to increase in the region. C130 patrols of the U.S./Russian MBL are routinely conducted, with multiple deployments of assets to Nome to support this mission requirement occurring in FY2008. A Bering Strait traffic routing system or traffic management scheme is being discussed and some level of regime will be implemented at some future date, with modifications/enhancements made to the associated ship routing/traffic management as vessel traffic levels change. The Coast Guard will specifically be involved in the implementation of any ship routing/traffic management schemes.

The North Pacific Fishery Management Council's Enforcement Committee met in October 2008 to discuss enforcement issues associated with adoption of an Arctic FMP and a closure of the Arctic Management Area to commercial fishing. Recognizing the role of the U.S. Coast Guard in enforcement of such a closure, the Enforcement Committee also recommended that the Arctic FMP enforcement plan include VMS as a monitoring tool. As noted in the Enforcement Committee's February 2008 meeting minutes, given the size of the area covered by the Arctic FMP and lack of suitable locations to logistically support enforcement assets which might operate in the area, the use of VMS as a tool to monitor fishing vessel activity in and around the area would be appropriate.

9.5.15 Underwater archeological sites[54]

Human populations may have arrived in North America as early as 13,000 years ago over the Bering Land Bridge, when sea levels were significantly lower. Recent MMS NEPA analyses of oil and gas development actions estimate that during this period sea levels for prehistoric sites were 50 m to 60 m below current sea levels. Prehistoric human activity may have taken place in areas that are now underwater. The sea level reached its current approximate position about 5,000 to 6,000 years ago.

Based on information from excavations of prehistoric sites on shore, it is possible to extrapolate to the types of underwater environments most likely to have been prehistoric sites. These activities were most likely to have taken place near water features, lagoons, and river or creek estuaries, lakes, similar to those found to have been exploited by prehistoric groups whose campsites remain on shore. The MMS noted

[54] This discussion follows the discussion in the Chukchi Sea FEIS (MMS 2007). The discussion of submarine archeological resources in the Beaufort Sea is based on MMS 2003.

that relict terrestrial landforms might provide indicators of places where archeological sites might be especially likely.

It is also possible that archeological sites may still survive. Surviving sites are most likely to be found under the following conditions:

- Areas of no ice gouging, which allows the potential preservation of terrestrial sediments and landforms. These areas have been found inside barrier islands and in other areas where there is stable, floating shorefast ice.
- The presence of in situ Quaternary terrestrial sediments such as peat, soil horizons, and river-bar and -bank deposits.
- The presence of submerged and buried terrestrial landforms.

Ice gouging refers to the furrows cut into the sea bottom when sea ice comes in contact with the bottom and moves across it. This is less likely in deeper water, but is also less likely in some inshore waters protected by shorefast floating ice, or by barrier islands. Prehistoric sites will not be found below 50 to 60 m (27 of 33 fathoms).

Numerous shipwrecks are also present in the action area. Most of these are likely to be within the waters of the State of Alaska. However, shipwreck sites may occur in deeper waters than prehistoric sites.

9.5.16 Passive Use

There are people who will never visit the Arctic, but who would still be willing to pay money or make other sacrifices to preserve the unique Arctic environment. These persons might be willing to pay for management measures to prevent commercial fishing activity from emerging in the Arctic, in order to contribute to the preservation of the Arctic's unique attributes, even if they did not expect to use them themselves. Perhaps they derive personal utility from knowing that the living marine resources of the Arctic Ocean (and its adjacent seas) remain unchanged by commercial fishing activities, or perhaps they believe that traditional northern peoples have a right to an unchanged Arctic marine environment, upon which so many depend. People who feel this way can be said to have a "passive use value" [55] for the Arctic environment. [56]

Their willingness to pay to preserve the Arctic and its biota in a certain state, rather than risk the consequences of, for example, commercial fishing activity, provides a measure of their passive use value of adopting Alternatives 2, 3, or 4, rather than Alternative 1. More detailed discussions of passive use values may be found in Freeman (2003) and Boardman *et al*. (1996). Treatment of passive use value in the context of living marine resource management in the North Pacific and Bering Sea appears in several recent NOAA Fisheries Service regulatory actions, including the 2007 Endangered Species Act Critical Habitat Designation for the North Pacific Right Whale (73 FR 19000, April 8, 2008) and a series of

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[55] This class of benefits has also been called "existence" or "non-use" benefits. The term "passive use" stems from a decision by the D.C. Circuit Court of Appeals in Ohio v. U.S. Department of the Interior (880 F.2d 432 [1989]). This decision "legitimized the inclusion of these values in natural resource damage cases brought by the federal government." (Freeman, 2003).

[56] Although, for simplicity, passive use values are described here with respect to persons who do not use the resource, it is technically possible that a person may have both active and passive use values for the same asset. Boardman *et al*. point out that a person may value a wilderness area because they expect to hunt in it, and because they place a value on knowing that others will value it in the future, even if they never use it. In this instance, people who don't visit the Arctic may still be affected by changes there, because of impacts on world-wide climate. These people might still have a non-use value independent of that.

NPFMC management actions pertaining to the western distinct populatin segment of Steller sea lions (NMFS 2001, 68 FR 204, January 2, 2003 (among others)).

This passive use analysis is concerned with a willingness to pay for an incremental change in the status of future Arctic ecosystems that would occur because of one or another of the management actions under consideration. Willingness to pay, in this context, would be conditioned upon the following considerations. Under the status quo, there is no certainty that commercial fisheries would emerge in the Arctic FMP region; neither is there a guarantee that commercial fisheries would not emerge under one of the three action alternatives. The Arctic environment is undergoing substantial physical, environmental, and ecological change as a result of global warming. This analysis is concerned with consumers' willingness to pay for an alteration in this trajectory of change. Accelerating resource prices and climate change induced exploitation cost changes are increasing other human activity in the Arctic, and are likely to continue to do so, even if commercial fishing is prevented or delayed by this action. These activities would modify the Arctic environment, presumably adversely affecting its "perceived" pristine state. Thus, as time passes and these other actions take place, the willingness to pay to prevent commercial fishing could also change. It may increase, if the other activity reduces the desirable attributes of the Arctic environment and increases the marginal value of what remains. It may decrease, if the other changes eliminate what was valued.

Passive use benefits are difficult, but not impossible, to measure accurately. Use values can often be estimated based on observations of market behavior (i.e., revealed preference), but that is not immediately possible for passive use values, which are characterized by a lack of direct behavioral impact. Survey methods are often the only means available to isolate and quantify these values, and there has been controversy over the accuracy of survey results. To date, no research aimed specifically at estimating changes in passive use values associated with changes in the suite of living marine resources present in the U.S. Arctic EEZ has been performed, to our knowledge. Nonetheless, indirect evidence strongly suggests that these values do exist and, as such, must be accounted for, in complying with the requirements of E.O.12866 and other applicable law.

Several variations on statistical survey methods are the principal means of estimating passive use values. Other methods have been proposed, but thus far one or another form of the contingent valuation method (CVM) has typically been employed in empirical measurement studies. There remains controversy over survey result accuracy; however, U.S. Federal Courts have sanctioned the technique's use in such applications as resource damage assessment (e.g., oil-spills). In the Arctic FMP context, the presence of passive use values are expected to increase the potential for net economic and welfare benefits to the Nation, accruing from Alternatives 2, 3, or 4, when compared to Alternative 1, the No Action alternative. Since the three action alternatives accomplish similar things, it is unlikely that there would be readily discernable difference between the passive use benefits emerging from any of the three action alternatives, although this remains an empirical question over the range of precision offered by CVM.

9.6 Evaluation of the alternatives

9.6.1 The baseline

The baseline against which these alternatives are evaluated is the current state of the fisheries in Federal waters.

- As noted in Section 8.6.7, the only commercial fishery in the action area EEZ is the small scale and poorly documented fishery for red king crab in Kotzebue Sound. Salmon and herring fisheries take place in state waters in Kotzebue Sound. Some salmon set netting has taken place

in the EEZ in Kotzebue Sound. However, salmon fishing is not covered by the FMP under consideration. There is also a commercial fishing operation conducted within State waters in the Colville River delta.
- There are sport fisheries in the Kotzebue Sound region, and on rivers and lakes along the haul road. These fisheries do not, however, take place in federal waters.
- There are subsistence fisheries and marine mammal harvests throughout the action area. The fisheries are not conducted in federal waters, except perhaps incidentally. Marine mammal harvests may take place in federal waters, but at times when these are covered by sea ice. Harvests of marine mammals will not be regulated by the proposed action.

Under the current management regime, the Federal Government cannot regulate the actions of groundfish vessels in this region. The Federal Government can regulate the actions of vessels fishing for king and tanner crab in the southern water of the Chukchi Sea under the terms of crab FMP which delegates management of these fisheries to the state of Alaska. The state has established regulations consistent with the crab FMP to govern fishing in these waters.

The sizes and the characteristics of the fish stocks in these regions are very uncertain. It is unlikely that fishing operations in this region, beyond those fishing for red king crab in Kotzebue Sound, would currently be profitable, due to the poor knowledge of fish stocks, the short operating season, and the costs of operations in a remote region with limited infrastructure.

9.6.2 Alternative 1: Status quo

Alternative 1 is the no action or regulatory status quo alternative. Under Alternative 1:

- No groundfish fishing is currently authorized under state regulation. The State may choose to modify its regulations in the future to permit a groundfish fishery, or may authorize it by emergency order or commissioner's permit. The state would not take this action lightly or without development of a fisheries plan. There is no reasonably foreseeable action by the state that would do this.
- Crab fishing would be authorized under the crab FMP as far north as Point Hope. The crab FMP defers management authority to the State of Alaska. There appears to be an extremely small and casual inshore red king crab fishery in state waters in Kotzebue Sound. There is no reasonably foreseeable action by the state that would change this fishery or extend authorized fishing in the action area EEZ.
- Scallop fishing would be authorized as far north as the Bering Strait under the authority of the Scallop FMP and as far north as Point Hope under State mangement. No scallop fishery is known to have taken place in this region. No scallop fishery would be permitted north of Point Hope. There is no reasonably foreseeable action by the state that would change this status or extend authorized fishing in the action area EEZ.

Should interest develop in commercial fishing in this region, the Federal Government would not have a management structure in place that would allow it to regulate the fishing activity. Given the requirements for analysis, Council review, and publication of a notice of availability for the FMP, and of proposed and final rules, it is likely that it would take over a year for the Federal government to take action to regulate fishing.

The State cannot regulate vessels that operate in the EEZ and that do not have a state license. This may include, for example, catcher-processors that may enter these waters without carrying a state license. The State could take steps to authorize commercial fishing for groundfish and scallops by vessels that it licenses throughout the area north of Bering Strait, or for new crab fisheries north of Point Hope. Based on the discussion of subsistence fishing and marine mammal hunting, it is conceivable that a commercial fishery could have an impact on these activities. The potential impact of unregulated fishing on marine mammals, including those used for subsistence is detailed in section 7. It is impossible at this time to know if there would actually be an impact, or to describe what it might be without knowing the specifics of the fishery and the animals impacted. The State of Alaska would certainly take these potential impacts into account if it took action.

9.6.3 Alternative 2

Alternative 2 would adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing and amend the crab FMP to terminate its geographic coverage at Bering Strait. Under Alternative 2:

- No groundfish or scallop fishing would be authorized in the EEZ north of Bering Strait. This fishery would be precluded by the Arctic FMP and the State would not be able to authorize a fishery in Federal waters.
- No crab fishing would be possible, for the same reasons.

This alternative would make it illegal to fish in the EEZ north of Bering Strait and would create a framework that could be amended in future should interest in a fishery emerge. The existence of an FMP and implementing regulations would make it possible to issue EFPs to fishing operations; that may provide a way to create new information on fish stocks and their characteristics. The development of a commercial fishery would require an FMP amendment and implementing regulations. Based on experience with Council actions of similar significance and complexity, it is likely that this process would take over a year. This alternative would preclude the emergence of a fishery pursuant to State regulations.

This alternative would end the commercial red king crab fishery in Kotzebue Sound. Given the lack of information available on this fishery, it is impossible to determine the size of this impact. However, it is expected to affect fewer than four persons a year who are likely to earn small amounts of income from this fishery. This estimate is based on the numbers of Alaska permits issued for this fishery; permits issued may exceed permits fished. This alternative would have no other impacts on commercial, subsistence, personal use, or recreational fishing, or on subsistence harvest of marine mammals.

This alternative, and Alternatives 3 and 4, which also prohibit commercial fishing, create federal enforcement responsibilities and management issues that currently are difficult to evaluate. The alternatives focus on the prohibition of fishing in remote areas. In order to evaluate the enforcement issues these raise, it would be necessary to do a threats assessment to determine who would have an incentive to go into the closed area, when they would enter the area, for which species, and the location of their offload port. In the absence of historical fishing in the region, and without information on the nature and size of the available stocks of fish, or the nature of the operations that would harvest them, these questions cannot currently be answered. There would be additional issues if the threat was foreign as opposed to domestic. If the main threat was foreign, it would be necessary to draft agreements to work cooperatively with the nation from which the threat originated. Given the remote areas that would be regulated, enforcement would depend heavily on the Coast Guard (Passer, pers. comm.).[57]

Closure of an additional area of the EEZ to any commercial domestic fishing will expand Coast Guard enforcement requirements. Normally closed area enforcement, depending on activity level and

[57] Passer, Jeff. Special Agent in Charge, NOAA Office of Law Enforcement, Alaska Division. P.O. Box 21767, Juneau, AK 99802-1767. Personal communication, December 2, 2007.

regulatory/enforcement regime put in place, requires some level of surveillance by air assets, surface assets, or some combination of both. Implementation of a no fishing requirement and the associated enforcement in the U.S. Arctic EEZ will most certainly have resource impacts. The level of impact on Coast Guard resources will be dependent on actual fish stock levels and the associated demand to extract these stocks. Additionally, the significant additional distances from normal Coast Guard asset patrol areas to the Arctic EEZ will only exacerbate the impact and overall employment hours associated with these resources. Requirements related to Coast Guard asset surveillance and patrolling in the Arctic EEZ would be mitigated to a significant degree by adoption of a universal VMS requirement for all underway domestic fishing vessels in the Bering Sea (Inman, pers. comm.).

As noted in Section 2.4 of the EA, there are two options for structuring the FMP that can be adopted with Alternatives 2, 3 or 4. The first identifies three fisheries, snow crab, Arctic cod, and saffron cod, as subjects for the FMP, and specifies maximum sustainable yield, status determination criteria, optimum yield, annual catch limits, and annual catch targets for each of these species. Under this option, the optimum yield would initially be set just high enough to account for bycatch in subsistence harvests of other species. The second option places all species above a trophic level of approximately three in an ecosystem component category and establishes a maximum sustainable yield for these. No specifications are required for target species, as none are listed in the FMP. Both options contain procedures for amendment if that becomes desirable. More detailed descriptions may be found in Section 2.4.

Both options are expected to have small scientific or administrative costs prior to the possible emergence of a targeted fishery. Neither option appears to have implications for the ongoing scientific work of the AFSC. The Center has already begun to devote more resources to studying fish stocks in the action area under the status quo. The scope and cost of this work are not expected to change under any of the alternative or option combinations. The analytical work that will be used for the optimal yield determination under Option 1 and the maximum sustainable yield determination under Option 2 has already been done and incorporated into the FMP. The cost of this work is therefore a “sunk” cost, already incurred, and is not a cost of any alternative and option combination.

Option 2 does not appear to have any implications for the annual Council specifications process; however, Option 1 may require the BSAI plan team, the SSC, the AP, and the Council to incur minimal additional costs to make annual catch limit and annual catch target determinations. NMFS would incur some minimal additional costs to publish these specifications. These costs are expected to be minimal prior to the development of interest in an Arctic fishery because in the absence of significant new information they would likely involve adopting the previous year’s specifications. In addition, NMFS is likely to avoid the need for publishing an additional set of specifications by incorporating the Arctic specifications into the annual BSAI rule.

9.6.4 Alternative 3

Alternative 3 would adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing and the crab FMP to terminate its geographic coverage at Bering Strait. The traditional and historic red king crab fishery in the Chukchi Sea would be exempt from the Arctic FMP.

