UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

JAN 1 4 2008

Dear Reviewer:

In accordance with provisions of the National Environmental Policy Act (NEPA), we enclose for your review the Final Environmental Impact Statement (FEIS) For Issuing Annual Quotas to the Alaska Eskimo Whaling Commission for a Subsistence Hunt on Bowhead Whales for the Years 2008 through 2012.

This FEIS was prepared pursuant to NEPA to assess the environmental impacts associated with NOAA's issuance of an annual subsistence hunt quota. In May 2007, the International Whaling Commission reauthorized the subsistence hunt catch limit for another five years. NOAA's proposed action is to issue annual quotas to the AEWC subject to the terms and conditions of the co-management agreement between the Agency and the Commission. The purpose of this action is twofold: to manage the conservation and subsistence utilization of the Western Arctic stock of bowhead whales (as required by under the Marine Mammal Protection Act, the Whaling Convention Act, and other applicable laws) and to fulfill the Federal Government's trust responsibility to recognize the cultural and subsistence needs of Alaska Natives.

Additional copies of the FEIS may be obtained from the Responsible Program Manager identified below. The document is also accessible electronically through the NMFS Alaska Region's website at http://www.fakr.noaa.gov/analyses/bowhead/eis/default.htm.

A 30-day public comment period is being provided upon release of this FEIS. Please send comments to the Responsible Program Manager identified below by either mail or email. When submitting email comments include the following document identifier in the comment subject line: **Final Bowhead Whale EIS**. NOAA is not required to respond to comments received during the agency's 30 day review period as a result of the issuance of the FEIS. However, comments received by March 3, 2008 will be reviewed and considered for their impact on issuance of a Record of Decision (ROD). The ROD will be made available publicly on the Alaska Region's website following final agency action on or after March 14, 2008.

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Sincerely,

Rodney F. Weiher, Ph.D.
NOAA NEPA Coordinator

Enclosure

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

Lead Agency: USDC National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Alaska Region
Juneau, Alaska, and Seattle, Washington

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Cooperating Agencies: Alaska Eskimo Whaling Commission

Abstract: The National Marine Fisheries Service (NMFS) proposes to authorize subsistence harvests of the Western Arctic stock of bowhead whales for the years 2008 through 2012, under the Whaling Convention Act, and a cooperative agreement with the Alaska Eskimo Whaling Commission (AEWC). Under the International Convention for the Regulation of Whaling, the International Whaling Commission (IWC) approves overall five-year subsistence catch limits for the Western Arctic stock of bowhead whales based upon the needs of Native hunters in Alaskan villages and in Russian villages along the Chukotka Peninsula. On an annual basis, NMFS can issue the AEWC the Alaskan share of this quota by regulation. The subsequent hunt is managed under the Whaling Convention Act, cooperatively by NMFS and the AEWC. The purpose of this action is twofold: to manage the conservation and subsistence utilization of the Western Arctic stock of bowhead whales (as required under the Marine Mammal Protection Act [MMPA], the Whaling Convention Act, and other applicable laws) and to fulfill the Federal Government's trust responsibility to recognize the cultural and subsistence needs of Alaska Natives. The IWC conducted its 59th Annual Meeting, May 28-31, 2007 in Anchorage, Alaska, and, based on the management advice of the IWC Scientific Committee, adopted a catch limit for 2008 through 2012 identical to that of the previous five-year period. Alternative 3 corresponds to the IWC action, and is the Agency's preferred alternative. Alternative 3 would authorize a maximum mortality of 82 bowheads in a single year, if the authorized carry-over of 15 unused strikes were to occur. The subsistence harvest is also subject to an overall limit of no more than 255 bowhead whales over the five-year period 2008 through 2012. This level of mortality is considered negligible in magnitude for the bowhead population, in light of current abundance and growth trends. The overall effects of human activities associated with subsistence whaling under Alternative 3 results in a minor impact rating for the Western Arctic bowhead whale stock.

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ACRONYMS AND ABBREVIATIONS

2-D	two-dimensional
3-D	three-dimensional
ABF	Alaska Board of Fisheries
ACIA	Arctic Climate Impact Assessment
ADCCED	Alaska Department of Commerce, Community, and Economic Development
ADF&G	Alaska Department of Fish and Game
AEWC	Alaska Eskimo Whaling Commission
AMAP	Arctic Monitoring and Assessment Programme
ASRC	Arctic Slope Regional Corporation
AWI	Animal Welfare Institute
Cd	cadmium
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CI	Confidence Interval
cm	centimeters
CV	Coefficient of Variation
dB	decibels
dB re 1μPa at 1 m	decibels re 1 microPascal at 1 meter
DDTs	Dichlorodiphenyltrichloroethanes
DEW-Line	Defensive Early Warning System
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FR	Federal Register
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
ft	feet
G&G	Geological and Geophysical
HCHs	hexachlorocyclohexanes
Hg	mercury
Hz	hertz
IBLA	Interior Board of Land Appeals
ICRW	International Convention for the Regulation of Whaling
IHLC	Inupiat History, Language and Culture Commission
in^3	cubic inches
IPCC	Intergovernmental Panel on Climate Change
ISS	Ice/Sea Segments
IWC	International Whaling Commission
K	carrying capacity
kHz	kilohertz
km	kilometers

ACRONYMS AND ABBREVIATIONS (CONTINUED)

m	meters
mi.	miles
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MSY	Maximum Sustainable Yield
N(#)	number of whales estimated to have passed within # km of visual range based on visual surveys from shore
n. mi.	nautical miles
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NRDC	National Resources Defense Council
NSB	North Slope Borough
OCs	Organochlorines
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSP	optimum sustainable population
P(#)	proportion of whales estimated to have passed within #km range based on acoustic data and aerial surveys
PAHs	polycyclic aromatic hydrocarbons
PBR	potential biological removal
PCBs	polychlorinated biphenyls
POP	Platforms of Opportunity Program
psi	pounds per square inch
Q	A catch control rule developed by the IWC Scientific Committee
REDOIL	Resisting Environmental Destruction on Indigenous Lands
RFFAs	reasonably foreseeable future actions
ROD	Record of Decision
ROI	rate of increase
RY	replacement yield
Se	selenium
SEIS	Supplemental EIS
SLA	Strike Limit Algorithm
st. mi.	statute miles
TEK	traditional ecological knowledge
TOX	toxaphene
U.S.	United States
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service
WCA	Whaling Convention Act
WF	Whaleman Foundation
Y-K	Yukon-Kuskokwim

EXECUTIVE SUMMARY

ES.1 Description of the Proposed Action

The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) proposes to authorize subsistence harvests of the Western Arctic stock of bowhead whales for the years 2008 through 2012, under the Whaling Convention Act (WCA), and a cooperative agreement with the Alaska Eskimo Whaling Commission (AEWC). Under the International Convention for the Regulation of Whaling (ICRW), the International Whaling Commission (IWC) approves overall five-year subsistence catch limits for the Western Arctic stock of bowhead whales based upon the needs of Native hunters in Alaskan villages and in Russian villages along the Chukotka Peninsula. On an annual basis, NMFS can issue the AEWC the Alaskan share of this quota by regulation. The subsequent hunt is managed under the WCA, cooperatively by NMFS and the AEWC.

The purpose of this action is twofold: to manage the conservation and subsistence utilization of the Western Arctic stock of bowhead whales (as required under the Marine Mammal Protection Act [MMPA], the WCA, and other applicable laws) and to fulfill the Federal Government's trust responsibility to recognize the cultural and subsistence needs of Alaska Natives.

The IWC conducted its 59th Annual Meeting, May 28-31, 2007 in Anchorage, Alaska, and, based on the management advice of the IWC Scientific Committee, adopted a catch limit for 2008 through 2012 identical to that of the previous five-year period. Alternative 3 corresponds to the IWC action, and is the preferred alternative, as noted below. For additional information on the legal context and regulatory history of the proposed action, see Sections 1.1 and 1.2.

The proposed action continues implementation of IWC subsistence catch limits which have been in effect since 1977. The IWC, NMFS, and the AEWC have cooperated in conserving and managing the subsistence harvest of bowhead whales for 30 years. The Western Arctic bowhead whale stock has been the subject of extensive research by scientists of NMFS and the North Slope Borough, so a considerable body of knowledge has been developed. In general, relatively few public and agency comments were received during the scoping period and during the period for comments on the Draft Environmental Impact Statement (EIS). For a summary see Section 1.3. Among the issues raised in agency and public comments are the following:

- compliance with National Environmental Policy Act (NEPA) requirements, including the adequacy of the alternatives analyzed;
- the biological and social effects of subsistence whaling;
- the analysis of cumulative effects from climate change and oil and gas exploration and development;
- the need for the proposed level of subsistence whaling allocations; and
- humane methods of take.

ES.2 Status of the Western Arctic Stock of Bowhead Whales

The Western Arctic bowhead whale is listed as "endangered" under the Endangered Species Act (ESA) and designated as "depleted" under the MMPA. However, the stock has been increasing in recent years. The current estimate of 10,545 whales is between 46% and 101% of the estimated

pre-exploitation abundance (10,400-23,000). Some analyses suggest that the population may be approaching carrying capacity, though there is no sign of slowing in the population growth rate. The average annual level of human-caused mortality and serious injury is estimated to be 41 whales, which exceeds neither the Potential Biological Removal (PRB) level (95 whales), as discussed in Section 1.1.3 and Section 3.2 nor the IWC's annual catch limit (67 strikes per year, and not to exceed 255 whales landed for five years).

ES.3 Subsistence Hunting of Bowhead Whales

Most of the Western Arctic bowhead whales migrate annually from wintering areas in the northern Bering Sea, through the Chukchi Sea in the spring, and into the Beaufort Sea where they spend the summer. In the autumn they return to the Bering Sea to overwinter. Ten Alaskan coastal villages along this migratory route participate in traditional subsistence hunts of these whales: Gambell, Savoonga, Little Diomede, and Wales (on the Bering Sea coast); Kivalina, Point Hope, Wainwright, and Barrow (on the coast of the Chukchi Sea); and Nuiqsut and Kaktovik (on the coast of the Beaufort Sea).

The bowhead whale hunt constitutes an important subsistence activity for these communities, providing substantial quantities of food, as well as reinforcing the traditional skills and social structure of local Alaska Native culture. Such hunts have been regulated by a quota system under the authority of the IWC since 1977, with Alaska Native subsistence hunters from northern Alaskan communities taking less than one percent of the stock of bowhead whales per year.

Additional information on the cultural traditions of Alaska Native bowhead whaling is found in Section 3.5, while Section 3.6 describes the co-management role of the AEWC.

ES.4 Alternatives

This EIS is prepared pursuant to NEPA, (42 United States Code [U.S.C.] 4321 et seq.). Rather than the more limited review of an Environmental Assessment (EA), the fuller analysis of an EIS is provided here to provide greater transparency and opportunity for public review of NMFS's administration of the bowhead subsistence whaling program. The EIS considers four alternatives for this proposed action. Additional information on the alternatives is found in Section 2.

Under the IWC provisions, the limits on aboriginal subsistence whaling consist of two components. No more than 255 bowhead whales may be landed during the period 2008 through 2012. In addition, no more than 67 bowhead whales may be struck per year, with provision for a carry-over of up to 15 unused strikes from one year to the subsequent year, as detailed below in Alternative 3. The term "strike limit" is used to refer to this limitation on the number of whales that may be struck, and the term "unused strike" refers to an unused portion of the limit on the number of whales that may be struck. The strike limit is larger than the landed limit, to take into account that in some cases, whalers may strike or harpoon a whale and then not be able to land the whale.

For the three action alternatives (Alternative 2, Alternative 3, and Alternative 4), bowhead subsistence quotas are set annually by NMFS through regulations. The regulations are good for one year, so they must be re-issued every year. NMFS meets annually with the AEWC to review

the stock status and results of the previous year's hunt. If it is determined that a hunt can proceed, NMFS issues regulations setting the quota for the year.

ES.5 Alternative 1 (No Action) – Do not grant the AEWC a quota.

Under this alternative, NMFS would not issue the AEWC a subsistence whaling quota for cultural and nutritional purposes. This could occur if NMFS chose not to issue an annual quota because of environmental concerns.

ES.6 Alternative 2 – Grant the AEWC an annual strike quota of 67 bowhead whales, not to exceed a total of 255 landed whales over the five years 2008 through 2012, with no unused strikes added to the annual quota.

Under this alternative, NMFS would (through annual regulations) grant the AEWC an annual strike quota of 67 bowhead whales, subject to a total of 255 landed whales over the five years 2008 through 2012. A 'strike' is defined as hitting a whale with a lance, harpoon, or explosive device while 'landing' means bringing a whale or any parts thereof onto the ice or land in the course of a whaling operation (50 Code of Federal Regulations [CFR] 230.2). The quota for 255 landed whales represents the United States (U.S.) portion of the total allocation of 280 landed whales granted by the IWC to aboriginal whalers. The actual allocation of strikes between Alaska Eskimos and Russian Chukotkan Natives is determined on an annual basis through a bilateral agreement between the U.S. and Russian governments. Under this alternative, no unused strikes from a previous year would be added to the quota for a subsequent year, notwithstanding the IWC's approval of a carry-over of unused strikes in the bowhead subsistence quota.

ES.7 Alternative 3 (Preferred Alternative) – Grant the AEWC an annual strike quota of 67 bowhead whales, not to exceed a total of 255 landed whales over the five years 2008 through 2012, with no more than 15 unused strikes from the previous year added to the annual strike quota. This alternative would continue management as in the recent past, and as adopted in action by the IWC in late May 2007.

Under this alternative (the proposed action), NMFS would (through annual regulations) grant the AEWC an annual strike quota of 67 bowhead whales (plus carry-over), not to exceed a total of 255 landed whales over the five years 2008 through 2012. This alternative differs from Alternative 2, by allowing 15 unused strikes from a previous year to be added to the quota for a subsequent year, consistent with the IWC catch limit. A carry-over of up to 15 unused strikes was approved by the IWC, and allows for variability in hunting conditions from one year to the next within limits that conserve the Western Arctic bowhead stock.

ES.8 Alternative 4 – Grant the AEWC an annual strike quota of 67 bowhead whales, not to exceed a total of 255 landed whales over the five years 2008 through 2012, where, for unused strikes, up to 50% of the annual strike limit is added to the strike quota for a subsequent year.

Under this alternative, NMFS would (through annual regulations) grant the AEWC an annual strike quota of 67 bowhead whales per year (plus carry-over), not to exceed a total of 255 landed whales over the five years 2008 through 2012. This alternative differs from Alternative 3 by

allowing up to 50% of the unused annual strike limit from a previous year, (i.e., up to 33 whales struck) to be added to the quota for a subsequent year.

ES.9 Summary of Effects

In the sections that follow, the analysis of the biological effects of the alternatives on the Western Arctic bowhead whale stock focuses on the strike quota (i.e., 67 per year, with carry-over in some alternatives), rather than a quota for landed whales (255 for the period 2008 through 2012). There are no definitive data on the fate of whales struck and not landed, also referred to as struck and lost. Some of the struck and lost whales are likely to die as a result of the strike. As a precautionary measure, the analysis here estimates maximum mortality, and thus assumes for analytic purposes that all whale strikes result in mortality.

ES.9.1 Alternative 1–Direct and Indirect Effects on the Western Arctic Bowhead Whale Stock

Alternative 1 would eliminate the quota for subsistence taking of bowhead whales and result in the elimination of authorized subsistence whaling activities and harvest. No bowhead whales would be taken in subsistence harvests. The magnitude, extent, and duration of direct mortality under this alternative are therefore considered negligible to the population of bowheads. Human activities associated with subsistence whaling would be sharply reduced under this alternative, so that the amount of noise and disturbance from subsistence whaling would also be considered negligible. For additional information on the effects of this alternative, see Section 4.4.

ES.9.2 Alternative 2–Direct and Indirect Effects on the Western Arctic Bowhead Whale Stock

Under Alternative 2 the maximum annual mortality would be 67 bowhead whales, based on a strike limit of 67, and assuming that every strike may result in mortality. The subsistence harvest is further subject to a limit that no more than 255 bowhead whales may be landed during the five-year period. Under this alternative, total maximum mortality would be 335 (5x67) whales. Given the current abundance and growth trends, a total annual mortality of 67 bowhead whales under this alternative is unlikely to cause the population to decline or slow its rate of recovery. The magnitude, geographic extent, and duration of this level of mortality are therefore considered negligible for the bowhead population. Human activities associated with subsistence whaling under Alternative 2 would vary from year to year and place to place depending on whale movements, weather, ice characteristics, and social factors. Effects of human activities are localized and coincide with the presence of whales during their spring and autumn migrations. Disturbance to the Western Arctic bowhead whale stock from subsistence whaling activities under Alternative 2 would be localized and short-term and would be considered a minor impact level to the stock. For additional information on the effects of this alternative, see Section 4.4.

ES.9.3 Alternative 3–Direct and Indirect Effects on the Western Arctic Bowhead Whale Stock

Alternative 3 would authorize a maximum mortality of 82 bowheads in a single year, if the authorized maximum carry-over of 15 unused strikes were to occur. The subsistence harvest is also subject to the limit that no more than 255 bowhead whales may be landed over the five-year

period 2008 through 2012. Over the five-year period the total maximum mortality could be 350 whales (5x67, plus 15 carried over) or an average of 70 bowhead whales per year. This level of mortality is considered negligible in magnitude for the bowhead population, in light of current abundance and growth trends. The extent and duration of the effects under this alternative are the same as those for Alternative 2, so the overall impact is rated as negligible. The effects of human activities associated with subsistence whaling under Alternative 3 would be similar to those described for Alternative 2, with disturbance at a minor impact level for the Western Arctic bowhead whale stock. For additional information on the effects of this alternative, see Section 4.4.

ES.9.4 Alternative 4–Direct and Indirect Effects on the Western Arctic Bowhead Whale Stock

Alternative 4 would authorize a maximum mortality of 100 bowheads in a single year, if the maximum carry-over of 33 unused strikes were to occur. The subsistence harvest is also subject to the limit that no more than 255 bowhead whales may be landed over the five-year period 2008 through 2012. Assuming that each strike were to result in mortality, over the five-year period the total mortality could be 368 whales (5x67, plus 33 carried over strikes), or an average of 74 bowheads per year. This level of mortality is still considered negligible in magnitude at the current population level for bowheads, in light of current abundance and growth trends. The extent and duration of the effects under this alternative are the same as those for Alternative 2, so the overall impact is rated negligible. While the direct biological impact may be rated as negligible, the carry-over provision of this alternative would exceed that authorized by the IWC in the May 2007 meeting. The effects of human activities associated with subsistence whaling under Alternative 4 would be similar to those described for Alternative 2, with disturbance at a minor impact level for the Western Arctic bowhead whale stock. For additional information on the effects of this alternative, see Section 4.4.

ES.9.5 Effects of the Alternatives on Individual Whales

In addition to the effects of harvest on the Western Arctic bowhead whale stock, there are indirect disturbance effects on individual bowhead whales, not subject to the harvest. These impacts will be negligible in magnitude, extent, and duration under Alternative 1, since under this alternative no subsistence whaling would occur. Under Alternatives 2, 3, and 4, subsistence whaling would occur, and as described in the effects analysis in Section 4.4, the magnitude, extent and duration of the associated disturbance effects would be minor for the individual bowhead whales not subject to harvest. For additional information on the effects of the alternatives on individual whales, see Section 4.5.

ES.9.6 Effects of the Alternatives on Other Wildlife

In the absence of bowhead whaling under Alternative 1, subsistence hunting would be redirected to other species (especially seals, walrus, and caribou), resulting in minor, localized effects in terms of mortality. For species that often congregate in numbers, like walrus and caribou, disturbance could affect numerous animals for each hunting event, and the effects would be considered moderate. For species that are primarily dispersed, like seals and polar bears, few animals would be disturbed and the effects would be considered minor. Alternatives 2, 3, and 4

would have no more than negligible or minor effects on other wildlife species. For additional information see Section 4.7.

ES.9.7 Socio-cultural Effects of the Alternatives

Alternative 1 would result in major adverse impacts to the communities that rely heavily on subsistence hunts of bowheads for nutritional and cultural sustenance. This alternative would raise Environmental Justice concerns, since it would result in disproportionate adverse impacts to the predominantly minority and low income populations of the AEWC member communities. Alternative 1 would also likely be viewed as a failure on the part of NMFS to exercise its trust responsibility with respect to Alaska Eskimos and, possibly, to Native Americans in general. Alternatives 2, 3, and 4 would provide for continuation of subsistence bowhead whaling, with many beneficial effects of major magnitude, extent, and duration. For further information see Section 4.8.

ES.9.8 Cumulative Effects of the Alternatives

This EIS analyzes the cumulative effects of the alternatives when taken together with impacts from other activities and phenomena, such as oil exploration and climate change. The analysis of cumulative effects on the Western Arctic bowhead whale stock, found in Section 4.6, concludes that none of the alternatives, when ongoing mitigation measures are taken into consideration, would result in major adverse impacts on the bowhead whale population. None of the alternatives, when combined with other reasonably foreseeable activities, would result in major adverse effects on other wildlife species (Section 4.7). As for socio-cultural effects, only Alternative 1 (No Action) would result in major adverse effects, and this hold true when the cumulative effects of other activities are take into consideration (Section 4.8).

The following tables reproduced from Chapter 4 of this EIS summarize the direct, indirect, and cumulative effects under each alternative for all resources where environmental consequences were evaluated.

Table ES-1
Bowhead Whale Subsistence Harvest EIS Effects at a Glance

Effect Type	Alternative 1 No Action	Alternative 2 Allocate 67 Strikes, No Carry-over	Alternative 3 Allocate 67 Strikes, Carry-over up to 15	Alternative 4 Allocate 67 Strikes, Carry-over up to 50% (34)
Effect Type	Alternative 1 No Action	Alternative 2 Allocate 67 Strikes, No Carry-over	Alternative 3 Allocate 67 Strikes, Carry- over up to 15	Alternative 4 Allocate 67 Strikes, Carry-over up to 50% (34)
Direct and Indirect Effects on Whale Population - Mortality (Section 4.4)	Negligible	Negligible	Negligible	Negligible
Direct and Indirect Effects Whale Population - Disturbance (Section 4.4)	Negligible	Minor Adverse	Minor Adverse	Minor Adverse
Direct and Indirect Effects on Individual Whales (Section 4.5)	Disturbance - Negligible	Disturbance - Minor Adverse	Disturbance - Minor Adverse	Disturbance - Minor Adverse
Cumulative Effects on Whale Stock (Section 4.6)	Mortality - Negligible Disturbance - Minor Adverse	Mortality - Negligible Disturbance - Minor Adverse	Mortality - Negligible Disturbance - Minor Adverse	Mortality - Negligible Disturbance - Minor Adverse
Effects on other Wildlife (Section 4.7)	Minor Adverse to Moderate Adverse	Negligible to Minor Adverse	Negligible to Minor Adverse	Negligible to Minor Adverse
Effects on Subsistence Patterns (Section 4.8.1)	Major Adverse	Major Beneficial	Major Beneficial	Major Beneficial
Effects on Health (Section 4.8.2)	Major Adverse	Major Beneficial	Major Beneficial	Major Beneficial
Effects on Public Safety (Section 4.8.2)	Minor Beneficial	Minor Adverse	Minor Adverse	Minor Adverse
Effects on Other Tribes (Section 4.8.3)	Moderate Adverse to Major Adverse	Negligible	Negligible	Negligible
Effects on the General Public (Section 4.8.4)	Anti-whaling public – Moderate Beneficial Pro-indigenous rights public – Moderate Adverse	Anti-whaling public – Minor Adverse Pro-indigenous rights public – Minor Beneficial	Anti-whaling public – Minor Adverse Pro-indigenous rights public – Minor Beneficial	Anti-whaling public – Minor Adverse Pro-indigenous rights public – Minor Beneficial
Effects on Environmental Justice (Section 4.8.5)	Major Disproportionate Adverse Effects	No Disproportionate Adverse Effects	No Disproportionate Adverse Effects	No Disproportionate Adverse Effects

Key:

Adverse ←----------**Neutral**----------→**Beneficial**

Major	Moderate	Minor	Negligible	Minor	Moderate	Major

Disproportionate Adverse Effects	No Disproportionate Adverse Effects

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Table ES-2
Summary of Direct, Indirect, and Cumulative Effects on Bowhead Whales

Effect		Alternative 1 No Action: Do Not Grant AEWC a Quota	Alternative 2 Grant AEWC Annual Quotas (67 Strikes) with No Unused Strikes Carried Over	Alternative 3 (Preferred Alternative) Grant AEWC Annual Quotas (67 Strikes) with No More Than 15 Unused Strikes Carried Over Any One Year	Alternative 4 Grant AEWC Annual Quotas (67 Strikes) with Up to 50% of Unused Strikes Carried Over Any One Year
Direct and Indirect Effects	Mortality	Because this alternative would result in no authorized subsistence whaling, no direct or indirect mortality is likely. The magnitude, extent and duration of effects are considered negligible to the population of bowheads.	This alternative would authorize a continuing level of direct subsistence harvests comparable to the previous five years. Given the current level of bowhead abundance, the magnitude, extent, and duration of direct mortality under this alternative is considered negligible to the population of bowheads.	Bowhead whales - (Same as Alternative 2)	Bowhead whales - (Same as Alternative 2)
	Disturbance	The noise and disturbance to bowheads under this alternative, with no subsistence whaling, would be considered negligible in magnitude, extent, and duration.	For the bowhead population, the direct and indirect effects of noise and disturbance under this alternative would be minor in magnitude, extent, and duration.	Bowhead whales - (Same as Alternative 2)	Bowhead whales - (Same as Alternative 2)
Cumulative Effects		For bowhead whales, this alternative would contribute a negligible amount of mortality and disturbance to the cumulative effects on bowheads. Overall cumulative effects, taking into account other human activities and natural factors in the project area, are considered negligible in magnitude, extent, and duration in regard to mortality. In regard to disturbance, the cumulative effects are considered minor in magnitude, extent, and duration, at the population level.	For bowhead whales, this alternative would contribute a negligible amount of mortality and disturbance to the cumulative effects on bowheads. Overall cumulative effects, taking into account other human activities and natural factors in the project area, are considered negligible in magnitude, extent, and duration in regard to mortality. In regard to disturbance, the cumulative effects are considered minor in magnitude, extent, and duration, at the population level.	Bowhead whales - (Same as Alternative 2)	Bowhead whales - (Same as Alternative 2)

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Table ES-3
Summary of Direct, Indirect, and Cumulative Effects – Other Wildlife

Effect		Alternative 1 No Action: Do Not Grant AEWC a Quota	Alternative 2 Grant AEWC Annual Quotas (67 Strikes) with No Unused Strikes Carried Over	Alternative 3 (Preferred Alternative) Grant AEWC Annual Quotas (67 Strikes) with No More Than 15 Unused Strikes Carried Over Any One Year	Alternative 4 Grant AEWC Annual Quotas (67 Strikes) with Up to 50% of Unused Strikes Carried Over Any One Year
Direct and Indirect Effects	Mortality	For other species (especially seals, walrus, and caribou), hunting pressure would increase to compensate in part for the loss of whale harvest and could lead to reductions in game populations around the whaling villages. In magnitude, extent, and duration, these effects are considered minor to moderate, depending on the importance of the species as a subsistence resource.	For ice-dependant species, this alternative would have negligible to minor direct and indirect effects, depending on the species. For other wildlife species (including threatened or endangered species), this alternative would have negligible to minor direct and indirect effects, depending on the species.	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) – (Same as Alternative 2)	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) – (Same as Alternative 2)
	Disturbance	Increased hunting efforts on subsistence species other than bowheads would cause noise and disturbance to other wildlife in many areas around the whaling communities and would be considered minor to moderate, depending on the social structure of the species (aggregated or dispersed).	For ice-dependant species, this alternative would have negligible to minor direct/indirect effects, depending on the species. For other wildlife (including threatened or endangered species), this alternative would have negligible to minor direct/indirect effects, depending on the species.	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) – (Same as Alternative 2)	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) – (Same as Alternative 2)
Cumulative Effects		To partially compensate for the loss of bowhead hunting under Alternative 1, increased harvest of other species would contribute to the adverse effects of climate change on ice-dependent species and add to the difficulty of managing other game populations, especially with the uncertainty of how climate change will affect different species.	For ice-dependent species, cumulative effects are likely to be dominated by the effects of climate change and the contribution of the alternatives is considered negligible to minor. For other wildlife species (including threatened and endangered species) – cumulative effects are likely to be dominated by conservation issues independent of whaling activities. The contribution of the alternatives to the cumulative effects on these species is considered negligible.	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) – (Same as Alternative 2)	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) – (Same as Alternative 2)

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Table ES-4
Summary of Direct, Indirect, and Cumulative Effects – Socio-cultural

Effect		Alternative 1 No Action: Do Not Grant AEWC a Quota	Alternative 2 Grant AEWC Annual Quotas (67 Strikes) with No Unused Strikes Carried Over	Alternative 3 (Preferred Alternative) Grant AEWC Annual Quotas (67 Strikes) with No More Than 15 Unused Strikes Carried Over Any One Year	Alternative 4 Grant AEWC Annual Quotas (67 Strikes) with Up to 50% of Unused Strikes Carried Over Any One Year
Direct and Indirect Effects	Effects on Subsistence	Direct effects include: ▪ loss of an annual average of one million pounds of bowhead *maktak* and meat, a highly valued food, ▪ diminished social cohesion occasioned by the shared work among whaling crews and others cooperating in the year round work of preparation for whaling, ▪ disruption in the bonds established through food sharing, and ▪ diminished opportunity for young people to continue to learn the knowledge, practice, and beliefs associated with this central cultural institution. Indirect effects include: ▪ redirection of subsistence harvest effort to other subsistence resources, and ▪ greater recourse to purchased food, with adverse nutritional and economic implications, would result. These direct and indirect effects are adverse and of major magnitude and extent, but of unknown duration.	Direct effects include continuation of existing subsistence practices such as: ▪ the subsistence food contribution of bowhead whales, ▪ the cooperative work and food sharing practices, and ▪ the crucial cultural learning opportunities for young people. Indirect effects include: ▪ continuation of the current levels of diversity in subsistence resource uses, and continuing levels of reliance on subsistence foods, supplemented by purchased foods. These direct and indirect effects are positive and major in magnitude, extent, and duration.	(Same as Alternative 2)	(Same as Alternative 2)
	Effects on public health and safety	Direct and indirect effects include: ▪ elimination of exposure to very low levels of contaminants in bowhead whale foods, ▪ adverse effects on diet and health as nutritious bowhead foods are replaced to some extent by less nutritious purchased foods, and ▪ elimination of exposure to the safety risks associated with whaling, but increased exposure to risks in hunting of other subsistence resources, such as seals and walrus. These direct and indirect effects of this alternative on health are adverse and major in magnitude and extent, but of unknown duration. The effects on safety would be minor.	Direct and indirect effects include: ▪ continued high levels of reliance on nutritious bowhead whale foods, and ▪ continued exposure to the current levels of risk inherent in bowhead whaling and other subsistence pursuits. Taken together, the highly beneficial nutritional effects outweigh the infrequent and therefore minor safety risks. This alternative has positive effects of major magnitude, extent, and duration.	(Same as Alternative 2)	(Same as Alternative 2)
Cumulative Effects		Given the important nutritional and cultural role of bowhead whale foods, under this alternative, in magnitude, extent, and duration, the cumulative effects on subsistence practices and nutrition and health would be adverse and major. This alternative would make a major contribution to overall cumulative adverse effects on subsistence practices, when considered alongside other activities in the project area. Cumulative effects of climate change are increasing the risks associated with weather, open water, and unstable, unpredictable ice. Subsistence harvest effort redirected to other resources would involve similar risks on the ice and open water, though not through the use of harpoon guns and large block and tackle equipment. This alternative makes a minor contribution to the cumulative adverse effects on public safety which overall would be minor to moderate.	For spring whaling, the cumulative effects of other activities, notably those associated with oil and gas exploration and development would be rated as adverse and minor. For fall whaling, the likely magnitude of impacts from these activities is less certain, because it turns on the timing, location, and extent of oil and gas related activities and on the effectiveness of mitigative measures. Taking into account magnitude and likelihood, these impacts would be adverse and could be moderate, based on the effectiveness of current mitigation measures for oil and gas activities. The beneficial contribution of the proposed activities to cumulative effects, in authorizing the subsistence whale hunt, would be a greater proportion of overall cumulative effects than the contribution of noise from oil and gas exploration and development. Overall, cumulative effects on subsistence patterns would be positive and minor to moderate.	(Same as Alternative 2)	(Same as Alternative 2)

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1.0 PURPOSE AND NEED

1.1 Introduction

1.1.1 Summary of the Proposed Action

The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) proposes to issue annual quotas to the Alaska Eskimo Whaling Commission (AEWC) to allow continuation of its subsistence hunt for bowhead whales from the Western Arctic stock[1] for the five years 2008 through 2012. The purpose of NMFS's proposed action is to fulfill its federal trust responsibilities by recognizing the nutritional and cultural needs of Alaskan Natives, to the fullest extent possible consistent with applicable law, and to ensure that any aboriginal subsistence hunt of whales does not adversely affect the conservation of the Western Arctic bowhead whale stock.

This Environmental Impact Statement (EIS), prepared pursuant to the National Environmental Policy Act (NEPA, 42 USC 4321 et seq.), considers four alternatives for issuing the AEWC a share of catch limits approved by the International Whaling Commission (IWC). The proposed action would comply with NMFS's responsibilities under Section 101(b) of the Marine Mammal Protection Act (MMPA) and under the Whaling Convention Act (WCA).

1.1.2 Location of Action

The project area is the entire geographic range of the Western Arctic bowhead stock. The users of the bowhead resource affected by the proposed action are the residents of Alaska villages currently participating in subsistence hunts of Western Arctic bowhead whales. These include Gambell, Savoonga, Little Diomede, and Wales (located along the coast of the Bering Sea); Kivalina, Pt. Hope, Wainwright and Barrow (along the coast of the Chukchi Sea); and Nuiqsut and Kaktovik (on the coast of the Beaufort Sea). The IWC approved catch limit is also shared with Russian subsistence hunters in villages along the Chukotka Peninsula (Figure 1.1.2-1).

1.1.3 Summary of Western Arctic Bowhead Whale Status

The current understanding is that the majority of the Western Arctic bowhead whale population migrates annually from wintering areas in the northern Bering Sea, through the Chukchi Sea in the spring (March through June), to the Beaufort Sea where they spend much of the summer (mid-May through September). In the autumn (September through November) they return to the Bering Sea to overwinter (November through March) (Braham et al., 1980; Moore and Reeves, 1993). Because the bowhead whale species is listed as "endangered" under the Endangered Species Act (ESA), the Western Arctic population is classified as a strategic stock under the MMPA and therefore also designated as "depleted" under the MMPA. The Western Arctic bowhead whale stock has been increasing in recent years; the current estimate of 10,545 is between 46% and 101% of the pre-exploitation abundance estimated at 10,400-23,000 by Woodby and Botkin (1993). Some analyses suggest the population may be approaching carrying capacity though there is no sign of slowing in the population growth rate (Brandon and Wade, 2006).

[1] Also referred to as the Bering-Chukchi-Beaufort Seas stock and the Bering Sea stock.

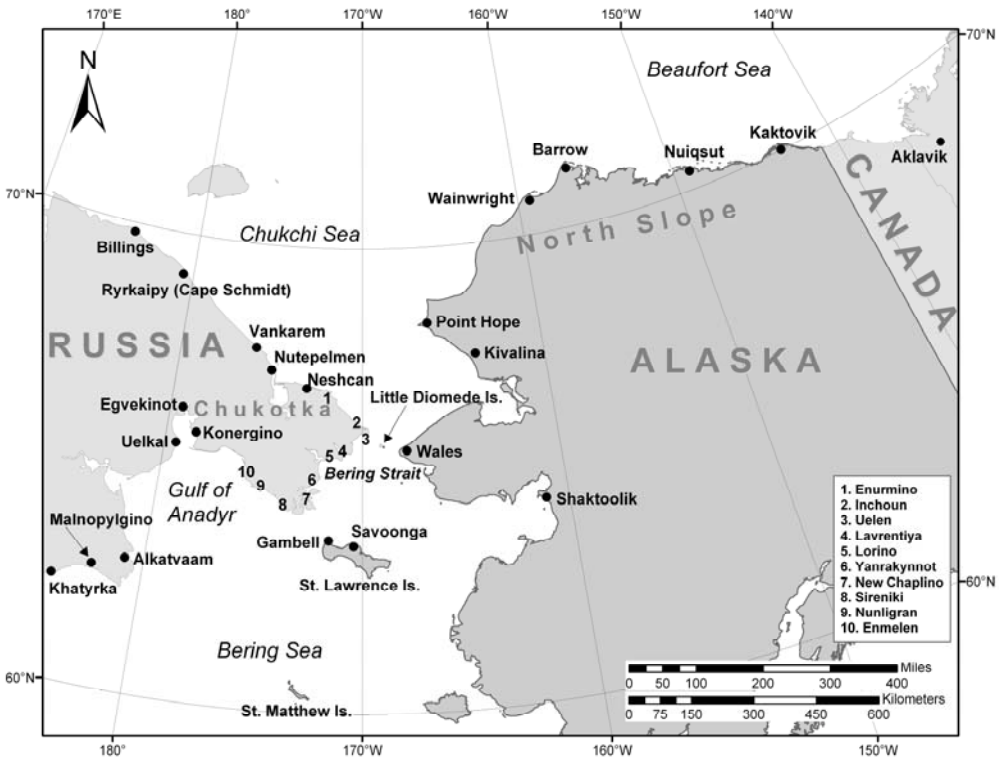

Figure 1.1.2-1 Historic and Current Bowhead Whaling Villages in Alaska, Canada, and Russia.

The estimated annual mortality rate incidental to commercial fisheries (0.2 whales per year) is not known to exceed 10% of the potential biological removal (PBR). PBR for the Western Arctic bowhead stock is 95 therefore, 10% of PBR is 9.5 animals and this level of mortality can be considered insignificant. The average annual level of intentional human-caused mortality and serious injury (41 animals) is not known to exceed the PBR (95) or the IWC annual strike limit (67) (Angliss and Outlaw, 2005). Criteria developed for recovery of large whales in general (Angliss et al., 2002) and bowhead whales in particular (Shelden et al., 2001) will be used in the next five-year evaluation of stock status.