Under Alternative 3:

- No groundfish or scallop fishing would be authorized in the EEZ north of Bering Strait. This fishery would be precluded by the Arctic FMP and the State would not be able to authorize a fishery in federal waters.
- Crab fishing would be possible between Bering Strait and the latitude of Point Hope. The FMP would exempt crab fishing from federal management, thus deferring management

authority to the State of Alaska from Bering Strait to Pt. Hope. The Arctic FMP would prohibit all crab fishing north of the latitude of Pt. Hope.

This alternative would have no impacts on commercial, subsistence, personal use, or recreational fishing, or subsistence marine mammal hunting compared to the baseline under consideration. The State of Alaska could, and probably would, continue to allow the small scale red king crab fishery in or near Kotzebue Sound.

9.6.5 Alternative 4

Alternative 4 would adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

Under Alternative 4:

- No groundfish or scallop fishing would be authorized in the EEZ north of Bering Strait. This fishery would be precluded by the Federal FMP and the State would not be able to authorize a fishery in Federal waters.
- Crab fishing would be possible between Bering Strait and the latitude of Point Hope. The FMP would defer management authority to the State of Alaska through the Council's crab FMP. The Arctic FMP would prohibit crab fishing north of the latitude of Point Hope.

This alternative would have no impacts on commercial, subsistence, personal use, or recreational fishing, or subsistence marine mammal hunting compared to the baseline under consideration. The State of Alaska could, and probably would, continue to allow the small scale red king crab fishery in Kotzebue Sound under authority of the Council's current crab FMP.

9.6.6 Summary of costs and benefits

Table 9-10 summarizes the costs and benefits of this action. Because of the uncertainty about future events in this region, it is not possible to quantify these costs and benefits.

Table 9-10 Summary of the costs and benefits of this action

	Alt 1	Alt 2	Alt 3	Alt 4
Benefits	This alternative may avoid some costs associated the determination of OFL and ABCs for selected species, and enforcement costs.	Creates a framework in which future fisheries development may proceed in a sustainable manner. This should benefit a commercial fishery if one eventually evolves. It will also benefit other users of ecosystem services in the region that might be affected by a commercial fishery, for example subsistence users of marine mammals.		
Costs	The only current commercial fishery in the region may be a very small scale crab fishery in Kotzebue Sound. The management costs associated with this fishery are very small. NMFS is not currently aware of an intent by commercial fishermen to fish in this region. However, under the status quo vessels that are not licensed by the State of Alaska may enter these waters and begin fishing operations; there would be a significant lag NMFS ability to implement a regulatory structure to protect fishery sustainability, or elements of the environment, such as habitat or marine mammals, that may be impacted by a fishery.	Prohibition on all fishing may create new enforcement responsibilities for NOAA Office of Law Enforcement and the U.S. Coast Guard. . It is not currently possible to evaluate these with current information. Because of the prohibition on crab fishing in Kotzebue Sound, costs may be higher for this alternative than for alternatives 3 and 4 because of the new restriction imposed on the crab fishery. May create minor continuing administrative costs for determining and periodically updating specifications for selected species. This is more likely for Option 1 than for Option 2. May create some small costs as the Kotzebue Sound crab fishery could no longer continue in the summer.	Prohibition on all fishing (aside from the crab fishery in federal waters of Kotzebue Sound) may create new enforcement responsibilities for NOAA Office of Law Enforcement and the U.S. Coast Guard. It is not currently possible to evaluate these with current information. May create minor continuing administrative costs for determining and periodically updating specifications for selected species. This is more likely for Option 1 than for Option 2.	
Net benefits	It has not been possible to quantify the benefits or costs of these actions, therefore a quantitative assessment of net benefits is not possible.			

Chapter 10 Initial Regulatory Flexibility Analysis

This Initial Regulatory Flexibility Analysis (IRFA) evaluates the proposal by the North Pacific Fishery Management Council to create an Arctic Fishery Management Plan. This IRFA addresses the statutory requirements of the Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (5 U.S.C. 601-612).

10.1 The purpose of an IRFA

The RFA, first enacted in 1980, was designed to place the burden on the government to review all regulations to ensure that, while accomplishing their intended purposes, they do not unduly inhibit the ability of small entities to compete. The RFA recognizes that the size of a business, unit of government, or nonprofit organization frequently has a bearing on its ability to comply with a Federal regulation. Major goals of the RFA are (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require that agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities. The RFA emphasizes predicting impacts on small entities as a group distinct from other entities and on the consideration of alternatives that may minimize the impacts while still achieving the stated objective of the action.

On March 29, 1996, President Clinton signed the Small Business Regulatory Enforcement Fairness Act. Among other things, the new law amended the RFA to allow judicial review of an agency's compliance with the RFA. The 1996 amendments also updated the requirements for a final regulatory flexibility analysis, including a description of the steps an agency must take to minimize the significant (adverse) economic impacts on small entities. Finally, the 1996 amendments expanded the authority of the Chief Counsel for Advocacy of the SBA to file *amicus* briefs in court proceedings involving an agency's alleged violation of the RFA.

In determining the scope or "universe" of the entities to be considered in an IRFA, NMFS generally includes only those entities that can reasonably be expected to be directly regulated by the proposed action. If the effects of the rule fall primarily on a distinct segment, or portion thereof, of the industry (*e.g.*, user group, gear type, geographic area), that segment would be considered the universe for the purpose of this analysis. NMFS interprets the intent of the RFA to address negative economic impacts, not beneficial impacts, and thus such a focus exists in analyses that are designed to address RFA compliance.

Data on cost structure, affiliation, and operational procedures and strategies in the fishing sectors subject to the proposed regulatory action are insufficient, at present, to permit preparation of a "factual basis" upon which to certify that the preferred alternative does not have the potential to result in "significant economic impacts on a substantial number of small entities" (as those terms are defined under RFA). Because based on all available information it is not possible to "certify" this outcome, should the proposed action be adopted, a formal IRFA has been prepared and is included in this package for Secretarial review.

10.2 What is required in an IRFA

Under 5 U.S.C. Section 603(b) of the RFA, each IRFA is required to contain:

- A description of the reasons why action by the agency is being considered;
- A succinct statement of the objectives of, and the legal basis for, the proposed rule;

- A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply (including a profile of the industry divided into industry segments, if appropriate);
- A description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
- An identification, to the extent practicable, of all relevant Federal rules that may duplicate, overlap or conflict with the proposed rule;
- A description of any significant alternatives to the proposed rule that accomplish the stated objectives of the proposed action, consistent with applicable statutes, and that would minimize any significant adverse economic impact of the proposed rule on small entities. Consistent with the stated objectives of applicable statutes, the analysis shall discuss significant alternatives, such as:
    1. The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
    2. The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
    3. The use of performance rather than design standards;
    4. An exemption from coverage of the rule, or any part thereof, for such small entities.

10.3 What is a small entity

The RFA recognizes and defines three kinds of small entities: (1) small businesses, (2) small non-profit organizations, and (3) and small government jurisdictions.

Small businesses. Section 601(3) of the RFA defines a "small business" as having the same meaning as "small business concern" which is defined under Section 3 of the Small Business Act (SBA, 15 U.S.C. 632). "Small business" or "small business concern" includes any firm that is independently owned and operated and not dominant in its field of operation. The SBA has further defined a "small business concern" as one "organized for profit, with a place of business located in the United States, and which operates primarily within the United States or which makes a significant contribution to the U.S. economy through payment of taxes or use of American products, materials or labor."...A business concern may be in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that where the firm is a joint venture there can be no more than 49 percent participation by foreign business entities in the joint venture." (13 CFR 121.105)

The SBA has established size criteria for all major industry sectors in the United States, including fish harvesting and fish processing businesses. A business involved in fish harvesting is a small business if it is independently owned and operated and not dominant in its field of operation (including its affiliates) and if it has combined annual receipts not in excess of $4.0 million for all its affiliated operations worldwide. A seafood processor is a small business if it is independently owned and operated, not dominant in its field of operation, and employs 500 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide. A business involved in both the harvesting and processing of seafood products is a small business if it meets the $4.0 million criterion for fish harvesting operations. Finally a wholesale business servicing the fishing industry is a small business if it employs 100 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide.

The SBA has established "principles of affiliation" to determine whether a business concern is "independently owned and operated." In general, business concerns are affiliates of each other when one concern controls or has the power to control the other or a third party controls or has the power to control both. The SBA considers factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists. Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, are treated as one party with such interests aggregated when measuring the size of the concern in question. The SBA counts the receipts or employees of the concern whose size is at issue and those of all its domestic and foreign affiliates, regardless of whether the affiliates are organized for profit, in determining the concern's size. However, business concerns owned and controlled by Indian Tribes, Alaska Regional or Village Corporations organized pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601), Native Hawaiian Organizations, or Community Development Corporations authorized by 42 U.S.C. 9805 are not considered affiliates of such entities, or with other concerns owned by these entities solely because of their common ownership.

Affiliation may be based on stock ownership when (1) A person is an affiliate of a concern if the person owns or controls, or has the power to control 50 percent or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock, or (2) If two or more persons each owns, controls or has the power to control less than 50 percent of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern.

Affiliation may be based on common management or joint venture arrangements. Affiliation arises where one or more officers, directors or general partners control the board of directors and/or the management of another concern. Parties to a joint venture also may be affiliates. A contractor or subcontractor is treated as a participant in a joint venture if the ostensible subcontractor will perform primary and vital requirements of a contract or if the prime contractor is unusually reliant upon the ostensible subcontractor. All requirements of the contract are considered in reviewing such relationship, including contract management, technical responsibilities, and the percentage of subcontracted work.

Small non-profit organizations The RFA defines "small organizations" as any not-for-profit enterprise that is independently owned and operated and is not dominant in its field.

Small governmental jurisdictions The RFA defines small governmental jurisdictions as governments of cities, counties, towns, townships, villages, school districts, or special districts with populations of fewer than 50,000.

10.4 What is this action

This action is described in detail in Chapter 2 of the EA, and Section 9.4. At the time of preparation of this IRFA (September 2008) the Council has not identified a preferred alternative. The four alternatives under consideration by the Council are shown in Table 10-1.

Table 10-1 Description of the four alternatives

1	Status quo
2	Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait.
3	Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. Amend the crab FMP to terminate its geographic coverage at Bering Strait. A red king crab fishery in the Chukchi Sea of the size and scope of the historic fishery in the geographic area where the fishery has occurred would be exempt from the Arctic FMP.
4	Adopt an Arctic FMP that closes the entire Arctic Management Area to commercial fishing. The Arctic FMP would cover the area north of Pt. Hope for crab and north of Bering Strait for groundfish and scallops.

10.5 Objectives and reasons for considering the proposed action

The purpose of the proposed action is to establish Federal fisheries management in the Arctic Management Area in compliance with the Magnuson-Stevens Act. The action is necessary to prevent commercial fisheries from developing in the Arctic without the required management framework and scientific information on the fish stocks, their characteristics, and the implications of fishing for the stocks and related components of the ecosystem.

10.6 Legal basis for the proposed action

The Magnuson-Stevens Act is the primary domestic legislation governing management of the nation's marine fisheries. In 1996, the United States Congress reauthorized the Magnuson-Stevens Act to include, among other things, a new emphasis on the precautionary approach in U.S. fishery management policy. The Magnuson-Stevens Act contains ten national standards, with which all FMPs must conform and provides the primary guidance for the management of the federal fisheries.

Under the Magnuson-Stevens Act, the Council is authorized to prepare and submit to the Secretary of Commerce for approval, disapproval or partial approval, a FMP and any necessary amendments, for each fishery under its authority that requires conservation and management. The Council conducts public hearings so as to allow all interested persons an opportunity to be heard in the development of FMPs and amendments. (16 U.S.C. 1852(h)).

10.7 Number and description of small entities directly regulated by the proposed action

This action will only regulate commercial fishing for groundfish or shellfish, not subsistence, recreational, or personal use fishing in the action area. There is only one known commercial fishery in the EEZ in the action area. As described in detail of Section 8.6.7 of the RIR, there may be a small, poorly documented, commercial fishery for red king crab in the summer in a portion of the EEZ in Kotzebue Sound.

A survey of the Alaska Department of Fish and Game fish ticket data base back to 1985 only identified a single fish ticket for this fishery. This was a ticket for a very small amount of red king crab delivered in the summer of 2005. However, as discussed in the RIR, it is likely that landings in this fishery are not always reported on official state landings records. The waters in which this fishery occurs were set apart from other waters for reporting purposes in 2005. From 2005 to 2007, from three to four persons acquired the State of Alaska K09X permits that are required to fish commercially in this area.[58] The number of permit holders, rather than the number of operations with fish tickets, is assumed to best represent the number of entities directly regulated by this action. All of these operations are believed to be small entities with annual gross revenues under $4 million. A description of these operations may be found in Section 8.6.7 of the RIR.

10.8 Recordkeeping and reporting requirements

The IRFA should include "a description of the projected reporting, recordkeeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record..." (5 U.S.C. § 603(b)(4)).

The analysis did not identify any new "projected reporting, record keeping and other compliance requirements" associated with any of the alternatives.

10.9 Federal rules that may duplicate, overlap, or conflict with proposed action

An IRFA should include "an identification, to the extent practicable, of all relevant Federal rules that may duplicate, overlap or conflict with the proposed rule..." (5 U.S.C. § 603(b)(5))

This analysis did not reveal any Federal rules that duplicate, overlap, or conflict with the proposed action.

10.10 Description of significant alternatives

An IRFA should include "a description of any significant alternatives to the proposed rule that accomplish the stated objectives of [the Magnuson-Stevens Act and any other] applicable statutes and which minimize any significant [implicitly adverse] economic impact of the proposed rule on small entities." (5 U.S.C. § 603(c))

As noted, at the time of the preparation of this draft IRFA, the Council has not identified a preferred alternative.

Alternatives 1, 3, and 4 have no known impacts on directly regulated small entities. Alternative 2, which prohibits all commercial fishing, would prohibit any crab fishing that may be taking place in the small and poorly documented fishery in Kotzebue Sound. As noted in Section 9.5.8, based on permit issuance it appears that two to four small entities may fish there in a year (although permit issuance does not necessarily entail fishing activity, and there is only one fish ticket from this fishery since 1985); income from any fishery is likely to be small.

[58] These are Alaska interim use permits, and are not limited entry permits. This fishery is not under limited entry.

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Appendices

Appendix 1. Council motion.

Council Motion – Arctic Fishery Management (June 2007)

In October 2006, the Council directed staff to prepare a discussion paper on management of fisheries in the Exclusive Economic Zone (EEZ) waters of the Arctic Ocean. The Council is interested in exploring policy options, such as a Fishery Management Plan (FMP), to conserve marine resources and manage existing or potential future fisheries in this region. The Council received that report at the December 2006 meeting, and tasked staff to further develop options for fishery management in the Arctic.

At present, the Council does not have an FMP that provides comprehensive authority over fishery management issues in the EEZ waters of the Chukchi and Beaufort Seas. Two of the Council's FMPs cover parts of the Arctic region for some species (i.e. the crab FMP and scallop FMP both cover part of the Chukchi Sea north of Bering Strait to Point Hope).

The Council has determined that a more deliberate and comprehensive management regime should be put in place for the Arctic region. This is partly in anticipation of potential fishery development in the region if climate conditions continue to warm. But this is also in response to some of the unique ecological conditions in the Arctic region, and the unique nature of the region's coastal communities, that merit more attention than has been given to this area previously.

The Council has reviewed several options for accomplishing its goal. These options were analyzed in a discussion paper prepared by staff for Council review in June 2007. These options include amending the existing FMPs so that they cover the Arctic region, writing a new Arctic FMP, or preparing a Fishery Ecosystem Plan. The issues each of these approaches raise have been evaluated by the Council at its June 2007 meeting, and the Council believes that a combination of amending the existing crab and scallop FMPs to terminate their coverage at Bering Strait and preparing a new comprehensive FMP for the Arctic region is the best approach. A single FMP covering the Alaskan Arctic would be a more holistic approach to marine resource management in the ecosystem. As part of that process, the Council intends that this new FMP contain elements of a Fishery Ecosystem Plan in that it should emphasize the unique habitats and resources of the Arctic and how marine resource management could be accomplished against this backdrop.

Therefore, the Council tasks staff with developing a draft Arctic FMP. This should include development of a problem statement or purpose and need statement, a suite of alternative management actions, and other supporting information required under the MSA, as amended in 2006.