On February 22, 2000, NMFS received a petition from the Center for Biological Diversity and Marine Biodiversity Protection Center to designate critical habitat for the Western Arctic bowhead stock under the ESA. Petitioners asserted that the nearshore areas from the United States (U.S.)-Canada border to Barrow, Alaska should be considered critical habitat. On May 22, 2001, NMFS found the petition to have merit and initiated a formal review (66 Federal Register [FR] 28141). On August 30, 2002 (67 FR 55767), NMFS announced its decision to not designate critical habitat for this population. NMFS decided not to designate critical habitat because: (1) the decline and reason for listing the species was over exploitation by commercial whaling, and habitat issues were not a factor in the decline; (2) there was no indication that habitat degradation is having any negative impact on the increasing population; (3) the population is abundant and increasing; and (4) existing laws and practices adequately protect the species and its habitat (67 FR at 55767).

1.1.4 Eskimo Tradition of Subsistence Hunt of Bowhead Whales

Inupiat and Siberian Yupik Eskimos have hunted bowhead whales continuously for over 2,000 years (Stoker and Krupnik, 1993). Hunting bowhead whales in Alaska remains a communal activity that supplies important meat and *maktak*[2] for the entire community, as well as for feasts and during annual celebrations. Formalized patterns of hunting, sharing, and consumption characterize the modern bowhead harvest. In addition, whaling captains are highly respected for their traditional knowledge of ice, weather, and whale behavior, which is necessary to hunt successfully, for their generosity in supporting their whaling crews, and for their stewardship of traditions of sharing and distributing *maktak* throughout the community. Of all subsistence activities in these communities, the bowhead whale hunt represents one of the greatest concentrations of community-wide effort and time. It is highly productive, accounting for a substantial percentage of the food consumed in the AEWC communities. As the principal activity through which traditional skills for survival in the Arctic are passed to younger generations, the bowhead hunt provides ongoing reinforcement of the traditional social structure. Thus, the bowhead subsistence hunt is a large part of the cultural tradition of these communities and their modern cultural identity (Worl, 1979; Braund et al., 1997).

Subsistence whaling has been regulated by a catch limit under the authority of the IWC since 1977. Alaska Native subsistence hunters from northern Alaskan communities (Figure 1.1.2-1) take less than 1% of the stock of bowhead whales per year (Philo et al., 1993). After 1977, the number of whales landed ranged between 8 and 55 per year and whales struck and lost ranged from 5 to 28 per year (AEWC and North Slope Borough [NSB], 2007).

1.2 Legal Framework

The following section describes the legal framework that will guide agency decisions related to this project, including federal trust responsibility, governance of aboriginal subsistence whaling quotas under the WCA, species protection and conservation under the MMPA and ESA, and environmental review under NEPA.

1.2.1 Federal Trust Responsibility

NMFS, as an agent of the federal government, has a trust responsibility to Indian tribes. The concept of "trust responsibility" is derived from the special relationship between the federal government and Indians. Based upon provisions of the U.S. Constitution authorizing Congress to regulate commerce "among the several states, and with the Indian Tribes" (U.S. Constitution, Article I, Section 8, clause 3), the trust responsibility was first delineated by Supreme Court Chief Justice John Marshall in *Cherokee Nation v. Georgia*, 30 U.S. 1 (5 Pet.) (1831). Later, in *Seminole Nation v. United States*, 316 U.S. 286 (1942), the Court noted that the U.S. has charged itself with moral obligations of the highest responsibility and trust toward Indian tribes. The scope of the federal trust relationship is broad and incumbent upon all federal agencies. The U.S. government has an obligation to protect tribal land, assets, and resources as well as a duty to carry out the mandates of federal law with respect to American Indian and Alaska Native tribes. This unique relationship and its foundation in the Constitutional provide the basis for legislation,

[2] *Maktak* is whale skin and a layer of blubber that is used for food.

treaties, and Executive Orders (EO) that grant unique rights or privileges to Native Americans (*Morton v. Mancari*, 417 U.S. 535, 551-53 [1974]).

In furtherance of this trust responsibility and to demonstrate respect for sovereign tribal governments, the principles described above were incorporated into Secretarial Order No. 3206, dated June 5, 1997, and signed by the Secretaries of Commerce and Interior. This Order, entitled "American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act," directs both departments to carry out their responsibilities under the ESA in a manner that brings into accord the federal trust responsibility to tribes, tribal sovereignty, and statutory missions of the departments, so as to avoid or minimize the potential for conflict and confrontation. However, this Secretarial Order did not extend to Alaska Natives; and hence, on January 19, 2001, the Secretary of Commerce and the Secretary of the Interior signed Secretarial Order No. 3225, entitled "Endangered Species Act and Subsistence Uses in Alaska" (Supplement to Secretarial Order 3206), to extend to Alaska Natives the principles articulated in Order No. 3206.

On May 14, 1994, EO 13084 was issued, requiring each federal agency to establish meaningful consultation and collaboration with Indian tribal governments (including Alaska Natives) in formulating policies that significantly or uniquely affect their communities. Entitled "Consultation and Coordination with Indian Tribal Governments," the order requires agency policy-making to be guided by principles of respect for tribal treaty rights and responsibilities that arise from the unique legal relationship between the federal government and the Indian tribal governments. Furthermore, on issues relating to treaty rights, EO 13084 directs each agency to explore and, where appropriate, use consensual mechanisms for developing regulations.

On November 6, 2000, EO 13175 replaced EO 13084. The order carries the same title and strengths as the previous order about the government-to-government relationship between the U.S. government and Indian tribes. EO 13175 requires that all executive departments and agencies consult with Indian tribes and respect tribal sovereignty in developing policy on issues that affect Indian communities.

1.2.2 International Convention for the Regulation of Whaling

The International Convention for the Regulation of Whaling (ICRW) is an international treaty that was signed on December 2, 1946, to "provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry" (ICRW, December 2, 1946, 161 United Nations Treaty Series 72). The U.S. was an original signatory to the ICRW in 1946. A main focus of the ICRW was the establishment of the IWC. The IWC is an international organization, administered by a Secretary and staff. IWC membership consists of one Commissioner from each Contracting Government (i.e., government of a nation that signed the ICRW). Under Article V.1 of the ICRW, the IWC's charge is to adopt regulations with respect to the conservation and utilization of whale resources by periodically amending the provisions of the Schedule, a document that is an integral part of the ICRW. IWC regulations adopted in the Schedule may establish protected and unprotected species; open and close seasons and waters; implement size limits, time, method, and intensity of whaling; and specify gear, methods of measurement, catch returns, and other statistical and biological records, and methods of inspection (Article V.1) for whale stocks. The IWC seeks to reach its decisions by consensus. Voting procedures apply when consensus is not possible.

According to Article III.2 of the ICRW and the Rules of Procedure, to amend the Schedule and adopt whaling regulations requires a three-fourths majority of all who voted yes or no (each Contracting Government has one vote). Criteria in Article V.2 of the ICRW specify that amendments to the Schedule shall meet the following criteria:

a. Be necessary to carry out the objectives and purposes of the ICRW and provide for the conservation, development, and optimum utilization of whale resources;
b. Be based on scientific findings;
c. Not involve restrictions on the number or nationality of factory ships or land stations, nor allocate specific quotas to any factory ship(s) or land station(s); and
d. Take into consideration the interests of the consumers of whale products and the whaling industry.

The IWC established a Scientific Committee, consisting of approximately 200 of the world's leading whale biologists, to provide advice on the status of whale stocks to inform the development of IWC whaling regulations. The Scientific Committee considers particular subject matter based on the scientific needs of the IWC. These needs are broadly expressed in the ICRW text, which directs the IWC to: "encourage, recommend, or, if necessary, organize studies and investigations relating to whales and whaling; collect and analyze statistical information concerning the current condition and trend of the whale stocks and the effects of whaling activities thereon; and study, appraise, and disseminate information concerning methods of maintaining and increasing the populations of whale stocks" (Article IV.1).

The IWC recognizes a distinction between whaling for commercial purposes and whaling by aborigines for subsistence purposes. Aboriginal provisions were incorporated into predecessor treaties to the ICRW and have been a part of the whaling regime under the ICRW since the time of the first Schedule (note that 'aborigines' refers to indigenous groups for purposes of this EIS). The IWC governs aboriginal whaling internationally by setting overall catch limits on stocks. To initiate the process, Contracting Governments acting on behalf of aborigines in their respective nations make a proposal to the IWC based on cultural and nutritional needs (i.e., they submit a needs statement). At the 1994 Annual Meeting, the IWC adopted Resolution 1994-4 to reaffirm the following three broad objectives as general guidelines for evaluating such proposals from Contracting Governments:

1. To ensure that the risks of extinction to individual stocks are not seriously increased by subsistence whaling;
2. To enable aboriginal people to harvest whales in perpetuity at levels appropriate to their cultural and nutritional requirements, subject to the other objectives; and
3. To maintain the status of whale stocks at or above the level giving the highest net recruitment and to ensure that stocks below that level are moved towards it, so far as the environment permits.

Since 1997, the IWC has set catch limits for aboriginal subsistence whaling generally in five-year increments, subject to annual review. These catch limits are contained in paragraph 13 of the Schedule. Catch limits for Western Arctic bowhead whales have been expressed in two components: a limit on the number of whales landed, and a slightly higher limit on the number of whales that may be struck. The term “strike limit” is often used to refer to this limitation on the number of whales that may be struck. This approach takes into account the fact that not all

whales struck are landed and ensures an upper limit on total strikes for conservation management. The WCA defines aboriginal subsistence whaling as whaling authorized by paragraph 13 of the Schedule annexed to and constituting a part of the ICRW (50 Code of Federal Regulations [CFR] 230.2). Aboriginal subsistence whaling is not otherwise defined in the Schedule, but the following definition of subsistence use was adopted by consensus at the 2004 Annual Meeting of the IWC:

1. The personal consumption of whale products for food, fuel, shelter, clothing, tools, or transportation by participants in the whale harvest.
2. The barter, trade, or sharing of whale products in their harvested form with relatives of the participants in the harvest, with others in the local community or with persons in locations other than the local community with whom local residents share familial, social, cultural, or economic ties. A generalized currency is involved in this barter and tra[d]e, but the predominant portion of the products from each whale are ordinarily directly consumed or utilized in their harvested form within the local community.
3. The making and selling of handicraft articles from whale products, when the whale is harvested for the purposes defined in (1) and (2) above.

General principles governing aboriginal subsistence whaling are contained in paragraph 13(a) of the Schedule, and catch limits are set under paragraph 13(b) of the Schedule. Paragraph 13(a) of the current Schedule includes the prohibition on the "strik[ing], tak[ing] or kill[ing] calves or any whale accompanied by a calf," applicable to Western Arctic bowhead whales, and the requirement that "all aboriginal whaling shall be conducted under national legislation that accords with paragraph 13 of the Schedule" (IWC 2005a:13(a)(4)&(5)). Native peoples engaging in subsistence hunts do so under permit issued by their governments. In the case of Alaska Eskimo and Russian Native subsistence hunts, the U.S. and the Russian Federation make a joint request to the IWC for a subsistence hunt for bowhead whales, based, in part, on the needs of their respective Native communities (Appendix 8.1). Once the IWC approves a request for an aboriginal subsistence whaling quota (Appendix 8.1) and sets catch limits for each whale stock in five-year increments, the WCA provides the mechanism for the U.S. to implement these quotas.

1.2.3 Whaling Convention Act

The Whaling Convention Act (WCA) was enacted to implement the domestic obligations of the U.S. government under the ICRW. IWC Schedule provisions to which the U.S. has not objected shall become effective with respect to all persons and vessels subject to the jurisdiction of the U.S. in accordance with the terms of the Schedule provisions and Article V of the ICRW (WCA § 916k). Under Section 916b of the WCA, the Secretary of State (with concurrence by the Secretary of Commerce) is vested with the power of presenting or withdrawing objections to regulations of the IWC on behalf of the U.S. as a Contracting Government.

The Secretary of Commerce holds general powers, which have been delegated to NMFS, to administer and enforce whaling[3] in the U.S., including issuance of necessary regulations to carry out that authority (WCA §§ 916d, 916k). The regulations (located at 50 CFR Part 230) prohibit

[3] Under Section 102(f) of the MMPA, commercial whaling is expressly banned in waters subject to the jurisdiction of the United States.

whaling, except for aboriginal subsistence whaling authorized by the IWC (50 CFR 230.1). NMFS publishes aboriginal whaling quotas set in accordance with paragraph 13 of the Schedule in the Federal Register, together with any relevant restrictions, and incorporates them into cooperative agreements with the appropriate Native American whaling organization, (entities recognized by this agency as representing and governing the relevant Native American whalers for the purposes of cooperative management of aboriginal subsistence whaling) (50 CFR 230.6(a)). Publication of the quota is contingent upon agency completion of a NEPA review. Any quotas published are allocated to each whaling village or tribal whaling captain by the appropriate Native American whaling organization.

The WCA regulations track the IWC provisions that prohibit whaling of any calf or whale accompanied by a calf (50 CFR 230.4(c)); they also prohibit any person from selling or offering for sale whale products from whales taken in aboriginal subsistence hunts, except that "authentic articles of Native handicrafts" may be sold or offered for sale (50 CFR 230.4(f)) (defined under the MMPA as items composed wholly or in some significant respect of natural materials) (MMPA § 101(6)(2)). Regulations also require that whaling not be conducted in a wasteful manner (50 CFR 230.4(k), MMPA § 101(b)(3)).

The WCA and its implementing regulations require licensing and reporting of aboriginal whale harvests (WCA § 916d; 50 CFR 230.5, 230.8). No one may engage in aboriginal subsistence whaling unless the person is a whaling captain or a crew member under the whaling captain's control (50 CFR 230.4(a)). The license may be suspended if the whaling captain fails to comply with WCA regulations (50 CFR 230.5(b)). No person may receive money for participation in aboriginal subsistence whaling (50 CFR 230.4(e)). The whaling captain and Native American whaling organization are also responsible for reporting to NMFS, among other things, the number, dates, and locations of strikes, attempted strikes, or landings of whales, including certain data from landed whales (50 CFR 230.8). For the bowhead quota, these provisions are also laid out in the Cooperative Agreement between NOAA and the AEWC (Appendix 8.2).

1.2.4 NOAA-AEWC Cooperative Agreement

The AEWC was formed in 1977 to represent the bowhead subsistence hunting communities of Alaska in an effort to convince the U.S. government to take action to preserve the Eskimos' subsistence hunt of bowhead whales. The purposes of the AEWC are to ensure that the hunting is conducted in a traditional, non-wasteful manner; to communicate to the outside world the cultural significance of bowhead whaling for the North Slope Inupiat and St. Lawrence Island Yupik; and to promote scientific research on bowhead whales to ensure their continued existence without unnecessary disruption to the whaling communities. During the initial years of controversy, the AEWC adopted its first Management Plan (May 1977), asserting the management and enforcement authority of the AEWC, requiring registration of whaling captains, specifying the traditional methods of whaling to be permitted, and requiring reporting of harvests and strikes by whaling captains (Langdon, 1984:45). With the signing of a cooperative agreement in 1981, the foundations for cooperation between NOAA and AEWC were established, and this framework has endured to the present. The AEWC also agreed to cooperate with the U.S. in scientific research efforts and to develop a management plan to be followed by all bowhead whale subsistence hunters to help improve the efficiency of the subsistence hunt.

NOAA and the AEWC have agreed to work together through a Cooperative Agreement, but they bring different sources of authority to the cooperative effort. The underlying authority of the AEWC is based on the formal cultural traditions of leadership by whaling captains. In addition, the tribal governments of the participating villages, including the Inupiat Community of the Arctic Slope, have delegated to AEWC the tribal authority to manage the subsistence whaling of tribal members (Langdon, 1984:51). The members of the AEWC are the registered bowhead subsistence captains and their crew members from the northern Alaskan communities. There are two classes of members: voting members and non-voting members from communities identified above in Section 1.1.2. Voting members are the registered bowhead subsistence captains in each community. The crew members are non-voting members. The AEWC is directed by a board of elected Commissioners, one from each of the participating communities. This Board has authority over all of the Commission's affairs (AEWC By-Laws, 1982 and as amended and restated October 14, 1992). Federal authority for bowhead management is governed by statute. Management of the Eskimo subsistence bowhead whale hunt is shared through the Cooperative Agreement between the AEWC and NOAA (Appendix 8.2). (Note that NMFS serves as the representative of NOAA, its parent agency, in the administration of subsistence whaling in Alaska.)

The purposes of the NOAA-AEWC Cooperative Agreement are to:

- protect the Western Arctic population of bowhead whale and the Eskimo culture;
- promote scientific investigation of the bowhead whale; and
- effectuate the other purposes of the WCA, the MMPA, and the ESA, as these acts relate to the aboriginal subsistence hunts for whales.

To achieve these purposes, the agreement provides for cooperation between members of the AEWC and NOAA in management of the subsistence bowhead whale hunt. The agreement also provides for an exclusive enforcement mechanism applied to any violation by the registered member whaling captains or their crews. For actions of AEWC members as they relate to aboriginal subsistence bowhead hunts, the AEWC is the first line of enforcement for the MMPA, the ESA, the WCA, the ICRW and its Schedule, the AEWC management plan; or the agreement itself (Appendix 8.2 and Chapter 3 Section 3.6). To support the scientific and administrative functions of the AEWC, NOAA has provided funds through annual grants, reaching as much as $400,000 per year in the early part of this decade (NOAA, 2007).

Although the AEWC, the IWC, and NOAA had significantly different perspectives on the population status of the bowhead population at the outset, the rise of cooperative management in this case is highly distinctive in the degree to which the AEWC and the NSB committed to a major peer-reviewed program of scientific research to improve understanding of the bowhead population status and dynamics in order to persuade the IWC to increase the subsistence quota (Langdon, 1984; Freeman, 1989). As improved census methods brought larger population estimates throughout the 1980s, the IWC raised the subsistence catch limits. The AEWC members felt this research vindicated their traditional knowledge perspective that the bowhead population was much larger than the alarming estimates of the late 1970s.

1.2.5 Marine Mammal Protection Act and Endangered Species Act

The Marine Mammal Protection Act (MMPA) was enacted to protect and conserve marine mammals and their habitats. Section 2 of the MMPA contains the general purposes and policies of the act through congressional findings (16 United States Code [U.S.C.] 1361). Concerned that certain marine mammal species and population stocks were in danger of extinction or depletion, Congress established protections to encourage development of those stocks to the greatest extent feasible, commensurate with sound policies of resource management. Therefore, Congress specified that the primary objective of marine resource management under the MMPA is to maintain the health and stability of the marine ecosystem. Section 2 indicates that stocks should not be permitted to diminish beyond the point at which they cease to be a significant functioning element of the ecosystem, and they should not be permitted to diminish below their optimum sustainable population (OSP).

To achieve Section 2 general purposes and policies, Congress established a moratorium on the taking and importing of marine mammals in Section 101(a) (16 U.S.C. 1371(a)). Under the MMPA, 'take' means to "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. 1362(13)). Except for certain military readiness or scientific activities, the term 'harassment' means "any act of pursuit, torment, or annoyance which, (1) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A Harassment]; or (2) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B Harassment]" (16 U.S.C. 1362(18)(A)).

This moratorium is not absolute. In particular, the MMPA allows the take of marine mammals by Alaska Natives for subsistence purposes, provided that such activities are not accomplished in a wasteful manner (16 U.S.C. 1371(b)). Inedible by-products such as baleen, bone, and ivory may be fabricated into Native handicrafts for sale, under these regulations. In addition, Section 113 of the MMPA specifically states that the provisions of the MMPA are in addition to, and not in contravention of, existing international treaties, conventions, or agreements (e.g., the ICRW) (16 U.S.C. 1383(a)).

The Endangered Species Act (ESA) is the principal federal law that guides the conservation of endangered or threatened species. Similar to the MMPA, the ESA expressly provides for Alaska Native subsistence activities (16 U.S.C. 1539(e)). Under Section 7 of the ESA, NMFS consults with itself and with the U.S. Fish and Wildlife Service (USFWS) on the effects of its proposed actions on endangered and threatened species.

1.2.6 National Environmental Policy Act

The National Environmental Policy Act (NEPA) was enacted to create and carry out a national policy designed to encourage harmony between humankind and the environment. While NEPA neither compels particular results nor imposes substantive environmental duties upon federal agencies (*Robertson v. Methow Valley Citizens Council*, 490 U.S. 332 (1989)), it does require that federal agencies follow certain procedures when making decisions about any proposed federal actions that may affect the environment. These procedures ensure that an agency has the best possible information with which to make an informed decision with regard to environmental

effects of any proposed action. They also ensure that the public is fully apprised of any associated environmental risks. Regulations promulgated by the Council on Environmental Quality (CEQ) (40 CFR 1500-1508) contain specific guidance for complying with NEPA.

Under the CEQ regulations, federal agencies must prepare an environmental assessment (EA) to determine whether a proposed action is likely to have a significant impact or effect on the quality of the human environment, or an EIS, which involves a longer public process and does not need to conclude with a finding of no significant impact (FONSI). Proposed alternatives are analyzed both in terms of context and intensity of the action. If information in an EA indicates that the environmental effects are not significant, the agency issues a FONSI to conclude the NEPA review. This was the case in 2003 when NMFS published a final EA and FONSI in support of the 2003 through 2007 bowhead whale quota allocations to AEWC (NMFS, 2003).

For the next five-year quota block, NMFS has decided to prepare an EIS rather than an EA. This decision was not based on any new determination that significant effects occur as a result of the bowhead subsistence hunt, but rather to take advantage of the EIS's longer process and to provide greater transparency and opportunity for public review of its administration of the bowhead subsistence whaling program. An EIS provides a more detailed statement of the environmental impacts of the action, possible alternatives, and measures to mitigate adverse effects of the proposed actions. The EIS achieves NEPA's policy goals by ensuring that agencies take a hard look at environmental consequences and by guaranteeing broad public dissemination of relevant information. Although the MMPA and NEPA requirements overlap in some respects, the scope of NEPA goes beyond that of the MMPA by considering the impacts of the proposed federal action on non-marine mammal resources such as human health and cultural resources.

An EIS culminates in a Record of Decision (ROD). The ROD will document the alternative selected for implementation as well as any conditions this agency imposes, and it will summarize the impacts expected to result from the action.

1.3 Public Involvement and Scoping Process

NEPA is often referred to as a "procedural statute." The law requires opportunities for public review and submission of comments. In preparing an EIS, the public process begins with scoping, which is the agency's first step in planning its analysis. The lead agency will typically consult with expert staff in determining the proper way to describe the proposed action, its alternative actions, and the environmental issues it feels are important to analyze in the document. The agency will also alert the public and affected stakeholders to its decision to prepare an EIS and solicit input into the scope of the document. With this information, the agency will prepare a draft EIS and make that document available for a minimum 45-day public review. Public meetings during the review period may be scheduled, depending on the level of interest in the proposed action by the public. Once the public review period on the draft EIS is completed, the agency will review comments received and respond to those comments and make revisions to the draft EIS to answer questions, provide increased clarity, and if need be, conduct additional analysis where previous analysis was found lacking. Once completed, the agency publishes a final EIS document and, after a minimum 30-day review period, issues its ROD.

The scoping process for this EIS involved a number of activities that included both internal and public scoping. These activities are described in the following paragraphs.

Internal Scoping

During the internal scoping phase, NMFS identified a preliminary list of resources to address in the EIS, along with four preliminary alternatives (including the no-action alternative) to serve as starting points for discussion. These alternatives and issues were previously analyzed in the 2003 EA. This effort was conducted to help the public provide more meaningful comment on resource issues and alternatives to the proposed action during the public scoping period with the intention of reevaluating resources and alternatives, if needed, following receipt and review of public comment.

Public Scoping

On October 18, 2006, NMFS issued a Notice of Intent to prepare an EIS for issuing a bowhead whale subsistence quota to the AEWC for the years 2008 through 2017 (71 FR 61460). NMFS requested comments on the proposed issuance of annual quota over a ten-year period, requested information on the affected environment, and requested comments on the issues to be analyzed in the document. NMFS also sent a public news release to local Alaska newspapers and statewide public radio. In addition, NMFS sent letters to all federally recognized tribal governments located in the affected geographic area, soliciting their comments. Comments from the public were accepted through December 15, 2006.

During the scoping period, comments were received from two federal agencies, the Environmental Protection Agency (EPA) and the Marine Mammal Commission (MMC). In addition, the Animal Welfare Institute (AWI) submitted comments, written on behalf of themselves and the Whaleman Foundation (WF). The AWI letter included as an attachment a December 2005 submission to the Inter-American Commission on Human Rights from Ms. Sheila Watt-Cloutier on behalf of the Inuit of the Arctic regions of the U.S. and Canada, concerning alleged violations resulting from actions by the U.S. with regard to global warming.

The NMFS allocation of a bowhead whale subsistence harvest quota is a recurring regulatory action of over two decades' standing. As a result, many stakeholders are familiar with the action, and this may explain why a limited number of public comments were received. The issues raised in the scoping comments are incorporated and addressed in the preparation of this EIS. The following paragraphs summarize these comments, drawing attention to those that augmented the issues already identified for analysis by NMFS.

The scoping comments from federal agencies focused for the most part on NEPA procedural questions. The MMC recommended that formulation of alternatives be deferred until the IWC had concluded its action in May 2007. The EPA letter emphasized the importance of meeting NEPA requirements for the components of the EIS, including a careful description of the purpose and need, an adequate range of alternatives, and a thorough cumulative effects analysis. In addition, attention was directed to requirements under the ESA, and under EOs concerning consultation with federally recognized tribes and analysis of environmental justice. EPA policy suggestions concerning cooperating agency status for affected Alaska Native tribes were highlighted. Finally, EPA also suggested analysis of habitat capacities, including areas used by bowhead whales for migration and seasonal concentration.

The scoping comments from AWI (and WF) included NEPA procedural concerns and a variety of topics for analysis in the EIS. AWI asserted that as a matter of NEPA procedure, the U.S. cannot submit a request for revised catch limits to the IWC until the EIS process is complete. However, U.S. negotiating positions at the IWC are not subject to NEPA. Rather, the federal action, for which the EIS must be completed, is NMFS's issuance of a quota to the AEWC, not the U.S.' request for a quota from the IWC. Of particular note in the recommended topics for analysis, the AWI submission emphasized the variety of cumulative effects potentially arising from climate change both to the whale population and to the Inuit communities. AWI also requested analysis of habitat health and an assessment of impacts from military sonar activity. Concerning subsistence harvest practices, AWI requested analysis of the accuracy of harvest reporting and of the basis for identification of the subsistence need. Finally, in suggesting discussion of the national and international legal framework for subsistence bowhead whaling, AWI stated that if NMFS is prepared to authorize a subsistence harvest in the event that the IWC did not renew the catch limit, it must include analysis of the impacts of such an action on the effectiveness of the ICRW and, as a result, on whale populations.

Public Review of the Draft EIS

The Draft EIS was released for public review on August 3, 2007. The public review period ended on October 12, 2007. Printed copies and/or compact disc copies of the document were provided for interested agencies, non-governmental organizations, and individuals who requested them (See Appendix 8.5).

NMFS received substantive written comments from the MMC, AWI, AEWC, and the EPA. The MMC, AEWC, and EPA generally expressed support for analysis and findings of the EIS, and supported adoption of the preferred alternative. The AWI letter posed criticisms on a number of topics, similar to those submitted during the scoping period.

Key issues raised in public comments included:

- compliance with NEPA requirements, including the adequacy of the alternatives analyzed;
- the biological and social effects of subsistence whaling;
- the analysis of cumulative effects from climate change and oil and gas exploration and development;
- the need for the proposed level of subsistence whaling allocations; and
- humane methods of take.

Substantive comments were addressed in responses to comments and used to make additions and modifying text to the Final EIS as appropriate. Appendix 8.6 details the public comments on the Draft EIS and provides responses to each comment.

2.0 ALTERNATIVES, INCLUDING THE PROPOSED ACTION

Under the WCA, NMFS can issue an annual bowhead whale quota based on IWC Schedule provisions pertaining to the aboriginal subsistence harvest of Western Arctic bowhead whales. The subsequent hunt is managed cooperatively by NMFS and the AEWC.

The IWC conducted its 59th Annual Meeting May 28-31, 2007 in Anchorage, Alaska, and based on the management advice of the IWC Scientific Committee, adopted a catch limit for 2008 through 2012 identical to that of the previous five-year period. Alternative 3 corresponds to the IWC action, and is the preferred alternative as noted below.

In the IWC Schedule, the limits on aboriginal subsistence whaling of Western Arctic bowheads consist of two components. No more than 255 bowhead whales may be landed during the period 2008 through 2012. In addition, no more than 67 bowhead whales may be struck per year, with provisions for a carry-over of up to 15 unused strikes from one year to the subsequent year, as detailed below in Alternative 3. The term "strike limit" is used to refer to the limitation on the number of whales that may be struck, and the term "unused strikes" refers to an unused portion of the limit on the number of whales that may be struck.

2.1 Alternative 1 (No Action) – Do not grant the AEWC a quota

Under this alternative, NMFS would not issue the AEWC a subsistence whaling quota for cultural and nutritional purposes. This could occur if NMFS chose not to issue an annual quota based on environmental concerns.

2.2 Alternative 2 – Grant the AEWC an annual strike quota of 67 bowhead whales, not to exceed a total of 255 landed whales over five years 2008 through 2012, with no unused strikes added to the annual quota.

Under this alternative, NMFS would (through annual regulations[4]) grant the AEWC an annual strike quota of 67 bowhead whales, subject to a total of 255 landed whales over the five years 2008 through 2012. The quota for 255 landed whales represents the U.S. portion of the total quota of 280 landed whales granted by the IWC to aboriginal whalers. The actual allocation of strikes between Alaska Eskimos and Russian Chukotkan Natives is determined on an annual basis through a bilateral agreement between the U.S. and Russian Governments (Appendix 8.3)[5]. Under this alternative, no unused strikes from a previous year would be added to the quota for a subsequent year, notwithstanding the IWC's approval of a carry-over of unused strikes in the bowhead subsistence quota.

[4] The actual quota issuance to the AEWC would be made on an annual basis by NMFS. See 50 CFR 230.6.

[5] The current agreement was signed in 2002. It is expected that following the actions of the May 2007 IWC meeting in renewing the bowhead aboriginal subsistence harvest allocation, the U.S. and the Russian Federation will sign a new agreement in spring 2008.

2.3 Alternative 3 (Preferred Alternative) – Grant the AEWC an annual strike quota of 67 bowhead whales, not to exceed a total of 255 landed whales over the five years 2008 through 2012, with no more than 15 previously unused strikes from the previous year are added to the annual strike quota. This alternative would continue management as in the recent past and as quoted by the IWC in late May 2007.

Under this alternative (the proposed action), NMFS would (through annual regulations) grant the AEWC an annual strike quota of 67 bowhead whales (plus carry-over), not to exceed a total of 255 landed whales over the five years 2008 through 2012. This alternative differs from Alternative 2, by allowing up to 15 unused strikes from a previous year to be added to the quota for a subsequent year, consistent with the IWC catch limit. A policy to permit carry-over of 15 unused strikes was approved by the IWC. A carry-over allows for variability in hunting conditions from one year to the next within limits that conserve the Western Arctic bowhead stock.

2.4 Alternative 4 – Grant the AEWC an annual strike quota of 67 bowhead whales, not to exceed a total of 255 landed whales over the five years 2008 through 2012, where, for unused strikes, up to 50% of the annual strike limit is added to the strike quota for a subsequent year.

Under this alternative, NMFS would (through annual regulations) grant the AEWC an annual strike quota of 67 bowhead whales per year (plus carry-over), not to exceed a total of 255 landed whales over the five years 2008 through 2012. This alternative differs from Alternative 3 by allowing up to 50% of the unused annual strike limit from a previous year (i.e., up to 33 whales struck) to be added to the quota for a subsequent year.

2.5 Alternatives Considered but Not Carried Forward

Alternatives considered but discarded included alternatives that both substantially decreased and increased the annual and five-year bowhead whale subsistence quotas for Alaska Eskimos. A substantially decreased quota would not meet Alaska Eskimo-documented need for bowheads. A substantially increased quota may exceed Eskimo subsistence needs and has not been requested. One option under Alternative 1 would be to compensate the AEWC for not exercising its subsistence rights. While it may be appropriate for the AEWC to receive compensation for economic harm due to a prohibition of a commercial activity, in this case the AEWC is requesting a quota for cultural and nutritional subsistence purposes, something that cannot be compensated financially. Such alternatives were rejected because they do not meet the first objective of the proposed action, which is to meet the documented cultural and nutritional needs for bowhead whales by Alaska Eskimos. While the No Action Alternative does not meet this first objective, NMFS has included it in accordance with NEPA.

Another alternative considered but not carried forward was to analyze issuance of annual whaling quota over a ten-year period rather than a five-year period. As introduced in the Notice of Intent to prepare this EIS, NMFS indicated that it was going to assess a longer time period. The rationale for this was to avoid preparing another EIS in five years' time (to coincide with the next IWC decision on bowhead subsistence catch limits) unless significant changes to the environment warranted such an analysis. NEPA does not require that EAs or EISs be renewed in a specified timeframe; rather it only requires a new document be prepared or updated when

significant changes to the federal action or to the human environment occur. Based on internal discussions, the agency has determined that while pursuing a longer time frame for its NEPA analysis has some merit from an analytical and administrative point-of-view, introducing such a concept now could be confusing to the AEWC and the public because it would be inconsistent with the IWC's five-year catch limits and its current decision-making process.

2.6 Environmentally Preferred Alternative

NEPA requires that an agency identify the environmentally preferred alternative when preparing the ROD for an EIS. The CEQ has advised that such an alternative is to be based only on the physical and biological impacts of the proposed action on the resources in question, and not the social or economic impacts of the action. In this EIS, Alternative 1 (No Action) would not authorize annual subsistence bowhead whaling by Alaska Eskimos and no bowhead whales would be taken. Therefore, Alternative 1 is identified as the environmentally preferred alternative based on impacts to bowhead whales. See *Section 4 Environmental Consequences* for a full analysis of predicted impacts of this alternative on the complete human environment.

2.7 Preferred Alternative

The agency has identified Alternative 3 as its preferred alternative because it meets the purpose and need of this action; it achieves the socio-cultural benefits of the subsistence hunt at minimal environmental cost; and it keeps the harvest level and strike limit at current levels. Alternative 3 would also correspond to the action taken by the IWC during its 59th Annual Meeting May 28-31, 2007 in Anchorage, Alaska, when based on the management advice of the IWC Scientific Committee, it adopted a catch limit for 2008 through 2012 identical to that of the previous five-year period.

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3.0 AFFECTED ENVIRONMENT

3.1 Geographic Location

The Western Arctic stock of bowhead whales occurs in the Bering, Chukchi, and Beaufort Seas. The Bering Sea is in the northernmost region of the Pacific Ocean, bordered on the north and west by the Russian Federation, on the east by mainland Alaska, and on the south by the Aleutian Islands. The Bering Sea is connected to the Arctic Ocean, which includes the Chukchi Sea on the northern side of the Bering Strait and the Beaufort Sea to the east of the Chukchi Sea.

3.2 The Western Arctic Stock of Bowhead Whale

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 3.2-1). The latter is the Western Arctic stock, the largest remnant population and only stock found within U. S. waters (Rugh et al., 2003).

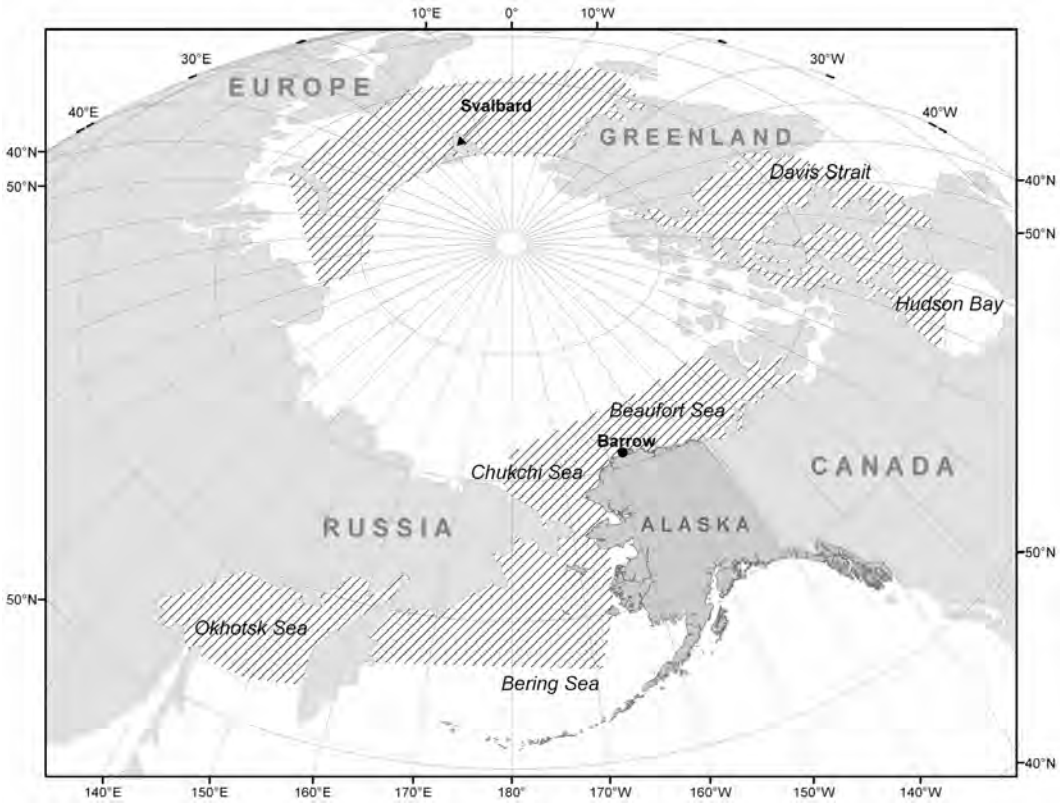

Figure 3.2-1 Circumpolar area occupied by the five bowhead whale stocks.

3.2.1 Current Abundance, Trends, Genetics, and Status

Abundance and Trends. 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). The traditional ecological knowledge (TEK) of Eskimo whalers pointed out shortcomings in the visual counts such as a lack of correction factors for whales that continued to migrate past the census site under the ice of closed leads or that migrate farther offshore (Huntington, 2000). The census counts have been conducted under the direction of the North Slope Borough Department of Wildlife Management since the mid-1980s (Dronenberg et al., 1986; George et al., 1988). 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; George et al., 2004a). These counts continue to be the primary source of abundance information for this stock (George et al., 2004a).

The most recent ice-based counts occurred April 5, to June 7, 2001 near Barrow, Alaska (George et al., 2004a). Observers recorded 3,295 unique individuals and an additional 532 whales that may have been observed before during the 1,130 hours of watch effort. This count included 121 calves (3.7% of the unique whales). Passive acoustic surveillance was conducted almost continuously from April 16 to May 31, 2001 resulting in 27,023 locations of vocalizing bowhead whales. The estimated number of whales within 4 kilometers (km) of the perch (N[4]) was 9,025 (SE = 1,068). The estimated proportion of the whales within 4 km of the perch (P[4]) was 0.862 (SE = 0.044, computed by a moving blocks bootstrap). Combining these, the abundance estimate (N[4]/P[4]) for 2001 was 10,470 (SE = 1,351) with a 95% confidence interval of 8,100-13,500. The estimated annual rate of increase (ROI) of the population from 1978 to 2001 was 3.4% (95% Cl 1.7%-5%) (Figure 3.2.1-1).

Zeh and Punt (2004) reviewed and revised abundance estimates from 1978 to 2001 (Angliss and Outlaw, 2006: Table 41) increasing the 2001 estimate slightly from 10,470 to 10,545 bowhead whales. The current estimate of 10,545 (Zeh and Punt, 2004) is between 46% and 101% of the abundance prior to the onset of commercial whaling in the mid-nineteenth century estimated at 10,400-23,000 (Woodby and Botkin, 1993; see also Bockstoce et al., 2005). Some analyses suggest the population may be approaching carrying capacity though there is no sign of slowing in the population growth rate (Brandon and Wade, 2006).

Genetics. Rooney et al. (2001) analyzed patterns of genetic variability among bowhead whales. Samples were taken from whales from the northern coast of Alaska, and from whales landed on St. Lawrence Island in the Bering Sea. The results of the research indicated that there was no genetic bottleneck (an evolutionary event that occurs when a population is reduced to a level insufficient to maintain diversity) in the Western Arctic stock and that the level of genetic variability has remained relatively high (nucleotide diversity = 1.63%) in spite of the depletion of the stock by commercial whalers in the 1800s. The stock reached its lowest abundance around 1914, when commercial whaling ceased; it is estimated that at that time there were 1,000 to 3,000 bowhead whales in the stock (Woodby and Botkin, 1993).

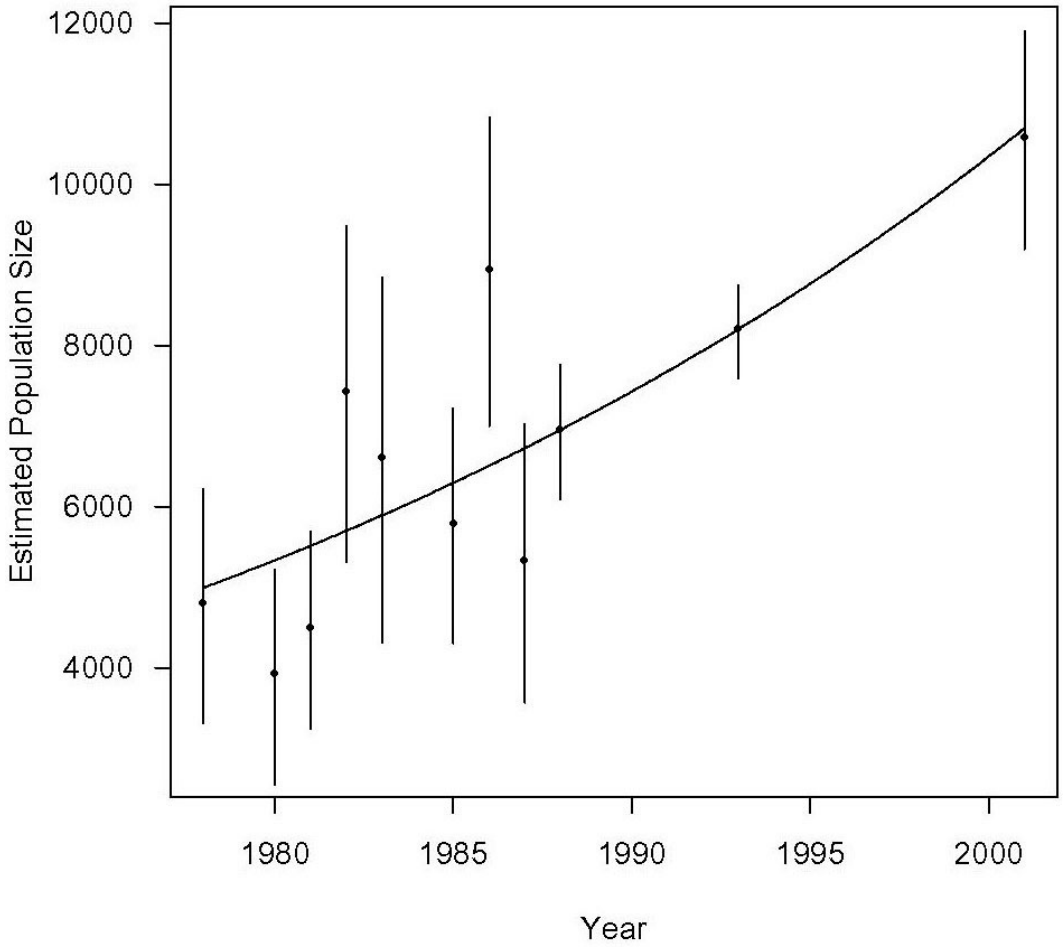

Figure 3.2.1-1 Abundance and trends of the Western Arctic bowhead whale population, 1978-2001 (from George et al., 2004a).

Comparisons between the Western Arctic stock and the Okhotsk Sea stock showed a much greater haplotypic diversity[6] (0.93) in the Western Arctic samples than in the Okhotsk Sea samples (0.61). Analyses of microsatellite and sequence data revealed significant genetic differences between the two populations, indicating that the populations represent discrete gene pools (LeDuc et al., 2005). These differences indicate that the two populations should be considered genetically and demographically separate for management purposes; geneflow between them is negligible at most. The results also seem to parallel those for gray whales (LeDuc et al., 2002), another North Pacific species with a large eastern population showing high diversity and a small western population with considerably lower diversity.

[6] Haplotypic diversity is a measure of the genetic variation between individuals or populations and is one way to describe the degree of relatedness between them. Most organisms have two sets of chromosomes (diploidy), one set inherited from each parent. Thus different versions of each gene (alleles) may be present (Aa, Bb, Cc, etc.). The haplotype describes the genes on one set (ABC). Populations may have several haplotypes, or combinations of different alleles (ABC, ABc, AbC, etc). Comparison of haplotypes between populations is typically done by examining mitochondrial DNA (mtDNA), which is inherited from one parent only (mother), counting the number of differences in the nucleotide base pairs between them. This is used to calculate haplotypic diversity (h). High values, as in this case, indicate that the populations may be genetically distinct.

Taylor et al. (2007) examined the plausibility of multiple bowhead whale stocks in the Western Arctic population. They synthesised four lines of evidence that related to understanding stock structure: (1) movement and distribution, (2) basic biology, (3) history of commercial whaling, and (4) interpretation of genetic patterns. The paper reviewed 30 years of research plus contributions from traditional ecological knowledge. In terms of bowhead biology, bowhead whales have adapted to living in an arctic ecosystem where ice coverage and food resources vary through time. Taylor et al. (2007) concluded that this varying environment makes both the evolutionary reason for multiple breeding stocks within the Bering Sea and the biological feasibility of maintaining separation within a relatively small pelagic area unlikely. There is variability in the timing that individual bowhead whales migrate, in the timing of the peak of the migration itself, and in the location of both summering and wintering grounds. The variation is a result of both changing environmental conditions and changes in the whales' age and reproductive state. Furthermore, the available area for any potential segregation of feeding or breeding groups is well within the ability of individual whales to travel in a few days time. No evidence was found that a small discrete stock, like the Okhotsk Sea stock, is present and killed in any numbers during the spring or autumn migration of Western Arctic bowhead whales. No data were found to support risk to a separate feeding group. Other insights using genetic data were weak, but nearly all results were consistent with a single stock that is out of equilibrium following commercial depletion. Bowhead whales being out of genetic equilibrium was supported by differences found between age cohorts, both in empirical data and simulated data. The only significant genetic findings worth further consideration were differences involving St. Lawrence Island. However, the comparisons that were significant involved small sample sizes and could just as well result from genetic patterns found between different age cohorts. At the 2007 IWC meeting in Anchorage, Alaska, the IWC Scientific Committee Sub-committee on Bowhead, Right and Gray Whales concluded after a three year investigation of the stock structure of the Bering-Chukchi-Beaufort population of bowhead whales (as summarized in Taylor et al. (2007)) that the available evidence best supports a single-stock hypothesis for Western Arctic bowhead whales (IWC 2007:7).

Status and Management. Since 1931, bowhead whales have been protected from commercial whaling internationally, first under the League of Nations Convention, and since 1949 by the ICRW. Under the IWC, an important feature of the Convention is the emphasis it places on scientific advice. The Convention requires that amendments to the Schedule 'shall be based on scientific findings.' To this end, the Commission has established a Scientific Committee. The Scientific Committee comprises up to 200 of the world's leading whale biologists. Many are nominated by member governments. In addition, in recent years it has invited other scientists to supplement its expertise in various areas. The size of the Committee, as well as the subject matter it addresses, has increased considerably over time. In 1954, it comprised 11 scientists from 7 member nations. At the IWC annual meeting in Anchorage, Alaska in 2007 it comprised over 220 participants (including some 59 invited participants); 32 member nations were represented. The U.S. delegation is the largest with over half of its scientific representation coming from NMFS.

The IWC Schedule establishes the following principles for aboriginal subsistence harvests: (1) for stocks above the Maximum Sustainable Yield (MSY) level, aboriginal subsistence catches shall be permitted so long as total removals do not exceed 90% of MSY; (2) for stocks below MSY level, but above a certain minimum level, aboriginal subsistence catches shall be permitted so long as they are set to allow stocks to increase to the MSY level; (3) catches will be kept

under review; and (4) for bowheads, it is forbidden to strike, take, or kill calves or any whale accompanied by a calf. In addition, the IWC Scientific Committee advises the IWC on a range of rates of increase to the MSY level. To achieve the goals of these principles, the IWC assesses aboriginal whale harvests under various catch control rules. The most important of these rules is replacement yield (RY), which estimates the number of animals that can be killed and leave the population the same size at the end of the year as at the beginning of the year. Another catch control rule, designated Q, was developed to give an appropriate catch limit across any population level to meet these principles (Wade and Givens, 1997). The catch control rule Q allows the proportion of net production allocated to recovery to increase as a population becomes more depleted and decrease for a population above MSY and approaching carrying capacity (K). For populations above the MSY level, Q is capped at 90% of MSY, as required by IWC Schedule sub-paragraph 13(a).

The 1998 stock assessment of bowhead whales (IWC, 1999) reported that the RY value ranged between 108 and 123 animals and the Q value ranged between 102 and 120 animals. The IWC Scientific Committee reported that the population "appears to be near MSY, and would very likely increase under catches of up to 108 animals" (IWC, 1999). The 2004 stock assessment of bowhead whales (IWC, 2005a) reported that the population was close to K with a high probability of being above the MSY level based on the most recent abundance estimate from the 2001 bowhead whale census. Therefore, the use of Q (estimated to range between 137 and 324 animals, capped at 90% of MSY) was more appropriate than RY. After further analyses, the best estimate of Q was determined to be 257 bowhead whales (range: 155-412 animals; Brandon and Wade, 2006). The annual number of whales landed and struck has always fallen well below this number (Figure 3.2.1-2).

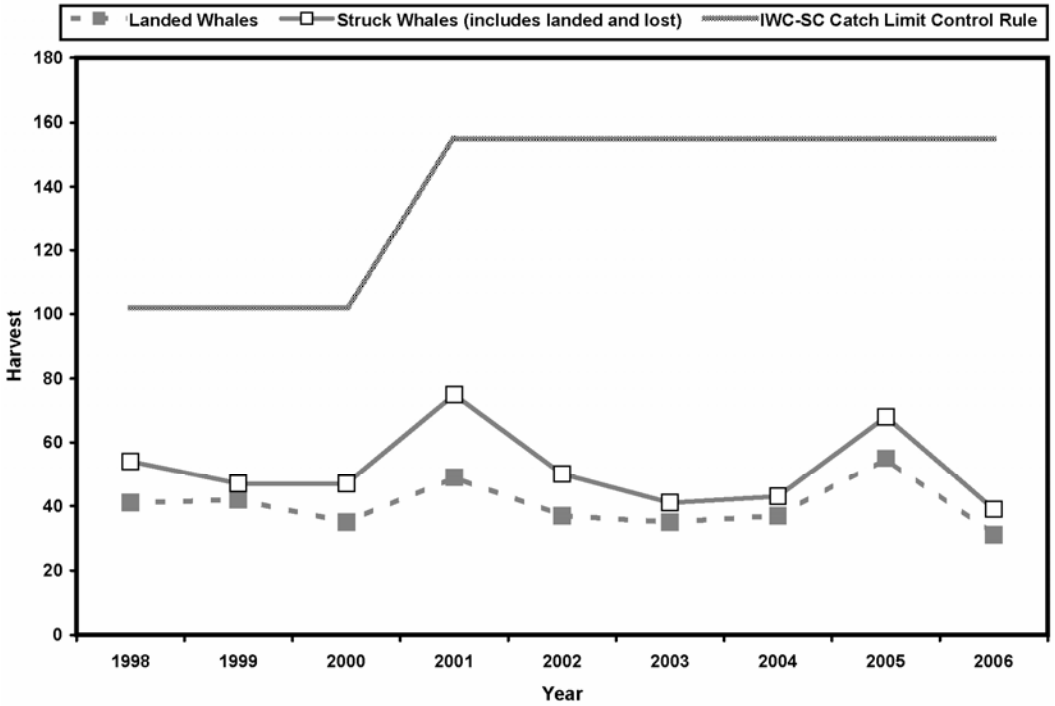

Figure 3.2.1-2 Annual number of Western Arctic bowhead whales landed and struck by Eskimo villages in Alaska, 1998-2006, compared to the IWC-SC catch limit control rule for the population Q1998-2001 = 102 whales (lower bound) and Q2002-2006 = 155 whales (lower bound).

Eskimos have been taking bowhead whales for at least 2,000 years (Marquette and Bockstoce, 1980; Stoker and Krupnik, 1993), and subsistence takes have been regulated by a quota system under the authority of the IWC since 1977. Alaska Native subsistence hunters take approximately 0.1-0.5% of the stock per year (Philo et al., 1993). Yet with a subsistence take that averages between 40 to 50 strikes per year, the Western Arctic stock has continued to grow at 3.4% annually, adding roughly 356 bowhead whales to the population in 2001 (0.034 x 10,470 whales).

The Western Arctic stock of bowhead whales remains listed as endangered under the ESA. Because of the ESA listing, the stock is classified as a depleted and a strategic stock under the MMPA. However, the Western Arctic bowhead whale population is healthy and growing under a managed hunt and has recovered to 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).

3.2.2 Migration and Distribution

General Migration Pattern. The Western Arctic stock is widely distributed in the central and western Bering Sea in winter (November to April), generally associated with the marginal ice front and found near the polynyas of St. Matthew and St. Lawrence Islands and the Gulf of Anadyr (Bogoslovskaya et al., 1982; Brueggeman, 1982; Braham et al., 1984; Ljungblad et al., 1986; Brueggeman et al., 1987; Bessonov et al., 1990; Moore and Reeves, 1993; Mel'nikov et al. 1998) (Figure 3.2.2-1). From April through June, these whales migrate north and east, following leads in the sea ice in the eastern Chukchi Sea until they pass Point Barrow, where they travel

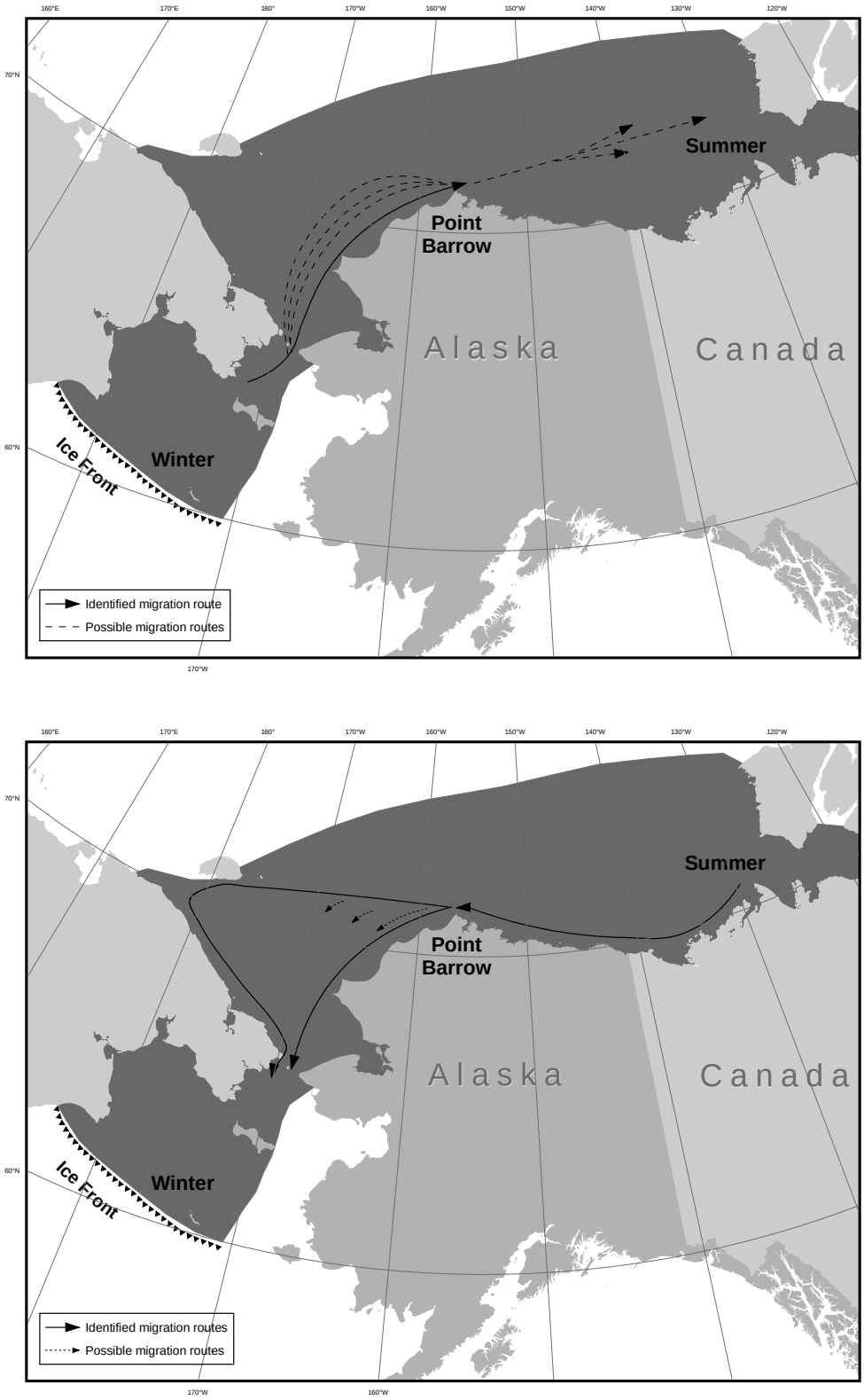

Figure 3.2.2-1 Western Arctic bowhead whale distribution and migratory patterns during the spring (a) and autumn (b) (from Angliss and Outlaw, 2005).

east towards the southeastern Beaufort Sea (Braham et al., 1980; Braham et al., 1984; Marko and Fraker, 1981). Most of the summer (June through September), bowhead whales are found in the Beaufort Sea (Hazard and Cubbage, 1982; Richardson, 1987; McLaren and Richardson, 1985; Richardson et al., 1986a, 1987a,b; Moore and Clarke, 1991), predominantly over outer continental shelf and slope habitats (Moore et al., 2000a). Spatial distribution seems to vary between years (Richardson et al., 1987b; Davis et al., 1983; Thomson et al., 1986), affected in part by surface temperature or turbidity fronts and anomalies (Borstad, 1985; Thomson et al., 1986).

During the autumn (early September to mid-October), bowhead whales migrate across inner shelf waters (Moore et al., 2000a), moving west out of the Beaufort Sea, as evidenced during aerial surveys (Richardson, 1987; Ljungblad et al., 1987; Moore et al., 1989a; Moore and Clarke, 1991), radio-tracking (Wartzok et al., 1990) and satellite-tracking (Mate et al., 2000; Krutzikowsky and Mate, 2000) (Figure 3.2.2-1). From mid-September to mid-October bowheads are seen in the northeast Chukchi Sea, some as far north as 72°N (Moore et al., 1986; Moore and Clarke, 1992). Whales migrate into the Chukchi Sea, with some whales turning southwest along the axis of Barrow Canyon (Moore and Reeves, 1993), while others head toward Wrangel Island (Mate et al., 2000; Krutzikowsky and Mate, 2000). When they reach the Siberian coast, they follow it southeast to the Bering Strait (Bogoslovskaya et al., 1982; Zelensky et al., 1995). Autumn migrants begin arriving on the northern coast of the Chukotka Peninsula in mid-September (Mel'nikov et al., 1998), October (Mel'nikov et al., 1997), or November (Mel'nikov and Bobkov, 1994), with large inter-year differences in the timing of the autumn migration through the Chukchi Sea (Mel'nikov et al., 1998). Whales continue to arrive along the Chukotka coast even in December (Mel'nikov et al., 1998). There appears to be a split in the migration across the Chukchi Sea, with some whales crossing from Point Barrow westward toward Wrangel Island (Mate et al., 2000), and others heading more directly from Point Barrow to the Bering Strait (Moore and Reeves, 1993; Mel'nikov et al., 1998). By late October and November, many whales arrive in the Bering Sea (Kibal'chich et al., 1986; Bessonov et al., 1990), where they spend the winter.

Bowheads in the Bering or Chukchi Seas in the Summer. Very few bowhead whales are found in the Bering or Chukchi Seas in summer (Dahlheim, et al., 1980; Miller et al., 1986); however, there have been enough sightings to indicate that not all bowhead whales migrate to the Beaufort Sea (Mel'nikov et al., 1998). Many have been seen in summer in the northeastern Chukchi Sea (Moore, 1992), and small groups have been observed traveling northwest along the Chukchi Peninsula in May (Bogoslovskaya et al., 1982; Bessonov et al., 1990; Ainana et al., 1995; Zelensky et al., 1995), June (Mel'nikov and Bobkov, 1993) and July (Mel'nikov et al., 1998). Studies conducted in 1994 have shown the presence of bowhead whales throughout the summer along the southeastern portion of the Chukchi Peninsula (Ainana et al., 1995) and the easternmost portion of the peninsula (Zelensky et al., 1995). Moore et al. (1995) suggested that bowheads seen in the Chukchi Sea in early October could have migrated from the Beaufort Sea three weeks earlier, as whales seen in the Alaskan Beaufort Sea in August and early September were often swimming in a westerly direction (Moore et al., 1989b).

Segregation by Size and Sex. During the spring migration, temporal segregation by size and sex class occurs in three overlapping pulses, the first consisting of sub-adults, the second of larger whales, and the third composed of even larger whales and cows with calves (Nerini et al., 1987; Rugh, 1990; Angliss et al., 1995; Suydam and George, 2004). Along the Chukchi Peninsula,

Russian Chukotkan Natives noted the appearance of large numbers of mothers with calves in late-March and early April followed by immature and adult animals (Bogoslovskaya et al., 1982). In the Beaufort Sea in summer, aggregations have usually consisted of only juveniles or of large whales that may include calves (Richardson, 1987; Davis et al., 1986). In 1983, Cubbage and Calambokidis (1987) found a significant inverse correlation between longitude and size class; encounter rates for larger whales increased moving west to east in the Beaufort Sea. Onshore and offshore distributions varied annually, suggesting that "sex- or age-class segregation patterns are temporally and spatially fluid and cannot be defined rigidly for any region or period" (Moore and Reeves, 1993). Segregation by size also occurs during the autumn migration (Braham, 1995; Suydam and George, 2004). George et al. (1995) showed a clear trend in progressively smaller whales harvested between August and November. Along the Chukchi Peninsula, the autumn migration splits into two pulses (Bogoslovskaya et al., 1982; Mel'nikov and Bobkov, 1993, 1994), though segregation by size or sex class was not confirmed as the cause.

3.2.3 Commercial Whaling

Bowheads were first commercially hunted in the Bering Sea in 1848, and in the following year more than 40 vessels took part in the hunt. Total catches were quite variable during the early years of commercial whaling. After low catches in 1853 and 1854, the fleet abandoned the Bering Strait and arctic grounds for the Okhotsk Sea grounds in 1855, 1856, and 1857. As hunting continued and the population was reduced, the whalers went farther and farther north and east. After decimating the Okhotsk Sea population, the fleet returned to the Bering Strait in 1858, remaining there and farther north for the next half-century. In 1889, steamships reached the summer feeding grounds off the Mackenzie River Delta, Canada, which remained the major focus of the industry until 1914, about the time that commercial whaling collapsed (Bockstoce and Botkin, 1980).

3.2.4 Subsistence Hunts

Eskimos have been taking bowhead whales for at least 2,000 years (Stoker and Krupnik, 1993). Although early historical records were not kept, it is estimated that Alaska Eskimos may have taken 20 whales a year (Ellis, 1991), and this level was not detrimental to the bowhead population:

> Subsistence hunting is not a new contributor to cumulative effects on this population. There is no indication that, prior to commercial whaling, subsistence whaling caused significant adverse effects at the population level. However, modern technology has changed the potential for any lethal hunting of this whale to cause population-level adverse effects if unregulated (Minerals Management Service [MMS], 2006a:201).

Partly as a result of concerns about sustainability, subsistence takes have been regulated by a catch limits under the authority of the IWC since 1977. The annual number of bowheads landed by Alaska Natives has ranged from 8 (in 1982) to 55 (in 2005) from the time records were first kept in 1973, while bowheads struck and lost have ranged from 5 (in 1999) to 82 (in 1977) (Figure 3.2.4-1). Hunters from the western Canadian Arctic community of Aklavik (Figure 1.1.2-1) killed one whale in 1991 and one in 1996 (kills that were not approved by the IWC). As

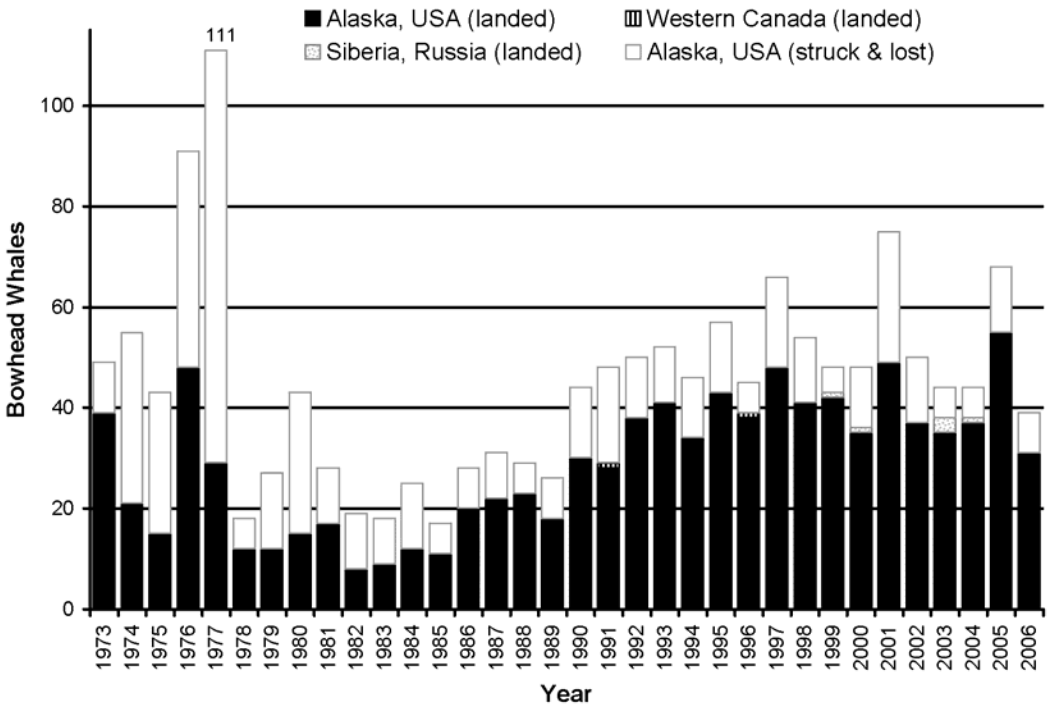

Figure 3.2.4-1 Number of bowhead whales landed, and struck and lost by subsistence hunters in the U.S., Canada and Russia, 1974-2006.

part of the shared quota with the Russian Federation, one animal was killed by Russian subsistence hunters in each of 1999 and 2000, three in 2003 (Borodin, 2004) and one in 2004 (Borodin, 2005) (Figure 3.2.4-1). Descriptions of the Alaska hunts and their management are provided in Sections 3.4 and 3.5, respectively.

3.2.5 Natural Mortality

Little is known about naturally occurring diseases and death in bowhead whales (e.g., Heidel and Albert, 1994). Studies of harvested bowhead whales have discovered bacterial, mycotic, and viral infections but not at a level that might contribute to mortality and morbidity (Philo et al., 1993). Skin lesions, found on all harvested bowhead whales, were not malignant or contagious. However, potentially pathogenic microorganisms inhabit these lesions and may contribute to epidermal necrosis and the spread of disease (Shotts et al., 1990). Exposure of these roughened areas of skin to environmental contaminants, such as petroleum products, could have significant effects (Albert, 1981; Shotts et al., 1990); Bratton et al. (1993), however, concluded that such encounters were not likely to be hazardous.

Evidence of ice entrapment and predation by killer whales, *Orcinus orca*, has been documented in almost every bowhead whale stock. The percentage of whales entrapped in ice is considered to be small, given that this species is so strongly ice-associated (Tomilin, 1957; Mitchell and Reeves, 1982; Nerini et al., 1984; Philo et al., 1993). The ice may also provide some protection from killer whale attacks. The frequency of attacks is unknown and killer whale distribution in northern waters has not been well documented (George et al., 1994). Of 195 whales examined during the Alaskan subsistence harvest (1976-92), eight had been wounded by killer whales (George et al., 1994). Seven of the eight bowhead whales were greater than 13 meters (m) in

length, suggesting either that scars are accumulated over time or that young animals survive a killer whale attack. Overall, the frequency of attacks on bowhead whales in the Bering Sea stock appears to be low (George et al., 1994). However, from the available data, it is not possible to assess the level of predation on bowhead whales by killer whales, particularly in terms of size-class selection and encounter rates.

3.2.6 Contaminants

A number of contaminants persist in the Arctic marine environment including polychlorinated biphenyls (PCBs), Dichlorodiphenyltrichloroethanes (DDTs), organochlorines and chlordanes. However, very limited data are available on baseline hydrocarbon concentrations in prey or tissues of bowhead whales or on the "normal" biochemical and histologic (microscopic) determinants used to assess oil related exposure and impacts. Organochlorines (OCs) are ubiquitous, persistent contaminants and are lipophilic (fat loving) and tend to bioaccumulate in lipid-rich tissues (i.e., blubber). Recent analyses were presented at a bowhead health and physiology workshop held in Barrow, Alaska, in 2002 (Willetto et al., 2002). Similar to other mysticetes, bowhead whale samples showed that among different blubber strata there may be differences in vertical distribution of organochlorines as well as lipid content. OC concentration levels varied from the Bering-Chukchi-Beaufort Seas suggesting that contaminant levels varied along the migratory range of the bowhead whale (Hoekstra et al., 2002a). The OC levels consistently fluctuated with seasonal migration between the Beaufort and Bering Seas over a 3.5-year period indicating that active feeding must be occurring in both areas to alter contaminant levels and profiles in tissues (discussed in Willetto et al., 2002).

Approximately 350 high quality blubber samples from bowhead whales were analyzed for lipid content, and the proportion of neutral lipids (i.e., triglycerides, non-esterified free fatty acids) that are key factors affecting the accumulation of lipophilic OCs (discussed by Ylitalo in Willetto et al., 2002). Lipid concentrations of bowhead blubber ranged from 25 – 83%, primarily triglycerides (94 – 100%). The mean lipid concentrations were significantly different among the three collection years (1998, 1999, 2000) and by season (autumn versus spring) (discussed by Zeh in Willetto et al., 2002). Blubber and liver samples were analyzed for selected OCs (toxaphene [TOX], PCBs, DDT, hexachlorocyclohexanes (HCHs), chlordanes, chlorobenzenes) to investigate bioaccumulation and biotransformation (Hoekstra et al., 2002a,b). In general, concentrations of OCs significantly increased with body length in male bowhead whales (Hoekstra et al., 2002a). Concentrations also increased with body length (i.e., age) in female whales but only up to the length of 13 m. Adult females (> 13 m) had generally lower concentrations than juvenile whales, which was attributed to the transfer of OCs from mother to young during gestation and lactation.

Geographic differences in contaminant exposure and accumulation (contamination varied by region) were reflected in OC concentrations in blubber of the bowhead whale, which was very likely a result of feeding in the respective regions, i.e., the Bering and Beaufort Seas (Hoekstra et al., 2002a). Age, gender, and concentration levels influence PCB biotransformation (Hoekstra et al., 2002b). The sum of PCB concentrations in bowhead whales was relatively low compared to levels found in other cetaceans. Heavy metal concentrations (i.e., cadmium [Cd], mercury [Hg], selenium [Se]) increased with age and tended to be high in Arctic marine mammals; however, Hg and Se were comparably very low in bowhead whales (Woshner et al., 2001, 2002; O'Hara et

al., 2006). In summary, contaminant levels for bowhead whales varied by gender, length (i.e., age), and season, but were relatively low compared to other marine mammals.

3.2.7 Fishery Interactions

The NMFS National Observer Program has no records of bowhead whale mortality incidental to commercial fisheries in Alaska (Angliss and Outlaw, 2005). However, several cases of rope or net entanglement have been reported from whales taken in the subsistence hunt (Philo et al., 1993), including those summarized in Table 3.2.7-1. Further, preliminary counts of similar observations based on reexamination of bowhead harvest records indicate that entanglements or scarring attributed to ropes may include over 20 cases (J.C. George, Department of Wildlife Management, NSB, personal communication). Some bowhead whales have had interactions with crab pot gear, one in 1993 and one in 1999. The average rate of entanglement in crab pot gear for 1999-2003 was 0.2 whales per year (Angliss and Outlaw, 2005).

Table 3.2.7-1
Evidence of Bowhead Whales Interacting with Ropes, Fishing Gear and Vessels, 1978-2004

Year	Number of Whales	Location	Description
1978	1	Wainwright	6 scars on caudal peduncle
1986	1	Kaktovik	Scars on caudal peduncle and anterior margin of flukes
1989	1	Barrow	12 scars on ridges of caudal peduncle
1989	1	south of Gambell	Rope wrapped around head, through mouth and baleen
1989*	1	Barrow	Rope ~32m long trailing from mouth
1990	1	Barrow	Scars on caudal peduncle; 2 ropes trailing from mouth.
1991*	1	Barrow	Apparent rope scar from mouth, across back
1993**	1	Barrow	Large female with crab pot line wrapped around flukes
1998**	1	NW of Kotzebue; near Red Dog Mine dock	Stranded - dead with line on it
1999**	1	Barrow	Whale entangled in confirmed crab gear. Line wrapped through gape of mouth, flipper, and peduncle. Severe injuries.
2003**	1	Near Ugashik	Stranded with rope tied around the peduncle; entangled?
2004**	1	Kaktovik	Boat propeller marks

Philo et al., 1993; * D. Rugh, NMFS, personal communication; ** J.C. George, NSB, personal communication

3.2.8 Offshore Activities, Petroleum Extraction

Oil and gas exploration and development are increasingly active in the Chukchi and Beaufort Sea in portions of the Western Arctic bowhead whale stock habitat. Extensive information about the effects of oil and gas activities on bowhead whales is discussed in four documents: (1) a Biological Opinion prepared by NMFS for the MMS pursuant to Section 7 of the ESA on Oil and Gas Leasing and Exploration Activities in the Beaufort Sea, Alaska (NMFS, 2006); (2) EIS prepared pursuant to the NEPA for the Beaufort Sea Planning Area, Oil and Gas Lease Sale, Sales 186, 195, and 202 (MMS, 2002a); (3) an EA prepared by the MMS for proposed Outer Continental Shelf (OCS) Lease Sale 202 - Beaufort Sea Planning Area (MMS, 2006a); and (4) Final Programmatic EA Arctic Ocean OCS Seismic Surveys 2006 (MMS, 2006b). Additional information is presented on the MMS Alaska OCS Region website: www.mms.gov/alaska.

There have been ten federal oil and gas lease sales within the Alaskan Beaufort Sea beginning with the Joint State of Alaska (State)-Federal Sale held in December 1979. The most recent federal sale was Beaufort Sea Sale 202, held on April 18, 2007. The MMS five-year lease plan

for 2007-2012 has additional sales scheduled in 2009 and 2011. Prior to 2000, no permanent facilities, or oil production, existed on the Beaufort Sea OCS outside of state waters. There are presently two offshore production facilities within state waters in the Beaufort Sea: Northstar and Endicott.

The potential effects of those projects and leasing and development of the OCS have been considered in the biological opinions regarding oil and gas leasing and exploration activities and oil production facilities (NMFS, 1999, 2001a, 2006). These oil and gas activities introduce noise into the marine environment that may disturb bowhead whales. Multiple marine geophysical (seismic) projects are planned for the Beaufort and Chukchi Seas in 2007. There are also plans to drill several exploration wells near Camden Bay in 2007 using two drill ships, each requiring support vessels, including ice breakers. Additional information on recent and planned oil and gas exploration and development activity is found in Sections 4.6.1.1 and 4.6.1.2.

Noise has been shown to cause avoidance behavior in migrating bowhead whales. Seismic activities and the use of ice breakers to support OCS activities present the highest probability for avoidance of any of the activities associated with oil exploration (NMFS, 2006). Studies have shown noise from ice breakers may be detected by acoustic instruments at distances exceeding 50 km (NMFS, 2003). It is reasonable therefore, to assume that bowheads could also detect this noise at this distance. The distance at which bowheads may react to noise is poorly described, but may exceed 20 km for marine seismic surveys as described below. Elevated sound levels in the marine environment could alter the hearing ability of whales, causing temporary or permanent threshold shifts if the sound levels are sufficiently high and the bowheads are in close proximity to the noise source. At present, researchers have insufficient information on the hearing ability and sensitivities of bowhead whales to adequately describe this potential. Information suggests most continuous and impulsive underwater noise levels would be at levels or durations below those expected to injure hearing mechanisms. Nonetheless, marine seismic activities may present concerns with respect to hearing.