An initial problem statement could include this language:

Under the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Council is authorized to conserve and manage the fishery resources of the EEZ off Alaska, including the Chukchi and Beaufort Seas. To date, no large commercial fisheries have developed in these areas, and thus the Council has not had a compelling reason to develop Fishery Management Plans for these Arctic marine areas off Alaska.

But the environment for commercial fishery development in the Alaskan Arctic may be changing, with warming trends in ocean temperatures and changes in seasonal sea ice conditions potentially favoring the development of commercial fisheries.

Although at this time there are no such fisheries in the EEZ off Alaska in the Arctic Ocean, and no routine fish surveys conducted in the region, the Council is interested in exploring policy and management options to prepare for future change.

In addition, the Council recognizes the unique ecological conditions of the Arctic, and expresses its concern over potential effects of commercial fishing on local residents who rely on subsistence fishing and hunting. The Council views the development of an Arctic FMP as an opportunity for implementing an ecosystem-based management policy that recognizes the unique issues in the Alaskan Arctic.

The Council also desires to clarify management authorities in the U.S. Arctic EEZ, and this action would accomplish that objective. A new Arctic Resources FMP would provide the Council a vehicle for addressing future management issues, including deferral of management to the State of Alaska.

The Council's initial preferred alternative will be to close the entire Arctic region, defined as the Chukchi and Beaufort Seas off Alaska, to commercial fishing for all marine species, including forage species, except for fisheries that have traditionally been prosecuted in these waters; currently, the only known commercial EEZ fishery in the Alaskan Arctic is for red king crab in the southern part of the Chukchi Sea. The Council will define its management approach in more detail in the Arctic FMP, including the conditions under which the Council will reconsider its policy for a general fishery closure.

Thus, the Council requests that the following alternatives be analyzed:

1. Status quo

2. Adopt an Arctic FMP, and amend the scallop and crab FMPs to terminate their geographic coverage at Bering Strait, with two options:

a) Close all waters north of Bering Strait to commercial fishing for all species, including forage species;

b) Close all waters north of Bering Strait to commercial fishing for all species, including forage species, but leave waters between Bering Strait and Point Hope open to commercial fishing for red king crab.

The Council will appoint members of an Arctic FMP Team to work with staff to develop a draft FMP.[59] Staff should consult with stakeholders to the extent practicable, including Arctic communities, outlining the Council's intent and objectives and seeking input and suggestions for future marine resource management in the Arctic EEZ off Alaska.

The Council, as part of this action, tasks staff with preparation of amendments to the existing scallop and crab FMPs to terminate their geographic coverage at Bering Strait. The Council requests that an initial draft Arctic FMP be presented to the Council at its December 2007 meeting. At that meeting, the Council will suggest further development of the draft FMP or send the draft FMP out for public review.
An outline of the process required, and draft language for the amendments, should be part of the package to be presented to the Council at the December 2007 meeting.

[59] Note: After passing this motion, the Council recommended that the Arctic FMP be deferred to the Ecosystem Committee in the interim, and that the Council may appoint an Arctic FMP Team some time in the future.

Appendix II. Outreach Program Summary

Introduction

The Council approved moving forward with an outreach program as an integral part of developing an Arctic FMP. The goal of this outreach program is to increase Alaska Native and regional community involvement in the Council process for developing commercial fishing policies and regulations. This section discusses the procedures followed and the documentation of Alaska Native and community participation in the evolution of the proposed Arctic management policy.

The Council's outreach program for developing the Arctic FMP is as follows. Council staff would oversee this program and maintain ongoing and proactive dialogue with Native and rural communities as the Arctic FMP evolves. The general sequence of outreach activities is as follows

- Identify coastal communities within North Slope Borough, Northwest Arctic Borough, & Nome Census Area that are adjacent to the action area (Chukchi Sea and Beaufort Sea and Nome area)

- Identify regional and village corporations, community governments, or other community or Native entities in each of those communities (e.g., regional nonprofits, etc.).

- Initial contact will be made with Kawerak, Maniilaq Corporation, Northwest Arctic Borough, North Slope Borough, Alaska Eskimo Whaling Commission, and Eskimo Walrus Commission. Once the leadership for these groups is identified, develop contact information for each of those entities.

- Contact each of the above six organizations, plus additional regional groups or other groups associated with Arctic resource management or development, and explain the Council's proposed Arctic FMP. Seek recommendations for further outreach to members of these groups, including regional villages, Native organizations, Tribal organizations, IRA Councils, or other entities.

- Follow through with the recommendations obtained above. This may involve contact (by letter) and a request for input from each individual and entity identified as being potentially affected by the proposed action, prior to the release of the preliminary analysis. Letter contact may include:
    - One-page flyer on the Council's proposed Arctic FMP development
    - New brochure on Council process: *Navigating the North Pacific Council Process*
    - June 2007 Council motion on Arctic FMP
    - Other materials that may be appropriate for the recipients

- Convene meetings as necessary and appropriate during the development of the analysis. This step may only be necessary if it is determined that the action has significant, unique, or substantial direct effects on a particular community. This could also be prompted by strong desires from individual communities that they have an opportunity for face to face discussion of the proposed action outside of the Council meetings or FMP Team meetings.

- Contact (by email, fax, or letter) and solicit input from each entity identified as being potentially affected by the proposed action, prior to the Council's scheduled final action (June 2008).

- After a decision by the Council, follow-up with the potentially affected entities (by email, fax, or letter) as to the results of the Council's action. Convey that the Council's action is a recommendation to the Secretary of Commerce, and further input can be provided to the Secretary.

- Document this consultation process including a summary of the process undertaken to solicit input from affected entities, solicitations for input, summaries of public meetings, and documents distributed. Include a brief summary of the participants and issues discussed at meetings.

The following is a brief summary of the main contacts made, method of contact, nature of the discussion, and any recommendations given.

Initial contacts were made with individuals either known to Council staff or recommended to staff during public comment or letters sent to the Council. From these initial contacts, additional persons and organizations were identified with whom further contact might be appropriate.

Some initial contacts were made by email, others by phone contact or personal visits. Early opportunities for informing the public of the Council's intent for Arctic fishery management were during the December 2006, April 2007 and June 2007 Council meetings, at which times interested members of the public either testified or discussed with staff and Council members their particular interests in the Arctic. During the October 2007 Council meeting, additional clarification was provided for the proposed alternatives to be analyzed, and additional public comment was received. And the Council was provided an update on outreach efforts at their December 2007 meeting, at which additional public comment was received.

Subsequently, a list of potential entities in villages of the northwest and Arctic regions was prepared, and specific individuals were identified for each entity. The Council's Ecosystem Committee recommended, and the Council concurred, that only specific individuals in entities that represented groups of villages be contacted first. The objective was to discuss with regional leaders the most appropriate way to increase participation and to help get the information out to the various individual villages, IRA Councils, or other organizations. The following is a summary of those contacts.

<u>Arctic Community or Native Organizations</u>

Craig George
Dr. Robert Suydam
North Slope Borough
Department of Wildlife Management
Barrow

The NSB's Department of Wildlife Management is responsible for research and data gathering on wildlife resources of subsistence, cultural, and related importance to residents of villages in the region north of the Brooks Range. Polar bear awareness and protection, ice seal research and data gathering, and bowhead whale hunt monitoring and biological sampling of harvested whales are some of the activities the Department is responsible for. Contacts were made to explain the Council's Arctic FMP program with Craig George, senior biologist and Dr. Robert Suydam, senior biologist. Mr. George suggested further contacts with the Alaska Eskimo Whaling Commission and the North Slope Borough.

Mr. George indicated several concerns with future commercial fisheries, should they develop, such as the potential impacts of removals of Arctic cod which are important food for marine mammals, and gear entanglements with marine mammals. Mr. George reported his observations of heavy trawl gear washing up on beaches in the area (e.g. Point Hope) and he has observed 4 to 5 bowhead whales harvested in the subsistence hunt with gear entangled on them or net or rope marks.

Mr. Suydam was emailed by staff to seek contacts with additional individuals or organizations. Mr. Suydam offered to contact others to identify interest in receiving briefings on the Council's intent. He forwarded information to: Taqulik Hepa, Director of the North Slope Borough's (NSB) Dept. of Wildlife Management; Karla Kolash, NSB Mayor's Office; Johnny Aiken, NSB Planning Department; Bessie O'Rourke and Laylay Hughes, NSB Law Office; Harry Brower, Chairman of the Alaska Eskimo Whaling Commission (AEWC); and Jessica Lefevre, Counsel for the AEWC.

Staff gave an in-person presentation of the Council's proposed Arctic FMP initiative to Dr. Suydam and Mr. George January 14, 2008 in Barrow. Discussion included general support for a commercial fishery closure provision in an Arctic FMP. North Slope Borough staff will discuss with the Mayor a letter in support and possible personal testimony before the Council.

Richard Glenn
Vice President
Arctic Slope Regional Corporation
Barrow

During the U.S. Coast Guard flight to Barrow on November 8, staff discussed the Council's Arctic FMP project with several representatives from organizations in Barrow, including ASRC, BASC, the North Slope Borough (NSB), the Ukpeagvik Inupiat Corporation, and the Naval Arctic Research Laboratory. Mr. Glenn was the spokesman for a group that greeted the U.S. Coast Guard flight, and Council staff took the opportunity to inform some of these individuals of the Council's plans. Mr. Glenn recommended that staff present the Council's FMP project to an upcoming NSB Assembly meeting; he also suggested a presentation to the joint NSB and Northwest Arctic Borough's Economic Development Summit which will be held in summer of 2008.

Bobby Schaefer
Northwest Arctic Borough
Kotzebue

Mr. Schaefer is a member of Maniilaq and also works for the Northwest Arctic Borough. Several email exchanges have notified Mr. Schaeffer of the Council's program. He requested being involved in the process, including an assistant, Tom Okliasik, who will become the Northwest Arctic Borough's Director of Planning.

Caleb Pungowiyi
Maniilaq Association
Kotzebue (now a resident of Wasilla)

Maniilaq Association has been providing extensive health, tribal, and social services to residents of rural Northwest Alaska. Based on information from its web site, the Maniilaq Association is a non-profit corporation that represents twelve federally-recognized tribes located in Northwest Alaska. The Association manages social and health services for people within the Northwest Arctic Borough and the village of Pt. Hope. Additionally, Maniilaq coordinates tribal and traditional assistance programs, as well as environmental and subsistence protection services.

Discussion with Mr. Pungowiyi included email correspondence and face to face discussions in Anchorage and Nome. Mr. Pungowiyi assisted in developing contacts with other people in the Nome and Kotzebue area, including Maniilaq and Kawerak.
Mr. Pungowiyi was the Director of Natural Resources for Maniilaq Corporation and he drafted the letter sent to the Council concerning development of the Arctic FMP. He requested being kept informed and

offered to help with outreach. He reviewed a PowerPoint presentation and considered it appropriate for outreach. He also forwarded the Council's motion to Taquilik Hepa, Director of the Department of Wildlife Management, North Slope Borough; to Bobby Schaeffer, Northwest Arctic Borough and Maniilaq Corporation, other key people in the Northwest Arctic Borough, communities from Point Hope south.

Alex Whiting
Environmental Specialist
Kotzebue IRA and Native Village of Kotzebue
Kotzebue

Mr. Whiting mailed written comments to the Council, and this was followed up by email communications acknowledging the letter. Mr. Whiting expressed interest in closing Arctic waters to trawl fishing for now, and he encouraged continued coordination and communications with the Kotzebue region in matters affecting the Arctic EEZ. He expressed concern over climate warming, loss of sea ice, and the continued decrease in amount and timing of production of ice algae that may have serious ramifications for the ecological systems of the Chukchi and Beaufort Seas and the abundance and composition of marine mammal forage fishes. Mr. Whiting noted that up to 70 percent of the Kotzebue Tribal annual subsistence needs come from the Chukchi Sea and Kotzebue Sound region, and thus the local Tribal people have a high level of interest and a desire to be involved as the Council process moves forward. He was pleased with the previous Arctic FMP discussion paper prepared for the Council, and suggested that letters to the Tribes in coastal communities is a good way for making contact, and offered assistance in obtaining contact information.

Vera Metcalf
Executive Director
Eskimo Walrus Commission
Nome

The EWC is a commission of the 19 villages in northwest Alaska working on co-management issues associated with Native harvest of walrus. Walrus are an important cultural, natural, and subsistence food resource to the Alaskan coastal Yupik and Inupiaq communities. These villages are in portions of the area considered the management area for the Arctic FMP. Contact included personal discussion of the Council's Arctic FMP with Ms. Metcalf during the Arctic Research Commission meeting in Nome. Ms. Metcalf was interested in Council staff presenting an overview of the Arctic FMP program to the Commission at one of their upcoming meetings. See additional information on the EWC's annual meeting below.

Loretta Bullard
President
Kawerak, Inc.
Nome

Kawerak, Inc. is the regional non-profit corporation in the Bering Straits Native Association area of northwest Alaska. Kawerak provides social services as well as educational, natural resources management, and economic development services to the peoples of the villages in the Bering Straits Native Association region. One of its four divisions, the Natural Resources Division, includes land management, fisheries, walrus, reindeer, and subsistence resources management programs. This region includes 20 villages in the Norton Sound, St. Lawrence Island, and Bering Strait region.

Issues discussed with Kawerak include concerns over local input to regional management decisions, concern over the Council's 2007 action regarding trawl fisheries in the northern Bering Sea, and desires for future super exclusive rights to fisheries resources in this region if they are developed.

Ms. Bullard scheduled Council staff for a presentation on the Arctic FMP at the upcoming Full Kawerak Board of Directors meeting on December 13, 2007 in Nome. See additional information on the Kawerak meeting below.

Charlie Lean
Retired ADF&G Fishery Manager
Norton Sound Economic Development Corporation
Nome

The NSEDC is one of six CDQ groups representing the fishing villages of the Norton Sound region. Mr. Lean is a biologist with NSEDC and a retired ADF&G fishery manager for the Norton Sound and Kotzebue Sound areas. Contacts with Mr. Lean included many emails and an opportunity to discuss the Council's FMP plans at the ARC commission meeting in Nome. Mr. Lean is supportive of allowing opportunities for fisheries to develop in the future. He provided information on the historic red king crab fishery in the southern Chukchi Sea area, and indicated that this region likely could continue to support a small commercial red king crab fishery in the future. He provided references to reports and memoranda with data used in the EA.

Reggie Joule
Representative for District 40T
Christine Hess
Chief of Staff
Alaska Legislature
Juneau

Staff presented to Reggie Joule and his Chief of Staff Christine Hess the Council's FMP initiative and intent. Mr. Joule expressed interest in the development of the FMP and volunteered to assist with outreach efforts. Ms. Hess contacted individuals in Barrow and Kotzebue to identify opportunities for outreach, and she recommended radio interviews as a means of contacting a wider audience in these regions. Mr. Joule testified before the Council at its December 2007 meeting and provided the following comments:

- support for the Council's intention to close to commercial fishing all Arctic EEZ waters until information is obtained to determine feasibility of any new fishery
- interest in local participation if any fishery were to be considered, including local involvement in data gathering and involvement in a new fishery
- two Boroughs in the region (North Slope and Northwest Arctic Boroughs) can help establish ties to the Council process and the Arctic FMP moves forward
- local fish and game advisory committees also could help with outreach to local residents
- supports gathering information before proceeding with fishery development
- need to identify how global warming is affecting the marine environment and how the ecosystem is changing before allowing fisheries to develop
- subsistence will always be of foremost importance to local people, but commercial fishery development may have a future in the Arctic
- local knowledge of fish resources is available and elders should be contacted
- need funding to gather data to help identify future fishery development opportunities

- these regions need economic development opportunities
- the Arctic would benefit from some kind of means for local communities to benefit from fishery development such as an expanded CDQ program

Mr. Joule expressed general support for the Council's initiatives and offered to help inform residents and to help staff contact groups in the region.

Agencies

Lyman Thorsteinson
Center Director
U.S. Geological Survey
Western Fisheries Research Center
Seattle

Staff discussed the Council's Arctic FMP initiative in person with Mr. Thorsteinson, Center Director. USGS conducts fishery research throughout the western U.S., and this Center is responsible for several western Alaska and Arctic fishery projects including a synthesis of information on fish species inhabiting Arctic waters. This study is being initiated in 2008.