Seismic Surveys. Seismic surveys in Alaska are scheduled in the summer and fall and are accomplished by sending sound waves down into the substratum (through the use of airguns) and receiving information about its oil-bearing potential based on the speed and strength of the returning echoes (National Research Council [NRC], 2003). Three types of offshore seismic surveys occur on the North Slope: marine streamer three-dimensional (3-D) and two-dimensional (2-D) surveys, ocean-bottom-cable seismic surveys, and high-resolution site-clearance surveys. Marine streamer 3-D and 2-D surveys involve a marine vessel that tows source arrays (airguns to generate acoustic energy) and passive-listening receiver equipment (called "streamers") to obtain geophysical data (MMS, 2006b). Streamers consist of long cables with multiple hydrophones that receive the echoes from the source energy as it bounces off the various substrata of the ocean floor. Airguns are the acoustic source for 3-D and 2-D seismic surveys.

Airgun arrays for both 3-D and 2-D seismic surveys emit pulsed rather than continuous sounds (MMS, 2006b). Airgun output usually is specified in terms of zero-to-peak or peak-to-peak levels (MMS, 2006b; Richardson et al., 1995a). Peak-to-peak values are about 6 decibels (dB) higher than zero-to-peak values (Richardson et al., 1995a). Airgun sizes are quoted as chamber volumes in cubic inches, and individual guns may vary in size from a few tens to a few hundreds of cubic inches (MMS, 2006b). The sound-source level (zero-to-peak) associated with both 3-D and 2-D seismic surveys ranges between 233 and 240 decibels re 1 microPascal at 1 meter (dB re

1μPa at 1 m)[7] (MMS, 2006b). Seismic sounds vary, but a typical 2-D/3-D seismic survey with multiple guns would emit energy at about 10-120 hertz (Hz), and pulses can contain energy up to 500-1,000 Hz (Richardson et al., 1995). Goold and Fish (1998) recorded a pulse range of 200 Hz-22 kilohertz (kHz) from a 2-D survey using a 2,120-cubic-inch-array. While most of the energy is directed downward (toward the ocean bottom) and the short duration of each pulse limits the total energy, the sound can propagate horizontally for several kilometers (Greene and Richardson, 1988; Hall et al., 1994). In waters 25-50 m deep, sound produced by airguns can be detected 50-75 km away, and these detection ranges can exceed 100 km in deeper water (Richardson et al., 1995a).

While high noise levels may affect whale hearing, or impact whales' use of sound to communicate or navigate, studies conducted on seismic research in the Beaufort Sea show that such effects on bowhead whales appear to be temporary, below exposure levels likely to cause injury or death, and therefore unlikely to prevent the survival and recovery of this species, provided these activities are properly authorized and mitigated. The deflection of bowheads from known migratory routes, however, does affect bowhead whale hunters. According to TEK, hunters were unable to find whales or bearded seals during seismic activities (B. Rexford, former chairman, Alaska Eskimo Whaling Commission, personal communication; H. Aishanna, Kaktovik Whaling Captain, personal communication, Kaktovik Whaling Captains Association, personal communication).

Site-Clearance Survey Activities. High-resolution seismic surveys primarily are used by the oil and gas industry to locate shallow hazards; obtain engineering data for placement of structures (e.g., proposed platform locations and pipeline routes); and detect geohazards, archaeological resources, and certain types of benthic communities (MMS, 2006b). All involved ships are designed to be quiet, as the higher frequencies used in high-resolution work are easily masked by the vessel noise if special attention is not paid to keeping the ships quiet. Airgun volumes for high-resolution surveys typically are 90-150 in^3, and the output of a 90 in^3 airgun ranges from 229-233 dB re 1μPa at 1 m (MMS, 2006b). Airgun pressures typically are 2,000 pounds per square inch (psi), although they can be used at 3,000 psi for more output (MMS, 2006b). Marine geophysical research or other activities involving seismic airguns may introduce significant levels of noise into the marine environment and have been demonstrated to alter the behavior of bowhead whales. Research on the effects of offshore seismic exploration in the Beaufort Sea, supported by the testimony of Inupiat hunters based on their experience, has shown that bowhead whales avoid these operations when within 20 km of the source and may begin to deflect at distances up to 35 km (Richardson et al., 1999).

Drilling. After seismic surveys indicate that commercially feasible quantities of oil or gas are present, exploratory drilling begins. Underwater noise levels from drill sites on natural or manmade islands are low, and inaudible at ranges beyond a few kilometers (Richardson et al., 1995a). Noise is transmitted very poorly from the drillrig machinery through land into the water

[7] Sound is typically measured in decibels, which measure the reduction of a sound's intensity over distance. Because sound travels differently through different media, the measurement of sound must also take into account a medium's impedance (or resistance) to sound pressure to be meaningful. A standard reference point for sound pressure in water (through which sound waves propagate more efficiently than through air) is one microPascal (1μPa), a measure of pressure. In underwater acoustics, the *source level* of a sound represents the intensity of a sound at a certain distance, usually one meter, from the source, referenced to one microPascal; this is the meaning of the scientific phrase dB re 1μPa at 1 m. The *received level* is the intensity of the sound at the listener's actual distance from the source; this is the value represented by the scientific phrase dB re 1μPa rms (rms = root mean square, a statistical measure of the average amplitude of the variable intensity of a sound wave).

(Richardson et al., 1995a). Drilling noise from icebound islands is generally confined to low frequencies and has a low source level. It would be audible at range 10 km only during unusually quiet periods; the usual audible range would be approximately 2 km (Richardson et al., 1995a). Davies (1997) concludes that bowheads avoided an active drilling rig at a distance of 20 km.

Under open water conditions, drilling sounds from islands may be detectable somewhat farther away, but the levels are still relatively low (Richardson et al., 1995a). Drilling noise from caisson-retained islands is much stronger than natural or manmade islands (Richardson et al., 1995a). At least during open water conditions, noise is conducted more directly into the water at caisson-retained islands than at island drill sites. Noise levels are generally higher near drill ships than near semisubmersibles or caissons. The drill ship hull is well coupled to the water and semisubmersibles lack a large hull area. Machinery on semisubmersibles is mounted on decks raised above the sea on risers supported by submerged floating chambers. Sound and vibration paths to the water are through either the air or the risers, in contrast to the direct paths through the hull of a drill ship (Richardson et al., 1995a).

Acoustic research for the Northstar project, one of the activities covered under prior Biological Opinions, estimated that the numbers of bowhead whales that may have been deflected more than 2 km offshore due to that noise source ranged from 0 to 49 during 2001-2004. In any year in which offshore seismic activities occur in the Beaufort Sea, many bowheads may be "taken" by harassment. NMFS estimated the level of seismic "takes" between 1,275 and 2,550 in 2000. However, considerable variability is associated with any such estimate; NMFS would not expect this number of bowhead whales to be harassed year after year. No estimation of bowhead whale takes due to noise from the Endicott project is available (NMFS, 2001a). However, Endicott is near shore and in relatively shallow waters, through which noise propagation into areas used by bowhead whales would be greatly attenuated. Bowhead whales are not likely to be affected by noise from the Endicott project due to its distance from the bowhead's autumn migration route and the limited distance that noise travels from gravel structures into the marine environment.

In summary, more sound is radiated underwater during drilling operations from drill ships than from semisubmersibles. In contrast, noise from drilling on islands radiates very poorly to water, making such operations relatively quiet. Noise levels from drilling platforms and certain types of caissons have not been well documented, but are apparently intermediate between those from vessels and islands (Richardson et al., 1995a). By far, the noisiest exploratory activity is seismic surveys.

Development. Once an economically viable discovery is made, development begins. This phase involves additional drilling, and the subsequent construction of roads; airstrips; and waste disposal, seawater treatment, gas handling, power generation, storage, maintenance, and residential facilities (NRC, 2003). Greene (1983) measured noise under shorefast ice during winter construction of an artificial island near Prudhoe Bay. Roads were built on the sea ice and trucks hauled gravel to a site in water 12 m deep. At distances less than 3.6 km, there was no evidence of noise components above 1,000 Hz, and little energy below 1,000 Hz (Richardson et al., 1995a). Construction-related sounds did not propagate well in shallow water under the ice during winter (Richardson et al., 1995a).

Oil Spills. MMS investigated the probability of spilled oil contacting bowhead whales (MMS, 2002a). Specific offshore areas, termed Ice/Sea Segments were identified and modeled for

probability of contact and overlay the migratory corridor of bowheads. Using data from the MMS oil spill analysis for Sale 170, and assuming an oil spill of 1,000 barrels or more occurred at any of several offshore release areas during the summer season, the chance of that oil contacting these regions within 30 days during the summer season ranged from 5-82%. Therefore, there is high variability from the effects of an oil spill impacting Ice/Sea Segment areas.

If an oil spill were concentrated in open water leads, it is possible that a bowhead whale could inhale enough vapors from a fresh spill to affect its health. The effects of oil contacting skin are largely speculative, but may include pre-disposing whales to infection. It has been suggested that if oil gets onto the eyes of bowhead whales it would enter the large conjunctival sac (Zhu, 1996) and move inward 4 to 5 inches (10 to 13 centimeters [cm]) and get behind most of the eye (T. Albert, NSB, personal communication). The consequences of this event are uncertain, but some adverse effects are expected. Bowhead whales may ingest oil encountered on the surface of the sea during feeding, resulting in fouling of their baleen plates. Albert (1981) suggests that broken off baleen filaments and tar balls are of concern because of the structure of the bowhead's stomach and could cause a blockage within a narrow passage of the digestive system.

Engelhardt (1987) stated that bowhead whales are particularly vulnerable to effects from oil spills due to their use of ice edges and leads where spilled oil tends to accumulate. The impacts of oil exposure to the bowhead whale population would also depend upon how many animals contacted oil. If oil found its way into leads or ice-free areas frequented by migrating bowheads, a significant proportion of the population could be affected. The NSB believes there are some scenarios, such as an oil spill in a spring lead system near Barrow, which could affect a large portion of the population. The likelihood of this is debatable, depending on how oil development proceeds in the Chukchi Sea (Craig George, North Slope Borough, personal communication, December 20, 2007).

While it is exceedingly difficult to predict the various aspects of an oil spill that would impact bowhead whales, it is reasonable to state that the numbers of whales that might be affected would be expected to be very small in terms of the current abundance. However, bowhead whales would be placed at particular risk in the event of a large oil spill occurring while the whales were migrating north through the Chukchi Sea, or east through the Beaufort Sea, traveling through the spring lead and polynya system. The numbers of whales affected may be much higher, however, as we must assume that the entire stock needs to make this migration to get to summering grounds. Whether such a spill would affect a significant portion of this population is uncertain.

Adult whales exposed to spilled oil likely would experience temporary, or perhaps permanent, nonlethal effects. Prolonged exposure to freshly spilled oil could kill some whales, but the numbers are estimated to be small due to a low chance of such contact (MMS, 2006f). However, there are no data available that definitely link a large oil spill with a significant population-level effect on a species of large cetacean.

While data from previous spills in other locations worldwide are broadly informative, there is uncertainty about the potential for population level effects or other potential outcomes should a large or very large spill occur in instances where whales are aggregated and/or constrained in

their option for alternative routes (for example, in the spring lead and polynya system due to ice conditions) or are aggregated in a feeding area, especially if aggregations contained large numbers of females and calves. The potential for a population level effect may exist if large numbers of females and calves, especially newborn or very young calves, were to be contacted by large amounts of freshly spilled oil. The uncertainty arises because:

- of the unique ecology of the bowhead whale;
- existing information about the effects of oil on very large cetaceans is inconclusive and, thus, it is not possible to confidently estimate the likelihood that serious injury to individuals of bowhead whales could or would occur with oil exposure;
- there is lack of agreement over the interpretation of post-Exxon Valdez oil-spill cetacean studies;
- there are not data sufficient to determine the vulnerability of newborn or other baleen calves to freshly spilled crude oil;
- it is very difficult, if not impossible, to obtain many of the kinds of data that have been gathered on some other marine mammals to assess acute or chronic adverse sublethal effects from an oil spill (or other affecters) on large cetaceans; and
- there is no other situation comparable to that which could exist if a large or very large oil spill occurred in, or moved into, the spring lead and polynya system, especially if this occurred when there were large numbers of females with newborn calves, occurred when calving was occurring, or occurred when hundreds of individuals were in the leads and polynya on their northward migration.

Most whales exposed to spilled oil could be expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, ingestion of oil-contaminated prey items, baleen fouling, reduction in food resources, or temporary displacement from some feeding areas. A few individuals may be killed as a result of exposure to freshly spilled oil. However, the combined probability of a spill occurring and also contacting bowhead habitat during periods when whales are present is considered to be low, and the percentage of the bowhead whale stock so affected is expected to be very small. Contaminated food sources and displacement from feeding areas also may occur as a result of an oil spill, but NMFS has concluded it is unlikely that the availability of food sources for bowheads would be affected given the abundance of plankton resources in the Beaufort Sea (Bratton et al., 1993; NMFS, 2001a).

3.3 Other Wildlife

A wide variety of marine mammals, birds, and other marine organisms occurs in the area where Alaskan Natives hunt for bowhead whales. These species are identified and discussed briefly below. Additional information about each marine mammal species can be found in Angliss and Outlaw (2005).

3.3.1 Other Marine Mammals

Under the MMPA, marine mammals are protected by a prohibition on take; however, Section 101(b) of the MMPA generally provides that the provisions of the MMPA do not apply to subsistence hunting of marine mammals by Alaskan Natives. The ESA contains a similar provision with respect to endangered or threatened species. Many Alaskan villages hunt a variety of marine mammals including the bearded seal, ringed seal, spotted seal, ribbon seal, beluga

whale, bowhead whale, polar bear, and walrus (MMS, 2002a). A discussion of the current status and trends of all marine mammals that inhabit the area where Alaska Eskimos hunt for bowhead whales follows.

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 the 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., 1981a; 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; 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; Lowry et al., 2000). Availability of food and freedom from disturbance seem to be important criteria for selection of coastal haulout sites (Lowry, 1982).

A reliable estimate of spotted seal population abundance, abundance trends, and stock structure is currently not available (Rugh et al., 1997; Angliss and Outlaw, 2005). 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 the 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). The mean annual subsistence take of spotted seals in the northern part of Bristol Bay from 1993-1995 was 244. As of August 2000, the subsistence harvest database indicated that the estimated number of spotted seals harvested for subsistence use per year was 5,265 animals (Angliss and Outlaw, 2005).

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; 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, 1981a). Some seals, particularly juveniles, may spend the summer in open-water areas of the Bering and Chukchi Seas (Burns, 1981a).

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; Burns et al., 1981a). Bearded seals are an important species for Alaskan subsistence hunters, with estimated annual harvests of 6,788 (Angliss and Outlaw, 2005).

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, 1981b; Braham et al., 1984; Moore and Barrowclough, 1984), inhabiting the northern part of the Bering Sea ice front from late March to early May (Burns, 1970, 1981b; Braham et al., 1984), and moving north with the receding ice edge in May to mid-July (Shustov, 1965; Tikhomirov, 1966; Burns, 1970, 1981b; Burns et al., 1981a). Ribbon seals usually haul out on thick pack ice (Shustov, 1965; Tikhomirov, 1966; Burns, 1981b; 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, 1981b). Single ribbon seals have been observed during the summer (June-August) within 84 miles (mi.) of the Pribilof Islands (Burns, 1981b), near Cordova, Alaska (Burns, 1981b) and south of the Aleutian Islands (Stewart and Everett, 1983).

A reliable estimate of abundance, abundance trends, and stock structure for the Alaska stock of ribbon seals is currently not available (Angliss and Outlaw, 2005). 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). Ribbon seals are also taken by Alaska Native subsistence hunters, primarily from villages in the vicinity of the Bering Strait and to a lesser extent at villages along the Chukchi Sea coast (Kelly, 1988a). The annual subsistence harvest was estimated to be less than 100 seals annually from 1968 to 1980 (Burns, 1981b). The more recent annual subsistence harvest in Alaska is estimated to be 193 (Angliss and Outlaw, 2005).

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; 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; 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; Frost et al., 1988, 1997, 1998, 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; 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; 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, 2005). 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. Ringed seals are an important species for Alaska Native subsistence hunters. The most recent annual subsistence harvest in Alaska is estimated to be 9,567 (Angliss and Outlaw, 2005).

Pacific Walrus. The Pacific walrus (*Odobenus rosmarus*) occurs primarily in the shelf waters of the Bering and Chukchi Seas (Allen, 1880; 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, 1982; 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). Walruses 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 the 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.

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; Fedoseev, 1984). Subsistence harvest mortality levels are estimated at 5,789 animals per year (Angliss and Outlaw, 2005).

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. A reliable abundance estimate for the Chukchi/Bering Seas population currently does not exist. The most recent estimate, made by the IUCN Polar Bear Specialist Group in 1998 estimated this population to be approximately 2,000-5,000 animals. The abundance of the southern Beaufort Sea stock is estimated to be 2,272 animals (Angliss and Outlaw, 2005).

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, only subsistence harvests by Alaska Natives have been permitted and overall harvest rates have declined. Both

stocks appear to have increased in abundance. 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 U.S. 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).

Gray Whale. Gray whales (*Eschrichtius robustus*) occur across 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 and Gulf of Alaska. 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 its depletion in the early 1900s caused by commercial whaling. Gray whales were listed as endangered under the ESA on June 2, 1970 (35 FR 8495). Then, following a comprehensive evaluation of their status (Breiwick and Braham, 1984), NMFS concluded on November 9, 1984 (49 FR 44774), that this population should be listed as threatened, instead of endangered, under the ESA. However, no further action was taken until 1991 when a subsequent review was completed and made available to the public on June 27, 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, NMFS proposed, on November 22, 1991 (56 FR 58869), that this population be removed from the list of endangered and threatened wildlife under the ESA. After an extensive review period, NMFS published a final notice of determination (58 FR 3121, January 7, 1993) 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 estimates are based on counts made during the 1997/98, 2000/01, and 2001/02 southbound migrations. Analyses of these data 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. Consequently, 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).

Previous analysis of abundance estimates from shore-based counts indicates that the population increased by approximately 2.5% per year (SE=0.3%) between 1967/68 and 1995/96 (Buckland and Breiwick, 2002). A Bayesian analysis of gray whale population dynamics for the same period suggested the rate of increase of the population could have been 3.4% (95% CI=2.54.2%), if the Russian Chukotkan Natives had not continued a harvest of roughly 40-80 whales per year (Wade and DeMaster, 1996). A provisional analysis incorporating the preliminary data from 2000/01 and 2001/02 speculates that the low estimates could have been a result of an unusual number of whales that did not migrate as far south as Granite Canyon in these years or that the high mortality rates observed in 1999 and 2000 may indicate a decline in gray whale abundance (Rugh et al., 2002).

Although the estimates show that migrating gray whales seemed to be decreasing between 1997/98 and 2000/01 to 2001/02, this decline in abundance appears to be temporary and related to the 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 drop 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; Gulland et al., 2005), calf production data (Perryman et al., 2002; Perryman et al., 2004; Urban et al., 2002), and a change in body condition of whales during the southward migration (LeBoeuf et al., 2000; Perryman and Rowlett, 2002).

The Alter et al. (2007) interpretation of historic gray whale abundance based on their analysis of genetic material is very much in debate at this time (Palsbøll et al., 2007; Alter and Palumbi, 2007). The authors suggest the entire Pacific metapopulation numbered on average 96,000 gray whales. In 2004, in the light of a similar genetic modeling paper published in 2003 (Roman and Palumbi 2003), the IWC Scientific Committee considered the general methodological issue of estimating carrying capacity and/or pre-exploitation population size in the context of the Scientific Committee's assessment work (source: http://www.iwcoffice.org/publications/editorialnew.htm#estimate [accessed 11/3/07]). The Scientific Committee agreed that such genetic methods have the potential to be one of a suite of tools that can be used to examine pre-exploitation abundance but that there are a number of limitations and uncertainties that must be considered when examining such data in a present-day management context. The Scientific Committee had agreed that the estimates of historic abundance provided in the Roman and Palumbi paper for the initial pre-whaling population sizes of humpback, fin and common minke whales in the North Atlantic had considerably more uncertainty than reported, and could not be considered reliable estimates of immediate pre-whaling population size. Particularly important in this regard was the mismatch between the time-period to which genetic estimates applied (i.e. the time period is difficult to determine and extremely wide) and the population sizes of whales immediately prior to exploitation (eg. see Baker and Clapham 2004).

Subsistence hunters in Alaska, Washington State, and the Russian Federation have traditionally harvested whales from this stock (Angliss and Outlaw, 2005). The U.S. and the Russian Federation have agreed that the IWC quota would be shared with an average annual harvest of

120 whales by the Russian Chukotka people and four whales by the Makah Indian Tribe, subject to the satisfaction of domestic legal requirements under NEPA and the MMPA, with respect to any subsistence hunt by the Makah Tribe. Russian aboriginals harvested 121 (+2 struck and lost) in 1999 (IWC, 2001a), 113 (+2 struck and lost) in 2000 (Borodin, 2001), 112 in 2001 (Borodin et al., 2002), 131 in 2002 (Borodin, 2003), and 126 (+2 struck and lost) in 2003 (Borodin, 2004), while the Makah Tribe harvested one whale in 1999 (IWC, 2001a). Based on this information, the annual subsistence take averaged 122 whales during the five-year period from 1999 to 2003.

Beluga Whale. 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 et al., 2001). 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; O'Corry-Crowe and Lowry, 1997). The Bristol Bay and eastern Bering Sea stocks occur within the Bering Sea/Aleutian Islands and Gulf of Alaska.

The population abundance estimate for the Bristol Bay stock is 2,133 animals, 18,142 animals in the eastern Bering Sea stock, 3,710 animals in the eastern Chukchi Sea stock, and 39,258 animals in the Beaufort Sea stock (Angliss and Outlaw, 2005). Current population trends for the Beaufort Sea and eastern Bering Sea stocks are unknown (Angliss and Outlaw, 2005). The Bristol Bay stock is considered stable and may be increasing and there is no evidence that the eastern Chukchi Sea stock is declining (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. 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). Since 2003, Alaska Native hunters have landed the following number of beluga whales for the years 2004 through 2006: Beaufort Sea stock – 32, 20, and 5 whales; Chukchi Sea stock – 54, 43, and 31 whales; eastern Bering Sea stock – 132, 249, and 166 whales; Kuskokwim stock – 0, 2, and 9 whales; and Bristol Bay stock – 16, 19, and 20 whales (Kathy Frost, Alaska Beluga Whale Committee, personal communication, November 2, 2007).

Minke Whale. Minke whales (*Balaenoptera acutorostrata*) are distributed worldwide. Sightings 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; Platforms of Opportunity Program [POP], 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). In the central Bering Sea, an estimated 936 minke whales (95% Confidence Interval [CI] 473-1,852, Coefficient of Variation [CV] = 0.35) were observed during the summer of 1999 (Moore et al., 2000b). However, this covers only a small portion of the Alaska stocks 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). No data exist on trends in abundance in Alaskan waters (Angliss et al., 2001).

Subsistence takes of minke whales by Alaska Natives are rare, but have been known to occur. Only seven minke whales are reported to have been taken for subsistence by Alaska Natives between 1930 and 1987 (C. Allison, IWC, personal communication). The most recent harvest (two whales) in Alaska occurred in 1989 (IWC, 1991).

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). They occur primarily in coastal waters, although they have been sighted well offshore (Heyning and Dahlheim, 1988). Seasonal movements in polar regions may be influenced by ice cover and in other areas primarily by availability of food. An estimated 1,123 killer whales belong to the eastern North Pacific Alaska resident stock (Angliss and Outlaw, 2005). Resident killer whales are not known to eat other marine mammals. Population trends for the entire stock are currently unknown though portions of the stock in Prince William Sound and Kenai Fjords have increased 3.3% per year from 1984 to 2002 (Matkin et al., 2003). Transient killer whales are the only known predators of bowhead whales (Angliss and Outlaw, 2005). In a study of marks on bowheads taken in the subsistence harvest, 4.1% to 7.9% had scars indicating the bowhead whales had survived attacks by killer whales (George et al., 1994). A minimum number of 314 transient killer whales have been photographed from the Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock (Angliss and Outlaw, 2005). There is no reported subsistence harvest of killer whales in Alaska (Angliss and Outlaw, 2005).

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; Dahlheim et al., 2000). They occur primarily in coastal waters, but are also found where the shelf extends offshore (Gaskin, 1984; Dahlheim et al., 2000). In 1999, aerial surveys were conducted in Bristol Bay resulting in an abundance estimate of 47,356 for this portion of the Bering Sea. Currently, there is no reliable information on population trends (Angliss and Lodge, 2003). Subsistence hunters in Alaska have not reported to take from this stock of harbor porpoise (Angliss and Lodge, 2003).

3.3.2 Marine Birds

Many species of birds occur in substantial numbers in the Arctic Coastal Plain and Beaufort Sea habitats and nearly all are migratory, present sometime during the period from May to early November. Species include waterfowl, shorebirds, loons, seabirds, hawks and eagles, ptarmigan, and songbirds (MMS, 2002a). Birds hunted by Alaska Eskimos in Barrow, Kaktovik, and Nuiqsut include the snowy owl, red-throated loon, tundra swan, eiders (common, king, spectacled, and Steller's), ducks, geese, and ptarmigan (MMS, 2002a). Three bird species that are listed under the ESA and that inhabit the areas where Alaska Eskimos hunt for bowhead whales are short-tailed albatross, spectacled eider, and Steller's eider.

Short-tailed Albatross. The short-tailed albatross (*Phoebastria (=Diomedea) albatrus*) is listed as endangered under the ESA and by the State of Alaska (65 FR 46643). The short-tailed albatross was originally listed in 1970, under the Endangered Species Conservation Act of 1969, prior to the passage of today's ESA (35 FR 8495). However, as a result of an administrative error (and not from any biological evaluation of status), the species was listed as endangered

throughout its range except within the U.S. (50 CFR 17.11). On July 31, 2000, this error was corrected when the USFWS (USFWS) published a final rule listing the short-tailed albatross as endangered throughout its range (65 FR 46643). These birds mate for life, laying eggs in October or November and incubating them for 65 days. The species is known to breed on only two remote islands in the western Pacific. Chicks leave the nest after five months to go to the North Pacific. Adults also spend the summer at sea, feeding on squid, fish, and other organisms. Most summer sightings of these birds are in the Aleutian Islands, Bering Sea, and Gulf of Alaska. During the late 1800s and early 1900s, hunters killed an estimated five million birds, stopping only when the species was nearly extinct. Protection of their nesting grounds has lead to an increased number of short-tailed albatross, from fewer than 50 birds in the late 1940s to over 600 birds in 1993 (Alaska Department of Fish and Game [ADF&G], 2001a). Presently, fewer than 2000 short-tailed albatrosses are known to exist (USFWS, 2005). Critical habitat has not been designated for this species.

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, 2002a) of spectacled eiders 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 lies south of St. Lawrence Island in the Bering Sea. 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, 2002a). Spectacled eiders have declined dramatically in Alaska since the 1960s (ADF&G, 2001, Spectacled Eider). 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, uncorrected for aerial detection bias, is 4,744 ± 907 pairs (arithmetic mean plus or minus two times the standard error associated with the sample) (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. The downward trend of 2.6% per year is bounded by a 90% confidence interval ranging from a 7.7% decline per year to a 2.7% increase per year (66 FR 9146). 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). All areas designated as critical habitat for the spectacled eider contained one or more of these physical or biological features: space for individual and population growth, and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring; and habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

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 range 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 surveys likely underestimated actual population size, however, because an unknown proportion of birds were missed when counting from aircraft, and no species-specific correction factor has been developed and applied (USFWS, 2002a). Nonetheless, 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 1989-2000.

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 factor or factors causing the decline was (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).

3.3.3 Other Species

Arctic coastal waters support a diverse community of planktonic and epontic species that are prey for fish, birds, and marine mammals. Both marine and anadromous fish inhabit coastal 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 and used by Alaska Eskimos (MMS, 2002a).

Fish species used by Alaska Eskimos in Barrow, Kaktovik, and Nuiqsut include Pacific salmon (chum, pink, silver, king, and sockeye), whitefish (round, broad, humpback, least cisco, Bering/Arctic cisco), Arctic char, Arctic grayling, burbot, lake trout, northern pike, capelin, rainbow smelt, arctic cod, tomcod, and flounder (MMS, 2002a).

Terrestrial mammals hunted by Alaska Eskimos in Barrow, Kaktovik, and Nuiqsut include caribou, moose, brown bear, Dall sheep, musk ox, arctic fox, red fox, porcupine, ground squirrel, wolverine, weasel, wolf, and marmot (MMS, 2002a).

3.4 Socio-economic Environment

The proposed action has effects on the human environment, notably the 10 member communities of the AEWC. This section describes the population size and ethnic composition, along with a key indicator of economic status, as a basis for the Environmental Justice analysis found in Section 4.8.5.

These communities are small, predominantly Alaska Native villages, with the exception that Barrow, as a regional service center is larger and more diverse. In 2005, the 10 AEWC communities counted a total 8,131 residents, of whom 6,333 or 77.9% are Alaska Native or part Alaska Native (Table 3.4-1). Barrow accounts for just over half of the total population, and is more diverse, with Alaska Native residents making up 64% of the community. The recent trend in population for these communities is a slight decline since the 2000 census, when the total population for these communities was 8,577 residents (5.2%) and 6,633 Alaska Native residents (4.5%) (U.S. Census Bureau, 2007).

Table 3.4-1
2005 AEWC Community Population and Ethnicity

Community	Total Population	Percent Alaska Native	Alaska Native Population
Barrow	4,199	64.0%	2,687
Diomede	132	93.8%	124
Gambell	660	95.8%	632
Kaktovik	276	84.0%	232
Kivalina	385	96.6%	372
Nuiqsut	411	89.1%	366
Point Hope	702	90.6%	636
Savoonga	695	95.5%	664
Wainwright	520	93.0%	484
Wales	151	90.1%	136
Total	8,131	77.9%	6,333

Source: Alaska Department of Commerce, Community, and Economic Development (ADCCED), 2007

The most current information concerning income and poverty levels is the 2000 Census. Table 3.4-2 shows that, using the federally defined poverty level, two of the AEWC communities have low levels (< 9% of residents), while three communities have intermediate rates (12% - 18% of residents). The remaining five communities have higher rates, ranging from 26% through 35% of residents living below the poverty level. Barrow has the lowest rate of household below the poverty level, resulting from higher levels of employment available in this service hub community. All but two of these communities exceed the average rate of Alaska residents living below the poverty level, which is 9.4%, and in most cases these are two and three times the Alaska average.

Table 3.4-2
Portion of Residents Living Below Poverty Level in 2000

Community	Percent
Barrow	8.62%
Diomede	35.44%
Gambell	28.47%
Kaktovik	28.47%
Kivalina	26.40%
Nuiqsut	2.37%
Point Hope	14.83%
Savoonga	29.06%
Wainwright	12.54%
Wales	18.30%
State of Alaska Rate	9.4%

3.5 Eskimo Tradition of Subsistence Hunt of Bowhead Whales

Bowhead whale hunting has been a part of Alaska Eskimo culture for at least 2,000 years (Stocker and Krupnik, 1993). Subsistence hunting communities along the western and northern coasts of Alaska participate in annual bowhead whale hunts and rely on the hunts for both cultural and subsistence needs (Braund et al., 1997). Historically, residents of the villages participate in one or more of the semi-annual hunts (Stocker and Krupnik, 1993). This section describes the importance of the on-going bowhead subsistence hunt, in relation to the overall pattern of subsistence production, in its key social organization features, and as a foundation of Inupiat and Siberian Yupik cultural identity and ceremonial life.

Bowhead subsistence whaling represents an especially important source of subsistence food among the AEWC communities. During the past 10 years (1997 - 2006), the AEWC villages have landed 410 bowhead whales, or an average of 41 whales per year. As shown in Table 3.5-1, the largest AEWC community of Barrow takes over half of the total, with an average of 23.4 bowhead whales landed per year in the last decade. Most of the rest of the communities take one to three whales per years, while the small communities of Wales and Little Diomede have highly intermittent harvests, and Kivalina has taken no whales in this period.

Table 3.5-1
Bowhead Whales Landed 1997 - 2006

	Gambell	Savoonga	Wales	Little Diomede	Kivalina	Point Hope	Wainwright	Barrow	Nuiqsut	Kaktovik	Total
Total Landed	14	25	2	2	0	30	38	234	33	32	410
Annual Ave.	1.4	2.5	0.2	0.2	0	3	3.8	23.4	3.3	3.2	41

Source: AEWC and NSB, 2007

Bowhead whales provide exceptionally large quantities of food. During the late 1980's, a method was developed to estimate the edible pounds produced from bowhead whales of various sizes (Braund and ISER, 1993). After weighing crew shares of *maktak* and meat from a number of harvests in Barrow, the authors established the average pounds of food produced per foot of length for small, medium, and large bowhead whales. As shown in Table 3.5-2, using the

detailed data on length of harvested whales, the 1993 method was applied to derive an estimate that an average of 1.03 million pounds of bowhead whale *maktak* and meat was produced annually over the past decade. However, a benchmark estimate can be constructed to suggest how much food might be available. The 2000 Census figures for the population of the AEWC villages (noted in Section 3.4), represent the population at approximately the mid-point of the period under consideration. For this population, the estimated total harvest would represent an annual harvest level of 121 pounds per capita, if the total population is counted, or 155 pounds per capita if the Alaska Native population is taken as the basis of the calculation. Since a considerable quantity of bowhead food is shared with kin group members and friends outside of the AEWC communities, the figures developed would tend to overestimate the per capita rate. In addition, it is important to keep in mind that this is a mathematical estimate only, and not a documented rate of food received by each household.

Table 3.5-2
Estimated Edible Pounds of Bowhead Whale 1997 - 2006

	Number Taken	Total Edible Pounds	Average Annual Edible Pounds
Small whales (17 - 34 ft.)	225	3,170,845	317,084
Medium whales (35 - 45 ft.)	100	3,237,857	323,786
Large whales (46 - 63 ft.)	81	3,892,129	389,243
Total	406	10,301,129	1,030,113

Source: AEWC and NSB, 2007

Additional facets of the importance of bowhead whale within the total annual round of subsistence harvests can be shown through the comprehensive household surveys, conducted in the period from 1987 through 1993, and reported in the ADF&G Subsistence Division subsistence harvest database. Surveys of this sort permit a more detailed perspective on the variation in bowhead harvest levels between participating communities and of the variation in the proportion of bowhead food in relation to other major subsistence resources. As displayed in Table 3.5-3, per capita harvest levels for bowhead whales, during the years studied, ranged from as high as 560 pounds in Kaktovik in 1992, to about 200 pounds per capita in several communities, and a very low level of bowhead harvest in Kivalina in 1992 at 39 pounds. Total subsistence production levels also varies among the communities, with the more heterogeneous community of Barrow having the lowest annual per capita total at 289 pounds, while the other ranged from 740 pounds to 885 pounds during the study years. In viewing these results, it is important to note that bowhead subsistence harvests vary from year to year, particularly for some of the smaller communities, so these results are indicative, and do not define a stable pattern. In addition, the period covered in these studies had lower bowhead harvest levels, on the whole, than those of the past decade. From 1987 - 1993, the communities averaged 28.6 bowheads whales landed per year, whereas in the past decade the average has been 41 bowhead whales landed per year, an increase of approximately 44%. This trend is even more important for Barrow, with average harvests of 13.7 whales per year in the period 1987 - 1993, compared to an average annual take of 23.4 whales per year in the past decade, an increase of 73%.

Table 3.5-3
Community Subsistence Harvest Levels by Species Group (Pounds per Capita)

Village	Bowhead whale	Other marine mammals	Game	Fish & marine invertebrates	Birds & eggs	Vegetation	Total
Barrow 1989	125.21	43.29	71.18	39.28	9.76	0.44	289.16
Kaktovik 1992	560.35	38.78	148.71	118.91	16.83	1.18	884.76
Kivalina 1992	38.55	279.47	165.25	253.29	10.79	14.03	761.38
Nuiqsut 1993	213	23.02	242.03	250.62	11.98	1.1	741.75
Wainwright 1989	218.23	302.27	178.18	37.15	15.41	ND	751.24
Wales 1993	188.19	392.14	25.53	121.99	11.62	4.69	744.16

Source: ADF&G, 2001d

In addition to this high reliance on bowhead whales, Inupiat and Siberian Yupik communities harvest many species throughout an intricate annual cycle of subsistence activities. The species composition of subsistence harvests in selected AEWC communities gives an indication of the flexible adaptation of subsistence patterns to ecological patterns of abundance and access to various resources. For example, while bowhead, caribou, and fish make up the majority of subsistence foods in most of the Inupiat communities, the Chukchi Sea communities rely more heavily on walrus and seal than do the Beaufort Sea villages (MMS, 2006a:168). In Table 3.5-4, the communities of Kaktovik, Barrow, and Nuiqsut have high proportions of total subsistence food derived from the bowhead harvest, and lower proportions from other marine mammals, while the communities of Wainwright, Kivalina, and Wales show much greater harvests of other marine mammals.

Table 3.5-4
Proportion of Subsistence Food Provided by Various Species Groups

Village	Bowhead whale	Other marine mammals	Game	Fish & marine invertebrates	Birds & eggs	Vegetation	Total Percent
Barrow 1989	43.3%	15.0%	24.6%	13.6%	3.4%	0.2%	100.0%
Kaktovik 1992	63.3%	4.4%	16.8%	13.4%	1.9%	0.1%	100.0%
Kivalina 1992	5.1%	36.7%	21.7%	33.3%	1.4%	1.8%	100.0%
Nuiqsut 1993	28.7%	3.1%	32.6%	33.8%	1.6%	0.1%	100.0%
Wainwright 1989	29.0%	40.2%	23.7%	4.9%	2.1%	ND	100.0%
Wales 1993	25.3%	52.7%	3.4%	16.4%	1.6%	0.6%	100.0%

Source: ADF&G, 2001d ND = no data

Households in the AEWC communities have very high rates of participation in production and consumption of bowhead subsistence foods. The comprehensive household surveys also documented the percentage of households using bowhead, trying to harvest, actually harvesting, receiving bowhead food from others, and giving bowhead food to other households. As seen in Table 3.5-5, for the five smaller communities with data, 74% to 97% of households use bowhead whale foods. Note too that this is the result of widespread sharing of food, since rather small proportion of households (4.8% - 21.2%) have actually harvested bowhead whales in the study years. For the larger communities of Barrow and Wainwright, the available data are more limited, demonstrating that 45% to 66% of household are involved in harvesting. If sharing and use data were available, it is likely that these two communities would also show extremely high proportions of households using bowhead whale foods. More detailed accounts of the

subsistence harvest patterns of Kaktovik, Nuiqsut, Barrow, Wainwright, and Point Hope are found in Appendix C of MMS (2006a).

Table 3.5-5
Rates of Participation in Bowhead Subsistence Activities

	Percentage of Households				
	Using	**Trying to Harvest**	**Harvesting**	**Receiving**	**Giving**
Barrow 1989	n/a	n/a	45.0	n/a	n/a
Kaktovik 1992	87.2	53.2	6.4	85.1	61.7
Kivalina 1992	90.3	64.5	4.8	88.7	48.4
Nuiqsut 1993	96.8	37.1	4.8	96.8	75.8
Pt. Lay 1987	87.5	21.2	21.2	84.4	21.2
Wainwright 1989	n/a	n/a	66.0	n/a	n/a
Wales 1993	73.8	26.2	11.9	64.3	40.5

Source: ADF&G, 2001d n/a = not available

Subsistence harvests occur within traditional use areas, for which hunters have accumulated detailed knowledge of the physical geography of landscape and waters, the social geography of place names and the associated stories, and the wildlife ecology of likely animal distributions by seasons and under varying weather conditions. Hunters have a repertoire of effective harvest strategies to draw upon as they hunt throughout these traditional harvest areas. Bowhead subsistence whaling occurs in U.S. waters primarily during the spring and autumn migrations as the bowhead whales move north and east through near shore leads in the spring, and then west and south as ice forms in the autumn. The bowhead migration patterns are conducive to spring harvests for westerly AEWC communities, while Barrow's location provides for successful spring and fall hunts, and the villages of Nuiqsut and Kaktovik participate in the fall hunts. The St. Lawrence Island communities of Gambell and Savoonga take bowhead in the fall migration, continuing as late as December. For an overview of community whaling areas and migration patterns, see Figure 3.5-1.

Subsistence activities are often centered in family groups, with widespread sharing of financial resources and equipment to support hunters, sharing of labor in harvesting, processing and distributing subsistence foods, and sharing of knowledge as elders provide practical information and ethical understandings for successful subsistence pursuits. The social organization of subsistence activities binds generations and families together across and even between communities. Subsistence whaling and the roles of whaling captains and whaling crews are especially prominent in the social organization of the Inupiat and Siberian Yupik whaling communities. The wives of whaling captains and whaling crew members also have an intricate set of interlinked responsibilities. These are particularly important in the preparation of bearded seal (*ugruk*) skins for the *umiaks*, still preferred in Barrow for the spring hunts due to their silence in the water (see Bodenhorn, 2000 for additional discussion). From aboriginal times, the whaling captain, or *umailik*, was recognized as a leader for his knowledge, success at hunting, support for the needs of his whaling crews throughout the year, and generosity in sharing the fruits of a successful hunt. Cooperation among whaling crews was critically important in the success of any hunt, and customary laws prescribed how a captain would distribute portions of the whale to the crews that helped in the capture as well as to the entire community (Worl, 1979). Hauling a whale onto the ice edge and processing the enormous amount of food provided required the cooperative labor of virtually the entire community.

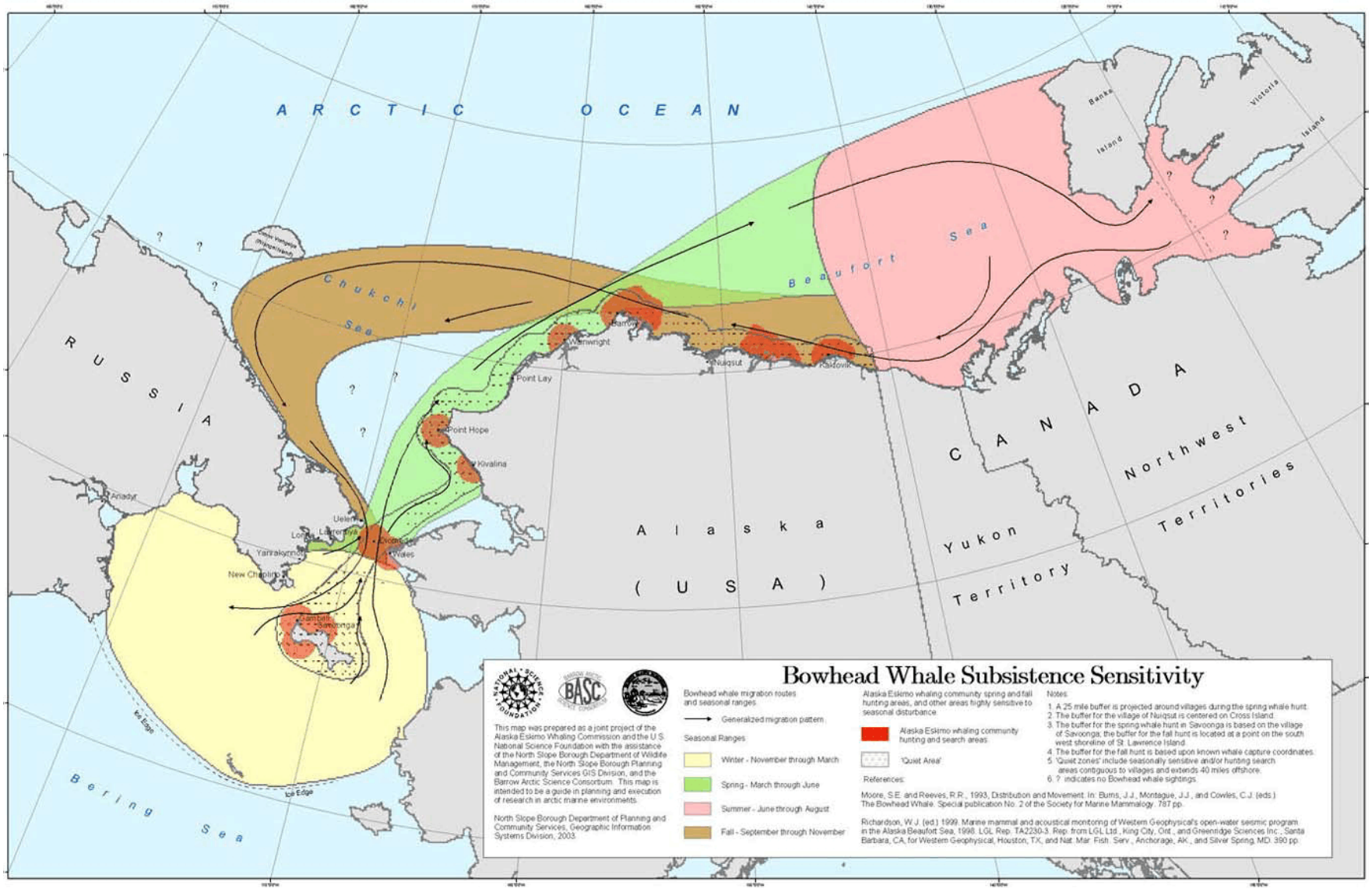

Figure 3.5-1 Bowhead whale subsistence sensitivity. Draft prepared by the National Science Foundation, the Barrow Arctic Science Consortium, and the North Slope Borough (2003).

In addition to the widespread sharing of bowhead whale foods, the non-edible parts of the whale such as baleen and bone are also valuable for craft work. No specific data are available on the quantities of baleen and bone distributed within and between communities. However, representatives of the AEWC and the Inupiat History, Language and Culture Commission (IHLC) provided an overview of these sharing and distribution patterns (Harry Brower Jr., personal communication, 2007; Dorcus Stein, personal communication, 2007). The whaling captains retain half of the baleen and bone, and distribute the remainder to the whaling crew. Captains and crew members share these materials with others in their communities and beyond. Some communities on the North Slope, the Bering Sea coast, and Norton Sound do not have access to bowhead whales, but value the baleen and bone as raw materials for use in making handicrafts. Craft producers may contact a whaling captain and offer to trade subsistence foods for such raw materials. A whaling captain might also take an interest in baleen craft courses at schools in the NSB and provide the raw materials for use in the class to support continuation of the artistic traditions. Craft production is widespread and important to Inupiat and Yupik communities.

Spiritual and moral values, beliefs, and cultural identity are expressed and recreated through subsistence harvest activities. The great gifts of food from bowheads are recognized in the ceremonies of the *Nalukatak* festival at the conclusion of spring whaling.

Since the late 1970s, subsistence bowhead whaling has been governed in the formal structures of international treaties, national legislation, and the Cooperative Agreement between NOAA and the AEWC. The IWC has determined catch limits for bowhead whale harvests, after considering the nutritional and cultural need for bowhead whales by Alaska Eskimos and the level of harvest that is sustainable. In 1986, the IWC accepted a method to calculate subsistence and cultural need of Alaska Eskimos for bowhead whales. This method incorporates the historic and current size of the Eskimo population residing in Alaskan subsistence hunting villages and the number of bowhead whales historically landed by each community (Appendix 8.1).

Because bowhead subsistence hunts are a community-wide activity, it is appropriate to consider the community population in association with the historic harvest levels. Besides abundance of bowhead whales, community population levels are a critical factor that influences harvests because the community population dictates the number and size of subsistence hunt crews and the amount of meat and *maktak* needed to feed the community, share with others, and provide for annual celebrations (Braund et al., 1997).

The first calculation of nutritional and cultural need was submitted to the IWC in 1983 and was accepted by the IWC in 1986 (U.S. Government, 1983). Using the same method for calculating need, the second calculation was submitted to and accepted by the IWC in 1988, when more extensive research provided additional historical subsistence hunting and human population data. The 1988 study used the most recent Eskimo population data available at that time, ranging from 1983 to 1987, to calculate then-current need (Braund et al., 1988). The third calculation of need was submitted to and accepted by the IWC in 1994, based on July 1, 1992 human population data generated by the State of Alaska, Department of Labor. The fourth calculation, submitted to the IWC in 1997, used the same method accepted by the IWC in 1986 for calculating need, presenting revised calculations based on July 1, 1997 human population data generated by the State of Alaska, Department of Labor (Braund et al., 1997). This same calculation was submitted to the annual IWC meeting in 2002. This need statement demonstrated a documented nutritional

and cultural need for 56 landed bowhead whales per year. Most recently, a 2007 calculation of subsistence need was submitted to the IWC, based on 2000 census data (Appendix 8.1). This statement documented a nutritional and cultural need for 57 landed bowhead whales per year.

The U.S. request to the IWC for the subsistence whaling allocation considered the AEWC-commissioned study and other factors relevant to the negotiations at the IWC meeting. The combined request of the U.S. and the Russian Federation was for a total of 285 bowhead whales for the five-year period from 2008 through 2012, (of which 25 would be available to the Chukotkan hunters and 255 would be available to the 10 Alaska Bowhead whaling communities). This represents an annual average of 51, compared to the 57 identified as the need level in the study. The U.S. request and the IWC catch limits are identical to the level authorized in the previous five-year block for 2003 through 2007.

3.5.1 Methodology of Eskimo Subsistence Hunt

The hunting of bowhead whales by Alaska Eskimos is believed to date back several thousand years with the use of harpoons and lances fashioned from stone, ivory, and bone. Seal-skin or walrus-skin covered whaling vessels known as *umiaks* were employed from aboriginal times and remain the most commonly used vessel for the spring hunt (Stocker and Krupnik, 1993). Crew sizes currently average six persons per vessel (www.mms.gov/alaska/native/rexford/rexford.htm). Before the whales arrived during each migration, ritual ceremonies were performed in special houses known as *karigi*, to ensure a successful hunt and to honor the whale (Ellis, 1991).

Alaska Eskimos continue to use traditional methods to take whales today, but have also incorporated Yankee whaling era technologies such as darting and shoulder guns as a method of improving efficiency and humane killing methods (Stocker and Krupnik, 1993). The harpoon with line and float attached is always used first since it is the forward part of the darting gun. Once the darting gun is thrown, the shoulder gun is almost always used as a back-up.

Contemporary hunts occur twice a year in the spring and autumn seasons based on ice and weather conditions. In the autumn season, aluminum skiffs or small open boats with outboard motors are used for the hunt due to the open water conditions. In the spring, traditional skin-covered *umiaks* are preferred because they are quieter and therefore more effective in the ice leads.

Traditionally, most of the whale was used for food, though other parts of the whale were used to make whaling gear, fishing equipment, traps, tools, and for many other practical day-to-day uses (Ellis, 1991). The gut was made into translucent windows, and the oil was used for heating, cooking, and lighting (Ellis, 1991). The bones were used for fences, house construction, and sled runners (Ellis, 1991). Baleen and bone are used in many forms of handicraft, including baleen baskets, scrimshaw, and carvings. Today, bowhead is still an important source of subsistence, where the skin and blubber, known as *maktak*, are either eaten raw or boiled in salted water (Ellis, 1991). Subsistence foods also include muscle, tongue, flukes, flipper, tongue, intestines, heart and kidney, as well as stomach and liver in Point Hope. Blood is used in *migiyaq* (fermented meat and blubber). The membrane on the liver is used for drum skins. The tympanic or ‘ear” bones are kept by the captains and prized by family members, and used for art work (Craig George, North Slope Borough, personal communication, December 20, 2007).

The AEWC has focused on improving humane killing methods (i.e., reducing time to death) and the efficiency of the hunt (i.e., struck to landed ratio)[8]. In the most recent IWC meeting held in Anchorage, Alaska in May 2007, the AEWC prepared, and the U.S. submitted to the Subcommittee on Whale Killing Methods a report documenting the significant increase in efficiency and improvements in whaling weapons technology (AEWC and U.S. Government, 2007). This report provided a detailed description of the dangerous ice and weather conditions of the modern hunt, and an account of contemporary subsistence whaling techniques and technology. The report noted that hunt efficiency has improved steadily from a historic hunt efficiency of approximately 50%, to a recent average of 75% of whales struck being landed. In some recent years, the efficiency is as high as 80% of the whales struck being landed (See Figure 3.5.2-2).

The report notes that a shoulder fired darting gun, using a black powder exploding projectile, has been used in Inupiat subsistence whaling for approximately 150 years, since it was introduced by the Yankee commercial whalers in the mid-nineteenth century. Beginning in 1987, the AEWC and its Weapons Improvement Program Committee worked with Dr. Egil Ole Øen and Henriksed Mek. Verksted of Norway to design, test, and promote use of a penthrite-loaded projectile to improve safety and certainty in use of the dart gun. The new design for penthrite projectiles and modified dart gun barrels were field tested through 2004. Beginning in 2005, training and certification for use of the new technology was phased in. As documented in this report, penthrite projectiles were successfully used in eight bowhead whale takes in 2005, and five in 2006. In these harvests the whales appeared to die instantly or quickly, following detonation of the penthrite projectile. With additional deliveries of penthrite projectiles in fall 2007 and 2008, the AEWC will complete its planned village training sessions for safe use of the new technology.

3.5.2 Results of Recent Hunts

Suydam and George (2004) summarize Alaskan subsistence harvests of bowheads from 1974 to 2003. Hunters landed a total of 832 whales during this time period. Subsequently, the number of bowheads landed by Alaska Natives was reported as 37 in 2004 (Suydam et al., 2005; 2006), 55 in 2005 (Suydam et al., 2006), and 31 in 2006 (Suydam et al., 2007). Barrow consistently landed the most whales (n = 490) while Little Diomede landed two (Figure 3.5.2-1). Shaktoolik, a village located on the coast of Norton Sound, Alaska, harvested one whale in 1980 but has not been a regular participant in the hunt. The number of whales landed at each village varied greatly from year to year (Figure 3.5.2-1), as success was influenced by village size and ice and weather conditions. The annual average subsistence take during the eight year period from 1999 to 2006 is 40 bowhead whales. The efficiency of the hunt (i.e., the number of whales landed compared to the number of whales struck) has increased since the implementation of the bowhead quota in 1978. Before 1978 the efficiency was about 50%; in recent years efficiency has averaged about 75% (Figure 3.5.2-2).

[8] The efficiency of the hunt is also expected to improve as a result of the passage of an emergency towing assistance provision contained in section 403 of the Hydrographic Services Improvement Act Amendments of 2002. Pub. L. 107-372.

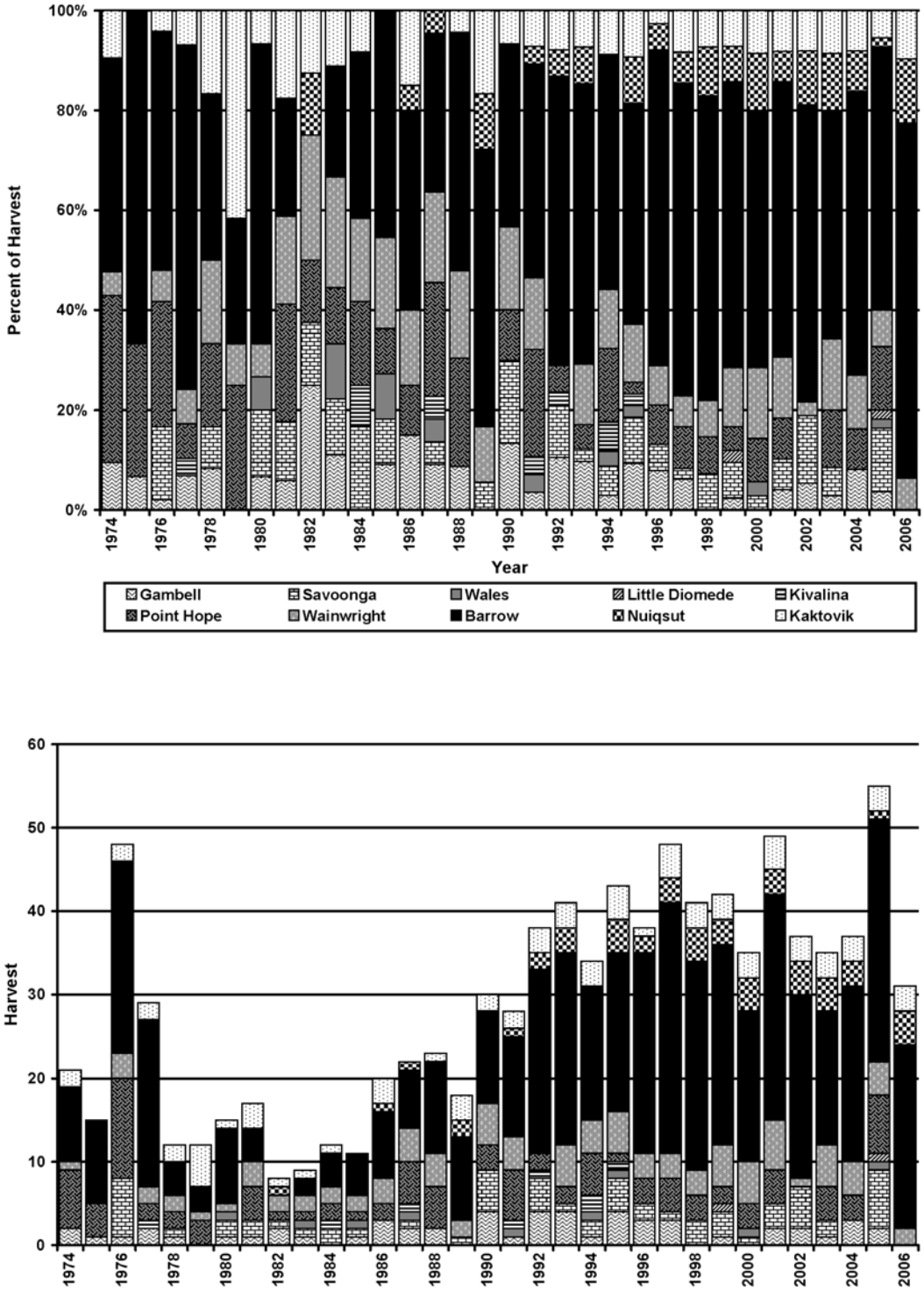

Figure 3.5.2-1 Number (a) and cumulative percent (b) of Western Arctic bowhead whales landed by Eskimo villages in Alaska, 1974-2006 (from AEWC and NSB, 2007).

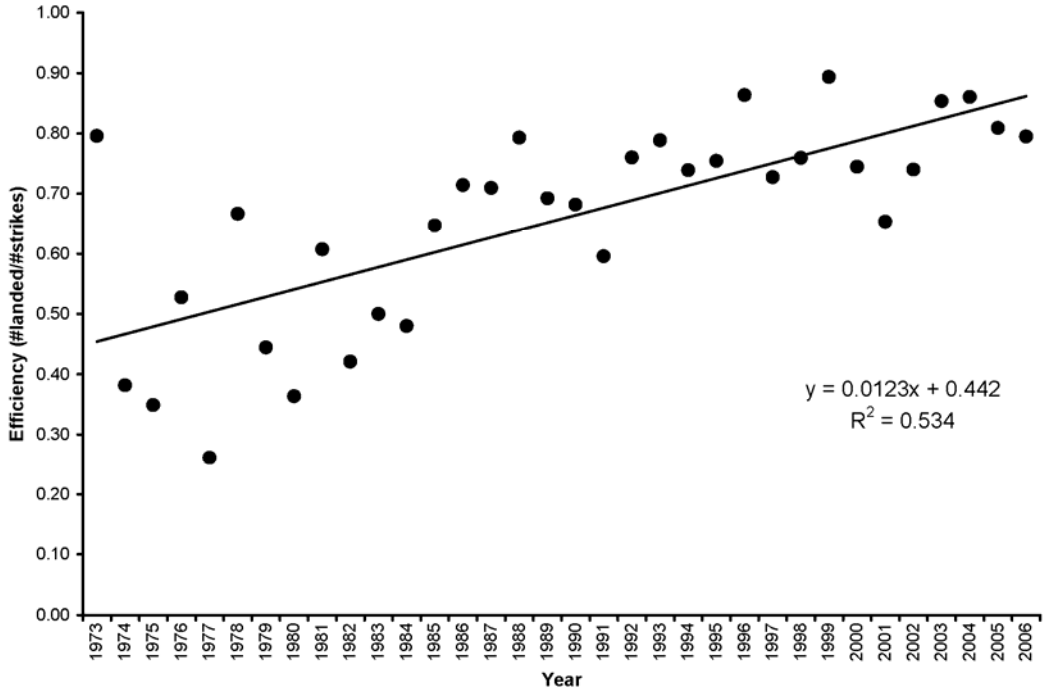

Figure 3.5.2-2 Efficiency of the Western Arctic bowhead whale subsistence hunt, 1973-2005 (from AEWC and NSB, 2007).

The size of landed whales differs among villages. Gambell and Savoonga (two villages on St. Lawrence Island) and Wainwright typically harvest larger whales than Point Hope and Barrow. These differences were likely due to hunter selectivity, whale availability and season. For example, during spring in Barrow, smaller whales were caught earlier in the season than larger whales while the opposite was true in the autumn (Suydam and George, 2004). Villages along the western coast of Alaska harvest bowhead whales primarily during the spring migration (Figure 3.5.2-3), while villages along the Beaufort Sea hunt during the autumn migration. In recent years, the villages on St. Lawrence Island have been able to hunt bowhead whales when they overwinter in the Bering Sea (Figure 3.5.2-3). Overall, the sex ratio of the harvest has been equal.

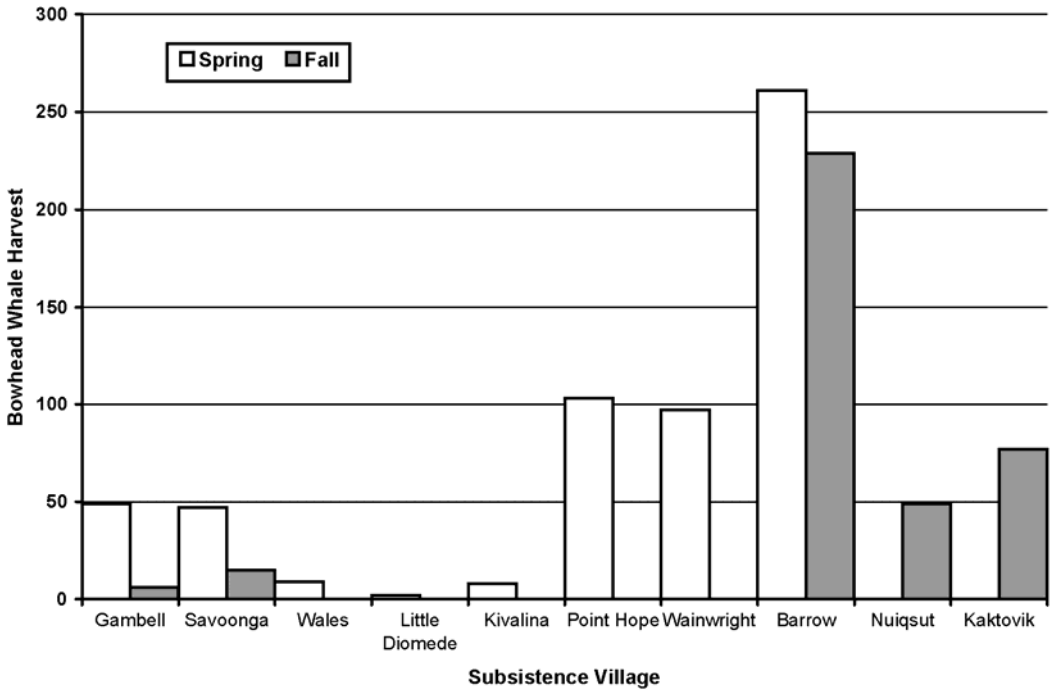

Figure 3.5.2-3 Western Arctic bowhead whale harvest by season for each Eskimo village in Alaska, 1974-2006 (from AEWC and NSB, 2007).

3.6 Co-management of Subsistence Whaling with AEWC

The purposes of the NOAA-AEWC Cooperative Agreement are to protect the Western Arctic population of bowhead whale and the Eskimo culture, to promote scientific investigation of the bowhead whale, and to effectuate the other purposes of the WCA, the MMPA, and the ESA, as these Acts relate to the aboriginal subsistence hunts for whales. Cooperative Agreements have been in place between NOAA and the AEWC since the first agreement was signed in March 1981, and have been renewed regularly thereafter[9].

3.6.1 Description of Management

The NOAA-AEWC Cooperative Agreement establishes a structure of relationships between the authorities and activities of NOAA and the AEWC. The Cooperative Agreement generally represents a functional delegation of on-the-ground management from NOAA to the AEWC, subject to NOAA oversight. The provisions of the Cooperative Agreement build on the provisions of the AEWC Management Plan (adopted in November 1977, renewed on March 4, 1981, and continuously since) (Appendix 8.4). The authority and responsibilities of the AEWC are contained in and limited by the Cooperative Agreement and Management Plan, as amended, to the extent that the Management Plan is not inconsistent with the Agreement. If AEWC fails to carry out its responsibilities, NOAA may assert its federal management and enforcement authority to regulate the hunt after notifying the AEWC of its intent, and providing an opportunity to the AEWC to discuss the proposed action. The AEWC Management Plan

[9] NOAA and AEWC are signatories to the Cooperative Agreement. However, NMFS has been delegated the responsibility for implementation.

provides that the AEWC is empowered to administer the following regulations: (1) insure an efficient subsistence harvest of bowhead whales; (2) provide a means within the Alaska Eskimo customs and institution to protect bowhead whale habitat and limit harvest to prevent extinction of the species; and (3) provide for Eskimo regulation of all whaling activities by Eskimo members of the AEWC (subsection 100.1). The AEWC may deny any person who violates these regulations the right to participate in the hunt, make civil assessments, and act as an enforcement agent (subsection 100.11(b)). In addition to administering and enforcing regulations within the Management Plan, the AEWC also provides village education programs including training programs for whaling captains and crews, and initiates research to improve the accuracy and reliability of weapons used to hunt bowhead whales (subsection 100.12).

3.6.2 Quota Distribution among Villages

Under the AEWC Management Plan, the AEWC consults with each whaling village before establishing the level of harvest for each whaling village during each season (subsection 100.26) and adjustments may be made during the season, if a village does not use its allocation. Each whaling captain registers with the AEWC on forms that disclose name, address, age, qualifications as a captain, and willingness to abide by and require the crew to abide by AEWC regulations (subsection 100.22).

3.6.3 Monitoring and Enforcement of Hunting Regulations

Reports of each hunt must include the date, place, time of strike, size, and type of bowhead whale, reasons if struck and lost, and condition of struck and lost whales (subsection 100.23). Whaling crews must use traditional harvesting methods (as defined under subsection 100.24). Meat and edible products must be used exclusively for consumption and not be sold or offered for sale. Violators, after opportunity for a hearing before the AEWC, are prohibited from hunting or attempting to hunt for a period of not less than one whaling season nor more than five whaling seasons and/or may be subject to a fine not to exceed $10,000. Should a dispute between NOAA and AEWC occur over any of these matters, and resolution does not occur after consulting with AEWC, the dispute will be referred to an administrative law judge (15 CFR 904.200-904.272).

From the earliest years of the Management Plan, the AEWC has shown a willingness to intervene with whaling captains to enforce the quota and other provisions. Langdon (1984:51) refers to examples from 1981 and 1982, while Freeman (1989:151) describes a 1985 incident. More recently, on approximately May 25, 2003, a female bowhead whale was taken in the Beaufort Sea off Barrow, Alaska, by the crew of an AEWC registered bowhead subsistence captain. On taking the whale, the crew realized it was accompanied by a calf, which then swam away. The U.S. elected to report two infractions to the IWC as the disposition of the calf was unknown (IWC, 2005b). The taking of a whale calf or a cow accompanied by a calf is prohibited by Alaska Eskimo hunting tradition, by the AEWC management plan for the bowhead subsistence hunt, the WCA regulations, and by the IWC Schedule. The AEWC considers the taking of a whale calf or a cow with a calf to be a very serious infraction. On May 30, 2003, the Commissioners of the AEWC convened a hearing to receive testimony from the members of the crew and from the members of other crews who were in the vicinity when the whale was taken. While testimony indicated that the taking might have been accidental, the Commissioners concluded that the crew knew a cow/calf pair was in the vicinity and did not act with proper caution under the circumstances. Therefore, the Commissioners voted to rescind the bowhead

subsistence captain's registration with the AEWC for two years (four seasons) beginning with the autumn 2003 bowhead subsistence hunt. The AEWC also confiscated the baleen taken from the whale and donated it to a local organization that supports Native artists. Under the WCA, it is illegal for anyone who is not a registered captain with the AEWC, or a member of the crew of a registered captain, to hunt bowhead whales. Anyone attempting to take a bowhead whale without being properly registered with the AEWC, or being a crew member of a registered captain, is subject to penalties under U.S. law.

Another calf taking occurred during the Fall 2006 hunt, Whale ID 06B10, 9/29/2006 (Male, 6.3 m), Barrow. This whale was landed and then deemed to be a calf. It had milk in its stomach and very short baleen (Suydam et al., 2007). On November 16, 2006, the Commissioners of the AEWC convened a hearing on this incident. After receiving testimony from the members of the crew and other crews in the area when the whale was taken, the Commissioners determined that this taking was an accident resulting from the fact that no cow was seen in the vicinity and the animal was large for a lactating calf.

3.6.4 Reporting requirements to NOAA and IWC

It is the responsibility of the whaling captains and crew to report to the commissioner of their village on a daily basis when they are whaling. The commissioner then reports to the AEWC central office in Barrow. The AEWC office takes a report which is passed on to the NMFS office in Anchorage. After completion of the whaling season, the AEWC office submits a final report to the U.S. Department of Commerce, NOAA office in Washington, D.C. According to the Cooperative Agreement, on the first of each month during the whaling seasons, the AEWC must inform NOAA of the number of bowhead whales struck during the previous month. The final report is due to NOAA within 30 days after the conclusion of the whaling season.

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 Methodology

This chapter describes the predicted direct, indirect, and cumulative effects on the biological and human environment from implementing the alternatives described in Chapter 2. The chapter begins by summarizing the methodology used to predict environmental consequences, including frequently used terms (Section 4.1.1); the steps and criteria used for determining the level of impact (Section 4.1.2); and an overview of the approach to cumulative effects assessment (Section 4.1.3). Section 4.2 explains how incomplete or unavailable information is dealt with in this document, and Section 4.3 identifies resources not carried forward for further analysis. Sections 4.4 and 4.5 analyze direct and indirect impacts to the Western Arctic bowhead whale stock and individual bowhead whales, respectively, from each of the alternatives, while Section 4.6 discusses the cumulative impacts to the Western Arctic bowhead whale stock. Sections 4.7 and 4.8 discuss the analyses of the direct, indirect, and cumulative impacts to other wildlife and the socio-cultural environment, respectively. Section 4.9 summarizes the biological and socio-cultural cumulative effects together.

4.1.1 Definition of Terms

The following terms are used throughout this document to discuss impacts:

Direct Effects – caused by the action and occurring at the same time and place (40 CFR 1508.8). Direct effects pertain to the proposed action and alternatives only.

Indirect Effects – defined as effects caused by an action and later in time or farther removed in distance but still reasonably likely. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density, or growth rate, and related effects on air and water and other natural systems, including ecosystems (40 CFR 1508.8).

Indirect effects are caused by the project, but do not occur at the same time or place as the direct effects. Indirect effects pertain to the proposed action and alternatives only.

Cumulative Effects – additive or interactive effects that would result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7). Interactive impacts may be either countervailing (where the net cumulative effect is less than the sum of the individual effects) or synergistic (where the net cumulative effect is greater than the sum of the individual effects). EISs address reasonably foreseeable cumulative effects issues, rather than speculative impact relationships. Section 4.1.3 describes steps involved in the cumulative effects assessment.

Reasonably Foreseeable Future Actions – this term is used in concert with the Council on Environmental Quality (CEQ) definitions of cumulative effects, but the term itself is not further defined. Most regulations that refer to "reasonably foreseeable" do not define the meaning of the words, but do provide guidance on the term. For this analysis, reasonably foreseeable future actions (RFFAs) or impacts are those that are likely (or reasonably certain) to occur within the

timeframe used for analyzing environmental consequences, and are not purely speculative. This determination of “reasonably foreseeable” is based on documents such as existing plans, permit applications, or announcements.

4.1.2 Steps for Determining Level of Impact

NEPA requires federal agencies to prepare an EIS for any action that may significantly affect the quality of the human environment. The CEQ regulations implementing NEPA state that an EIS should discuss the significance, or level of impact, of the direct, indirect, and cumulative effects of the proposed alternatives (40 CFR 1502.16), and that significance is determined by considering both the context in which the action will occur and the intensity of the action (40 CFR 1508.27). Context and intensity are often further broken down into components for impact evaluation. The context is composed of the extent of the effect (geographic extent or extent within a species, ecosystem, or region) and any special conditions, such as endangered species status or other legal status. The intensity of an impact is the result of its magnitude and duration. Actions may have both adverse and beneficial effects on a particular resource. A component of both the context and the intensity of an effect is the likelihood of its occurrence.

The combination of context and intensity is used to determine the level of impact on each type of resource. The first step is to examine the mechanisms by which the proposed action could affect the particular resource. For each type of effect, the analysts develop a set of criteria to distinguish between major, moderate, minor, or negligible impacts. The analysts then use these impact criteria to rank the expected magnitude, extent, duration, and likelihood of each type of effect under each alternative.

Tables 4.1-1 through 4.1-3 provide a guideline for the analysts to place the effects of the alternatives in an appropriate context and to draw conclusions about the level of impact. The criteria used to assess the effects of the alternatives vary for the different types of resources analyzed. The impact criteria tables use terms and thresholds that are quantitative for some components and qualitative for others. The terms used in the qualitative thresholds are somewhat imprecise and relative, necessarily requiring the analyst to make a judgment about where a particular effect falls in the continuum from "negligible" to "major." The following descriptions of the terms used in the criteria tables are intended to help the reader understand the distinctions made in the analyses.

The magnitude or intensity of effects on biological resources is generally assessed in terms relative to the population rather than the individual. The MMPA, as amended, established a management objective to reduce incidental mortality of marine mammals in commercial fisheries. To this end, it defines an upper limit guideline for fishery-related mortality for each species or management stock, its Potential Biological Removal (PBR). PBR is defined in the MMPA as "...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." According to the most recent NMFS stock assessment, the PBR for the Western Arctic stock of bowhead whales is 95 animals (Angliss and Outlaw, 2007).

PBR was originally intended as a measure of impact from commercial fisheries, and should not be used as a means of evaluating or limiting subsistence harvest. The subsistence harvest is managed under the authority of the Whaling Convention Act. Accordingly, the aboriginal

subsistence whaling provisions in the IWC Schedule take precedence over the PBR estimate for the purpose of managing the Alaska Native subsistence harvest from this stock. A conservative approach to setting the harvest limit is to use the values of the catch control rule Q from the 2006 stock assessment (see Section 3.2.1 for the introductory discussion of the catch control rule Q), which range from a low bound of 155 whales per year to a high bound of 412, with a best estimate value of 256 (Brandon and Wade, 2006). The 2006 Q values will also be used as thresholds for determining the level of impact on the bowhead whale population in this EIS. Recognizing that there is some uncertainty (Q is based on probability estimates) in the Q values, this assessment will employ the lower bound of Q at 155 whales, termed Q_{low} and the best estimate of Q at 257 whales, termed $Q_{best,}$ and the high bound of Q at 412 whales, termed Q_{high} , as impact threshold levels.

A take that is below Q_{low} (155 whales per year) is considered a negligible impact. A take that is between and Q_{low} (155 whales) and Q_{best} (256 whales) would be considered a minor impact. A take that is between Q_{best} (257 whales) and Q_{high} (412 whales) would be considered a moderate impact. A take greater than the Q_{high} (412 whales) would be considered a major impact. The impact criteria are summarized in Table 4.1-1.

For wildlife species other than bowhead whales, the magnitude of effects on the population is based on the potential mechanisms for effects on mortality and disturbance and the relationship of bowhead whaling activities with the species considered. The impact criteria for wildlife are summarized in Table 4.1-2.

The analysis of socio-cultural impacts examines effects on subsistence use patterns, whaling community health and nutrition, and public safety. For impacts to subsistence uses, the magnitude and intensity of effects are based on the potential for loss or substantial reduction in production of key subsistence resources. For impacts to health and nutrition, and to public safety, the magnitude of effects is based on the proportion of the communities and population affected.

The geographic extent component is intended to estimate the distribution of effects relative to the population or nonbiological resource as a whole. For bowhead whales and other wildlife, local populations are defined as those populations that are generally distributed near a particular whaling community in some portion of their ecological range.

The geographic extent of socio-cultural impacts is first defined in relation to the bowhead subsistence whaling communities and their traditional subsistence use areas. In addition, because these communities share bowhead subsistence foods widely, socio-cultural effects could indirectly extend to those distant receiving communities, including those in neighboring regions, and also the Inupiat and Siberian Yupik families living in Fairbanks and Anchorage who remain integrated in sharing networks. The impact criteria for socio-cultural resources are summarized in Table 4.1-3.