Jim Menard
Area Management Biologist
Norton Sound and Port Clarence Districts
ADF&G
Nome

Contact with Jim Menard was through initial queries with Denby Lloyd, Gene Sandone, and Fred Bue, all with ADF&G. Mr. Menard manages all commercial fisheries sin the Kotzebue Sound region. Mr. Menard provided basic information on salmon and sheefish fisheries in this area, all of which are in State waters. He provided some information on the red king crab fishery in the southern Chukchi Sea region. Charlie Lean provided additional information.

U.S. Coast Guard
Kodiak Air Station
Kodiak

Staff has discussed the Arctic FMP with several Coast Guard representatives. In early November 2007, staff exchanged emails and telephone calls with Lt CDR Jutras and AMTC Pudish to schedule an arctic reconnaissance overflight with the Coast Guard. Staff accompanied the Coast Guard in an HC 130 flight to Barrow, with an intermediate stop at Port Clarence, on November 8. This provided additional opportunity to discuss the Arctic FMP with other Coast Guard officers and guardsmen. This flight was piloted by CMDR Craig Breitung, Air Station Kodiak.

Bureau of Indian Affairs
Alaska Region
Juneau

Staff was referred to the BIA and its annual rural providers conference as a potential opportunity to present the Arctic FMP initiative to a large group of rural residents from across Alaska. Jennifer Caesar, BIA, recommended including the one page flyer that describes the FMP in the information packets provided to the delegates to the 2007 tribal services providers conference. Staff provided flyers for the convention held in Anchorage November 26-30, 2007.

Other Organizations and Media

Dr. James R. Lovvorn
Department of Zoology
University of Wyoming
Laramie, WY 82071

Staff discussed the Council's Arctic FMP project with Dr. Jim Lovvorn, an expert in spectacled eider feeding ecology in the northern Bering Sea and Chukchi Sea. Dr. Lovvorn provided some scientific information for the Arctic FMP environmental assessment and discussed concerns over human activities in certain sensitive feeding habitats in this region.

Steve Taufin
Alaska Report
Kodiak

Casey Kelly
KMXT Radio
Kodiak

Richard Beck
University of Cincinnati
Barrow Arctic Science Consortium (BASC)

The above three individuals accompanied staff and Coast Guard personnel on the November 8, 2007 Coast Guard HC 130 reconnaissance flight to the Arctic. During this flight and ground time in Barrow, staff conducted an interview with Mr. Kelly for later broadcast on KMXT radio, and provided information and recorded sound bites on the Arctic FMP and the Council's intent for future Arctic fishery management. Mr. Taufin discussed the Arctic FMP with staff, presumably for materials for his internet news site. Mr. Beck was briefed as well; he represents a group of scientists who collaborate on logistics support for Arctic research. The BASC manages the Barrow Environmental Observatory which has a new operations and research building in Barrow.

Oil and gas industry

Dr. Diane Sanzone
Dr. Bill Streever
BP Exploration (Alaska) Inc.
Anchorage

Staff sent emails to several oil and gas industry staff familiar to Council staff. Drs. Streever and Sanzone were briefed by email, and some follow-up correspondence ensued with Dr. Sanzone. The intent of this exchange was to familiarize them with the Council's proposed action; no concerns were voiced.

Caryn Rea
Conoco-Phillips
Anchorage

Similar to the above, staff corresponded with Ms. Rea via email. Subsequently, staff met with Ms. Rea to describe the Council's intent in more detail. Ms. Rea is involved with Conoco-Phillips' arctic oil and gas exploration and development programs and works in their environmental permitting group and is involved in related environmental assessments, research, and monitoring efforts on the North Slope. She expressed interest in keeping informed of the Council's program as it progresses.

Marilyn Crockett
Director
Alaska Oil and Gas Association
Anchorage

AOGA is an organization that represents the oil and gas industry in Alaska. AOGA lobbies for oil and gas industry interests and advocates for certain policies and legislative actions favorable to this industry. An email was sent to Ms. Crockett; no response was obtained. Staff has not yet followed up with another contact with AOGA.

<u>Conservation organizations</u>

Dr. Christopher Krenz
Oceana
Juneau

Janice Searles
Oceana
Portland

Jon Warrenchuk
Oceana
Juneau

Mike Levine
Oceana
Juneau

Staff has sent multiple emails and participated in many personal discussions, primarily with Dr. Krenz, to explain the Council's Arctic FMP program. Oceana has expressed in public testimony before the Council, as well as in email transmittals and personal discussions, that it is very supportive of the Council's proposed FMP. Oceana has indicated its preference for an expedited process for developing the FMP, production of an Environmental Assessment as the sole NEPA documentation, and outreach to interested Stakeholders at regional gatherings. A senior Oceana representative, Jim Ayers, has participated in several discussions of the Arctic FMP initiative as a member of the Council's Ecosystem Committee. Mr. Ayers has been supportive of how the Council is proceeding, and he has helped craft the outreach program in particular. Mr. Warrenchuk and Mr. Levine have attended many Council meetings to observe and discuss with staff the development of the Arctic FMP and accompanying documents, and similarly have been very supportive of the Council adopting an Arctic FMP..

Bubba Cook
World Wildlife Federation
Anchorage

Similar to the above contacts with Oceana, Council staff has discussed the Council's program with Mr. Cook and other representatives of WWF. WWF also has expressed in public testimony, correspondence and personal discussions that it is very supportive of the proposed Arctic FMP. WWF also prefers an expedited process for developing the FMP, production of an Environmental Assessment as the sole NEPA documentation, and appropriate outreach.

Dorothy Childers
Alaska Marine Conservation Council
Anchorage

AMCC has also been supportive of the Council's Arctic FMP and a closure of the Arctic to commercial fishing. Ms. Childers has attended many Council meetings and has testified in favor of the FMP and the Council's outreach program.

Raychelle Daniel
Ocean Conservancy
Washington, D.C.

The Ocean Conservancy is also supportive of the Council's Arctic FMP and has offered to help in preparation of the analyses that would support the Council's action.

Tom Van Pelt
National Audubon Society
Anchorage

Audubon Alaska recently published "Important bird areas of the Bering Sea ecoregion", and Mr. Van Pelt recommended this publication as a scientific summary report in support of the sensitivity of the Arctic as a region that is seasonally important to birds. Audubon Alaska supports the Council's proposed action.

<u>Presentations</u>

In addition to email contacts, phone conversations, and face-to-face discussions with individuals or groups, more formal presentations of the Council's Arctic FMP development program were made to specific groups. These included the Arctic Research Commission and the North Slope Science Initiative. The following documents these presentations.

U.S. Arctic Research Commission
Mead Treadwell, Chairman
And
Dr. John Farrell, Director
Lawson Brigham, Deputy Director
And Commissioners:
Michelle Eder
Vera Metcalf
Dr. Charles Vörösmarty
Dr. Susan Sugai

Arctic Research Commission's Nome Meeting
October 8, 2007

The U.S. Arctic Research Commission was established by the Arctic Research and Policy Act of 1984 (as amended, Public Law 101-609). The Commission's principal duties are (1) to establish the national policy, priorities, and goals necessary to construct a federal program plan for basic and applied scientific research with respect to the Arctic, including natural resources and materials, physical, biological and health sciences, and social and behavioral sciences; (2) to promote Arctic research, to recommend Arctic research policy, and to communicate our research and policy recommendations to the President and the Congress; (3) to work with the National Science Foundation as the lead agency responsible for implementing the Arctic research policy and to support cooperation and collaboration throughout the Federal Government; (4) to give guidance to the Interagency Arctic Research Policy Committee (IARPC) to develop national Arctic research projects and a five-year plan to implement those projects; and (5) to interact with Arctic residents, international Arctic research programs and organizations and local institutions including regional governments in order to obtain the broadest possible view of Arctic research needs.

Staff presented Arctic FMP PowerPoint to Commission members and staff on October 8, 2007 in Nome. During the presentation, Commissioners and staff discussed the lack of knowledge of Arctic fish resources, and the Commission suggested that a symposium might be convened in the near future, perhaps in association with the annual North Pacific Marine Science Conference, to outline a research program.

North Slope Science Initiative

Dick LeFebvre, Chairman
Tom Melius, Vice Chairman
John Payne, Director
NSSI Members:
Dr. Leslie Holland-Bartels (USGS)
Jon Kurland (NMFS)
Bob Winfree (NPS)
Karla Kolash (NSB)
John Goll (MMS)
Dee Williams (MMS)
Brent Sheets (DOE)
Ken Taylor (ADF&G)

Oversight Group Meeting
Anchorage
November 1, 2007

The North Slope Science Initiative is a multiagency group established in 2003 to develop a science-based program that integrates inventory, monitoring, and research activities to support resource-management decisions on the North Slope of Alaska. Comprised of industry, government, nongovernmental organizations, interested citizens, and Alaska Native representatives, the NSSI website indicates that this organization intends to work towards ensuring that inventory, monitoring, and research activities in Alaska's arctic region are systematically integrated across disciplines and individual projects or programs. The NSSI provides a forum to provide natural resource managers with the data and analyses necessary to evaluate multiple simultaneous goals and objectives related to land stewardship and legislative mandates for energy resource exploration and development on the North Slope. The NSSI also intends to provide a strategy in which information sharing can occur among agencies, nongovernmental organizations, industry, academia, and members of the public to increase communication and reduce redundancy among science programs.

Council staff presented the Arctic FMP development program to a meeting of the NSSI held in November 2007. Approximately 20 members and staff to the NSSI attended. This group is primarily representatives from State and Federal agencies that have responsibilities for resource management in the Alaskan Arctic. Also attending was Laura Furgione, Regional Director of the National Weather Service and Team Leader for NOAA's Alaska Region Collaboration Team, Integrated Service Assessment.

Kawerak, Inc.
Board of Directors Meeting

Members present:
Loretta Bullard, President
Brenna Ahmasuk, Minutes
Gilbert Tocktoo, Brevig Mission
Steve Longley, Council
Carolyn Ahkvaluk, Diomede
Robert Keith, Elim
Eddie Ungott, Gambell
Irene Sukongak, Golovin
Michael Thomas, King Island
Merlin Henry, Koyuk
Willie Foster, Marys Igloo
Clifford Johnson, Nome
Shirley Martin, St. Michael
Delbert Pungowiyi, Savoonga
Marlin Sookiayak, Shaktoolik
Darlene Turner, Shishmaref
Fred Pete, Sr., Stebbins
Kermit Ivanoff, Sr., Unalakleet
Clyde Ongtowasruk, Wales
Jacob Shwinona, Nome

December 13, 2007
Nome

Staff presented the Council's Arctic FMP program to the Kawerak Board meeting in Nome. Comments and recommendations included:

- concern over impacts of commercial fisheries near St. Lawrence Island and the halibut spawning, gray whale habitat, and fish spawning areas in that region
- will a 20-year research program be part of the Council's FMP
- need to describe potential effects of commercial fishing on marine mammals
- ice melting is occurring very fast, and there is no baseline data base available against which we can measure impacts of climate change
- fisheries will likely move northward and management needs to be conservative at first since we have no data; data are needed
- will climate warming bring new predators into the Arctic marine areas and affect current fish and mammal populations
- climate warming, changes in sea ice, changes in marine mammal distribution, and other environmental changes in the Arctic create a moving target that will make it very difficult to make management decisions
- support for a commercial fishery closure will help focus attention on the Arctic and the changes occurring as a result of warming
- generally, people agree that a commercial fishery closure is appropriate at this time
- keep the Arctic closed to commercial fishing until we know what effects from climate change we may be dealing with
- contact elders in the region for their traditional knowledge
- some may support development of small scale fisheries as long as a CDQ or similar program is part of that process
- if fisheries develop, they should be managed as super exclusive fisheries to benefit local communities
- some are concerned that Council involvement will create a new management authority to deal with and an associated bureaucracy

- consider drawing the no fishing line at Nunivak Island; there is a strong desire to retain the areas north of Nunivak Island as small, local fisheries only
- use subsistence resource users as a source to help craft the FMP, and include subsistence users in defining how any new fishery will develop
- will there be financial resources available to do studies
- consider asking adjacent countries to join in this effort; Russian fisheries may be having impacts on Arctic Alaskan fishery resources given the close proximity between the two countries

The Kawerak board was provided with one page flyers and the PowerPoint presentation.

Eskimo Walrus Commission
Annual Meeting
January 15-16, 2008
Nome

Commissioners present:

Vera Metcalf, Director	**Stan Piscoya, Nome**
Martin Robards, Biomonitor Specialist	**Ronald Oviok, Pt. Hope**
Charlie Brower, Chairman, Barrow	**Christine Komonaseak, Wales**
Victor Karmun, Vice Chairman, Kotzebue	**Melvin Apassingok, Gambell**
Enoch Oktolik, Wainwright	**Francis Alvanna, King Island**
Elmer Seetot, Jr., Brevig Mission	**Howard Weyiouanna, Sr., Shishmaref**
Clarence Waghiyi, Savoonga	**Kermit Ivanoff, Sr., Unalakleet**
Ronald Norton, Sr., Kivalina	**David David, Kwigillingok**
Frank Logusak, Togiak	**Joseph David, Sr., Mekoryuk**
Jerry Iyapana, Diomede	**Francis Pete, Stebbins**

The Eskimo Walrus Commission is a group of individuals representing the villages of western and northwestern Alaska that harvest Pacific walrus for subsistence needs. These individuals are experienced walrus hunters, and gather annually or more frequently as needed to establish regulations and conservation measures related to the subsistence harvest of walrus under a co-management agreement with the U.S. Fish & Wildlife Service. Staff presented the Council's Arctic FMP program to the Commissioners at the annual meeting of the Eskimo Walrus Commission meeting in Nome. Comments and recommendations included:

- Concern was expressed over the Council's lack of consultations with individuals in villages of the Arctic to seek their input on preparing the Arctic FMP
- Local residents want to participate in writing the Arctic FMP
- Many expressed concern over protection of subsistence use of resources
- Some are concerned over potential impacts of commercial fisheries on marine mammals
- One individual wanted his concerns over lack of input from local residents brought to the Council but felt that staff would not do so
- One individual asked about the kinds of data that would be required to open a fishery
- Some expressed concern over the impacts of trawling in the northern Bering Sea
- One asked for instances where the Council has taken into consideration local input on proposed Council actions
- If a fishery develops in the Arctic, would the Council ensure that local residents are the main beneficiaries of that fishery
- The Council is heavily represented by strong and powerful commercial interests and these are a force to be concerned about

- Does the Council consider pollution from Russia in its decisions
- The Council needs to have staff come to local groups and ask them to help write the Arctic FMP
- Before making comments on the Arctic FMP, the Eskimo Walrus Commission would like a written document that provides more information
- The U.S. Fish & Wildlife Service should have a walrus plan and give it to the Council to have the Council consider walrus in fishery management decisions
- Some expressed concern over trawling impacts on walrus habitat

The Eskimo Walrus Commission was provided with one page flyers, maps of the Arctic EEZ, and the PowerPoint presentation.

Northwest Arctic Borough
Assembly Regular Meeting
February 26, 2008
Kotzebue

Assembly members present:

Sikauraq Whiting, Mayor	**Walter G. Sampson, Vice President**
Helena Hildreth, Clerk	**Clement Richards, President**
Ramona Sheldon, Selawik	**Miles Cleveland, Ambler**
Carl Weisner, Kotzebue	**Suzt Erlich, Kotzebue**
Verne Cleveland, Noorvik	**Ron Moto, Deering**
Eugene Monroe, Noatak	**Sophie Ferguson, Kotzebue**
Gloria Shellabarger, Kiana	**John Schaeffer, Jr., Elder Representative**

The Northwest Arctic Borough Assembly is the government entity responsible for planning, land use, and other public services for people in the northwest region of Alaska. Villages of the Borough are Ambler, Buckland, Candle, Deering, Kiana, Kivalina, Kobuk, Kotzebue, Noatak, Noorvik, Selawik, and Shungnak. Staff presented a PowerPoint review of the proposed Arctic FMP to the Borough Assembly during a regular meeting in Kotzebue. Assembly members absent were Mr. Sampson and Ms. Ferguson. One-page flyers and the booklet "Navigating the North Pacific Council Process" were provided to the Assembly members and the public. Comments and discussion included the following:

- Generally, it is a good move for the Council to prohibit commercial fishing in the Arctic. This will alleviate concerns over large vessels moving into local waters and affecting local crab fishing.
- The Council may wish to talk with the local Kotzebue Sound Commercial Fishermen's Association, although some are not certain this organization is still active.
- A local or regional group should be formed to interact with the Council as the Arctic FMP proceeds; Barrow should be involved also.
- Many are interested in a CDQ program; there are no CDQ villages in the Arctic.
- Some are skeptical over why the Council is preparing an Arctic FMP; some want to know who is driving this issue and why so suddenly.
- The Council needs to have local representatives from this region and the Barrow region on the Arctic FMP Council.
- Some believe this is a good idea; it is proactive and recognizes climate change.
- Has the Council coordinated with the Arctic Council? Talked with adjacent foreign countries? Need to coordinate Arctic fishery planning with other circumpolar countries.
- The Council needs to communicate with the villages of this region, travel to the villages and speak with residents and let them know what is being proposed.

- What is the rush? Some are concerned this is developing too fast.
- If fisheries develop, many want local residents to be the main beneficiaries.
- Many wish to have a CDQ program in northwest Alaska. Consider building into the Arctic FMP a CDQ program. Villages need to benefit from future fishery development.
- Some felt that the existing Council CDQ program should be amended or modified to allow Arctic villages to participate.
- Many support the Council's proposed Arctic FMP; need to avoid large-scale commercial fishery development mistakes made in other parts of Alaska.
- How will the FMP be affected by offshore oil and gas development?
- Locals anticipate more vessel traffic in the area because of changes in Arctic ice conditions as climate warms.
- There is a great deal of interest and desire to create a CDQ program in this region, perhaps in association with the Arctic FMP. At least consider setting into place a CDQ structure in the Arctic FMP so regional villages can benefit from future commercial fisheries.

Northwest Arctic Borough Planning Commission
North Slope Borough Planning Commission
Special Meeting, Joint Planning Commission
April 2-3, 2008
Barrow, Alaska

Planning Commission members:
Paul Bodfish, Co-Chairman (Atqusuk)
Grant Hildreth, Co-Chairman (Kotzebue)
From the NSB:
Willard Neakok, Point Lay
Ray Koonook, Point Hope
Lucille Mayer, Wainwright
Richard Glenn, Barrow
Eli Nukapigak, Nuiqsut
Nora Jane Burns, Kaktovik
Jerry Sikvaiyugak, Anaktuvak Pass
Johnny Aiken, Planning Director, NSB, Barrow

From the NWAB:
Ron Hunnicutt, Kotzebue
Lester Hadley, Buckland
Barbara MacManus, Ambler
Carol Wesley, Noatak
Raven Sheldon, Selawik
Tom Hanifan, Kivalina
Tom Okleasik, Planning Director
Charlie Gregg, Land Specialist
John Chase, Community Planning and Coastal Area Specialist
Jaylene Wheeler, Community Planner and Permit Specialist

The Northwest Arctic Borough and North Slope Borough Joint Planning Commission met at the Inupiat Heritage Center to discuss potential effects of climate change on their regions and communities. Some members of the joint commission were present via telephone. Invited to this meeting were Jeff Walker, Regional Supervisor of Field Operations, Minerals Management Service, Anchorage; Lt. Cmdr. Michelle Webber, U.S. Coast Guard, Juneau; Scott Williams, BHP Billiton and Teresa Imm, Arctic Slope Regional Corporation; U.S. Bureau of Land Management, National Petroleum Reserve Alaska (did not attend); Glenn Gray, Alaska Coastal Management Program consultant; and Bill Wilson, Staff, NPFMC. Also attending was Cash Fay, BP Exploration (Alaska) Inc., and several members of the community of Barrow. As part of a series of presentations on potential development in the Arctic region and potential impacts of that development, in particular related to climate warming, NPFMC staff presented a PowerPoint review and update of the proposed Arctic FMP to the members of the Planning Commissions for both Boroughs. One-page flyers on the Arctic FMP, the booklets "Navigating the North Pacific Council Process", and the new "Current Issues March 2008" booklets were provided to the commission members and the public. Comments and discussion included the following:

- The Council needs to consult with Tribes in this region to seek their input and comments on the proposed Arctic FMP
- Many are interested in a CDQ program as part of the new Arctic FMP; there are no CDQ villages in the Arctic
- Some are skeptical over why the Council is preparing an Arctic FMP and how this may affect their subsistence way of life and the resources on which they depend
- One suggestion was to include a member of the Northwest Arctic and North Slope Boroughs on the Council to have representation as the Council makes decisions affecting this region
- Another suggestion was to include representatives from the region on any future plan team for the Arctic
- The Council needs to consult with the Inuit Circumpolar Conference as it prepares the Arctic FMP
- Does the Alaska National Interest Lands Conservation Act (ANILCA) require the Council to consult with Tribes? In discussion, it was concluded that ANILCA does not apply to Federal waters, only to State lands and State waters
- Is there information available on levels of contaminants in fishes of this region? Perhaps historic Russian dumping of nuclear waste caused nuclear contamination of Arctic fish resources?
- Arctic fish and other species are very important prey for seals and other marine mammals, and the Council should not allow commercial harvest of these resources
- Some requested copies of any documents, including environmental summaries and baseline reports, that the Council prepares as part of developing the Arctic FMP
- Who sits on the Council and how are they appointed?
- Will the Council consult and coordinate with Russia? What occurs in Alaska Arctic waters can affect people in Russia
- Some expressed concern over fishing gear, vessel sinking, and other sources of fishing gear loss in the Bering Sea and the subsequent transport of derelict gear and debris into the Arctic. Some bowhead whales have been observed to be entangled with fishing gear
- Is there sufficient scientific information available to allow decisions to be made on oil and gas exploration in the Chukchi Sea? What is the status of knowledge of fish and other resources in the Chukchi Sea?
- Will there be resource/fish surveys started in the Arctic as part of the Arctic FMP?
- Some want the Council to start holding a meeting periodically in the Arctic region to bring the Council process and Council members to this region

Other Outreach

Alaska Federation of Natives
Annual Meeting
October 26, 2007
Fairbanks

The Alaska Federation of Natives is an annual gathering of delegates from Native villages across Alaska to discuss the important issues of the times, to make plans affecting the lives of Alaskan Natives, and to take collective action on behalf of all Alaskan Native peoples. The annual AFN meeting is a unique opportunity to discuss issues with a wide spectrum of Native peoples from across the State and from nearly all Native organizations in Alaska.

Staff attended the 2007 AFN conference in Fairbanks in late October. Staff shared an informational booth with the U.S. Fish & Wildlife Service's Tribal Grants Program and the Federal Subsistence

Management Program. Staff displayed materials on the Arctic FMP and provided flyers as handouts to interested individuals. Contacts made during the AFN convention included residents from Nome, Kotzebue, Barrow, and Kaktovik as well as residents from other areas of Alaska: Kodiak, Perryville, Bethel, and several other villages. Most were interested in learning more about the Council's program, and some expressed concern that the Council has not adequately reached out to villages in western and Arctic Alaska to explain current and potential future changes in fishing regulations; those who expressed this concern felt that the Council pays more attention to the commercial fishing industry than to rural Alaska. Council staff also discussed the Council's CDQ program and other current projects (rationalization programs in particular).

KBRW
January 14, 2008
Barrow

Staff was interviewed by Janelle Everett, News Director, KBRW radio in Barrow on January 14, 2008. The taped discussion of the Council's Arctic FMP included questions and answers, particularly focusing on the effects of the proposed action on subsistence. Broadcasts of the interview will be made over multiple days to listeners of KBRW.

KOTZ
February 26, 2008
Kotzebue

Staff was interviewed by Ryan Pate, radio program host for KOTZ on February 26, 2008. This interview was recommended by Station Manager Suzy Erlich. The live broadcast covered a broad range of issues including background on the Council and fishery management plans. Discussion included effects of the proposed Arctic FMP on local subsistence activities, how it would mesh with State management of the existing Kotzebue Sound commercial salmon fishery, and what were some of the take-home messages staff heard at the Borough Assembly meeting earlier that day.

Naval War College
April 22,23, 2008
Newport, RI

Staff was invited to the Center for Naval Warfare Studies at the Naval War College to participate in an Arctic Issues Workshop. The workshop examined issues associated with potential opening of navigation and resource development in the Arctic region. The Navy intends that results from this workshop will help shape the research program of the Center for Naval Warfare Studies and contribute to the development of U.S. Maritime Strategy. Staff presented the Council's plan for developing an Arctic FMP, and provided input to a resource development scenario matrix. Attending were representatives from the Navy, Coast Guard, other Federal agencies, Canadian maritime interests, the Maritime Administration, State Department, and the oil and gas industry. The group developed a series of possible growth scenarios based on a continuum of high/low resource use and effective/ineffective governance alternatives.

Environmental Implications Workshop
Arctic Marine Shipping Assessment
Protection of the Marine Environment Working Group/Arctic Council
April 29-30, 2008
San Francisco, CA

Staff was invited to a workshop to develop information on the environmental implications of future Arctic marine shipping. The Arctic Marine Shipping Assessment will systematically consider the long term social, technological, economic, environmental, and political impacts of possible alternative scenarios for marine shipping in the global arctic region by mid century. Staff presented the Council's plan for developing an Arctic FMP. Participants in this workshop included the U.S. Arctic Research Commission, Transport Canada, Institute of the North, NOAA, Bergen Institute of Marine Research (Norway), BP Shipping, Coast Guard, and MMS.

Appendix III. Arctic FMP Essential Fish Habitat Information

The following essential fish habitat (EFH) information is proposed for inclusion in the Arctic FMP.

Background

In 1996, the Sustainable Fisheries Act amended the Magnuson-Stevens Act to require the description and identification of EFH in FMPs, adverse impacts on EFH, and actions to conserve and enhance EFH. Guidelines were developed by NMFS to assist Fishery Management Councils in fulfilling the requirements set forth by the Act.

EFH means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: "waters" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

With respect to type, the information available for almost all species is primarily broad geographic distributions based on specific samples from surveys and fisheries, which have not been linked with habitat characteristics. Furthermore, our ability to precisely define the habitat (and its location) of each life stage of each managed species in terms of its oceanographic (temperature, salinity, nutrient, current), trophic (presence of food, absence of predators), and physical (depth, substrate, latitude, and longitude) characteristics is very limited. Consequently, the information is restricted primarily to their position in the water column (e.g., demersal, pelagic), broad biogeographic and bathymetric areas (e.g., 100-200 m zone), and occasional references to known bottom types associations.

Identification of EFH for some species includes historical range information. Traditional knowledge and sampling data have indicated that fish distributions may contract and expand due to a variety of factors including, but not limited to, temperature changes, current patterns, changes in population size, and changes in predator and prey distribution.

The Council first identified EFH in 1998. In preparation of the 1999 EFH Environmental Assessment, EFH Technical Teams comprised of stock assessment authors, compiled scientific information and prepared the 1999 Habitat Assessment Reports. These reports provided the scientific information baseline to describe EFH. Importantly, recent scientific evidence does not substantially change existing life history profiles of the federally managed species. However, where new information does exist, new data helps to fill information gaps in the region's limited habitat data environment.

EFH descriptions were updated in 2005. Stock assessment authors reviewed information contained in the 1999 summaries and applied stock expertise, along with data contained in reference atlases (ADFG 2007; Council 2005; NOAA 1988 and 1990), fishery and survey data (NOAA 1998), and fish identification books (Hart 1973; Eschmeyer and Herald 1983; Mecklenburg and Thorsteinson 2002), to describe EFH for each life stage using best scientific judgment and interpretation.

In 2005, EFH text and map descriptions for most Council managed species were revised using an analytical approach. The approach focused on fish survey and fishery observer data. For adult and late juvenile life stages, each data set was analyzed for 95 percent of the total accumulated population for the species using GIS. For eggs and larvae, the EFH description is based on presence/absence data from surveys. Where information existed, the area described by these data is identified as EFH. The analyzed EFH data and area were further reviewed by scientific stock assessment authors for accuracy. This review ensures that any outlying areas not considered were included and gaps in the data were considered.

The EFH section of the Arctic FMP will undergo similar but simpler review. Fish survey and observer data is not available to analyze in this same manner. However, information does exist to describe EFH in the same manner as was completed for other Council FMPs in 1999. Thus, Arctic EFH for each species by life stage will be described as a general distribution using the best scientific information available.

EFH Descriptive Information Levels

EFH is defined in the Magnuson-Stevens Act as those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. The regulations specify the following requirements for EFH description. "FMPs must describe and identify EFH in text that clearly states the habitats or habitat types determined to be EFH for each life stage of the managed species. FMPs should explain the physical, biological, and chemical characteristics of EFH and, if known, how these characteristics influence the use of EFH by the species/life stage. FMPs must identify the specific geographic location or extent of habitats described as EFH. FMPs must include maps of the geographic locations of EFH or the geographic boundaries within which EFH for each species and life stage is found....[also] FMPs must demonstrate that the best scientific information available was used in the description and identification of EFH, consistent with national standard 2" (50 CFR 600.815(a)).

The EFH Final Rule (50 CFR 600.815(a)) specifies the following approach to gather and organize the data necessary for identifying EFH. Information is to be described using levels of information and all levels should be used to identify EFH, if information exists. The goal of this procedure is to include as many levels of analysis as possible within the constraints of the available data. Councils should strive to obtain data sufficient to describe habitat at the highest level of detail (i.e., Level 4).

> Level 1: Distribution data are available for some or all portions of the geographic range of the species. At this level, only distribution data are available to describe the geographic range of a species (or life stage). Distribution data may be derived from systematic presence/absence sampling and/or may include information on species and life stages collected opportunistically. In the event that distribution data are available only for portions of the geographic area occupied by a particular life stage of a species, habitat use can be inferred on the basis of distributions among habitats where the species has been found and on information about its habitat requirements and behavior. Habitat use may also be inferred, if appropriate, based on information on a similar species or another life stage.
>
> Level 2: Habitat-related densities of the species are available. At this level, quantitative data (i.e., density or relative abundance) are available for the habitats occupied by a species or life stage. Because the efficiency of sampling methods is often affected by habitat characteristics, strict quality assurance criteria should be used to ensure that density estimates are comparable among methods and habitats. Density data should reflect habitat utilization, and the degree that a habitat is utilized is assumed to be indicative of habitat value. When assessing habitat value on the basis of fish densities in this manner, temporal changes in habitat availability and utilization should be considered.
>
> Level 3: Growth, reproduction, or survival rates within habitats are available. At this level, data are available on habitat-related growth, reproduction, and/or survival by life stage. The habitats contributing the most to productivity should be those that support the highest growth, reproduction, and survival of the species (or life stage).

> Level 4: Production rates by habitat are available. At this level, data are available that directly relate the production rates of a species or life stage to habitat type, quantity, quality, and location. Essential habitats are those necessary to maintain fish production consistent with a sustainable fishery and the managed species' contribution to a healthy ecosystem.

The regulations specify that Level 1 information, if available, should be used to identify the geographic range of the species at each life stage. If only Level 1 information is available, distribution data should be evaluated (e.g., using a frequency of occurrence or other appropriate analysis) to identify EFH as those habitat areas most commonly used by the species. Levels 2 through 4 information, if available, should be used to identify EFH as the habitats supporting the highest relative abundance; growth, reproduction, or survival rates; and/or production rates within the geographic range of a species.

EFH Scientific Information

EFH descriptions are interpretations of the best scientific information. In support of this information, a review of FMP species is contained in Chapter 4 of the accompanying EA/RIR/IRFA.

Another important reference is the State of Alaska's *Catalogue of Waters Important for Spawning, Rearing, or Migration of Anadromous Fishes*. The catalogue is specific to freshwater fishes, including Dolly Varden char, whitefish and rainbow smelt, and focuses on freshwater and estuarine areas used by anadromous fishes throughout Alaska. The catalogue is divided into six regional areas: Arctic, Interior, Southcentral, Southeast, Southwestern, and Western. There are limitations to the catalogue, and many areas in Alaska have not been completely surveyed.
[http://www.sf.adfg.state.ak.us/SARR/FishDistrib/FDD_intro.cfm]

EFH Text Descriptions

The EFH Final Rule (50 CFR 600.815(a)(1)(iv)(B)) states the following:

> FMPs must describe EFH in text, including reference to the geographic location or extent of EFH using boundaries such as longitude and latitude, isotherms, isobaths, political boundaries, and major landmarks. If there are differences between the descriptions of EFH in text, maps, and tables, the textual description is ultimately determinative of the limits of EFH...the boundaries of EFH should be static.