The duration or frequency component provides the context of time. "Short-term" refers to a temporary effect that lasts from a few minutes to a few days, after which the affected animals or resource revert to a "normal" condition. "Long-term" describes more permanent effects that may last for years or from which the affected animals or resource never revert to a "normal" condition. Moderate is somewhere in between. Intermittent or infrequent effects are those that only occur a couple times a year or fewer. "Frequent" refers to effects that occur on a regular or

repeated basis each year. Other elements of the temporal context of effects, such as whether the effects occur primarily during a sensitive or critical part of the year, are described in the analyses for each species or resource.

This assessment also evaluates the likelihood of an effect, in other words whether the potential effects are plausible or just speculative. "Likely" effects are those that could arise from reasonable or demonstrated mechanisms and the probability of those mechanisms arising from the alternatives is greater than 50%. This does not imply that the analysts will perform a formal probability calculation. Instead analysts use professional judgment to make a qualitative determination that the probability of the effect occurring is more likely than not. The likelihood of occurrence is considered in assessing magnitude, extent, and duration, as these factors are defined above. The determination of level of impact for each of these three factors is made on the basis of effects that are more likely to occur than not.

4.1.2.1 Determining the quota

Since the late 1970s the IWC has determined catch limits for bowhead whale harvests, after considering the nutritional and cultural need for bowhead whales by Alaska Eskimos and Russian Natives and the level of harvest that is sustainable. In 1986, the IWC accepted a method to calculate subsistence and cultural need of Alaska Eskimos for bowhead whales. This method incorporates the historic and current size of the Eskimo population residing in Alaskan subsistence hunting villages and the number of bowhead whales historically landed by each community (Appendix 8.1).

The IWC first established the five-year block catch limits for this stock in 1997, allowing a total of 280 bowhead whales to be landed, or an average of 56 whales per year. Suitability of the strike limits is determined using the Bowhead Strike Limit Algorithm (SLA) program (IWC, 2005a). Inputs include bowhead whale catches, abundance estimates from 1978-2001, and the value of need (i.e., 67 whales multiplied by the number of years of the quota). In 2004, the results of the Bowhead SLA calculations showed “that this level of need can be satisfied while fully meeting the Commissioner’s management objectives” (IWC, 2005a:23). For the proposed 2008 through 2012 quota (Alternative 3), annual strike limits would be established at 67 bowhead whales struck, with an allowance for the carry-over of up to 15 unused strikes from any previous year (including 15 unused strikes from the 2003 through 2007 block quota). The IWC has sanctioned the aboriginal harvest of whales from this stock by both the U.S. and the Russian Federation. The annual strike limits and quotas for bowhead whales are determined at the beginning of each year after consultation with the AEWC and renewal of the U.S.-Russia bilateral agreement governing the allocation of the bowhead whale subsistence quota between the two countries. Of the quota, the U.S. and the Russian Federation have agreed on a suballocation of five whales per year to the Chukotkan aboriginal whalers (Appendix 8.3).

4.1.2.2 Impact Criteria

Table 4.1-1 provides a framework within which effects on bowhead whales can be assessed. This table summarizes the criteria for determining the level of impact based on the type (mortality or disturbance), the components (magnitude, extent, and duration) and the thresholds for four levels of effects (negligible, minor, moderate, and major). As noted in Section 4.1.2, the components of impact (magnitude, extent, and duration) are established in CEQ regulations. This framework represents the best judgment of the analysts in identifying mortality and disturbance as the key types of effects, and in establishing the thresholds for a spectrum of impact levels from negligible to major. The thresholds for mortality effects are established in relation to the IWC Scientific Committee catch control rule Q, as described in Section 4.1.2. The results of applying this framework are found in Sections 4.4 and 4.5, which describe the anticipated direct and indirect effects for each alternative on bowhead whales. Since the provisions for carry-over of strikes represent the key difference among the alternatives, the analysis focuses on evaluating the scope and intensity of effects from each level of the strike limit carry-over.

Table 4.1-1
Criteria for Determining Impact Level for Effects on Bowhead Whales

Type of Effect	Impact Component	Impact Level			
		Negligible	**Minor**	**Moderate**	**Major**
Mortality	Magnitude or Intensity	Total mortality assessment less than or equal to Q_{low} (less than 155 annually, or 775 for five years)	Total mortality assessment between Q_{low} and Q_{best} (155 – 257 annually, or 775 - 1285 for five years)	Total mortality assessment between Q_{best} and Q_{high} (257 - 412 annually, or 1285 - 2060 for five years)	Total mortality assessment equal to or greater than Q_{high} (greater than 412 annually or 2,060 for five years)
	Geographic Extent	No measurable population decline	Population decline measurable at one location	Population decline measurable at several locations	Population decline measurable across range of stock
	Duration or Frequency	No measurable population decline	Short-term or infrequent population decline	Moderate-term or intermittent population decline	Long-term and/or repeated population decline
Disturbance	Magnitude or Intensity	No measurable effects	Disturbance effects but distribution similar to baseline	Noticeable change in localized distribution	Enough to cause shift in regional distribution
	Geographic Extent	No measurable effects	Effects limited to one location	Effects distributed among several locations	Effects distributed across range of stock
	Duration or Frequency	No measurable effects	Periodic, temporary, or short-term	Moderately frequent or intermittent	Chronic and long-term

Table 4.1-2 provides a framework for assessing the effects of bowhead whale harvests and whaling-related activities on other biological resources (other than bowhead whales). These effects are primarily related to disturbance associated with whaling activities, or redirection of subsistence harvests to other species if bowhead whaling were prohibited. Some habitat damage can also occur from other actions and events. This table summarizes the criteria, developed by the project scientists, for determining the level of impact based on the magnitude, extent, and duration. Section 4.7 summarizes the anticipated direct, indirect, and cumulative effects under each alternative for other biological resources.

Table 4.1-2
Criteria for Determining Impact Level for Effects on Other Wildlife

Type of Effect	Impact Component	Impact Level			
		Negligible	**Minor**	**Moderate**	**Major**
Mortality	Magnitude or Intensity	Mortality effects but no measurable change in population	Causes minor population change	Causes moderate population change	Causes major population change
	Geographic Extent	No measurable effects	Effects limited to one location	Effects distributed among several locations	Effects distributed across range of population
Mortality	Duration or Frequency	No measurable effects	Short-term or moderate and intermittent or infrequent	Moderate and frequent or long-term and intermittent	Long-term and/or frequent
Disturbance	Magnitude or Intensity	No measurable effects	Disturbance effects but distribution similar to baseline	Noticeable change in localized distribution	Enough to cause shift in regional distribution
	Geographic Extent	No measurable effects	Effects limited to one location	Effects distributed among several locations	Effects distributed across range of stock
	Duration or Frequency	No measurable effects	Periodic, temporary, or short-term	Moderately frequent or intermittent	Chronic and long-term

Table 4.1-3 provides a framework for assessing the effects of bowhead whale harvests and whaling-related activities on the social and cultural environment, and the criteria, developed by the project scientists, for determining the level of impact based on the magnitude, extent, and duration. These effects are primarily related to subsistence characteristics and public health and safety. Section 4.8 summarizes the anticipated direct, indirect, and cumulative effects under each alternative for these resources.

Table 4.1-3
Criteria for Determining Impact Level for Effects on Socio-cultural Resources

Type of Effect	Impact Component	Impact Level			
		Negligible	Minor	Moderate	Major
Effects on subsistence	Magnitude or Intensity	No decline in production of major subsistence resources	Minor decline in production affecting few resources or limited seasons	Moderate decline in production affecting several resources or seasons	Substantial decline in production of major subsistence resources
	Geographic Extent	No measurable effects	Effects realized at few locations	Effects realized in numerous locations	Effects realized throughout the project area
	Duration or Frequency	No measurable effects	Periodic, temporary, or short-term	Moderate and frequent or long-term and intermittent	Chronic and long-term
Effects on public health and safety	Magnitude or Intensity	No measurable effects	The health and safety of < 5% of the population in the community would be affected	The health and safety of 5%-25% of the population in the community would be affected	The health and safety of >25% of the population in the community would be affected
	Geographic Extent	No measurable effects	Affects individuals in few communities	Affects individuals in half of the communities	Affects individuals throughout project area
	Duration or Frequency	No measurable effects	Periodic, temporary, or short-term	Moderately frequent or intermittent	Long-term and/or frequent

4.1.3 Steps for Identifying Cumulative Effects

To meet the requirements of NEPA, an EIS must include an analysis of the cumulative effects of a proposed action and its alternatives and consider those cumulative effects when determining environmental impacts. The CEQ guidelines for evaluating cumulative effects state that "...the most devastating environmental effects may result not from the direct effects of a particular action but from the combination of individually minor effects of multiple actions over time" (CEQ, 1997). The CEQ regulations for implementing NEPA define cumulative effects as follows:

> The impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7).

For this EIS, assessment of cumulative effects requires an analysis of the direct and indirect effects of the proposed harvest quota alternatives, in combination with other past, present, or RFFAs potentially affecting bowhead whales, and other biological, physical, and socio-economic resources. The intent of this analysis is to capture the total effects of many actions over time that would be missed by evaluating each action individually, and to assess the relative contribution of the proposed action and its alternatives to cumulative effects. The cumulative effects assessment then describes the additive and synergistic result of the harvest quota alternatives as they are reasonably likely to interact with actions external to the proposed actions. The ultimate goal of identifying cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of the harvest quota alternatives.

The methodology used for cumulative effects analysis in this EIS is similar to that followed in the Alaska Groundfish Fisheries Programmatic Supplemental EIS (SEIS) (NMFS, 2004), the Steller Sea Lion Protection Measures SEIS (NMFS, 2001b), the Setting the Annual Subsistence Harvest of Northern Fur Seal on the Pribilof Islands EIS (NMFS, 2005), and the Steller Sea Lion and Northern Fur Seal Research Final Programmatic EIS (NMFS, 2007a). It consists of the following steps:

- *Identify issues, characteristics, and trends within the affected environment that are relevant to assessing cumulative effects of the alternatives* – include lingering effects from past activities, and demonstrate how they have contributed to the current baseline for each resource. This information is summarized in Chapter 3.
- *Describe the direct and indirect effects of the harvest quota alternatives*. This information is presented in Chapter 4.
- *Define the spatial (geographic) and temporal (time) frame for the analysis*. This timeframe may vary between resources depending on the historical data available and the relevance of past events to the current baseline. The "reasonably foreseeable future" has been established as the next 10 years (through 2018) for the purposes of this EIS.
- *Identify past, present, and reasonably foreseeable external actions such as other types of human activities and natural phenomena that could have additive or synergistic effects* – summarize past and present actions, within the defined temporal and spatial timeframes, and also identify any RFFAs that could have additive or synergistic effects on identified resources. The cumulative effects analysis uses the specific direct and indirect effects of each resource alternative and combines them with these identified past, present, and reasonably foreseeable effects of the identified external actions.
- *Use cumulative effects tables to screen all of the direct and indirect effects, when combined with the effects of external actions, to capture those synergistic and incremental effects that are potentially cumulative in nature* – both adverse and beneficial effects of external factors are assessed and then evaluated in combination with the direct and indirect effects to determine if there are cumulative effects.

- *Evaluate the impact of the reasonably likely cumulative effects using the criteria established for direct and indirect effects and assess the relative contribution of the action alternatives to cumulative effects.*
- *Discuss rationale for determining the impact rating, citing evidence from the peer-reviewed literature, and quantitative information where available* – the term unknown can be used where there is not enough information to determine an impact level.

The advantages of this approach are that it closely follows 1997 CEQ guidance, employs an orderly and explicit procedure, and provides the reader with the information necessary to make an informed and independent judgment concerning the validity of the conclusions.

4.1.3.1 Relevant Past and Present Actions within the Project Area

Relevant past and present actions are those that have influenced the current condition of the resource. For the purposes of this EIS, past and present actions include both human-controlled events (such as subsistence harvest, oil and gas exploration and development activities, and commercial fisheries), and natural events, such as predation and climate change.

The past actions applicable to the cumulative effects analysis have been either presented in Chapter 3 or previously reviewed in the Arctic Ocean OCS Seismic Surveys Programmatic EA (MMS, 2006b), Chapter 4 of the Alaska Groundfish Draft Programmatic SEIS (NMFS, 2004), Steller Sea Lion Protection Measures SEIS (NMFS, 2001b), Setting the Annual Subsistence Harvest of Northern Fur Seals on the Pribilof Islands EIS (NMFS, 2005), and the Draft Steller Sea Lion and Northern Fur Seal Research Programmatic EIS (NMFS, 2007a). The cumulative effects analysis relies heavily on the descriptions presented in those documents. Additional past actions were identified using agency documentation, NEPA documentation, reports and resource studies, peer-reviewed literature, and best professional judgment. Table 4.1-4 lists relevant past and present actions, and notes where descriptions of those actions can be located.

4.1.3.2 Reasonably Foreseeable Future Actions (RFFAs)

RFFAs are those that 1) have already been or are in the process of being funded, permitted, described in fishery, oil and gas lease sale documents, or coastal zone management plans; 2) are included as priorities in government planning documents; or 3) are likely to occur or continue based on traditional or past patterns of activity. Judgments concerning the probability of future impacts must be informed rather than based on speculation. RFFAs to be considered must also fall into the temporal and geographic scope described in Section 4.1.3.3.

Reasonably foreseeable future human-controlled and natural actions were screened for their relevance to the alternatives proposed in this EIS. Due to the large geographic scope dealt with in this analysis, the identification of RFFAs was conducted on a broad scale, although some specific RFFAs were considered where applicable. The following list presents the actions to be considered in the cumulative effects analysis, and Table 4.1-4 compares those actions with past and present actions:

- *Subsistence activities*: Subsistence harvests of bowhead whales by Alaska Natives who dwell on the North Pacific Ocean or Arctic Ocean coasts of Alaska are likely to continue at present levels as described in Chapter 3. Subsistence harvests of other animals are likely to continue at present levels also.
- *Oil and gas activities*: Oil and gas leases in the Beaufort and Chukchi Seas will result in continued and future off-shore production facilities and pipelines, drilling activities, seismic programs, transportation and barging, staging, fixed and temporary camp operations, and ice road construction.
- *Industrial pollutants*: Oil pollution in the marine environment can occur from road runoff, bilge cleaning and ship maintenance, natural seeps, pipeline and platform spills, oil tanker spills, and offshore drilling. Other marine pollution and debris can occur due to industrial activities, waste disposal, and atmospheric deposition. Marine species may accumulate contaminants such as PCBs and polycyclic aromatic hydrocarbons (PAHs).
- *Commercial fisheries*: Federal and state fisheries operate according to the designated Fishery Management Plan (FMP). State-regulated and federally regulated fisheries in the project area are administered by the North Pacific Fishery Management Council (NPFMC) and the Alaska Board of Fisheries (ABF). The NPFMC oversees management of groundfish in the U.S. Exclusive Economic Zone (EEZ) off Alaska and ABF manages fisheries in nearshore waters as well as the offshore crab fisheries.
- *Commercial shipping*: It is anticipated that commercial shipping will increase in the future as northern Alaskan ports become ice-free for longer periods throughout the year, as onshore and offshore areas are developed for oil and gas, and as local communities grow.
- *Other economic development*: Coastal development within the project area, including port expansions and the construction of docks and facilities within the project area, is likely to occur as needs for marine support services and shipping capacity increase.
- *Scientific research*: Activities related to the scientific research of the physical environment, bowhead whales specifically, other marine mammals, fish, birds, and marine predator-prey relationships are likely to continue.
- *Climate variability*: Short-term changes in the ocean climate are likely to continue on a scale similar to those presently occurring, as described in Chapter 3. Evidence is emerging that human-induced global climate change is linked to the warming of air and ocean temperatures and shifts in global and regional weather patterns.
- *Mortality*: Disease, parasites, and predation will continue to result in mortality of marine mammals, fish, and birds. Factors such as exposure to contaminants, decreased genetic diversity, and increased stress can lead to reduced fitness, which in turn can increase susceptibility to mortality from disease and predation.

Table 4.1-4
Past, Present, and RFFAs Considered in the Impact Analyses

	Past and Present	Reference (within this EIS)	Reasonably Foreseeable
Human-Caused Events			
Subsistence activities	▪ Harvest of marine and terrestrial mammals, fish, and birds	Sections 1.1.4, 1.2, 2.1, 2.2, 2.3, 2.4, 3.2.4, 3.4, 3.5, 4.8	▪ Harvest of marine and terrestrial mammals, fish, and birds
Commercial harvest	▪ Commercial whaling	Section 3.2.3	▪ None
Oil and gas activities	▪ Seismic Exploration ▪ Offshore drilling and production ▪ Industrial noise	Sections 3.2.8, 4.6.1	▪ Seismic exploration ▪ Offshore drilling and production ▪ Industrial noise
Industrial pollutants	▪ Marine spills and pollution ▪ Marine debris ▪ Bioaccumulation ▪ Human health	Sections 3.2.8, 4.6, 4.8.1	▪ Marine spills and pollution ▪ Marine debris ▪ Bioaccumulation ▪ Human health
Commercial fisheries	▪ Crab fishery (entanglement in gear) ▪ Ship strikes	Sections 3.2.7, 4.6.3	▪ Crab fishery (entanglement in gear) ▪ Ship strikes
Commercial shipping	▪ Barge/vessel traffic and fuel spills ▪ Ship strikes	Section 4.6.3	▪ Barge/vessel traffic and fuel spills ▪ Ship strikes
Other development	▪ Military activity ▪ Coastal and infrastructure development ▪ Tourism	Section 4.6	▪ Military activity ▪ Coastal and infrastructure development ▪ Tourism
Scientific research	▪ Biological ▪ Oceanographic ▪ Geophysical/chemical (see oil and gas development)	Section 4.6.4	▪ Biological ▪ Oceanographic ▪ Geophysical/chemical (see oil and gas development)
Natural Events			
Climate variability	▪ Global warming	Section 4.6.2	▪ Global warming
Mortality	▪ Predation ▪ Disease and parasites	Sections 1.1.3, 3.2.5, 3.2.7, 4.4, 4.5, 4.6	▪ Predation ▪ Disease and parasites

Table 4.1-5 provides a list of the RFFAs likely to occur in the project area and identifies which resources a particular RFFA could affect.

Table 4.1-5
RFFAs Considered in the Cumulative Impact Analyses

RFFA	Anticipated Cumulative Impacts to Resource
Subsistence Activities	1, 2, 3, 4, 5, 6
Commercial Harvest	1, 2, 3, 6
Oil and Gas Activities	1, 2, 3, 4, 5, 6
Global and Industrial Pollutants	1, 2, 3, 4, 5, 6
Commercial Fisheries	1, 2, 5, 6
Commercial Shipping	1, 2, 5, 6
Other Development	1, 2, 5, 6
Scientific Research	1, 2
Climate Variability	1, 2, 3, 4, 5, 6,
Mortality	1, 2, 3
KEY	
1. Bowhead Whale (stock) 2. Other Wildlife 3. Eskimo Health	4. Eskimo Safety 5. Other Tribes and Aboriginals 6. General Public

4.1.3.3 Project Area and Scope for Analysis

The spatial scope of the effects analysis is the entire geographic range of the Western Arctic bowhead whale stock in the Bering, Chukchi, and Beaufort Seas, including Russian and Canadian waters in this range. When this spatial scope is not applicable to a given resource, a relevant geographic sub-area is defined in the analysis.

Evaluation of cumulative effects requires an analysis of the potential direct and indirect effects of the proposed alternatives, in combination with other past and present actions and RFFAs. The time frame or temporal scope for the past and present effects analysis was defined as the period since the Western Arctic bowhead whale stock was first commercially hunted in the Bering Sea in 1848. For each resource, the time frame for past and present effects is described in Section 3. RFFAs considered in the cumulative effects analysis consist of projects, actions, or developments that can be projected, with a reasonable degree of confidence, to occur in the foreseeable future and that are likely to affect the resources described. A common practice is to project 5 to 10 years forward, and in this case, the 10 year time frame was chosen because reasonable estimates regarding oil and gas exploration and development along the Chukchi and Beaufort Seas are available for this period.

4.2 Incomplete and Unavailable Information

The CEQ guidelines require that:

> When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency shall always make clear that such information is lacking (40 CFR 1502.22).

In the event that there is relevant information, but "the overall costs of obtaining it are exorbitant or the means to obtain it are not known" (40 CFR 1502.22), the regulations instruct that the following should be included:

- A statement that such information is unavailable;
- A statement of the relevance of such information to evaluate reasonably foreseeable significant adverse impacts;
- A summary of existing information that is relevant to evaluating the adverse impacts; and
- The agency's evaluation of adverse impacts based on generally accepted scientific methods.

In the analysis, this EIS identifies those areas where information is unavailable to support a thorough evaluation of the environmental consequences of the alternatives. The direct, indirect, and cumulative effects analyses are based on readily available information; however, whatever data gaps still exist are identified in accordance with the above CEQ guidelines.

4.3 Resources and Characteristics Not Carried Forward For Analysis

Species that would not be affected directly or indirectly by bowhead whaling activities include gray whales, minke whales, killer whales, harbor porpoise, short-tailed albatross, and many terrestrial mammals. These species were not considered for further analysis because the alternatives would not have any effects on these species.

4.4 Direct and Indirect Effects of the Alternatives on the Western Arctic Bowhead Whale Stock

Alternatives were developed based on the IWC recommended strike limit (including takes in both Alaska and the Russian Federation). The action alternatives primarily assess the merits of different options in the carry-over strikes without suggesting a change to the existing catch limits provided through the international forum of the IWC and as established through several decades of scientific research and calculations. In the analysis of impacts under the alternatives, the risk of mortality is estimated based on the strike limits, rather than the quota for landed whales. The fate of struck and lost whales, and the likelihood of their mortality, is not fully known. For the purposes of assessing biological impacts, it is necessary to take the precautionary approach and assume that all struck whales represent mortalities. This is a worst case scenario required for the analysis, and not an assertion that all strikes from subsistence whaling result in mortalities.

4.4.1 Alternative 1

Alternative 1 would eliminate a quota for subsistence taking of bowhead whales and may result in the elimination of subsistence whaling activities and harvest. No bowhead whales would be taken in subsistence harvests. So, the magnitude, extent, and duration of direct mortality under this alternative are considered negligible to the population of bowheads (as per Table 4.1-1). Human activities associated with subsistence whaling would be sharply reduced under this alternative, so that the amount of noise and disturbance from subsistence whaling would also be considered negligible.

4.4.2 Alternative 2

Alternative 2 would authorize a maximum annual mortality of 67 bowheads (strikes) for a five-year period, subject to a total of 255 landed whales over five years. Over the five-year period the total mortality could be 5x67 or 335 whales total. (The total mortality would be lower if all struck whales were landed because of the limit on landed whales.) The total annual mortality assessment under this alternative is 67 whales per year which, given the current abundance and growth trends (Section 3.2.1), is unlikely to cause the population to decline or to slow its rate of recovery. The magnitude, geographic extent, and duration of this level of mortality is therefore considered negligible for the bowhead population (Table 4.1-1). Human activities associated with subsistence whaling under Alternative 2 would vary from year to year and place to place depending on whale movements, weather, ice characteristics, and social factors. Effects of human activities are localized and timed to coincide with the presence of whales during their spring and autumn migrations. Disturbance to the whales from subsistence whaling activities under Alternative 2 would be localized and short-term and would be considered minor at the population level.

4.4.3 Alternative 3

Alternative 3 would authorize a maximum mortality of 82 bowheads (strikes) in a given year, if the authorized carry-over of 15 unused strikes were to occur, subject to a total of 255 landed whales over five years. Over the five-year period the total mortality could be 350 whales (5x67, plus 15 carried over) or an average of 70 bowhead whales per year. This level of mortality is considered negligible in magnitude for the bowhead population (Table 4.1-1), in light of current abundance and growth trends (Section 3.2.1). The extent and duration of the effects under this alternative are the same as those for Alternative 2, so the overall impact is rated negligible. The effects of human activities associated with subsistence whaling under Alternative 3 would be similar to those described for Alternative 2, with disturbance at a minor impact level.

4.4.4 Alternative 4

Alternative 4 would authorize a maximum mortality of 100 bowheads (strikes) in a given year, if the authorized carry-over of 33 unused strikes were to occur, subject to a total of 255 landed whales over five years. Over the five-year period the total mortality could be 368 (5x67, plus 33 carried over strikes), or an average of 74 bowheads per year. This level of mortality is considered negligible in magnitude at the population level for bowheads (Table 4.1-1), in light of current abundance and growth trends (Section 3.2.1). The extent and duration of the effects under this alternative are the same as those for Alternative 2, so the overall impact is rated negligible. The

effects of human activities associated with subsistence whaling under Alternative 4 would be similar to those described for Alternative 2, with disturbance at a minor impact level.

4.5 Direct and Indirect Effects of the Alternatives on Individual Whales

In addition to mortality if struck or landed, under the action alternatives, hunting activities have the potential to indirectly affect bowhead whales that are not being pursued. This includes the presence of vessels and underwater noise. The sound of one or more harpoon bomb detonations during a strike is audible for some distance. Acousticians listening to bowhead whale calls as part of the census report that calling rates decrease precipitously after a detonation. (Christopher W. Clark, Cornell Laboratory of Ornithology, personal communication). The range at which whales may be affected is unknown and will vary with environmental conditions (e.g., depth of water, ambient noise levels, ice conditions, bottom structure) and the depth at which the bomb detonates.

According to Alaska Native TEK, after a harpoon bomb detonation, some whales act "skittish" and wary (E. Brower, Barrow Whaling Captain's Association President, personal communication). Whales temporarily halt their migrations, turn 180 degrees away from the disturbance (i.e., move back through the lead systems), or become highly sensitized as they continue migrating (E. Brower, Barrow Whaling Captain's Association President, personal communication). These changes in migratory behavior in response to disturbance are short-term, as several whales are often landed at whaling villages such as Barrow in a single day (George, 1996).

In this respect, the indirect disturbance effects on individual whales will be negligible in magnitude, extent, and duration under Alternative 1, since under this alternative no subsistence whaling would occur. Under Alternatives 2, 3, and 4, subsistence whaling would occur, and as described in the effects analysis in Section 4.4, the magnitude, extent, and duration of the associated disturbance effects would be minor for individual bowhead whales.

4.6 Cumulative Effects of the Alternatives on the Western Arctic Bowhead Whale Stock

4.6.1 Offshore Petroleum Extraction Activities Including Seismic Surveys

4.6.1.1 Past and Present Oil and Gas Activities

Fifteen state and federal planning areas make up the Alaska Region for oil and gas exploration. Of these, leasing consideration is being proposed in four of the planning areas: Beaufort Sea, Chukchi Sea, Cook Inlet, and the North Aleutian Basin. For a summary of past, present, and future oil and gas exploration and development in the Beaufort and Chukchi Seas, which are the only areas that overlap with the distribution of the Western Arctic stock of bowhead whales, please refer to following documents:

(1) Biological Opinion prepared by NMFS for the Minerals MMS pursuant to Section 7 of the ESA on Oil and Gas Leasing and Exploration Activities in the Beaufort Sea, Alaska (NMFS, 2001).

(2) Biological Opinion prepared by NMFS for MMS pursuant to Section 7 of the ESA on Oil and Gas Leasing and Exploration Activities in the Beaufort Sea, Alaska and Authorization for small takes under the MMPA (NMFS, 2006).
(3) Final EIS for the Chukchi Sea Planning Area Oil and Gas Lease Sale 193 and Seismic Surveying Activity in the Chukchi Sea (MMS, 2007a).
(4) Final EIS for Beaufort Sea and Chukchi Sea Proposed Oil and Gas Lease Sales for Years 2007-2012 (MMS, 2007b).
(5) Final EIS and EAs prepared for the Beaufort Sea Planning Area Oil and Gas Lease Sale, Sales 186, 195, and 202 (MMS, 2003; MMS, 2004; and MMS, 2006a).
(6) Final EIS on the BPXA's Liberty Development Project (MMS, 2002b).
(7) Final EIS prepared on the Beaufort Sea Oil and Gas Development Project/Northstar (USACE, 1999).

Beaufort Sea

The terrestrial environment adjacent to the Beaufort Sea has experienced most of the oil and gas-related industrial development on the North Slope compared to development in nearshore and offshore waters. Oil and gas exploration and production activities have occurred on the North Slope since the early 1900s, and production has occurred for more than 50 years. Associated industrial development has included the creation of an industry-support community airfield at the town of Deadhorse and an interconnected industrial infrastructure that includes roadways, pipelines, production and processing facilities, gravel mines, and docks. Offshore exploration for oil and gas in the Beaufort Sea has occurred intermittently during the past 30 years. Offshore discoveries have resulted in field development from wells drilled directionally from onshore facilities and from a limited number of structures in nearshore waters (defined as inside the barrier islands) and offshore waters (defined as outside the barrier islands).

Lease Sales. Ten federal lease sales for the OCS have been held in the Beaufort Sea planning area since 1979. Currently there are 181 active leases in this area. Thirty-one exploratory wells have been drilled and there is production from a joint federal/state unit, with federal production of over 15 million barrels of oil since 2001. While the disposition of the leases purchased in recent lease sales is highly speculative at this time, it is probable that at least some seismic exploration and possibly some exploratory drilling could take place during the 10 year period identified for the cumulative effects analysis in the EIS. The State of Alaska made nearshore state waters (mean high tide line to 3 mi. offshore) available for leasing along much of the coast of the Beaufort Sea. Beaufort Sea Areawide Lease Sales are held annually in October. Four lease sales have been held to date. As of July 2004, 194 active leases in this area encompass 440,000 acres. Future state lease sales will continue on a regular basis.

Seismic Survey Activities. The vast majority of geophysical seismic surveys conducted in the Beaufort and Chukchi Seas to date used the less detailed 2-D methodology; future seismic surveys are likely to use the more informative 3-D methodology to explore for oil and gas deposits (MMS, 2006b). Openwater and over-ice seismic surveys in Beaufort Sea federal waters began in the late 1960s and peaked in the 1980s. More seismic activity permitted by the MMS has occurred in the Beaufort Sea OCS than in the Chukchi Sea OCS (MMS, 2006b). The 2-D marine seismic surveys in the Beaufort Sea began with two MMS Geological and Geophysical (G&G) permits issued in 1968 and four in 1969. Both over-ice and marine 2-D seismic surveys were conducted in the 1970s. With one exception, the 80 marine and 43 over-ice surveys

permitted in the Beaufort Sea OCS by MMS in the 1980s were 2-D. In the 1990s, both 2-D and 3-D seismic surveys were conducted. The first 3-D over-ice survey occurred in the Beaufort Sea OCS in 1983 and the first marine 3-D seismic survey occurred in 1996. More than 100,000 line-miles of 2-D and 3-D seismic surveys have been collected to date in the Beaufort Sea Planning Area (MMS, 2006b).

In 2006, Shell Offshore Inc., conducted open-water seismic programs, which consisted of an estimated 3,000 mi. of 3-D seismic line acquisition and site-clearance surveys in the eastern Beaufort and Chukchi Seas (MMS, 2006b). The open-water seismic program consisted of two vessels, one active in seismic acquisition and the second providing logistical support. Shell Offshore Inc., expects to eventually spend two to three seasons acquiring 3-D seismic data from all of its Beaufort Sea leases, although exactly which areas it surveys in any particular season will depend on ice conditions. The open-water program will involve a geotechnical investigation supported by a soil-boring vessel.

A 2-D seismic survey was conducted in late summer to early fall 2006 in the Mackenzie Delta region of the Canadian Beaufort Sea, by Input/Output, a subsidiary of GX Technology. This work provided high-resolution data for the Mackenzie Delta and adjoining Canada Basin (First Break, 2007).

Seismic surveys for exploration purposes in state waters are authorized under Miscellaneous Land Use Permits; however, seismic surveys conducted for other purposes, such as shallow hazard assessments, do not require permits unless they are not conducted from the ice and/or involve contact with the seafloor (MMS, 2006b). Since 1969, the State of Alaska has issued 42 permits for seismic survey activities in the Beaufort Sea. There are no current seismic activities in state waters in the Chukchi or Beaufort Sea Planning Areas. However, seismic activities in adjacent federal waters of the Chukchi Sea in autumn 2006 resulted at some times in seismic sounds entering into the state waters at detectable levels. Not all detectable noise would be expected to elicit a reaction to bowhead whales or other marine mammals.

Site Clearance Survey Activities. To date, high-resolution site-clearance surveys in the Beaufort Sea OCS were conducted for 30 exploration wells. Additional site-clearance surveys may have been conducted in the proposed action area where no exploration wells were drilled. In the Beaufort Sea OCS, site-clearance surveys in 2006 occurred on three oil and gas prospects.

Oil and Gas Development. Since the discovery and development of the Prudhoe Bay and Kuparuk oil field, more recent fields generally have been developed not in the nearshore environment, but on land in areas adjacent to existing producing areas. Notable exceptions to this are the Northstar, Endicott, and Lisburne fields. Endicott Field was developed using causeways whereas the Lisburne Field was developed using directional drilling from shore. The Oooguruk Field is currently under development by Pioneer Natural Resources Alaska in nearshore waters off of Oliktok Point (Figure 4.6.1.1-1). The Northstar development is an offshore gravel structure outside of the barrier islands with flow lines to onshore facilities. The Northstar facility has been issued a Letter of Authorization under the MMPA from NMFS to cover Level A and Level B taking of bowhead, gray, and beluga whales, and ringed, spotted, and bearded seals, incidental to operation of the facility. This includes potential effects from presence of personnel, structures, and equipment; oil spills; on-ice construction or transportation; vessel and helicopter activity;

and acoustic impacts from power generation and oil production. The Letter of Authorization excludes seismic surveys because they are not a component of operation of the facility.

Chukchi Sea

Lease Sales. There have been two sales in this area with the most recent in 1991. There have been five exploratory wells drilled with no commercial discoveries. There are no existing leases at this time. This area is included in the current program as a special interest sale. No interest was expressed in the first two calls for information in 2003 and 2004. There was industry interest expressed in a large portion of the area, in response to the call in early 2005, but there was not adequate time remaining in the current program to complete the necessary pre-lease steps and environmental documentation. The sale was deferred for consideration in the 2007-2012 program. Chukchi sale 193 is currently scheduled for 2007.

Seismic Survey Activities. Openwater and over-ice seismic survey activity in the federal waters of the Chukchi Sea has been significantly less than that in the Beaufort Sea (MMS, 2006b). The MMS-permitted seismic surveys have been conducted in the Chukchi and Beaufort Seas since the late 1960s/early 1970s. Between 1970 and 1975, 12 MMS G&G permits were issued for Chukchi Sea 2-D marine seismic surveys, but none between 1976 and 1982. Seismic survey activity increased between 1982 and 1991, when MMS issued 30 G&G permits. The most G&G permits issued in any one year in the Chukchi Sea was seven (six marine and one over-ice) in 1986. ConocoPhillips Alaska, Inc., and GX Technology conducted open-water seismic programs in the Chukchi Sea in 2006.

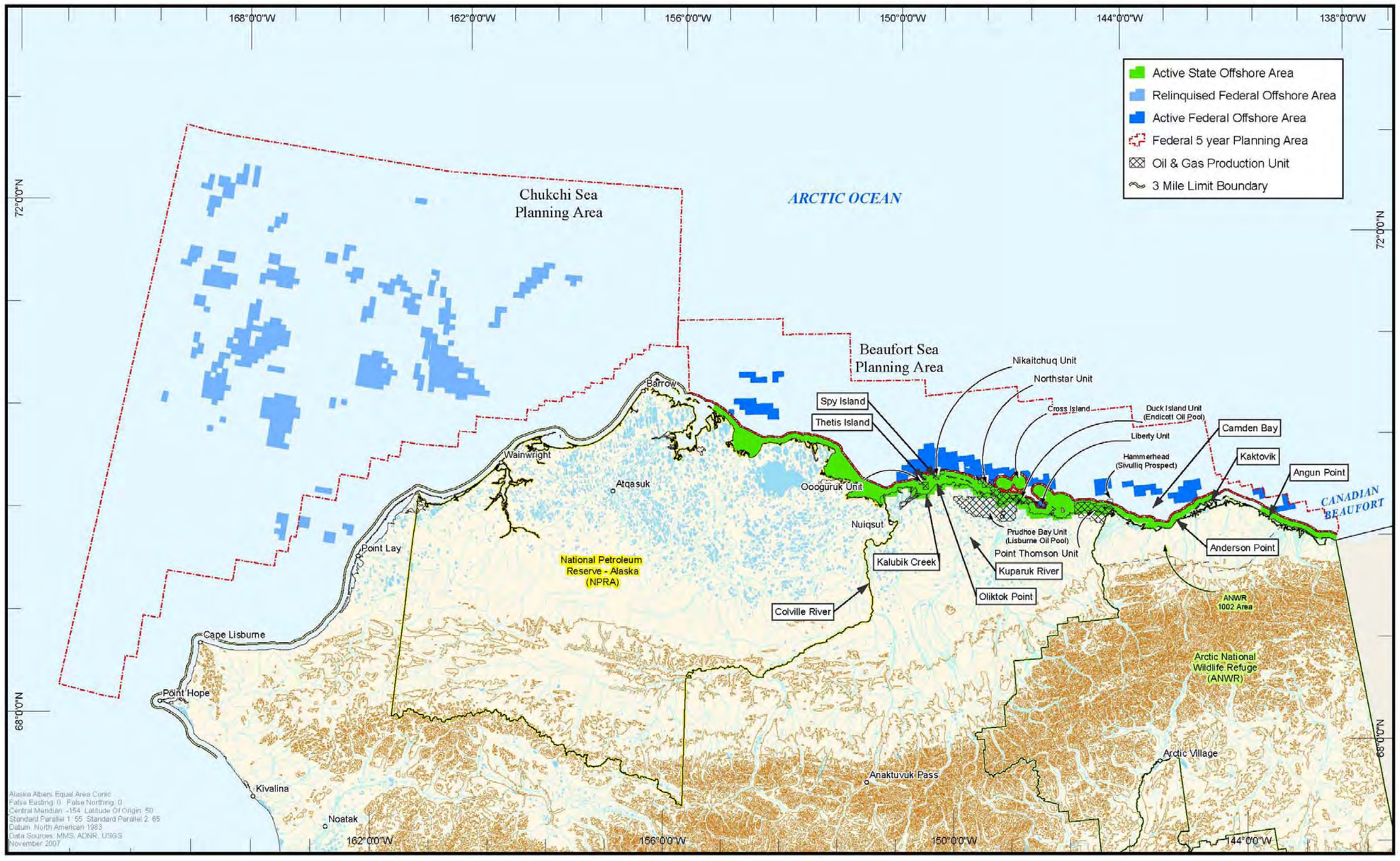

Figure 4.6.1.1-1 Offshore North Slope Oil and Gas Lease Areas

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In addition to the industry seismic surveys, a team from the University of Texas and the U.S. Geological Survey with research funding from the National Science Foundation acquired seismic data in the northern Chukchi Sea and Arctic Ocean, using the U.S. Coast Guard icebreaker Healy during the 2006 summer season. This seismic program forms part of a scientific study of the composition of submarine plateaus and the structure of the Earth's crust in the Arctic Ocean (MMS, 2006b).