The vastness of Alaska and the large number of individual fish species managed by FMPs make it challenging to describe EFH by text using static boundaries. To address this challenge, NMFS refers to the boundaries as defined by a Fishery Management Unit (FMU) for the FMP. The Arctic FMP FMU would be all marine waters in the EEZ of the Chukchi and Beaufort Seas from 3 nautical miles offshore the coast of Alaska to 200 nautical miles offshore, north of Bering Strait (from Cape Prince of Wales to Cape Dezhneva) and westward to the U.S./Russia Convention Line of 1867 and eastward to the U.S. Canada maritime boundary. The FMU southern boundary of Bering Strait would be changed to Pt. Hope for crab species under Alternative 4.

EFH Map Description

FMPs must include maps that display, within the constraints of available information, the geographic location of EFH or the geographic boundaries within which EFH for each species and life stage is found. A GIS system was used to delineate EFH map descriptions for this analysis. EFH descriptive maps depict, and are complimentary to, each life history EFH text description, if known. Maps are labeled and compiled at the end of this text description section.

EFH General Distribution

EFH is described as the general distribution for a species life stage, for all information levels and under all stock conditions. For Arctic EFH, general distribution is the area where presence has been documented by research effort and confirmed by species experts. Confirmation is achieved by review of each EFH description to ensure the area allows for stock and natural condition variances. Further, as specified in the EFH regulations, if little or no information exists for a given species life history stage, and habitat use cannot be inferred from other means, EFH should not be described (50 CFR 600.815(a)(1)(iii)(B)). This includes areas without systematic sampling and those areas where a species may have recruited to opportunistic sampling efforts in small numbers.

Objective

Describe EFH for Arctic stocks by each life history stage, where information exists. In those areas where information does not exist, then EFH will not be described.

EFH descriptions were analyzed through a process that met the objectives of the Magnuson-Stevens Act and EFH Final Rule. Specifically, the objective was to identify EFH for each FMP species, by particular life stage and using best scientific information and technology, as only those waters and substrates necessary to the species.

Rationale

Basic Rationales for Arctic EFH General Distribution:

- Adequately addresses unpredictable annual differences in spatial distributions of a life stage and changes due to long-term shifts in oceanographic regimes;
- Account for habitat production and contribution at some level;
- Allows for a stock’s long-term productivity, based on both high and low levels of abundance;
- Reflects the habitat required to maintain healthy stocks within the ecosystem;
- Provides for changes in the natural environmental condition, such as prey movements and areas needed for growth, maturation, and diversity;
- Offers a risk-averse approach and employs an additive ecosystem approach to suggest that, unless the information indicates otherwise, a more inclusive general distribution should describe EFH.

Methodology

The analysis examined available information and major data sources for the Arctic: Bering, Chukchi, and Beaufort Seas Coastal and Ocean Zones Strategic Assessment: Data Atlas (DOC/NOAA. Ehler, Ray, Fay, Hickok. 1988); Fishery observer and catch data for the BSAI Groundfish, BSAI Crab, and Scallop FMP fisheries (Fritz et al. 1998), NMFS survey records (Fair and Nelson 1999), USDOI Minerals Management Service studies, and, where appropriate, ADF&G survey information to select occurrences where one would reasonably (with high probability) expect to find a certain life stage of that species. Where this information exists, text describes EFH by life history stage. EFH descriptions underwent scientific stock assessment expert review for accuracy. Note: Information is limited for the Arctic Region; the Arctic lacks systematic fisheries stock survey assessments.

For Dolly Varden char, whitefishes, and rainbow smelt the analysis focused on two areas: marine and freshwater. EFH was generally described to include all marine waters from the mean higher high water line to the limits of the EEZ, since scientific information indicates these species are: 1) distributed throughout all marine waters during late juvenile and adult life stages and 2) found nearshore and along coastal migration corridors as early juvenile life stages out-migrate and adult life stages return to and from freshwater areas, respectively. Freshwater areas used by egg, larvae, juvenile, and returning adults will be described as those areas indexed by the state of Alaska's *Catalog of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes*. Specifically, these systems are generally defined as those areas above mean higher tide to the upper limits of the freshwater system that supports these fish and includes rivers, streams, and those hydrologically connected waters of the main source, such as estuaries, sloughs, channels, contiguous wetlands, and connected lakes and ponds.

Notes:

1. Species listed in this section are known to have been commercially harvested or recruited to scientific sampling gear in the Arctic Region. Incidental or occasional occurrences of a species does not transpose to:
    a. A larger EFH Description for the species;
    b. A higher knowledge of this species range or habitat requirements.
2. EFH cannot be described for many species and life history stages:
    a. Species general distribution is not within Arctic Management Area.
    b. Information exists, however is site specific and does not depict a general distribution, rather an even broader range. Simply, the scale does not allow for a refinement of the area; all waters are not considered EFH for every species and life stage.
3. Late Juvenile and Adult EFH Descriptions are often repetitive:
    a. Life stages are hard to discern.
    b. Individual life stage recruits the same to sampling effort.
4. Crab EFH descriptions exist for the Arctic and are within the current BSAI Crab FMP (EFH FEIS April 2005). The BSAI crab fishery descriptions would change under Alternative 2 and 3. Under these alternatives, the crab descriptions north of the Bering Straight would be part of the Arctic FMP. Crab descriptions south of Bering Strait would remain in the BSAI Crab FMP. Under Alternatives 1 and 4, crab EFH up to Pt. Hope would remain in the crab FMP.
5. Scallop EFH descriptions exist within the current Scallop FMP (EFH FEIS April 2005). The scallop FMU in the scallop FMP that includes Arctic waters would change under Alternatives 2, 3, and 4. Scallop EFH descriptions north of Bering Strait would be part of the Arctic FMP.
6. Salmon EFH descriptions exist for the Arctic within the current Salmon Fisheries FMP (EFH FEIS April 2005).
7. The ADF&G Anadromous Fish Catalog identifies fresh water areas used by char, smelt, and whitefish. Thus, the ADF&G catalogue is the primary reference source for these species, where information exists.

Table 1. References Used to Describe Arctic EFH (See references)

Arctic FMP Species	Information Sources				
	Fishes of Alaska Mecklenburg;Thorsteinson	NOAA 1990	NOAA 1998	NOAA 1988 Bering, Chukchi, and Beaufort Seas Data Atlas	Council 2005	ADFG Catalogue of Anadromous Fish Waters
Pacific halibut	X					
Pacific herring	X					X
Pacific salmon	X				X	X
Dolly Varden char	X					X
Red king crab				X	X	
Whitefish[a]	X					X
Arctic cod	X					
Saffron cod	X			X		
Yellowfin sole	X		X	X	X	
Alaska plaice	X		X	X	X	
Other flatfish						
Flathead sole/Bering flounder	X	X	X	X	X	
Starry flounder	X		X	X		
Walleye pollock	X	X	X	X	X	
Other gadids						
Pacific Ocean perch	X				X	
Capelin	X			X	X	
Rainbow smelt	X			X	X	
Eulachon	X					X
Pacific sand lance	X			X		
Skates	X		X	X	X	
Sharks	X		X	X	X	
Gunnels	X			X	X	
Pricklebacks	X			X	X	
Eelpouts	X				X	
Sailfishes	X			X	X	
Lumpsuckers	X					
Poachers	X					
Sculpin[b]	X		X	X	X	
Laternfishes	X				X	
Sticklebacks	X				X	
Greenling	X					
Squid					X	
Blue king crab				X	X	
Opilio tanner crab				X	X	
Scallops				X	X	

[a] Includes inconnu; Arctic, Bering, and least ciscoes; and broad, humpback, and round whitefishes

[b] Includes spatulate (0 to 400m), Arctic staghorn (0 to 250), ribbed (20 to 150m), fourhorn (0 to 25m), shorthorn (0 to 500m), Arctic (0 to 25m), and great sculpin (0 to 200) and the hamecon (0 to 500m)

Table 2. EFH Information Levels for Arctic Fish

Arctic FMP Species		Life History Stage			
		Eggs	Larvae	Juvenile	Adult
P	Pacific halibut	Not Described			
P	Pacific herring				
P	Pacific salmon				
P	Dolly Varden char				
P	Red king crab				
P	Whitefish[a]				
E	Arctic cod	-	-	1	1
E	Saffron cod	-	-	1	1
E	Yellowfin sole	-	-	1	1
E	Alaska plaice	-	-	1	1
E	Other flatfish				
E	Flathead sole/Bering flounder	-	-	1	1
E	Starry flounder	-	-	1	1
E	Walleye pollock	-	-	-	-
E	Other gadids	-	-	-	-
E	Pacific Ocean perch	-	-	-	-
E	Capelin	-	-	-	1
E	Rainbow smelt	-	-	-	1
E	Eulachon	-	-	-	-
E	Pacific sand lance	-	-	-	1
E	Skates	-	-	-	-
E	Sharks	-	-	-	-
E	Gunnels	-	-	-	-
E	Pricklebacks	-	-	-	-
E	Eelpouts	-	-	-	-
E	Sailfishes	-	-	-	-
E	Lumpsuckers	-	-	-	-
E	Poachers	-	-	-	-
E	Sculpin[b]	-	-	-	-
E	Laternfishes	-	-	-	-
E	Sticklebacks	-	-	-	-
E	Greenling	-	-	-	-
E	Squid	-	-	-	-
E	Blue king crab	1	-	1	1
E	Opilio tanner crab	1	-	1	1
E	Scallops	-	-	-	-
Arctic FMP Species		Eggs	Larvae	Juvenile	Adult

P	Prohobited Species
E	Ecosystem Component Species
1	Level of EFH Information where distribution data is avlaible for some or all of the species goeprahpic range (General Distribution). In many instances, one map describes EFH for both late juvenile and adult life stages; both life stages often recruit to the same sampling method and are difficult to distinguish. See specific EFH Text for any specific differences.
a	Includes inconnu; Arctic, Bering, and least ciscoes; and broad, humpback, and round whitefishes
b	Includes spatulate (0 to 400m), Arctic staghorn (0 to 250), ribbed (20 to 150m), fourhorn (0 to 25m), shorthorn (0 to 500m), Arctic (0 to 25m), and great sculpin (0 to 200) and the hamecon (0 to 500m)

Arctic EFH Text Descriptions

Prohibited Species Category

The Prohibited Species category includes Pacific halibut, herring, salmon, Dolly Varden char, and whitefish. EFH will not be described for Pacific halibut, herring, salmon, whitefish, and Dolly Varden char since these species are not managed under the FMP.

Ecosystem Component Species

EFH Description for Arctic Cod

Insufficient information is available to determine EFH for Eggs, Larvae, and Early Juveniles.

Late Juveniles
EFH for late juvenile Arctic cod is the general distribution areas for this life stage located in pelagic and epipelagic waters from the nearshore to offshore areas along the entire shelf (0-200m) and upper slope (200-500m) throughout Arctic and often associated with ice floes.

Adults
EFH for adult Arctic cod is the general distribution area for this life stage located in pelagic and epipelagic waters from the nearshore to offshore areas along the entire shelf (0-200m) and upper slope (200-500m) throughout Arctic and often associated with ice floes.

EFH Description for Saffron Cod

Insufficient information is available to determine EFH for Eggs, Larvae, and Early Juveniles.

Late Juveniles
EFH for late juvenile Saffron cod is the general distribution area for this life stage, located in pelagic and epipelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m) shelf throughout Arctic waters and wherever there are substrates consisting for sand and gravel.

Adults
EFH for a Saffron cod is the general distribution area for this life stage, located in pelagic and epipelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m) shelf throughout Arctic waters and wherever there are substrates consisting for sand and gravel.

EFH Description for Yellowfin Sole

Insufficient information is available to determine EFH for Eggs, Larvae, and Early Juveniles.

Late Juveniles
EFH for late juvenile yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the entire shelf (0 to 200 m), mostly in Arctic waters south of Point Barrow, and wherever there are soft substrates consisting mainly of sand.

Adults
EFH for adult yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the entire shelf (0 to 200 m), mostly in Arctic waters south of Point Barrow, and wherever there are soft substrates consisting mainly of sand.

EFH Description for Alaska Plaice

Insufficient information is available to determine EFH for Eggs, Larvae, and Early Juveniles.

Late Juveniles
EFH for late juvenile Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Point Barrow mainly in areas consisting of sand and silt and known to migrate in association with seasonal ice movements (deeper in winter, shallower in summer).

Adults
EFH for late juvenile Alaska plaice is the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Point Barrow mainly in areas consisting of sand and silt and known to migrate in association with seasonal ice movements (deeper in winter, shallower in summer).

EFH Description for Flathead Sole / Bering Flounder

Note: Flathead sole and Bering flounder are grouped together due to similarity of these two species and habitat associations. Generally, flathead sole are located south of Bering Strait, while Bering flounder range throughout the Bering and Chukchi Seas to Point Barrow.

Insufficient information is available to determine EFH for Eggs, Larvae, and Early Juveniles.

Late Juveniles
EFH for late juvenile flathead sole/Bering flounder is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m) and middle (50 to 100 m) shelf mostly in Arctic waters south of Point Barrow and wherever there are soft substrates consisting mainly of sand and mud.

Adults
EFH for adult flathead sole/Bering flounder is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m) and middle (50 to 100 m) shelf mostly in Arctic waters south of Point Barrow and wherever there are soft substrates consisting mainly of sand and mud.

EFH Description for Starry Flounder

Insufficient information is available to determine EFH for Eggs, Larvae, and Early Juveniles.

Late Juveniles
EFH for late juvenile starry flounder is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays, estuaries, and river mouths and along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Point Barrow and wherever there are soft substrates consisting mainly of sand, silt, and mud.

Adults
EFH for adult starry flounder is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays, estuaries, and river mouths and along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Point Barrow and wherever there are soft substrates consisting mainly of sand, silt, and mud.

EFH Description for Walleye Pollock

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Other Gadids

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Pacific Ocean Perch

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Capelin

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, and Late Juveniles.

Adults

EFH for adult capelin is the general distribution area for this life stage, located in epipelagic and epibenthic waters along the coastline, within nearshore bays, and along the inner (0 to 50 m) shelf throughout Arctic waters with spawning occurring in intertidal and subtidal shallow areas consisting of sand and gravel.

EFH Description for Rainbow Smelt

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, and Late Juveniles.

Adults

EFH for adult rainbow smelt is the general distribution area for this life stage, located in epipelagic and epibenthic waters along the nearshore throughout Arctic waters in areas of mainly consisting of sandy gravel and cobbles with spawning occurring in coastal freshwater streams.

EFH Description for Eulachon

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Pacific Sand Lance

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Skates

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Sharks

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Gunnels (Pholidae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Pricklebacks (Stichaedae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Eelpouts (Zoarcidae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Snailfishes (Liparidae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Lumpsuckers (Cylcopteridae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Poachers (Agonidae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Sculpins (Cottidae)

Species group includes the spatulate (0 to 400m), Arctic staghorn (0 to 250), ribbed (20 to 150m), fourhorn (0 to 25m), shorthorn (0 to 500m), Arctic (0 to 25m), and great sculpin (0 to 200) and the hamecon (0 to 500m).

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Laternfishes (Myctophidae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Sticklebacks (Gasterosteridae)

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Greenling

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Squid

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

EFH Description for Blue King Crab

Eggs
Essential fish habitat of the blue king crab eggs is inferred from the general distribution of egg-bearing female crab (see also Adults).

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile blue king crab is the general distribution area for this life stage, located in bottom habitats along the nearshore (spawning aggregations) and the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters, with local distributions surrounding St. Lawrence Island e1tending northward into Bering Strait, and wherever there are rockier substrates areas and shell hash.

Adults
EFH for adult blue king crab is the general distribution area for this life stage, located in bottom habitats along the nearshore (spawning aggregations) and the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters, with local distributions surrounding St. Lawrence Island e1tending northward into Bering Strait, and wherever there are rockier substrates areas and shell hash.

EFH Description for Opilio Tanner Crab (*C. opilio*)

Eggs
Essential fish habitat of Tanner crab eggs is inferred form the general distribution of egg-bearing female crab (see also Adults).

Larvae—No EFH Description Determined
Insufficient information is available.

Early Juveniles—No EFH Description Determined
Insufficient information is available.

Late Juveniles
EFH for late juvenile tanner crab is the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Cape Lisburne, wherever there are substrates consisting mainly of mud.

Adults
EFH for adult tanner crab is the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Cape Lisburne, wherever there are substrates consisting mainly of mud.

EFH Description for Weathervane Scallops

Insufficient information is available to determine EFH for Eggs, Larvae, Early Juveniles, Late Juveniles, and Adults.