Site Clearance Survey Activities. In the 1980s, five high-resolution site-clearance surveys were conducted in the Chukchi Sea OCS prior to five exploration wells being drilled. No high-resolution site-clearance surveys occurred in the Chukchi Sea in 2006 (MMS, 2006b,d).

Oil and Gas Development. There are currently no remaining leases from earlier sales and no operating oil or gas facilities in the Chukchi Sea Planning Area.

4.6.1.2 Reasonably Foreseeable Future Oil and Gas Activities

Beaufort Sea

Lease Sales. Lease sale 202 is the last of three sales in MMS' current five-year offshore plan, which ends in June 2007 (MMS, 2006b). As required by the Outer Continental Shelf Lands Act (OCSLA), MMS has prepared a final proposed five-year program (2008 through 2012) to replace the current 2002 through 2007 leasing program. Options for the Federal OCS Lease Sales during this five year period in the Beaufort Sea include two lease sales; Sale 209 in 2009 and Sale 217 in 2011.

Seismic Surveys. Projected seismic 2-D/3-D surveys in the Beaufort Sea planning area are estimated at three per year for 2007 and 2008 and two per year for 2009 and 2010 (MMS, 2006b). In State waters, seismic surveys are projected at one per year for 2008 and 2010 (MMS, 2006b).

Site Clearance Survey Activities. In those leased blocks where there is sufficient potential for further exploration drilling or development and production, geological site surveys, and shallow hazard surveys would be required. MMS projects two site clearances per year between 2007 and 2010 (MMS, 2006b). ConocoPhillips Alaska, Inc., planned to conduct an over-ice geophysical survey and portions of a site-clearance survey in the Beaufort Sea just north of Cross Island in spring 2007 (EPA, 2007) and received an Incidental Harassment Authorization from NMFS. However, the planned work was not conducted.

Oil and Gas Exploration and Development. The 2006 Alaska Ocean OCS Seismic studies Programmatic EA discusses oil and gas exploration and development projects in the Beaufort Sea and their cumulative effect in more detail (MMS, 2006e). These projects include:

- Shell Offshore Inc. - Proposes to drill exploration targets during open water season on various MMS OCS lease blocks in the Beaufort Sea. Proposed activities include exploration and appraisal drilling offshore approximately 16 mi. north of Pt. Thomson in Camden Bay.
- Oooguruk Unit - This unit is located northwest of the Kuparuk River Unit in shallow waters of the Beaufort Sea, near Thetis Island. An offshore production island between

Thetis Island and the Colville River Delta has been completed, along with a 5.7 mi. off-shore underground pipeline, from the island to landfall near the mouth of Kalubik Creek, which was completed and successfully tested in spring 2007. Nakaitchuq Unit - Involves construction of a gravel pad with drilling, gathering, and production facilities on Oliktok Point, construction of a gravel drilling island near Spy Island, a 3.8 mi. sub-sea flow line and utility bundle to Oliktok Point for fluid processing, and a 14 mi. pipeline from Oliktok Point to a tie in to the Kuparuk common carrier pipeline. A small gravel island is to be constructed within the barrier islands for future drilling.

- Liberty Project - BP Alaska is in the process of pursuing the Liberty Project in Beaufort Sea waters east of Prudhoe Bay. Current plans call for accessing the project through directional drilling from onshore.
- State of Alaska - Stratigraphic test well could be drilled at one of two potential locations in state waters offshore of the 1002 area of the Arctic National Wildlife Refuge. Drilling operations will be conducted in winter using a mobile offshore drilling unit.
  - approximately 20 mi. southwest of Kaktovik near Anderson Point;
  - approximately 30 mi. southeast of Kaktovik near Angun Point.
- State of Alaska - onshore/on-ice geotechnical program will acquire soil borings in state waters from approximately 200 feet (ft) onshore seaward to 10 km offshore between the state's offshore Hammerhead leases and the shoreline within the Point Thompson Unit.
- Canadian Beaufort exploration and development – Activities on new and existing leases in the Canadian Beaufort are expected to continue in the near future.

Chukchi Sea

Lease Sales. In June 2007, MMS published a Final EIS for proposed Lease Sale 193 in the Chukchi Sea. The lease sale is a carry over from the MMS 2002 to 2007 Oil and Gas Leasing Program and is currently scheduled to occur in early 2008. The recent MMS five year leasing program for 2008 through 2012 calls for two addition lease in the Chukchi Sea planning area; Sale 212 in 2009 and Sale 221 in 2010.

In the western Chukchi in Russian waters, there has been little exploration activity. The simultaneous U.S./Russia OCS lease sale that was proposed in the five-year program for 1992 through 1997 was canceled, with this area being deferred for consideration in later programs (MMS, 2006b). No additional oil and gas development activities have been identified in the Russian Chukchi Sea.

Seismic Survey Activity. Additional seismic surveys are planned for the Chukchi Planning area for the remainder of the five-year leasing program (MMS, 2006b). MMS projects that three surveys per year would occur during 2007 and 2008, but that this would decrease to about two per year in 2009 and 2010.

Site Clearance Survey Activities. High resolution site-clearance surveys on leases in the Chukchi Sea are not anticipated until at least 2009 and 2010 and would consist of only one site-clearance per year (MMS, 2006b). This contrasts with site-clearance survey activities in the 1980s, when five high-resolution site-clearance surveys were conducted in the Chukchi Sea OCS prior to five exploration wells being drilled. No high-resolution site-clearance surveys occurred in the Chukchi Sea in 2006 (MMS, 2006b,d).

Summary

In both the Beaufort and Chukchi Seas lease areas, bowhead whales can be affected by combined effects of noise and activity from all of these sources in nearshore waters, including seismic activity, site-clearance seismic surveys, drilling, and other oil and gas development activity.[10] As a result, whales may experience short-term displacement from traditional migration routes to areas farther offshore, thereby making it harder for subsistence hunters to both hunt and retrieve the harvested whales.

4.6.1.3 Effects of Noise on Bowhead Whales

Past and Present Effects

The spring season appears to be a particularly critical period in the bowheads' annual cycle. This is the time most, if not all, of the population migrates, through areas covered by dense ice, where migration routes are constrained and most likely to be blocked by elevated sound sources (Richardson et al., 1995a,b). Exposure to man-made sound and contaminants may produce short- and long-term effects (Richardson and Malme, 1993; Bratton et al., 1993). However, Richardson and Malme (1993) state that data are not available to assess long-term impacts. Further, research in 1996 through 1998 showed that some seismic noise can deflect autumn migration of bowheads to farther offshore (Miller et al., 1999; Richardson, 1999; Richardson et al., 1999). Residents of the Arctic have expressed concern regarding the cumulative and long-term effects of anthropogenic noises on Western Arctic bowhead whales (Ahmaogak, 1985, 1989). Anthropogenic impact is a function of the extent that industrial activities coincide with the bowhead whales' seasonal occupation of certain regions and the whales' tolerance level of the impacts (Richardson and Malme, 1993; Bratton et al., 1993).

As noted in Section 3.2.8 of this EIS, the effects of oil and gas activities on bowhead whales are discussed at length in several documents: NMFS (2006), MMS (2002a), and MMS (2006a) with additional information presented on the MMS Alaska OCS Region website: www.mms.gov/alaska. NMFS (2006) concluded that the effects from an encounter with aircraft generally are brief and whales should resume their normal activities within minutes (Patenaude et al., 2002). Bowheads may exhibit temporary avoidance behavior to vessels at distances of 1 to 4 km. Many earlier studies indicate that most bowheads exhibit avoidance behavior when exposed to sounds from seismic activity. Bowheads also exhibited tendencies for reduced surfacing and dive duration, fewer blows per surfacing, and longer intervals between successive blows. Eskimo whalers have stated that noise from seismic surveys and some other activities at least temporarily displaces whales farther offshore, especially if the operations are conducted in the main migration corridor (MMS, 2006b). Studies in the 1980s indicated that bowheads appeared to recover from these behavioral changes within 30-60 minutes following the end of seismic activity (Richardson et al., 1986b; Ljungblad et al., 1988). Monitoring studies of 3-D seismic exploration in the nearshore Beaufort Sea during 1996-1998 have demonstrated that nearly all bowhead whales will avoid an area within 20 km of an active seismic source (Richardson et al., 1999). Sound levels received by bowhead whales at 20 km ranged from

[10] Certain proposed activates by Shell Offshore Inc. are undergoing administrative and legal challenges. The final resolution of these challenges may affect foreseeable future offshore oil development in both the Beaufort Sea and Chukchi Sea Planning Areas.

117-135 dB re 1μPa rms[11] and 107-126 dB re 1μPa rms at 30 km, but did not persist beyond 12 hours after seismic operations (Richardson et al., 1999). Data from monitoring seismic operations from 1996 through 1998 suggested that the offshore displacement may have begun roughly 35 km (19 nautical miles [n. mi.] or 22 statute miles [st. mi.]) east of the activity and may have persisted more than 30 km to the west (Richardson et al., 1999). Bowheads reoccupied the area within 12-24 hours after seismic surveys ended (Richardson et al., 1999).

Bowheads have been sighted within 0.2-5 km from drill ships, although bowheads change their migration speed and swimming direction to avoid close approach to noise-producing activities. During autumn migration, however, bowheads may avoid drill ships and their support vessels at 20-30 km. There are no observations of bowhead reactions to icebreakers breaking ice, but it has been predicted that roughly half of the bowheads would respond at a distance of 4.6-20 km when the signal-to-noise ratio is 30 dB (Richardson et al., 1995a).

Available information does not indicate that oil and gas-related activity (or any recent activity) has had detectable long-term adverse population-level effects on the overall health, current status, or recovery of the bowhead population (MMS, 2006b). Data indicate that the bowhead whale population has continued to increase over the timeframe that oil and gas activities have occurred and that there is no evidence of long-term displacement from habitat (MMS, 2006b).

Reasonably Foreseeable Future Effects

Overall, bowhead whales exposed to noise-producing activities are most likely to continue to experience temporary, nonlethal behavioral effects in the future. The cumulative effect of noise on bowhead from offshore oil and gas activities would be expected to be similar to those described and summarized for OCS leasing and exploration.

Oil and gas activities during migration could potentially add to the overall noise and disturbance from subsistence hunting activities and potentially affect habitat use (MMS, 2006c). Reactions to aircraft overflights and vessels are relatively brief, lasting only a few minutes with greater reaction to drill ships and seismic vessel. Whales disturbed by noise and activity from all sources in nearshore waters, including site-clearance seismic surveys, could experience short-term displacement from migration routes to areas farther offshore. The available data on reaction to noise and disturbance do not indicate any lasting population–level effect on bowheads, based on the level of activity in the Beaufort and Chukchi since the 1970s (NMFS, 2006). However, the cumulative effects of these future-noise generating activities are less certain. As sea ice retreats due to climate change, drill ships and seismic exploration vessels may have access to areas where they were previously excluded at certain times of the year, which may contribute to an increased exposure to bowheads to future offshore oil and gas activities. However, it is not clear whether such potential changes in the distribution of seismic efforts, site-clearance activities, or

[11] Sound is typically measured in decibels, which measure the reduction of a sound's intensity over distance. Because sound travels differently through different media, the measurement of sound must also take into account a medium's impedance (or resistance) of sound pressure to be meaningful. A standard reference point for sound pressure in water (through which sound waves propagate more efficiently than through air) is one microPascal (1μPa), a measure of pressure. In underwater acoustics, the *source level* of a sound represents the intensity of a sound at a certain distance, usually one meter, from the source, referenced to one microPascal; this is the meaning of the scientific phrase dB re 1μPa at 1 m. The *received level* is the intensity of the sound at the listener's actual distance from the source; this is the value represented by the scientific phrase dB re 1μPa rms (rms = root mean square, a statistical measure of the amplitude of the variable intensity of a sound wave).

development activities would coincide with potential changes in the distribution or migratory movements of bowheads as a result of climate change.

Overall, bowheads exposed to noise producing activities, including subsistence hunting, marine and aircraft traffic, and oil and gas activities, most likely would experience temporary, nonlethal behavioral effects, such as avoidance behavior. Effects could potentially be longer term, if sufficient oil and gas activity were to occur in a localized area, but long-term displacement of bowhead whales as a result of human activity has not been demonstrated (MMS, 2007a). Cumulative effects of disturbance from noise are considered minor at the population or stock level. A detailed discussion of the contribution of effects of oil and gas activity to the overall cumulative effects on bowhead whales is presented in the 2006 Arctic Region Biological Opinion for Oil and Gas Activity in the Beaufort and Chukchi Sea (NMFS, 2006) and the 2007 Chukchi Oil and Gas Lease Sale 193 Final EIS (MMS, 2007a).

4.6.1.4 Oil Spills

The Biological Opinion prepared for oil and gas leasing and exploration activities by the MMS in the Beaufort Sea considered the effects on bowhead whales if there was to be oil and gas leasing and exploration on the OCS portion of the U.S. Beaufort Sea (MMS, 2006f). Oil spills can occur during seismic exploration, exploratory drilling, construction and operation of offshore platforms, and from subsea pipelines. Spills can occur as large spills, greater than 1,000 barrels, small spills, between 50 and 1,000 barrels, and very small spills, under 50 barrels (MMS, 2006f). The probability of a large oil spill is considered to be remote during exploration, but was assessed due to the pronounced effects it might have on bowheads and the potentially higher probabilities associated with subsequent development and production phases (NMFS, 2006).

Bowhead whales can be affected by oil spills through displacement, direct contact with oil, and disturbance from response vessels. Displacement of individual bowhead whales may occur in the event of a large oil spill, and avoidance of the contaminated area may last for several years (MMS, 2001). This suggests that bowhead whales may have some ability to detect an oil spill and would avoid surfacing in the oil by detouring away from the spill area (NMFS, 2001c). Displacement from feeding areas or contaminated food may also occur as a result of an oil spill, but it is unlikely that the availability of food sources for bowheads would be affected given the abundance of plankton resources in the Beaufort Sea (Bratton et al., 1993).

Modeling efforts have indicated that only up to 2% of the Beaufort Sea bowhead whale population would be affected by a large oil spill (NMFS, 2001c). However, the impacts of oil exposure to the bowhead whale population would depend upon how many animals contacted oil. In the worst case, if oil found its way into leads or ice-free areas frequented by migrating bowheads, a substantial portion of the population could be affected (Englehart, 1987).

Prolonged exposure to freshly spilled oil could kill some whales, but the numbers are estimated to be small due to a low chance of such contact (MMS, 2006f). This would be most likely to occur if oil spilled into a lead that bowhead whales could not escape (MMS, 2006f). Most whales exposed to spilled oil could be expected to experience temporary, nonlethal effects from skin contact with oil, inhalation of hydrocarbon vapors, and ingestion of oil-contaminated prey (NMFS, 2006). Spilled oil may also foul the baleen fibers of mysticete whales during feeding at

the surface, including the bowhead whale, temporarily impairing food-gathering efficiency or resulting in the ingestion of oil or oil-contaminated prey (Geraci and St. Aubin, 1987).

Bowhead whales may be displaced temporarily from an oil-spill area due to the large numbers of personnel, equipment, vessels, and aircraft that could be involved in oil-spill cleanup activities. However, because of such displacement, fewer bowhead whales would be expected to be exposed to oil as a result of cleanup operations (MMS, 2001, 2006f). The Industry Site-Specific Bowhead Whale-Monitoring Program should be effective in detecting a delay or blockage of the migration (MMS, 2004).

In investigating the probability of spilled oil contacting bowhead whales, MMS identified specific offshore areas (Ice/Sea Segments [ISS]) and modeled for probability of contact with a spill. Certain of these ISS's overlay the migratory corridor of the bowhead (MMS, 2003). Using data from the MMS oil spill analysis for Sale 170, and assuming an oil spill of 1,000 barrels or more occurred at any of several offshore release areas during the summer season, the chance of that oil contacting these ISS's within 30 days during the summer season ranged from 5-82%. Overall, the combined probability of a spill occurring and also contacting bowhead habitat during periods when whales are present is considered to be low, and the percentage of the bowhead whale stock so affected is expected to be very small. The NSB believes there are some scenarios, such as an oil spill in a spring lead system near Barrow, which could affect a large portion of the population. The likelihood of this is debatable, depending on how oil development proceeds in the Chukchi Sea (Craig George, North Slope Borough, personal communication, December 20, 2007).

4.6.2 Climate Change - Cumulative Effects of Environmental Variability

4.6.2.1 Past and Present Effects of Climate Change

Evidence of climate change in the past few decades, commonly referred to as global warming, has accumulated from a variety of geophysical, biological, oceanographic, and atmospheric sources. The scientific evidence indicates that average air, land, and sea temperatures are increasing at an accelerating rate. Although climate changes have been documented over large areas of the world, the changes are not uniform and affect different areas in different ways and intensities. Arctic regions have experienced some of the largest changes, with major implications for the marine environment as well as for coastal communities. Recent assessments of climate change, conducted by international teams of scientists (Gitay et al., 2002 for the Intergovernmental Panel on Climate Change [IPCC]; Arctic Climate Impact Assessment [ACIA], 2004; IPCC, 2007), have reached several conclusions of consequence for this EIS:

- Average arctic temperatures increased at almost twice the global average rate in the past 100 years.
- Satellite data since 1978 show that perennial arctic sea ice extent has shrunk by 2.7% per decade, with larger decreases in sea ice extent in summer of 7.4% per decade.
- Arctic sea ice thickness has declined by about 40% during the late summer and early autumn in the last three decades of the twentieth century.
- The ice pack is retreating from the land sooner in the spring and reforming later in the fall. This affects the timing of phytoplankton blooms and zooplankton concentrations.

- The ice pack is retreating further seaward than in the past, which creates larger areas of open water near coastal areas and leads to larger waves, higher storm surges, and accelerated rates of coastal erosion. This dynamic is exacerbated by rising sea levels due to thermal expansion of seawater and other sources.
- The arctic tundra is warming rapidly, causing permafrost to thaw deeper in the summer and over much larger areas than previously observed, accompanied by substantial changes in vegetation and hydrology.
- The melting ice pack, melting glaciers, and increased precipitation are adding large amounts of freshwater to the sea, causing decreases in salinity that may combine with longer ice-free seasons to affect the timing and intensity of phytoplankton blooms.

Bowhead whales are associated with and well adapted to ice-covered seas with leads, polynyas, openwater areas, or thin ice that the whales can break through to breathe. Arctic coastal peoples have hunted bowheads for thousands of years, but the distribution of bowheads in relationship to climate changes and sea ice cover in the distant past is not known. It has been suggested that a cold period 500 years ago resulted in less ice-free water near Greenland, forcing bowheads to abandon the range, and that this led to the disappearance of the Thule culture (McGhee, 1984; Aagaard and Carmack, 1994, as cited in Tynan and DeMaster, 1997). However, it is not clear if larger expanses and longer periods of ice-free water will be beneficial to bowheads. The effect of warmer ocean temperatures on bowheads may depend more on how such climate changes affect the abundance and distribution of their planktonic prey rather than the bowheads' need for ice habitat itself (Tynan and DeMaster, 1997).

4.6.2.2 Reasonably Foreseeable Future Climate Change Effects

The most recent analysis of climate change (IPCC, 2007) concluded that there is very strong evidence for global warming and associated weather changes and that humans have "very likely" contributed to the problems through burning fossil fuels and adding other "greenhouse gasses" to the atmosphere. This study involved numerous models to predict changes in temperature, sea level, ice pack dynamics, and other parameters under a variety of future conditions, including different scenarios for how human populations respond to the implications of the study. It is not clear how governments and individuals will respond or how much these future efforts will reduce greenhouse gas emissions. Although the intensity of climate changes will depend on how quickly and deeply humanity responds, the models predict that the climate changes observed in the past 30 years will continue at the same or increasing rates for at least 20 years.

The implications of these trends for bowheads are uncertain but they may be beneficial, in contrast to affects on ice-obligate species such as polar bears and walrus (ACIA, 2004). There will be more open water and longer ice-free seasons in the arctic seas which may allow them to expand their range as the population continues to recover from commercial whaling. However, this potential for beneficial effects on bowheads will depend on their ability to locate sufficient concentrations of planktonic crustaceans to allow efficient foraging. Since phytoplankton blooms may occur earlier or at different times of the season, or in different locations, the timing of zooplankton availability may also change from past patterns (Arrigo and van Dijken, 2004). Hence, the ability of bowheads to use these food sources may depend on their flexibility to adjust the timing of their own movements and to find food sources in different places (ACIA, 2004).

Moore and Laidre (2006) have examined sea ice changes in areas important to the Western Arctic bowhead stock and developed a conceptual model of how sea ice changes could affect the whales' access to prey. There was little change in the average amount of open water along the primary springtime migration corridors but extreme variability in the amount of open water from year to year (Moore and Laidre, 2006). Years with early and extensive retreat of the ice pack may allow migrating bowheads to access areas they could not occupy when sea ice is more extensive. This affects the migration routes of the whales and may therefore affect the ability of whaling communities to hunt successfully. However, for the past 10 years bowheads have been feeding more frequently in ice-free waters northeast of Barrow than in past years, leading to increased hunting success for Barrow crews in the fall (Treacy, 2002; Bodenhorn, 2003; as cited in Moore and Laidre, 2006). This observed pattern of new feeding opportunities for bowheads agrees with modeling predictions that the retreat of the ice edge relative to the underwater shelf break facilitates wind-driven upwelling of zooplankton-rich waters, as well as allowing greater primary production in ice-free waters, which leads to a beneficial increase in prey availability for bowheads (Moore and Laidre, 2006).

4.6.3 Commercial Shipping and Fishing

4.6.3.1 Past and Present Effects

Commercial shipping and fishing activities would potentially affect mortality of bowhead whales through ship strikes or interactions with fishing gear or result in disturbance from vessel noise. Between 1976 and 1992, only three ship strike injuries were documented out of a total of 236 bowhead whales examined from the Alaskan subsistence harvest (George et al., 1994). Since that publication, six additional whales have been noted with ship strike injuries (1995-2002) out of approximately 180 examined whales (J.C. George, Department of Wildlife Management, NSB, personal communication), indicating that the rate of ship strikes may have increased slightly in recent years. The most recent stock assessment provides no estimate for past mortality from ship strikes (Angliss and Outlaw, 2007). The low number of observed ship strike injuries suggests that bowheads either do not often encounter vessels or that avoid interactions with vessels. It is possible that an unknown number of unobserved and unreported mortalities may occur after ship strikes. However, given the steadily increasing population trend, the magnitude of this potential effect is likely to be small. It is not known when or where ship strikes are most likely to occur.

Most commercial fishing activity in the Bering Sea occurs well south of the range of bowhead whales. There are very limited commercial fisheries in the Chukchi Sea and none in the Beaufort Sea due to small commercial fish stocks, operating difficulties near sea ice, and great distance to markets (ACIA, 2004). The North Pacific Groundfish Observer Program places observers on many of the large commercial fishing vessels that operate in the northern Bering Sea but there are no observer records of fishery interactions with bowheads either through entanglements in fishing gear or ship strikes (Angliss and Outlaw, 2005). There are also no self-reported interactions from vessels without observers. However, since 1978 there have been approximately 20 records of scarring by fishing lines and entanglement in crab fishing gear from bowheads that have been harvested or found stranded on beaches (Angliss and Outlaw, 2005). Data from the NSB Department of Wildlife (1990-2001) suggest that perhaps 10% of the population exhibits clearly identifiable fishing line injuries of varying degrees of severity (George, 2001). It is not known whether these injuries are from active fishing gear or from gear that had been lost and drifting. The number of serious injuries resulting from fishing gear entanglement appears to be

very small. The most recent stock assessment report attributes 0.2 mortalities per year resulting from interactions with fishing gear (Angliss and Outlaw, 2007).

The effects of anthropogenic noise, such as vessel noise, on bowhead whales are primarily related to disturbance of migration. The effects of noise are discussed in detail in Section 4.6.1.

4.6.3.2 Reasonably Foreseeable Future Effects

Observed and predicted decreases in the summer extent of the ice pack could lead to a substantial increase in commercial shipping in the Arctic, especially if the Northwest Passage becomes reliably navigable (ACIA, 2004). Increased vessel traffic in the Beaufort and Chukchi Seas would be likely to result in greater disturbance effects on foraging bowheads and could result in a higher incidence of ship strikes with the potential for serious injury and mortality. However, if bowheads are able to move away from future shipping lanes and still find suitable foraging areas, the increased risk of ship strikes could be minimal.

Commercial and subsistence fishing activities are certain to continue in the future but potential changes in fishing effort relative to the range of the bowhead are not clear. Some commercially exploited fish stocks may expand in both abundance and northward range as a result of climate warming while other stocks are predicted to decline (ACIA, 2004). It is not clear whether such changes would lead to increased or decreased fishing effort in arctic waters. The potential risk of injury to bowheads from entanglement in fishing gear is therefore uncertain but likely to remain small in the foreseeable future given the relatively high cost of transporting arctic fish resources to distant markets.

The effects of anthropogenic noise, such as vessel noise, on bowhead whales are primarily related to disturbance of migration. The effects of noise are discussed in detail in Section 4.6.1.

4.6.4 Research Activities

4.6.4.1 Past and Present Effects

Research activities occurring in the project area have the potential to affect bowhead whales, primarily by introducing noise into the environment, incidentally through operation of the vessel or intentionally through seismic surveys or sonar.

The greatest potential impact from arctic-based research comes from underwater noise generated by icebreakers. The Western Arctic Shelf Basin Interactions project was a multi-year, interdisciplinary program investigating the impacts of climate change on biological, physical, and geological processes in the Western Arctic Ocean. The project was conducted from the US Coast Guard HEALY and POLAR STAR icebreakers. Although radiated noise levels for these ships have not been measured, estimated source levels for icebreakers of similar size range from 177-191 dB re 1μPa at 1 m (Richardson et al., 1995a: Table 6.5). Increases in noise level (510 dB) during ice breaking are caused by propeller cavitation, are broadband (10-10,000 Hz), and are extremely variable over the period of pushing ice. Noise from research activities aboard the icebreakers, or from ice camps may also be audible underwater, but their source level would be expected to be much lower than that of a ship breaking ice. It should be noted that ambient sea-ice noise is also extremely variable, with source levels of 124-137 dB re 1μPa at 1 m for 4 and 8 Hz tones measured for ice deformation noises at pressure ridges (Richardson et al., 1995a).

Based on previous studies of bowhead response to noise, ice-breaking noise could result in temporary displacement of whales from the area where the icebreakers were operating and could potentially cause temporary deflection of the migration corridor (see Section 4.6.1 for further discussion of noise disturbance).

Research specifically on bowhead whales has been conducted since the early 1980s. The early focus of research was to understand the species' biology and ecology, particularly abundance, distribution, and habitat use. Current research focuses on population growth, genetics, and response to anthropogenic sources, particularly because bowheads utilize habitat near oil and gas developments. The following briefly describes the type of research being conducted on bowhead whales.

Land, vessel, and aerial surveys are conducted to collect data on population abundance, distribution, and behavior throughout the bowhead whales' range. Individual and group behaviors are observed during these surveys to provide information on feeding ecology, distribution, habitat use, and behavior. Shore-based counts along the migration route, particularly at Point Barrow, are supplemented with acoustic survey data (George et al., 2004a). Acoustic survey data are collected with the use of autonomous acoustic recorders. Calls of individual whales are localized in realtime or once the recorders have been collected. Radio and satellite tracking provides information on the migration pattern and timing, distribution, and habitat use (Mate et al., 2000). Tags are placed on whales through the use of a pole extended from a vessel in close proximity to the whale or via a crossbow. Skin biopsy samples are also taken to study genetic variability among and within stocks, as well as sex of the whales. The characteristics and segregation of size and age class, in addition to calf growth patterns, are determined through the use of photo identification and photogrammetry taken during aerial surveys (Rugh, 1990; Koski et al., 1993). Many studies have also been conducted to determine the effect of anthropogenic noise (i.e., drilling, dredging, seismic surveys) on the behavior of bowhead whales (e.g., Richardson et al., 1995a,b). Generally, these ship-based and aerial surveys could cause temporary disturbance of individual whales in the area and result in avoidance of the vessel. Aerial surveys are generally flown at heights that do not harass the whales.

Various tissue samples are taken from harvested or stranded whales for physiological studies. Stomach content analysis and isotopic composition of materials (baleen, muscle, and blubber) provide information on the feeding ecology (e.g., Lowry, 1993). These studies can be supplemented with collection of zooplankton in feeding areas to determine the prey composition. Reproductive tissues are taken to determine age of whales, pregnancy rates, and toxicology studies (effects of contaminants on tissues) (e.g., Willetto et al., 2002). Mortality of bowheads is studied by looking at the bacterial, mycotic, and viral infection rates of harvested whales (Philo et al., 1993). Because tissue samples are taken from whales already dead, there would be no effects on bowheads associated with this type of research. Furthermore, the knowledge gained from this research would be beneficial in understanding whale biology and ecology.

4.6.4.2 Reasonably Foreseeable Future Effects

Research is expected to continue in the area. Noise from 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 long-term behavioral or physiological adverse effects on the bowheads in this stock.

4.6.5 Other Development

4.6.5.1 Past and Present Effects

Other activities that may possibly contribute to the cumulative effects on bowhead whales include military activities, other industrial development, and tourism. The surface and airspace of the Chukchi and Beaufort Seas are not extensively used for testing or training of aircraft, vessels, weapon systems, and personnel. There are no military vessels or aircraft stationed in the Beaufort or Chukchi Seas. None of the airspace over the Beaufort and Chukchi Seas is classified as "special use airspace" for the military by the Federal Aviation Administration. Military vessels may occasionally transit through the area. Submarines are often used for oceanic research or military activities in the area, particularly for use of passive and active acoustic technologies. Information about the response of bowhead whales to submarines is not available. Passive acoustics would not introduce noise to the environment and would likely result in no impact to bowhead whales.

Past military activities in the area were associated with the Defensive Early Warning System (DEW-Line), an integrated chain of radar and communications sites across Alaska, northern Canada, and Greenland. This system was discontinued in 1963 and replaced with short- and long-range radar. The U.S. Department of Defense is in the process of dismantling the abandoned sites.

On the Chukchi Sea, the major industrial developments are associated with the Red Dog Mine and Delong Mountain Terminal. Red Dog Mine is the largest producer of zinc concentrate in the world. Mining operations have reserves for over 40 years. The Delong Mountain Terminal receives ore concentrate from the Red Dog Mine and stores it until the area is free of ice. Approximately 250 barge trips per year transfer 1.5 millions tons of concentrate to about 27 bulk cargo ships, which are anchored 6 mi. offshore (MMS, 2006b).

Tourism activities are concentrated on land but may include the occasional use of marine vessels and aircraft. The effects of vessels are related to ship strikes and anthropogenic noise. The effects of ship strikes are discussed in Section 4.6.3 and the effects of anthropogenic noise on bowheads are discussed in Section 4.6.1.

4.6.5.2 Reasonably Foreseeable Future Effects

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 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. 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 potential ship strikes and increased noise. The effects of ship strikes are discussed in Section 4.6.3 and the anthropogenic noise on bowheads are discussed in Section 4.6.1.

4.6.6 Cumulative Effects of the Alternatives on Bowhead Whales

The major elements of cumulative effects on bowheads have been described above, primarily in terms of mortality and disturbance. The intent of this section is first to summarize the combined effects from factors other than subsistence whaling and then to assess the contribution of the alternatives to the overall cumulative effects on bowheads. (For the direct and indirect effects of subsistence harvests on bowhead whale populations, see Section 4.4.)

4.6.6.1 Anthropogenic Mortality from Sources other than Subsistence Whaling

Offshore oil and gas development would not likely contribute to mortality unless there was an oil spill. The potential magnitude of mortality on bowheads would depend on a large number of variables that cannot be predicted ahead of time: size, location, and timing of a spill; ice/open water characteristics at the time; weather; cleanup efforts; and presence of whales. Although there are a number of oil development projects that could contribute to this risk of mortality, the high degree of uncertainty regarding the magnitude and duration of a future oil spill event precludes the identification of a particular mortality level as a "reasonably foreseeable" effect. Ship strikes and entanglement in fishing gear are also likely contribute to mortality and could affect whales throughout their range. Evidence from harvested whales indicates that entanglement is fairly common (perhaps 10%) but probably temporary for most whales because serious injuries are thought to be relatively rare and observed mortality from these sources is 0.2 whales per year (Angliss and Outlaw, 2007). The incidence of ship strikes and entanglement could increase in the future depending on the impacts of climate change on the expansion of fisheries and marine traffic in the Arctic. The very low level of bowhead mortality from sources other than subsistence whaling efforts (less than one whale per year) is unlikely to cause the population to decline or slow its rate of recovery. The magnitude, geographic extent, and duration of this level of mortality is therefore considered negligible for the bowhead population (Table 4.1-1).

4.6.6.2 Disturbance from Sources other than Subsistence Whaling

Offshore petroleum development, shipping, fishing, and research all contribute marine noise and activities that may disturb bowheads to the point of altering their movement patterns and behavior. These activities take place across the range of the bowheads and are likely to continue or expand in the future. Although climate change does not disturb whales directly, it may affect bowhead movement patterns and behavior through its effects on sea ice distribution and zooplankton populations. Long-term and localized sources of noise such as offshore petroleum facilities can be regulated to mitigate the effects on bowheads during the times when they are present, but none the less may lead to bowheads avoiding those areas, essentially creating habitat loss. Mobile sources of noise such as marine vessels tend to be short-term and inconsistent in

time and place. Whales may avoid these sources when they encounter them but are not likely to abandon a particular area of their range unless the disturbance is more consistent. While human sources of disturbance could serve to inhibit the use of some areas by bowheads, the retreat of sea ice due to climate change may allow bowheads to expand their range. The cumulative effect of disturbance on bowheads is minor in magnitude, since the distribution of the bowhead population is unlikely to be changed. Concerning the factor of geographic extent, the disturbance effects discussed in this section are primarily localized, but in a number of locations, for a rating of moderate. The duration of these effects is short-term, for a rating of minor. In all, the effects of disturbance are unlikely to limit bowhead population growth and so they are considered to be minor (Table 4.1-1).

4.6.6.3 Contribution of the Alternatives to Cumulative Effects

Alternative 1 would eliminate the federal quota for subsistence taking of bowhead whales and result in the elimination of subsistence whaling activities and harvest. The magnitude of direct mortality under this alternative is considered negligible to the population of bowheads. Human activities associated with subsistence whaling would be sharply reduced under this alternative so that the amount of noise and disturbance from subsistence whaling would be considered negligible. The cumulative effects of human activities other than subsistence whaling were described and rated negligible to minor in the preceding sections. Alternative 1 would contribute a negligible amount of mortality and disturbance to the cumulative effects on bowheads as previously described.

Alternative 2 would authorize a maximum annual mortality of 67 bowheads (strikes) for a five-year period (up to 335 whales total, subject to a cap of 255 landed whales) (see Section 4.4 for more detailed discussion). This level of mortality is considered negligible at the population level for bowheads (Table 4.1-1). Mortality from sources other than subsistence whaling is also considered negligible (as described above), so the cumulative effect of these two sources of mortality would be considered negligible at the population level. Human activities associated with subsistence whaling under Alternative 2 would vary from year to year and place to place depending on whale movements, weather, ice characteristics, and social factors. Disturbance to the whales from subsistence whaling activities under Alternative 2 would not affect the distribution of bowheads, and would be localized and short-term, so this is considered a minor impact to the population. Subsistence whaling activities would contribute on a regular, seasonal basis to the cumulative effects of disturbance from non-whaling activities. Overall, disturbance sources tend to be minor in magnitude, to impact a relatively small portion of the range for the population, or to be very short in duration. The cumulative effects of disturbance from all sources, including the contribution from Alternative 2, would be considered minor to the population.

Alternative 3 would authorize a maximum mortality of 82 bowheads (strikes) in a given year, if the authorized maximum carry-over of 15 unused strikes were to occur, with a total mortality of up to 350 whales over the five-year period, subject to a cap of 255 landed whales (see Section 4.4 for more detailed discussion). This level of mortality is considered negligible at the population level for bowheads (Table 4.1-1). The cumulative effects analysis for Alternative 3 is similar to that described for Alternative 2 above, with negligible cumulative effects through mortality and minor cumulative effects through disturbance, including the contribution from Alternative 3.

Alternative 4 would authorize a maximum mortality of 100 bowheads (strikes) in a given year, if the authorized maximum carry-over of 33 unused strikes were to occur, with a total mortality of up to 368 whales over the five-year period, subject to a cap of 255 landed whales (see Section 4.4 for more detailed discussion). This level of mortality is considered negligible at the population level for bowheads (Table 4.1-1). The cumulative effects analysis for Alternative 4 is similar to that described for Alternative 2 above, with negligible cumulative effects through mortality and minor cumulative effects through disturbance, including the contribution from Alternative 4.

4.7 Direct, Indirect, and Cumulative Effects on Other Wildlife

4.7.1 Direct and Indirect Effects of the Alternatives

Alternative 1 would eliminate the federal quota for bowhead whales and result in the elimination of authorized subsistence whaling activities and harvest. It is likely that hunting pressure on other species (especially seals, walrus, and caribou) would increase substantially to compensate in part for the loss of whale harvest. Although this increased effort on other species is unlikely to replace the whale harvest, it could lead to moderate reductions in the populations of popular game species around the whaling communities. Hunting pressure on smaller game species might increase a small amount with minor effects on populations. Increased hunting activity would also increase noise and disturbance to game species and other wildlife. Since the loss of whaling would affect a number of communities, increased hunting disturbance would affect game populations in numerous locations, but not range-wide for any species. For species that often congregate in numbers, like walrus and caribou, disturbance could affect numerous animals for each hunting event and the effects would be considered moderate. For species that are primarily dispersed, like seals and polar bears, few animals would be disturbed and the effects would be considered minor. The duration of effects would depend on the duration of a whaling moratorium but the frequency of disturbance on other wildlife would likely vary from minor to moderate.