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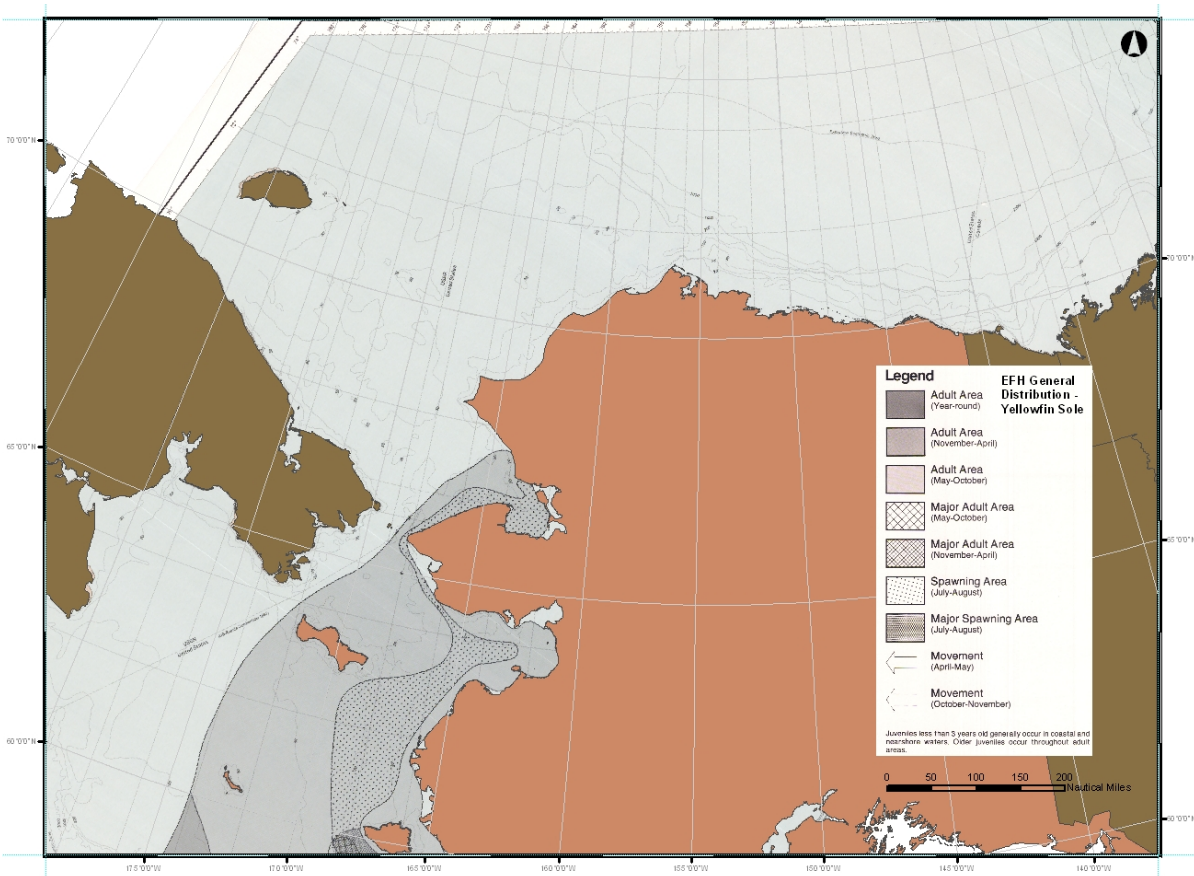
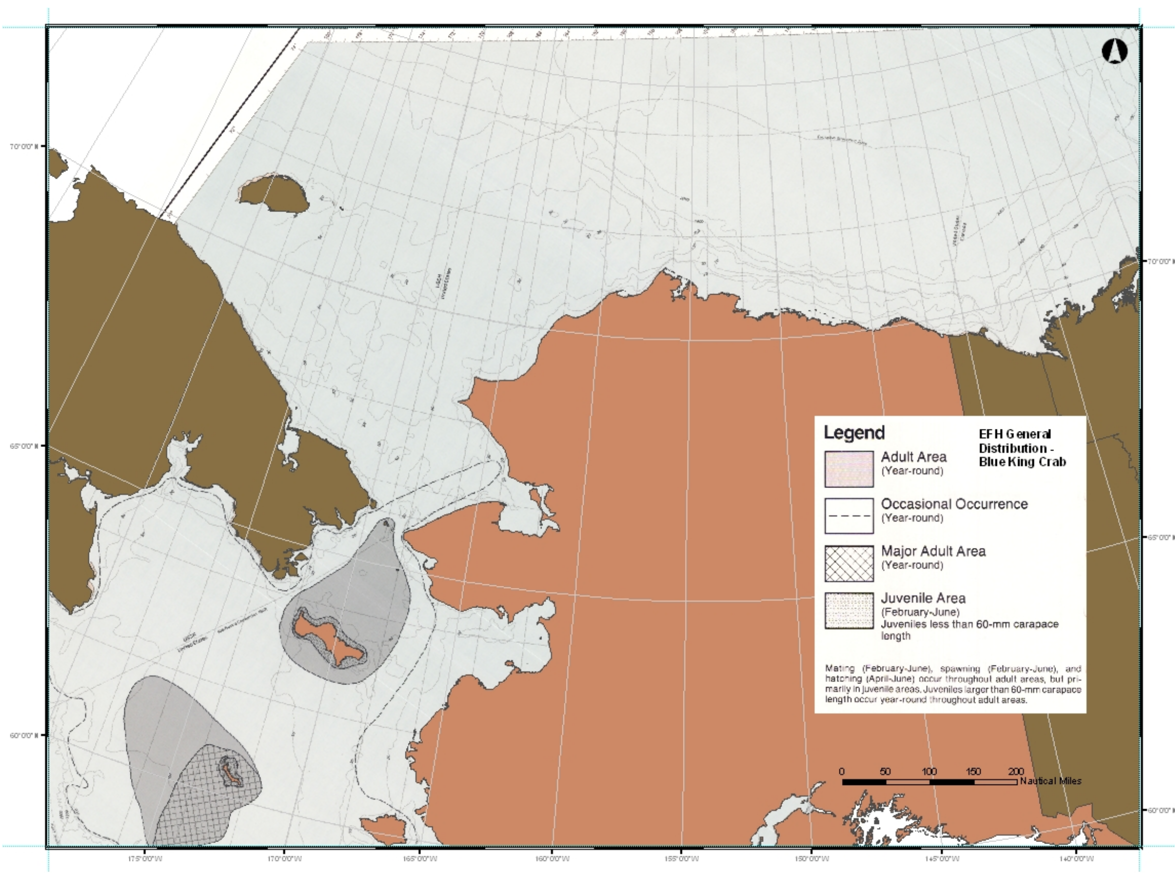
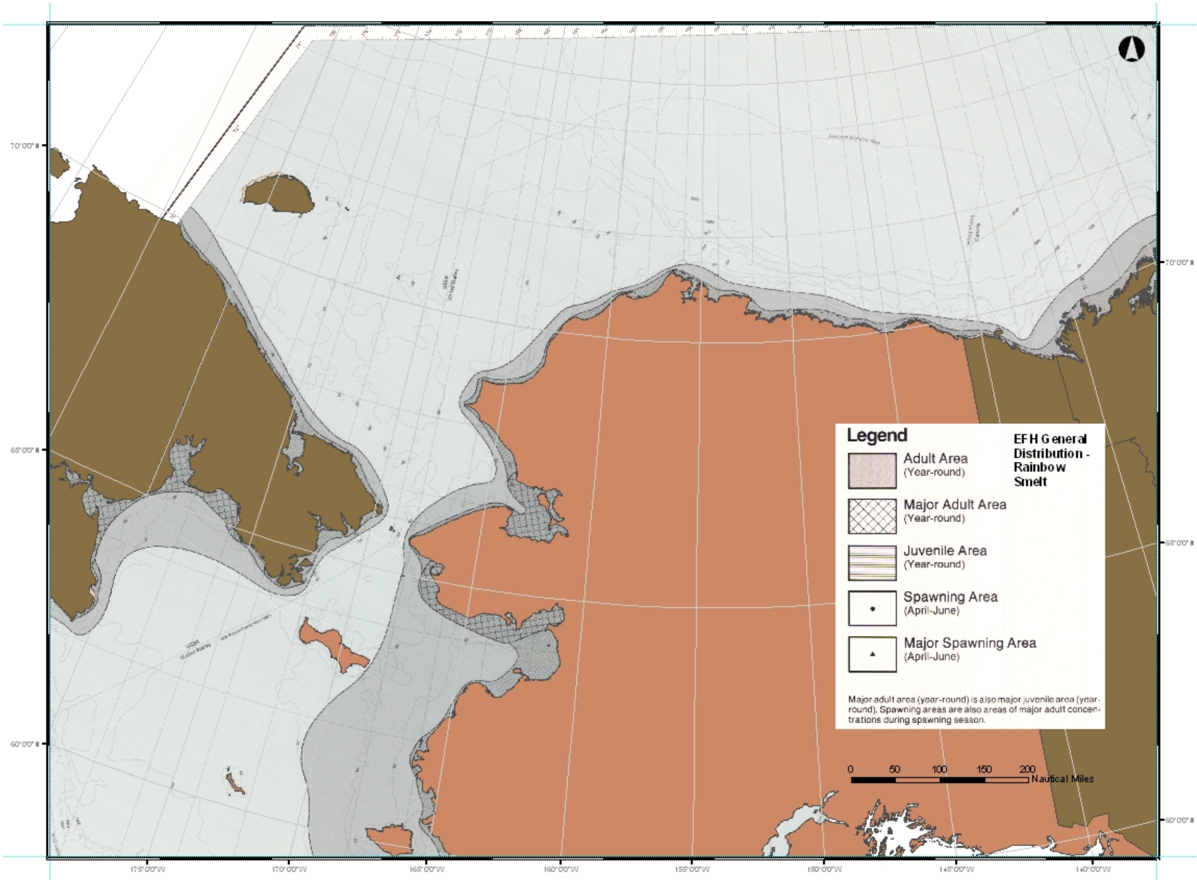
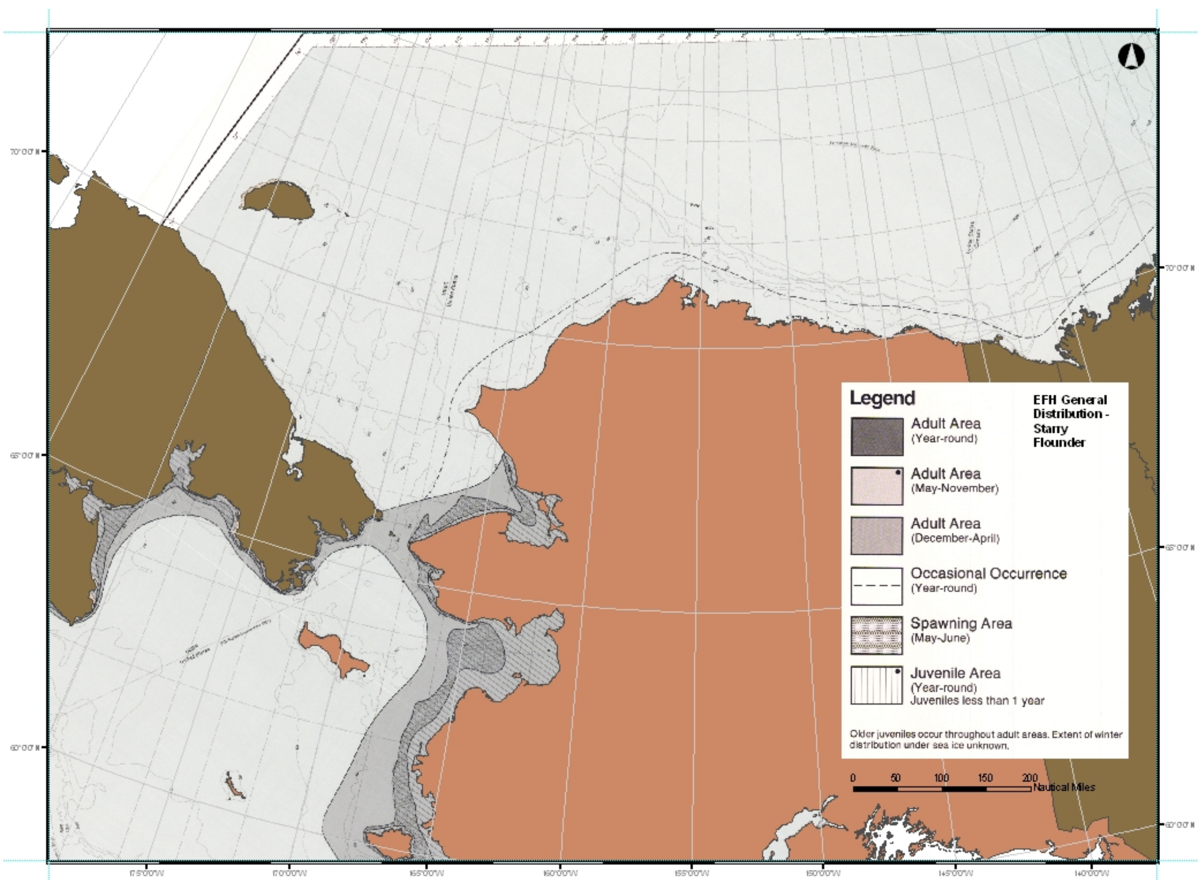


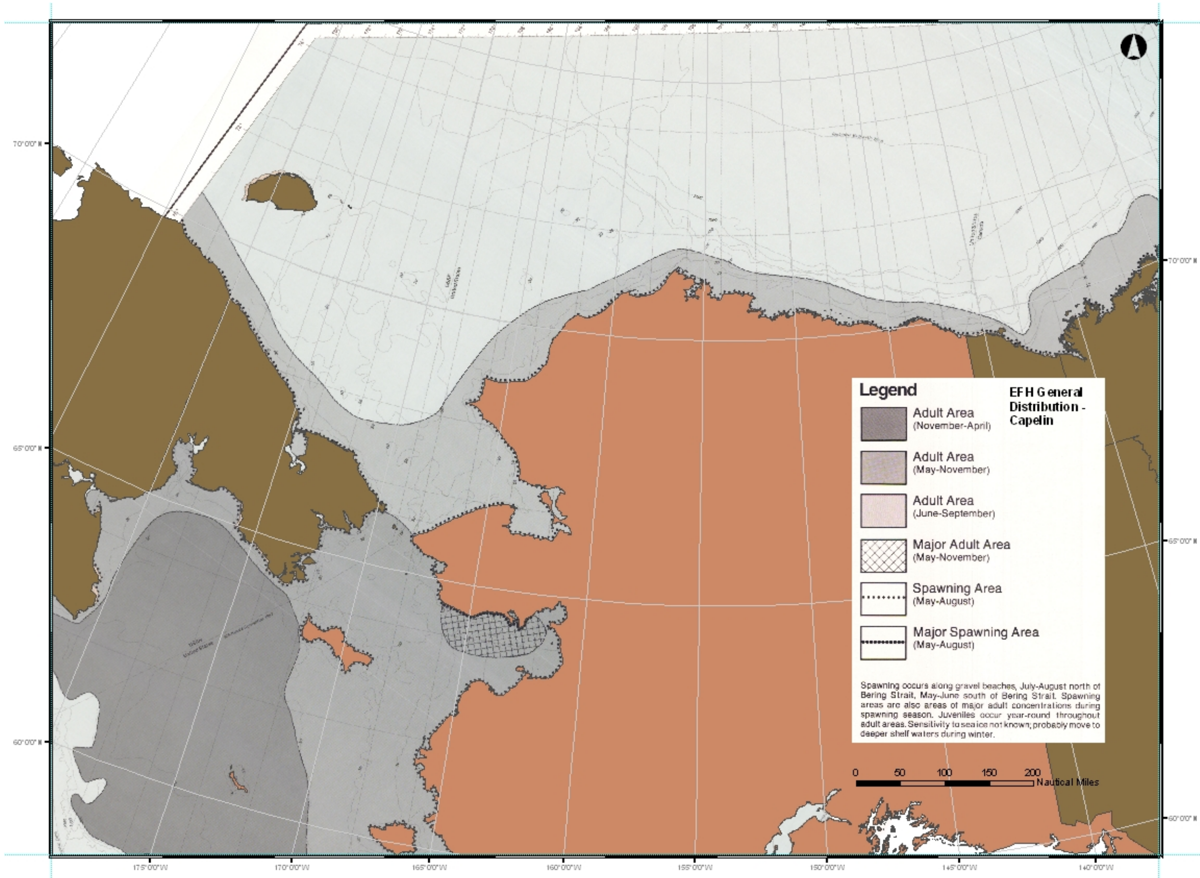
Legend
EFH General Distribution - Yellowfin Sole
Adult Area (Year-round)
Adult Area (November-April)
Adult Area (May-October)
Major Adult Area (May-October)
Major Adult Area (November-April)
Spawning Area (July-August)
Major Spawning Area (July-August)
Movement (April-May)
Movement (October-November)
Juveniles less than 3 years old generally occur in coastal and nearshore waters. Older juveniles occur throughout adult areas.
0 50 100 150 200 Nautical Miles

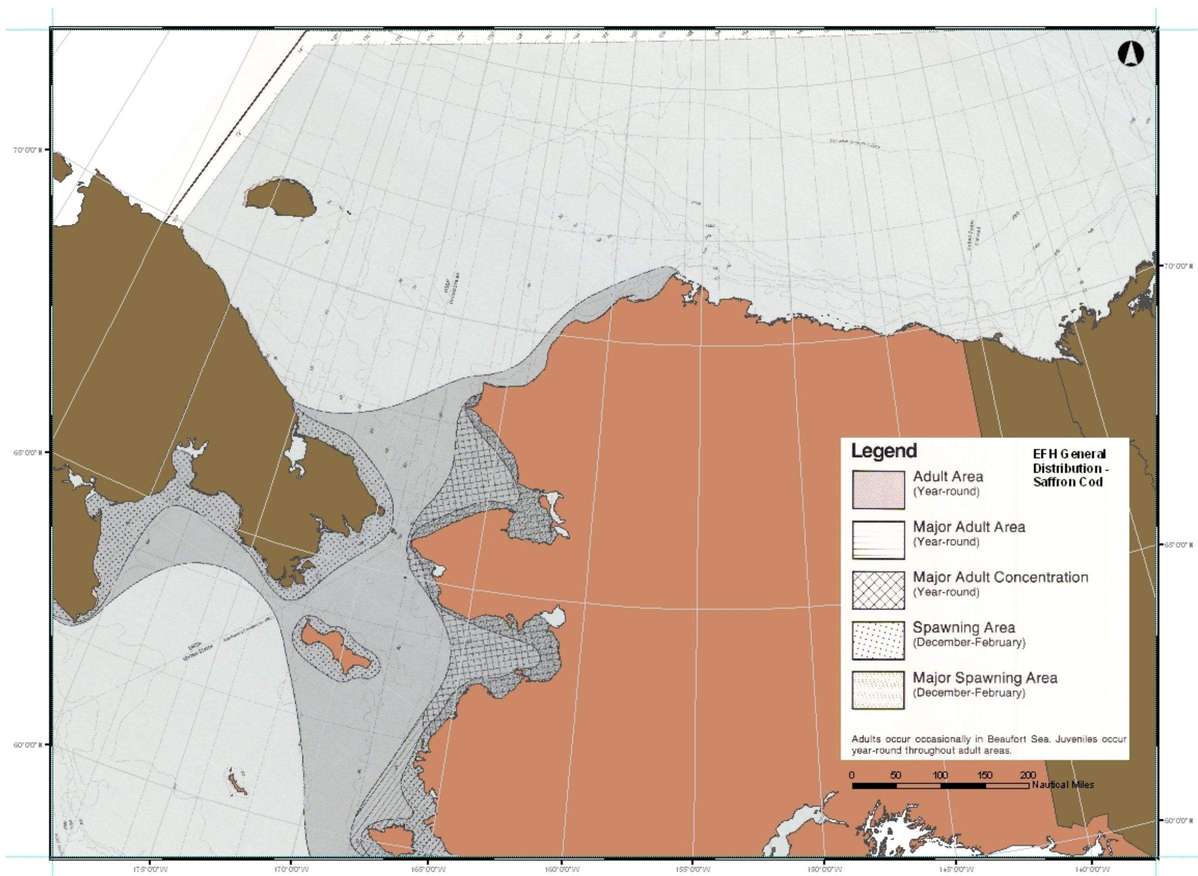


Legend
EFH General Distribution - Blue King Crab
Adult Area (Year-round)
Occasional Occurrence (Year-round)
Major Adult Area (Year-round)
Juvenile Area (February-June) Juveniles less than 60-mm carapace length
Mating (February-June), spawning (February-June), and hatching (April-June) occur throughout adult areas, but primarily in juvenile areas. Juveniles larger than 60-mm carapace length occur year-round throughout adult areas.
0 50 100 150 200 Nautical Miles

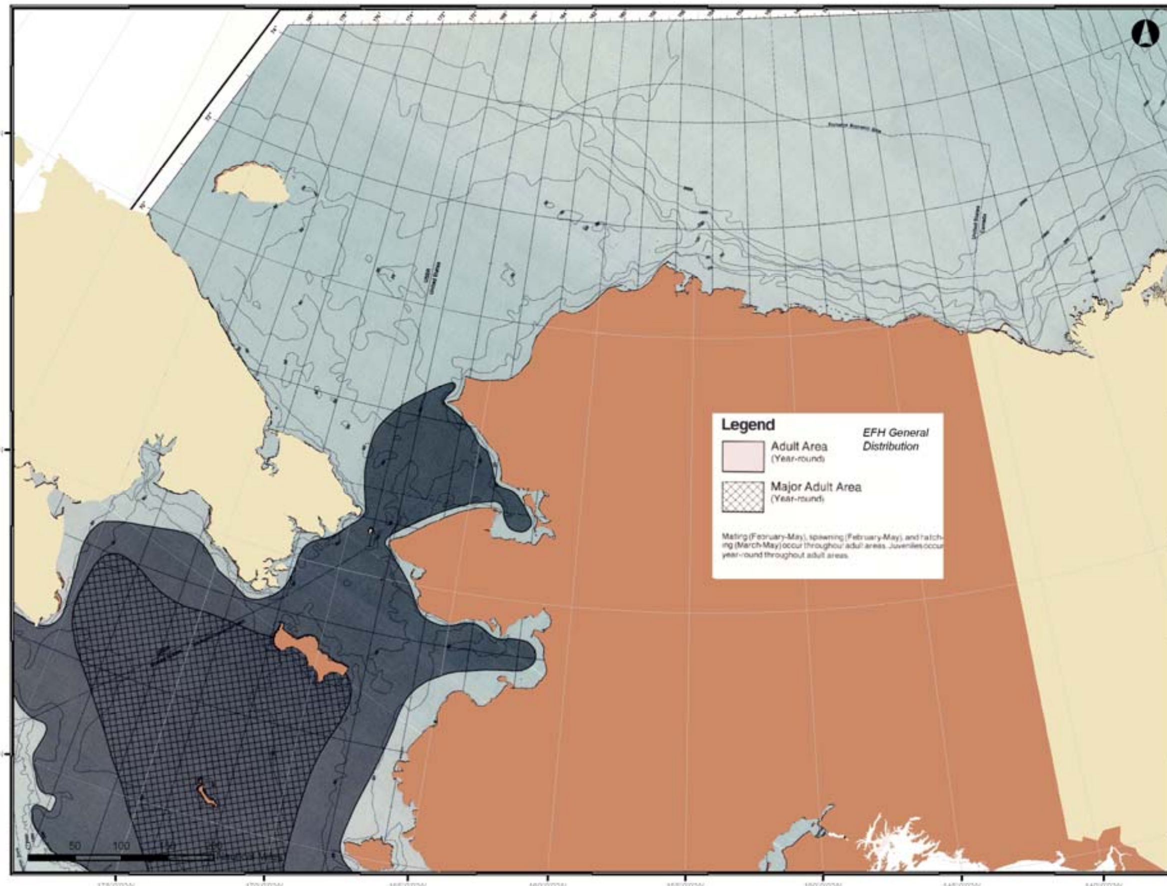

Legend
EFH General Distribution - Rainbow Smelt
Adult Area
(Year-round)
Major Adult Area
(Year-round)
Juvenile Area
(Year-round)
Spawning Area
(April-June)
Major Spawning Area
(April-June)
Major adult area (year-round) is also major juvenile area (year-round). Spawning areas are also areas of major adult concentrations during spawning season.
0 50 100 150 200 Nautical Miles


Legend
EFH General Distribution - Starry Flounder
Adult Area
(Year-round)
Adult Area
(May-November)
Adult Area
(December-April)
Occasional Occurrence
(Year-round)
Spawning Area
(May-June)
Juvenile Area
(Year-round)
Juveniles less than 1 year
Older juveniles occur throughout adult areas. Extent of winter distribution under sea ice unknown.
0 50 100 150 200 Nautical Miles

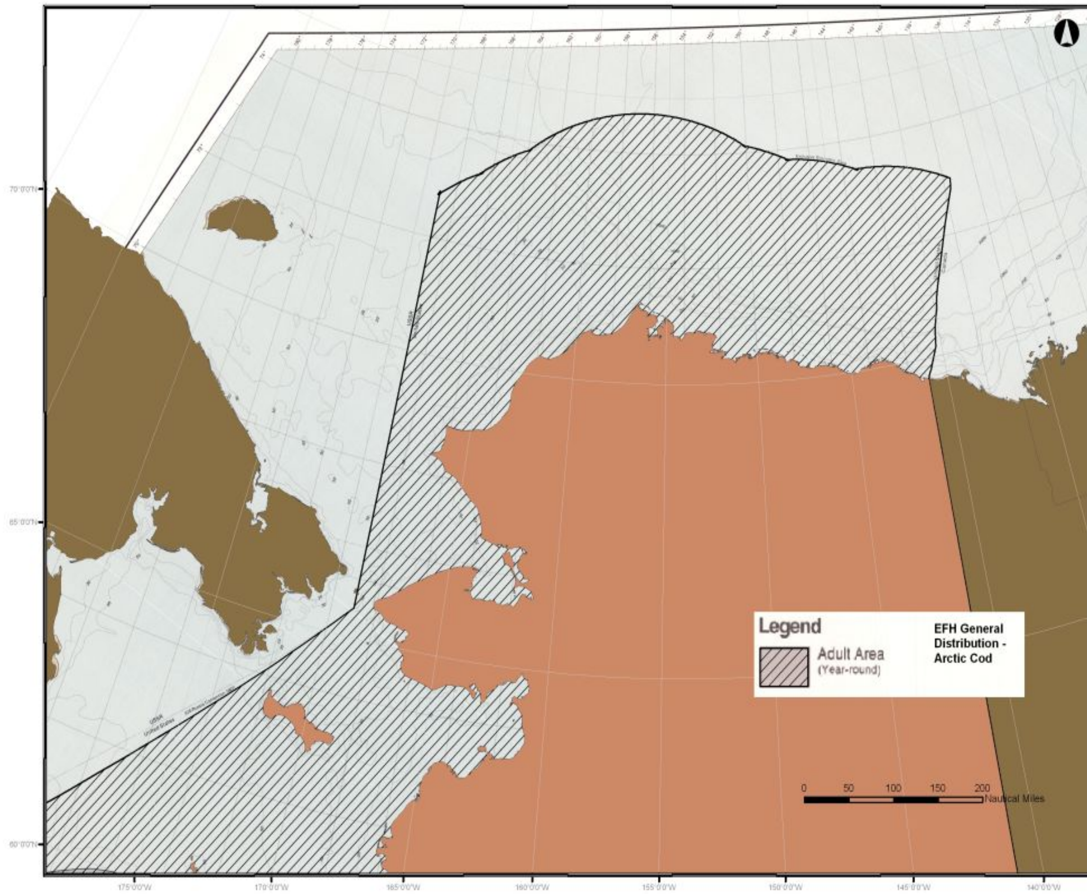

Legend
EFH General Distribution - Capelin
Adult Area (November-April)
Adult Area (May-November)
Adult Area (June-September)
Major Adult Area (May-November)
Spawning Area (May-August)
Major Spawning Area (May-August)
Spawning occurs along gravel beaches, July-August north of Bering Strait, May-June south of Bering Strait. Spawning areas are also areas of major adult concentrations during spawning season. Juveniles occur year-round throughout adult areas. Sensitivity to sea ice not known; probably move to deeper shelf waters during winter.
0 50 100 150 200 Nautical Miles

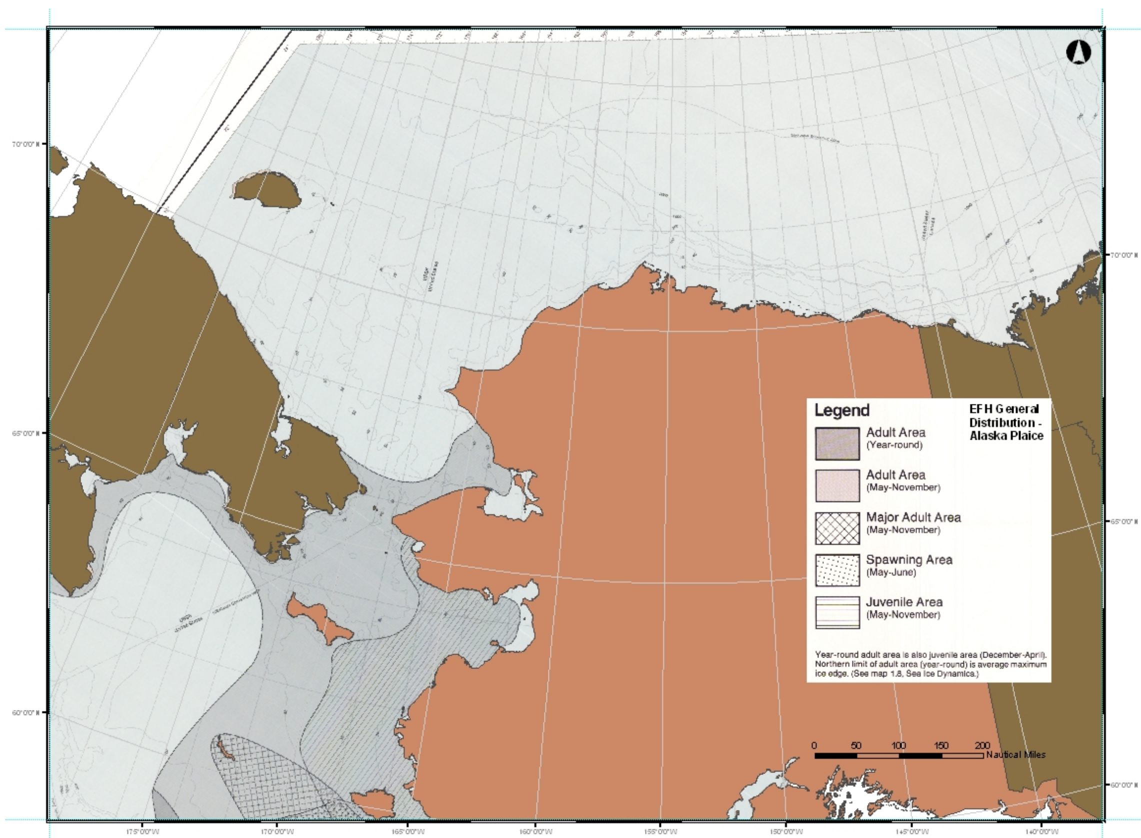

Legend
EFH General Distribution - Saffron Cod
Adult Area (Year-round)
Major Adult Area (Year-round)
Major Adult Concentration (Year-round)
Spawning Area (December-February)
Major Spawning Area (December-February)
Adults occur occasionally in Beaufort Sea. Juveniles occur year-round throughout adult areas.
0 50 100 150 200 Nautical Miles

Snow Crab EFH Map



Place holder for Flathead sole/Bering Flounder map


Legend
Adult Area
(Year-round)
EFH General Distribution - Arctic Cod
0 50 100 150 200
Nautical Miles


Legend
EFH General Distribution - Alaska Plaice
Adult Area
(Year-round)
Adult Area
(May-November)
Major Adult Area
(May-November)
Spawning Area
(May-June)
Juvenile Area
(May-November)
Year-round adult area is also juvenile area (December-April). Northern limit of adult area (year-round) is average maximum ice edge. (See map 1.8, Sea Ice Dynamics.)
0 50 100 150 200
Nautical Miles