Alternatives 2, 3, and 4 are not expected to have more than negligible or minor effects on other wildlife species. The USFWS was consulted and concurred with NMFS's conclusion that the proposed action is not likely to adversely impact ESA listed species under USFWS jurisdiction (USFWS, 2002b). Just as individual whales may be indirectly affected by hunting activities, (e.g., vessel noise) (Section 4.5), other wildlife such as seals or polar bears may also be disturbed by these activities. Moreover, the Native villages and communities that currently harvest bowhead whales would be likely to alter their harvest patterns of other subsistence foods depending on the number of bowhead whales harvested. This currently occurs, as other species may be sought out when bowheads cannot be hunted due to weather/ice or whenever a village's hunting is only partially successful. At these times it is possible that subsistence hunters may increase their harvest of other animals, such as seals, ducks, fish, caribou, bear, walrus, beluga whales, or Dall sheep. It is not possible to quantify this effect, as each subsistence food may have its own individual value and place within the Native diet. A pound of bowhead whale *maktak* is not necessarily replaceable by a pound of caribou or whitefish, even if that were possible. In magnitude, extent, and duration, these effects are considered negligible to minor.

4.7.2 Cumulative Effects of the Alternatives

4.7.2.1 Past and Present Effects

Chapter 3 describes a number of marine and terrestrial wildlife species that are present in the Alaskan coastal areas considered in this EIS. Some of these bird and mammal species are affected directly or indirectly by bowhead whaling activities:

- Disturbance (marine species);
- Mortality associated with supplying whaling crews with food (seals, caribou);
- Mortality associated with whaling equipment (bearded seal, walrus, furbearers);
- Personal defense mortality of polar bears attracted to hunting camps and butchering sites;
- Mortality associated with community celebrations (waterfowl, caribou, seals); and
- Mortality associated with alternative food sources when whaling is not successful (marine and terrestrial species).

Other species (gray whales, minke whales, killer whales, harbor porpoise, short-tailed albatross, and many terrestrial mammals) would not be affected directly or indirectly by bowhead whaling activities. These species will not be considered further because the alternatives would not contribute to any cumulative effects for the species.

Chapter 3 summarizes the major natural and human-influenced factors that affect different wildlife species in the Arctic. For most of these species, reasonable population estimates and trends are not available so it is difficult to establish the relative importance of natural and human influenced factors to population level effects. Some of the major human influenced factors that contribute to cumulative effects on these species include:

- Subsistence and sport hunting;
- Noise and disturbance from motorized vehicles and vessels;
- Environmental contamination (air, water, and land) from distant industrial and agricultural sources;
- Oil spills and other discharges from marine traffic;
- Noise and pollution from oil and gas development;
- Environmental changes due to global warming; and
- Commercial fishery interactions.

4.7.2.2 Reasonably Foreseeable Future Effects

All of the human activities and factors that have contributed to wildlife effects in the past are likely to continue in the future. The relative importance of various factors and intensity of effects on different species is likely to change over time, especially as environmental (climate) changes become more pronounced. Although extensive modeling efforts are underway to help predict changes in the physical environment (ACIA, 2004; IPCC, 2007), the synergistic responses of animals and humans to future environmental conditions are very difficult to predict. Major conservation concerns in the Arctic include substantial reductions in ice pack habitat with major adverse impacts on ice-dependent species such as seals, walrus, and polar bears (ACIA, 2004). In addition, the retreat of sea ice has forced many polar bears to spend more time on land where they are more susceptible to starvation and more frequent interactions with people, leading to an

increasing frequency of bear and human mortalities that will likely continue in the future (Wohlforth, 2004; Schliebe et al., 2006).

4.7.2.3 Cumulative Effects

Under Alternative 1, it is likely that hunting pressure and associated disturbance on other wildlife species (especially seals, walrus, and caribou) would increase substantially to compensate in part for the loss of whale harvest, which might result in minor to moderate reductions in game populations around the whaling communities. These populations are managed for sustainable harvests by the ADF&G the state under its regulations and under co-management agreements with Alaska Native Organizations. For ice-dependent species, cumulative effects are likely to be dominated by the effects of climate change but the contribution of Alternative 1 would be minor to moderate based on increased harvest and associated disturbance of ice-dependent marine mammals (i.e., seal and walrus populations), at least near whaling communities. Increased harvest of terrestrial game species might add to the difficulty of managing game populations, especially with the uncertainty of how climate change will affect different terrestrial species. For other species, including threatened and endangered species, cumulative effects are likely to be dominated by conservation issues independent of whaling activities, as outlined above. The contribution of Alternative 1 to the cumulative effects on these species would be moderate for important game species (e.g., caribou) and minor for other species based on increased hunting pressure.

Alternatives 2, 3, and 4 would result in a similar amount of whaling activity and harvest over a five-year period, although total take levels could vary annually among these alternatives, due to differing provisions concerning carry-over of unused strikes. Based on low magnitude, limited geographic extent, and short-term duration, the direct and indirect effects of these alternatives are considered to be negligible to minor for other wildlife, depending on the species. For ice-dependent species, cumulative effects are likely to be dominated by the effects of climate change and the contribution of the alternatives is considered negligible to minor. For other species, including threatened and endangered species, cumulative effects are likely to be dominated by conservation issues independent of whaling activities, as outlined above. The contribution of the alternatives to the cumulative effects on these species is considered negligible.

4.8 Direct, Indirect, and Cumulative Socio-cultural Effects

4.8.1 Effects on Subsistence Patterns

The past, present, and future importance of the bowhead whale in these Eskimo villages cannot be overemphasized. The AEWC has stated "whaling, more than any other activity, fundamentally underlies the total lifeway of these communities" (AEWC, undated). Eskimos have hunted the bowhead whale for over 2,000 years, and the hunt remains the dominant aspect of their culture. Subsistence whaling is a year-round activity in these villages, beginning each winter with preparation of skin boats and caribou hunting for meat supplies for the crews and sinew for sewing bearded seals skins used for *umiaks*, preparation of ice cellars, outfitting the camps with supplies. Spring whale hunting involves shared labor in harvesting followed by widespread distribution of bowhead whale food and, cultural events celebrating the harvest. By summer time, whalers are hunting for bearded seals for use in building *umiaks* for the following year's spring bowhead hunt, followed by autumn whaling (in Barrow, Nuiqsut, and Kaktovik).

Bowhead whale meat and oil have long provided and continue to provide important contributions to the Eskimo diet and are thought to be especially valuable in supplying high-calorie protein in a cold and harsh climate. Subsistence foods are highly nutritious and contain heart-healthy fats (Nobmann, 1997 in MMS, 2006c:167). A recent study found that Alaska Natives with higher levels of polyunsaturated fats, found in fish oils and marine mammals, had lower heart disease mortality (McLaughlin et al., 2005). A permanent loss of whale meat could precipitate the physical, psychological, and cultural trauma that often accompanies drastic and forced dietary changes (Michie, 1979). The sale of bowhead whale meat is prohibited; however, edible portions are shared throughout the communities of Alaska's North Slope. Bowhead whales also provide raw materials for the creation of Native handicrafts, which may be legally sold.

In 1997, the AEWC documented a level of 280 landed whales over a five-year period as necessary to provide for the nutritional and cultural needs of these communities. The 2007 need statement of the AEWC (Appendix 8.1) documents a continuing need at the same level. Any alternative that would provide fewer whales would be expected to have some level of adverse impact to socio-economic and cultural needs of these villages. It is not likely the nutritional or cultural void created would or could be filled with substitute foods. Imported foods cannot readily take the place of whale and other marine mammals which are central to the cultural identity and diets of Eskimos (Michie, 1979).

Under Alternative 1, there would be no federal authorization of subsistence bowhead whaling for the five years 2008 through 2012. With no subsistence whaling, the direct effects of this alternative would include the loss of tens of thousands of pounds of highly valued food, attenuation of the social cohesion occasioned by the shared work among whaling crews and other cooperators in the year round work of preparation for whaling, disruption in the bonds established through food sharing, and diminished the opportunity for young people to continue to learn the knowledge, practice, and beliefs associated with this central cultural institution (Worl, 1979). Indirectly, Alternative 1 would likely result in redirection of subsistence harvest effort to other subsistence resources, but it is unlikely that the volume of food produced in whaling could be recreated. It is likely that local residents would increase their use of imported foods, but given the high costs of imported foods, especially for frozen and fresh foods, it is likely that the increase would be in imported foods of lower nutritional value.

Eskimo leaders and institutions would likely contest the elimination of subsistence bowhead whaling, as they did in 1977 at the time of the IWC moratorium (Langdon, 1984). This might involve litigation, and highly charged efforts to petition federal agencies and the Congressional delegation seeking relief. Alternative 1 would likely be viewed by the AEWC as a failure by the U.S. government to uphold Native rights of Alaska Eskimos. Since the MMPA and ESA expressly provide for the right for Alaska Native subsistence hunting, and since there is no conservation-based rationale for denying the quota, elimination of a quota would not comport with NMFS's objective to accommodate federal trust responsibilities to the fullest extent possible consistent with applicable law. Alternative 1 could also result in confrontation between the AEWC and NMFS. Cooperative research and management efforts between the AEWC and NMFS that benefit marine mammals could be jeopardized. The loss of such an important subsistence food resource would be an impact of major magnitude. Since all AEWC communities would be similarly affected, this impact would be major in extent. The duration of such an effect is uncertain, since NMFS might revisit such a decision in a subsequent year, or it could last for the five-year period of the current authorizations for aboriginal subsistence

whaling. In all, the direct, indirect, and cumulative effects of Alternative 1 on subsistence patterns would be adverse and major (Table 4.1-3). Alternative 1 would result in major impacts to socio-cultural systems, and this contributes more to total cumulative effects than do the other activities, such as oil and gas exploration or ship strikes and fisheries entanglements.

Alternative 2 would provide for subsistence bowhead whaling at a level that would address the identified Alaska Eskimo cultural and nutritional subsistence needs. However, Alternative 2 provides for no carry-over of unused strikes. The direct effects would include continuation of the subsistence food contribution of bowhead whales, the cooperative work and food sharing practices, and crucial cultural learning opportunities for young people. Indirect effects would include continuation of the current levels of diversity in subsistence resource uses, and continuing levels of reliance on subsistence foods, supplemented by purchased foods. Alternative 2 would avoid the adverse reaction to no quota predicted under Alternative 1. With no carry-over of unused strikes, Alternative 2 would not provide the flexibility that whaling captains have been afforded for many years. When weather conditions are adverse late in a year, whaling captains have previously had confidence that unused strikes would be available in a subsequent year, although these have actually been used infrequently (i.e., once in the period 1998-2006, as shown in Figure 3.2.1-2). These direct and indirect socio-cultural effects are considered beneficial, and of major magnitude, extent, and duration.

The direct and indirect effects of Alternative 2 contribute to cumulative effects with the noise and disturbance impacts from oil and gas exploration and development as outlined in Section 4.6.1. In particular, whales tend to avoid areas of high noise, and these deflections of the migration might make subsistence whaling more time-consuming and, in periods of rough seas, more dangerous. These impacts may differ by season, and as a result of mitigation measures imposed by the MMS on industry and the cooperative Conflict Avoidance Agreements negotiated between industry and the AEWC (MMS, 2006c:170). The Conflict Avoidance Agreements include provisions for observers to sight whales and exclusion distances, so that seismic activities are stopped when whales are in the vicinity, in order to minimize disturbance. Generally, spring whaling occurs before seismic activities are underway, and mitigation measures and the Conflict Avoidance Agreement create exclusion zones to avoid seismic activities when whales are nearby. Cumulative effects on spring whaling would be rated as minor. For fall whaling, the likelihood of impacts is less certain, because it turns on the effectiveness of mitigative measures. The NSB and the AEWC have expressed on-going and more urgent concern about the potential for growing levels of seismic exploration to deflect bowhead whales further and for longer periods away from the traditional harvest areas. This would increase the displacement of traditional subsistence whaling practices, requiring greater travel distances, time and cost. On the basis of current knowledge, this analysis concludes that the deflection effects are generally limited, though not completely known, and that the potential for disturbance to the whales and to subsistence whalers result in cumulative socio-cultural effects that can be considered moderate in magnitude and extent, and minor in duration. In total, the cumulative effects of Alternative 2 on subsistence patterns would be positive and minor to moderate in magnitude, extent, and duration. The beneficial contribution of Alternative 2, in authorizing the subsistence whale hunt, is a greater proportion of total cumulative socio-cultural effects than the adverse effects resulting from other activities, including noise from oil and gas exploration and development.

Alternative 3 would provide for the same continuity in subsistence harvests and related social and cultural benefits as Alternative 2. However, Alternative 3 would provide for the longstanding flexibility to carry-over up to 15 unused strikes into a subsequent year. In contrast to Alternative 2, the carry-over feature of Alternative 3 would provide whaling captains with the continuing confidence that if adverse weather prevents a safe hunt late in the season, they will recoup the opportunity in the following year through the carry-over of up to 15 unused strikes. Direct, indirect, and cumulative effects would be the same described for Alternative 2. In total, the cumulative effects of Alternative 3 on subsistence patterns would be positive, and minor to moderate in magnitude, extent, and duration. When considered in conjunction with other cumulative effects, the beneficial contribution of Alternative 3, in authorizing the subsistence whale hunt, is a greater proportion of total cumulative socio-cultural effects than the adverse effects resulting from other activities, including noise from oil and gas exploration and development.

Alternative 4 provides for the ongoing subsistence allocation and the carry-over of unused strikes, up to half of the strike quota of 67, into a subsequent year. This might be viewed as more favorable to the AEWC because it would allow Alaska Eskimos the maximum flexibility in conducting their subsistence hunts from year to year. The direct and indirect impacts of Alternative 4 would be the same as for Alternative 2 concerning the continuing food production, social, and cultural benefits of the current levels of subsistence bowhead whaling. Direct, indirect, and cumulative effects would be the same described for Alternative 2. In total, the cumulative effects of Alternative 4 on subsistence patterns would be positive, and minor to moderate in magnitude, extent, and duration. When considered in conjunction with other cumulative effects, the beneficial contribution of Alternative 4, in authorizing the subsistence whale hunt, is a greater proportion of total cumulative socio-cultural effects than the adverse effects resulting from other activities, including noise from oil and gas exploration and development.

4.8.2 Effects on Eskimo Health and Public Safety

4.8.2.1 Nutritional Benefits and Risks

In addition to the food volume produced through subsistence bowhead whaling, nutritional benefits, and risks can be assessed, at least in qualitative terms. As a result of industrial pollution, long distance vectors for transport and deposition in Arctic environments, and high rates of persistence, many contaminants are found in Arctic subsistence resources. As described in Section 3.2.6, bowhead whale subsistence foods have been analyzed for their levels of contaminants, including PCBs, DDTs, OCs, and chlordanes and heavy metals. These contaminant levels varied with gender, length/age, and season, but were generally relatively low compared to other marine mammals. Reports by the Arctic Monitoring and Assessment Programme (AMAP) identified levels of contamination meriting closer public health attention in some parts of the Arctic, through generally not in Alaska (AMAP, 2002, 2003).

At the same time, public health officials recognize that the loss of subsistence foods would have far-reaching consequences throughout the socio-cultural system of small, predominantly indigenous communities. A report from the Alaska Division of Public Health, Section of Epidemiology in 1998 observed that:

> Changes in diet, lifestyle, and the social and cultural disruption that follows the cessation of subsistence may contribute to a wide array of changes in communities from increases in obesity and diabetes, to increases in violence, alcoholism and drug abuse (Egeland et al., 1998: 9).

Moreover, highly nutritious subsistence foods are generally replaced by nutritionally inferior purchased foods. The report further stated:

> The market foods that often replace locally harvested wildlife are high in saturated fat and vegetable oils and carbohydrates and often lower in nutrient value. In addition, dietary changes are complex in nature, often coinciding with a number of other lifestyle changes which also contribute to increases in chronic diseases such as heart disease, diabetes, and cancer (Egeland et al., 1998: 9).

In a 2004 update on risk and benefits of traditional foods, the Alaska Section of Epidemiology studied mercury contaminant levels in fish and marine mammals, including data on human uptake (i.e., biomonitoring through hair samples). This study reiterated the findings of the 1998 report and continued to recommend "unrestricted consumption of fish and marine mammals from Alaska waters as part of a balanced diet" (Arnold and Middaugh, 2004:2). The authors also acknowledged the AMAP work, and noted:

> Public health officials from AMAP and other arctic scientists concluded that the nutritional and physiological health benefits of traditional Arctic subsistence foods outweigh potential risks in most areas of the Arctic, and advise local public health policy makers to encourage continued traditional food use when indicated by risk benefit analyses (AMAP, 2002; 2003; cited in Arnold and Middaugh, 2004:11).

In short, documented contaminant levels in bowhead whales in Alaska do not represent a threat to the health of subsistence users at current levels. Given the low levels of risk, public health officials conclude that the nutritional decline from loss of subsistence foods, like bowhead whale meat and blubber, would be far more adverse.

Under Alternative 1, there would be no federal authorization of subsistence bowhead whaling for the five years 2008 through 2012. The direct effects of this alternative, assuming no unauthorized whaling, would be to eliminate the nutritional benefits of bowhead whale consumption, and to eliminate exposure to the low contaminant levels in bowhead whale meat and blubber. Indirect effects would include consumption of a different mix of subsistence foods, as hunters redirect their harvest efforts to species not prohibited to them. However, it is unlikely that redirected subsistence hunting effort could replace the exceptional volume of bowhead whale food for most of the affected communities. Instead, it is likely that purchased food of inferior nutritional value would become a larger portion of total food consumption, with deleterious health effects. As noted above, the loss of a central subsistence harvest activity may also contribute to behavioral health problems. The AEWC considers it very important to recognize the adverse nutritional and behavioral health effects that would likely follow if bowhead subsistence whaling were prohibited (AEWC, personal communication). In their view, this category of impacts has not been previously been given sufficient attention.

Because it would affect a large portion of the all AEWC communities, the effects of Alternative 1 would be adverse and major in magnitude and extent. The duration of these effects is not known, since the NMFS could revisit its decision in a subsequent year, or the decision to deny a quota could continue for the five-year period similar to current authorizations. In all, the effects of Alternative 1 on the nutrition and health would be adverse and major (Table 4.1-3).

Alternative 2 would reauthorize subsistence bowhead whaling at a level sufficient to address the identified Alaska Eskimo cultural and nutritional subsistence needs, with no provision for carry-over of unused strikes into a subsequent year. The direct effect of this alternative would be to continue the significant positive contributions of bowhead whale foods to the nutritional level of subsistence users. Concurrently, subsistence users would continue their low levels of exposure to contaminants in bowhead meat and blubber. Few indirect or cumulative effects would be expected, as this alternative provides for continuity in bowhead harvest levels, rather than redirection to other subsistence resources or purchased foods. The lack of provisions for carry-over of unused strikes may make a very small difference in harvest levels. While carry-over provisions do provide flexibility to whaling captains late in the season, they have rarely been used. Since this alternative does reauthorize the subsistence hunt, the effects of Alternative 2 on nutrition and health would be positive and major in magnitude, extent, and duration, securing a substantial subsistence harvest opportunity for all AEWC communities for the next five years.

Alternative 3 would provide for the same continuity in subsistence harvests and related social and cultural benefits as Alternative 2. The only difference is that Alternative 3 would continue the longstanding flexibility to carry-over up to 15 unused strikes into a subsequent year. The direct, indirect, and cumulative effects of Alternative 3 on health and nutrition are the same as those in Alternative 2. The additional flexibility provided by the opportunity to carry-over unused strikes into a subsequent year is expected to have a small, but positive, effect on harvest levels. Although this flexibility has rarely been used, carry-over of unused strikes could increase the take in a year following one in which adverse weather prevented optimal hunting success. Because this alternative reauthorizes the subsistence hunt, the effects of Alternative 3 on nutrition and health would be positive and major in magnitude, extent, and duration, securing a major subsistence harvest opportunity for all AEWC communities for the next five years.

Alternative 4 provides for the ongoing subsistence allocation and the carry-over of unused strikes, up to half of the strike quota of 67, into a subsequent year. The direct, indirect, and cumulative effects of Alternative 4 on health and nutrition are the same as those in Alternative 2. The additional flexibility provided by the opportunity to carry-over unused strikes into a subsequent year is expected to have a small, but positive, effect on harvest levels. Again, carry-over provisions have rarely been used, but the flexibility could increase the harvest in a year following one in which adverse weather prevented optimal hunting success. The effects of Alternative 4 on nutrition and health would be positive and major in magnitude, extent, and duration, securing a major subsistence harvest opportunity for all AEWC communities for the next five years.

4.8.2.2 Public Safety

Subsistence whaling carries a range of inherent risks, including the dangers of small open boats in Arctic waters, shore ice breaking off and isolating whaling camps, and accidents on the ice as snow machines travel from the village to ice edge whaling camps. Inupiat and Siberian Yupik

whalers have long expressed a profound concern for safety. A rich body of oral history includes episodes of hunters thrust into life threatening situations, as lessons for survival. Cumulative traditional knowledge and ongoing close-grained observations of weather and ice conditions are topics of constant discussion, as whaling captains and crews assess safety and risks arising from these conditions (George et al., 2004b).

Another class of safety risks arises from the incorporation of new technologies into whaling, ranging from the historic adoption of the harpoon bombs in the Yankee whaling era, to more recent use of heavy equipment and steel cables to haul massive bowhead whales up onto the ice. The AEWC has implemented a village training program to promote hunter safety and effectiveness, including the use of newer penthrite projectiles.

Several recent episodes are representative of the risks involved in whaling. In a tragic accident in 2005, a skin-covered whaling boat from Gambell capsized while helping to tow a bowhead back to the community in the 8 foot swells and overnight darkness. The mayor, his two children and another adult were drowned, while two crew members survived (Spero News, 2005; Siku Circumpolar News Service, 2005). In the mid-1990s, a Nuiqsut whaling boat capsized while on a resupply run in rough seas during the fall hunt. One hunter died. In a recent report to the IWC, the AEWC referred to an accident during a recent hunt in Barrow, in which "one of the most experienced harpooners in the Arctic was killed when his board capsized while towing a whale; he was trapped under it" (AEWC, 2006). In the early 1980s, six whale hunters from Savoonga survived a capsizing accident just after harpooning a large bowhead whale (Alaska Magazine, 1982).

Two major episodes of sudden break-off of the ice are recounted in George et al., (2004b). In a famous episode of onshore ice thrust, known in Inupiat as *ivu*, in 1957, the break up of shorefast ice was so sudden and abrupt that whaling camps and equipment were abandoned and dog teams cut loose, as whalers scrambled for shore. No lives were lost, but the event became famous as a warning about setting camp on flat pans of multi-year ice, referred to as *piqaluyak*. It took many years for whaling crews to recover and obtain new equipment. In 1997, 12 whaling camps and 142 people were carried off as the shorefast ice broke off, an event referred to as *uisauniq*. Although captains recognized some signs of unstable ice, this particular episode arose suddenly, without time to retreat to shore. Fortunately, many whalers had GPS equipment and radios, and the Barrow Search and Rescue helicopters were able to retrieve all hunters with no loss of life (George et al., 2004b). In another example of risks attributable to changes in ice quality, NSB officials cite recent instances of hunters falling through ice while traveling on snow machines from the community to the camps (R. Suydam, NSB, personal communication).

Injuries involving accidental discharge of harpoon bombs are reported in earlier decades. In 1940, an anthropologist working in Point Hope reported four accidental explosions of the shoulder guns, resulting in one death and one injury (Rainey, 1940). Three members of a Barrow whaling crew sustained injuries, serious in one case, when a bomb exploded in the whale gun in May 1968 (Naval Arctic Research Laboratory, 1968). Another accident involving equipment failure was reported in Barrow in 1992, when the block and tackle gear used to haul the whale up on the ice broke, and flying cables killed two women (R. Suydam, NSB, personal communication).

In the perspective of cumulative effects, the trends of several of these dangers interact with the effects of climate change, as the shorefast ice environment becomes more unstable and less predictable. In addition, changes in open water lead patterns oblige whaling crews to pursue bowhead whales through greater distances. Weather conditions may be less predictable and therefore more dangerous to whaling crews. Declines in the thickness of shorefast ice due to global warming increase the dangers of breakoffs, in which camps are separated from land, with significant dangers to the whaling crews (George et al., 2004b).

Under Alternative 1, there would be no federal authorization of subsistence bowhead whaling for the five years, 2008 through 2012. The direct effect of this moratorium would be to avoid exposure to the risks associated with whaling. However, as an indirect effect, subsistence efforts would be redirected to other resources and these involve risks as well. Harvest of other marine mammal species, such as seals and walrus, may involve similar risks. In the cumulative case, the effects of climate change are increasing the risks associated with less predictable weather, dangerous open water conditions, and unstable ice. In all, the effects of Alternative 1 on public safety would be positive and minor to moderate in magnitude, because subsistence harvest effort redirected to other resources would involve similar risks on the ice and open water, though not through the use of harpoon guns and large block and tackle equipment. Since the effects of this alternative would reach all AEWC communities they would be rated major in extent, and since this would last for five years, this would be moderate in duration. In all, the effects of Alternative 1 on public safety would be beneficial and minor.

Alternative 2 would provide for subsistence bowhead whaling at a level that would address the identified Alaska Eskimo cultural and nutritional subsistence needs. However, Alternative 2 provides for no carry-over of unused strikes. Direct and indirect effects of this alternative would be continuing exposure to the current levels of risk inherent in bowhead whaling, and other subsistence pursuits. The provisions regarding carry-over of unused strikes would not appreciable change the effects of this alternative. The cumulative effects would be driven by the effects of climate change, as noted in the account for Alternative 1. The magnitude of effects of Alternative 2 on public safety would be minor, since the effects reach a minor proportion of the communities, and major in extent, in that all AEWC communities are affected. The safety incidents are very infrequent, and so are rated minor in duration and frequency. In all, the effects of Alternative 1 on public safety would be adverse at a minor level.

Alternative 3 would provide for the same continuity in subsistence harvests and related social and cultural benefits as Alternative 2. The only difference is that Alternative 3 would provide for the longstanding flexibility to carry-over up to 15 unused strikes into a subsequent year. The direct, indirect, and cumulative effects would be the same as those noted for Alternative 2. In all, the effects of Alternative 3 on public safety would be adverse at a minor level.

Alternative 4 provides for the ongoing subsistence allocation and the carry-over of unused strikes, up to half of the strike quota of 67, into a subsequent year. The direct, indirect, and cumulative effects would be the same as those noted for Alternative 2. The effects of Alternative 4 on public safety would be adverse at a minor level.

4.8.3 Effects on Other Tribes and Aboriginals

The IWC provided for aboriginal groups to hunt whales in the original Schedule of Regulations adopted in 1946. The Commission began regulating aboriginal subsistence hunts when it first set catch limits for bowhead whales in 1977. Revision of bowhead catch limits in furtherance of subsistence hunts by Alaska Eskimos and Chukotkan aboriginal people sets no new precedent that could increase commercial or subsistence hunts. The media has reported that Canadian Aboriginal First Nations have also conducted subsistence hunts. Canada is not a member of the IWC, and the U.S. government opposes any hunts by Canadian Aboriginal people unless Canada seeks and receives authorization from the IWC. Nonetheless, Canada has, since 1991, allowed its Aboriginal people to take bowhead whales regularly from the Davis Strait and Hudson Bay stocks of bowhead whales. Infrequently, Canadian Inuvialuit have taken bowhead whales in the eastern Beaufort Sea at the Mackenzie Delta. As noted in Section 3.2.4, successful harvests of a single whale were reported for 1991 and 1996.

Under Alternative 1, there would be no NMFS authorization of subsistence bowhead whaling for the five years, 2008 through 2012. If the Russian Federation did the same, the Chukotkan aboriginal people would also be denied a subsistence hunt. This would represent the loss of the food value of up to five bowhead whales authorized per year, although average harvests as described in Section 3.2.4 are closer to one bowhead whale per year. Since the Canadian government has withdrawn from the IWC, the very limited harvest of Western Arctic stock bowheads would continue in the Mackenzie Delta area. As an indirect effect of Alternative 1, working relationships with other tribes might be adversely affected since the tribes might view NMFS's action under this alternative as a breach of faith by the U.S. government in upholding Native subsistence rights. Most Native tribes throughout the U.S. would likely view Alternative 1 as a failure on the part of NMFS to exercise its trust responsibility with respect to Alaska Eskimos, and possibly to Native Americans in general. In light of the potential for political action by Alaska Natives to defend the bowhead subsistence hunt, described in Section 4.8 above, the potential impact on other tribes may be moderate to major, depending on the extent to which this emerges as a national issue among Native American tribes.

Alternative 2 would provide for a continuing level of subsistence bowhead whaling and would promote cultural diversity and recognize the importance of maintaining traditions for the coherence of Alaska Eskimo groups. This alternative would also make it possible for the AEWC to carry on subsistence hunts that are sanctioned by the IWC. Official recognition that traditional subsistence activities, such as whale hunts, are culturally valuable will be reassuring to Native Americans in general. Thus, Alternative 2 would avoid the adverse, indirect effects of deterioration in working relations between NMFS and other tribes. Alternative 2 does not provide flexibility to the bowhead subsistence whalers in the form of carry-over of unused strikes into a subsequent year, but this is not likely to affect the working relations of NMFS with other tribes. The effects of Alternative 2 on other tribes would be negligible.

Alternative 3 provides for continuation of the current level of flexibility with carry-over of unused strikes, in that up to 15 can be carried into a subsequent year. The direct and indirect effects of this alternative on relations with other tribes are the same as those of Alternative 2. The effects of Alternative 3 on other tribes would be negligible.

Alternative 4 provides for a greater level of flexibility in that up to half of all unused strikes could be carried over into a subsequent year. The direct and indirect effects of this alternative on relations with other tribes are the same as those of Alternative 2. The effects of Alternative 4 on other tribes would be negligible.

4.8.4 Effects on the General Public

There is a segment of the U.S. population that is opposed to whaling, particularly commercial whaling (according to letters and environmental group communications to the U.S. government). However, many citizens and non-governmental groups understand and appreciate the cultural and nutritional needs of Alaskan Natives to harvest bowhead whales in a subsistence hunt. Some citizens and groups oppose all whaling, no matter the situation.

Under Alternative 1, there would be no federal authorization of subsistence bowhead whaling for the five years, 2008 through 2012. This alternative may be supported by citizens opposed to all whaling. However, as noted above Alternative 1 is likely to result in political action by Alaska Native whalers, appealing for support to the general public. Citizens who support a limited opportunity for aboriginal whaling may be sympathetic to the claims of the Alaska Native whalers that their needs have been sacrificed for ideological reasons. Alternative 1 may be most acceptable to citizens who oppose all whaling. The effects of Alternative 1 on the general public may be seen as mixed, with countervailing tendencies, depending on the position of support or opposition to subsistence whaling held by a particular portion of the general public. The overall result is a moderate impact, beneficial in the eyes of the anti-whaling public, and adverse for those who support indigenous whaling rights.

Alternative 2 provides for an ongoing subsistence hunt for bowheads at a level that meets the nutritional and cultural needs. However, this alternative would not provide any flexibility for carry-over of unused strikes. Citizens who support aboriginal whaling would support this allocation, and would be relieved that confrontations between the subsistence whaling communities and the government agencies have been avoided. Citizens who oppose aboriginal whaling would not support this alternative. The specifics of the provisions on carry-over of unused strikes are not likely to be consequential to the general public. The effects of Alternative 2 on the general public may be seen as mixed, with countervailing tendencies, depending on the position of support or opposition to subsistence whaling held by a particular portion of the general public. The overall result is a minor impact.

Alternative 3 provides for the ongoing subsistence whaling allocation at a level that meets the identified need, and provides flexibility to whaling captains in that up to 15 unused strikes can be carried over to a subsequent year. The support and opposition to this alterative among the general public would be the same at that described for Alternative 2. The effects of Alternative 3 on the general public may be seen as mixed, with countervailing tendencies, depending on the position of support or opposition to subsistence whaling held by a particular portion of the general public. The overall result is a minor impact.

Alternative 4 provides for the ongoing subsistence whaling allocation at a level that meets the identified need, and provides flexibility to whaling captains in that unused strikes up to half of the authorized strike limit can be carried over to a subsequent year. The support and opposition to this alterative among the general public would be the same at that described for Alternative 2.

The effects of Alternative 4 on the general public may be seen as mixed, with countervailing tendencies, depending on the position of support or opposition to subsistence whaling held by a particular portion of the general public. The overall result is a minor impact.

4.8.5 Environmental Justice

In February 1994, the President issued EO 12898 on Environmental Justice (1994), which requires the federal government to promote fair treatment of people of all races, so no person or group of people bear a disproportionate share of the negative environmental effects from the country's domestic and foreign programs. Fair treatment means that no population, due to lack of political or economic power, is forced to shoulder the negative human health and environmental impacts of pollution or other environmental hazards. Environmental justice means avoiding, to the extent possible, disproportionate adverse environmental impacts on low-income populations and minority communities.

A minority is any individual classified as American Indian, Alaska Native, Asian or Pacific Islander, African American, or Hispanic. A low-income person is a person with a household income at or below the U.S. Department of Health and Human Services poverty guidelines. A minority population and low-income population are defined as any readily identifiable group of minority or low-income persons who live in geographic proximity, and if circumstances warrant, geographically dispersed/transient persons (such as migrant workers or Native Americans) who would be similarly affected by a proposed program, policy, or activity.

Potentially affected populations are presented below. The analysis of benefits and adverse effects on minority and low-income populations is presented in Section 4.8.5.2.

4.8.5.1 Affected Populations

The communities affected by the proposed action are the 10 member communities of the AEWC. As discussed in Section 3.4, Socio-economic Environment, these are small, predominantly Alaska Native villages, with the exception that Barrow, as a regional service center, is larger and accounts for just over half of the regional population. In 2005 the AEWC member communities counted a total of 8,131 residents, of whom 6,333 or 77.9% are Alaska Native or part Alaska Native.

According to the 2000 Census, the 10 AEWC member communities had generally high rates of residents living below the federally-defined poverty level. Five communities (Diomede, Gambell, Kaktovik, Kivalina, and Savoonga) had comparatively high poverty rates, ranging from 26% through 35% of residents living below the poverty level. Three communities (Wainwright, Point Hope, and Wales) had intermediate rates, with 12% - 19% of residents below the poverty level. Two communities, Barrow and Nuiqsut, have low levels, with less than 9% of residents below the poverty level. All but two of these communities exceed the average rate of Alaska residents living below the poverty level, which is 9.4%, and in most cases these rates are two and three times the Alaska average.

For the purposes of the Environmental Justice analysis, all of the AEWC communities qualify as predominantly minority, based on the high percentages of Alaska Native residents. The majority of these communities would qualify has having significant proportions of residents living below the poverty level, particularly when compared to the Alaska average.

4.8.5.2 Environmental Justice Effects Analysis

The analysis of Environmental Justice concerns examines whether disproportionate, adverse human health or environmental impacts would affect minority and low income communities. As shown in Section 4.8.5.1, all of the AEWC communities affected by the proposed action would qualify as minority and in most cases low income communities. For the purposes of this EIS, major impacts on bowhead whale populations or major impacts on subsistence whaling patterns would raise Environmental Justice concerns, as these would have a disproportionate adverse impact.

Under Alternative 1, no quota for subsistence bowhead whaling would be provided. As noted in Section 4.8.1, this would have major adverse direct, indirect, and cumulative effects upon the communities. Disruption of the bowhead harvest would eliminate a substantial food resource, disrupt cooperative labor and sharing practices, disrupt the learning process for young hunters, and disrupt highly valued cultural ceremonial events, particularly *Nalukatak*, the spring whaling festival. As a result of these disproportionate adverse effects, Alternative 1 would raise Environmental Justice concerns.

Alternatives 2, 3, and 4 would provide for an ongoing subsistence bowhead whaling quota, with variations in the provisions for carry-over of unused strikes into a subsequent year. Since these alternatives provide for continuity of subsistence whaling, the communities would not be affected by adverse direct or indirect effects. Concerning cumulative effects, Section 4.6 concluded that none of the alternatives, when ongoing mitigation measures are taken into consideration, would result in major adverse impacts on the bowhead whale population. Therefore, Alternatives 2, 3, and 4 would provide beneficial effects for the AEWC communities and do not raise Environmental Justice concerns that a minority population may be disproportionately impacted.

4.9 Summary of Effects

As presented in Chapter 2 of this document, four alternatives are analyzed in this EIS. Under Alternative 1, NMFS would not issue the AEWC a subsistence whaling quota for cultural and nutritional purposes. This could occur if, among other things, NMFS chose not to issue a quota based on environmental concerns.

Under Alternative 2, NMFS would (through annual quotas) grant the AEWC an annual strike quota of 67 bowhead whales per year, subject to a total of 255 landed whales over the five years of 2008 through 2012. Under this alternative, no unused strikes from a previous year would be added to the quota for a subsequent year, notwithstanding the IWC's approval, in May 2007, of a carry-over of unused strikes in the bowhead subsistence quota.

Under Alternative 3 (the proposed action), NMFS would (through annual quotas) grant the AEWC an annual strike quota of 67 bowhead whales per year (plus carry-over), subject to a total of 255 landed whales over the five years of 2008 through 2012. Under this alternative, up to 15 unused strikes from a previous year (including from the 2003 through 2007 quota block) could be added to the quota for a subsequent year, consistent with the IWC catch limits adopted in May 2007. A carry-over of up to 15 unused strikes was approved by the IWC in May 2007. A carry-

over allows for variability in hunting conditions from one year to the next within limits that conserve the Western Arctic bowhead stock.

Under Alternative 4, NMFS would (through annual quotas) grant the AEWC an annual strike quota of 67 bowhead whales per year (plus carry-over), subject to a total of 255 landed whales over the five years of 2008 through 2012. Under this alternative, up to 50% of the unused annual strike limit from a previous year (including from the 2003 through 2007 quota block) could be added to the quota for a subsequent year. The 50% carry-over (i.e., up to 33 whales struck) would not be consistent with the actions of the IWC in May 2007.

The following tables (Tables 4.9-1 through 4.9-3) summarize the direct, indirect, and cumulative effects under each alternative for all resources where environmental consequences were evaluated and found to be possible. More detailed discussions of direct, indirect, and cumulative effects can be found in Sections 4.4 through 4.8.

Table 4.9-1
Summary of Direct, Indirect, and Cumulative Effects on Bowhead Whales

Effect		Alternative 1 No Action: Do Not Grant AEWC a Quota	Alternative 2 Grant AEWC Annual Quotas (67 Strikes) with No Unused Strikes Carried Over	Alternative 3 (Preferred Alternative) Grant AEWC Annual Quotas (67 Strikes) with No More Than 15 Unused Strikes Carried Over Any One Year	Alternative 4 Grant AEWC Annual Quotas (67 Strikes) with Up to 50% of Unused Strikes Carried Over Any One Year
Direct and Indirect Effects	Mortality	Because this alternative would result in no authorized subsistence whaling, no direct or indirect mortality is likely. The magnitude, extent, and duration of effects are considered negligible to the population of bowheads.	This alternative would authorize a continuing level of direct subsistence harvests comparable to the previous five years. Given the current level of bowhead abundance, the magnitude, extent, and duration of direct mortality under this alternative is considered negligible to the population of bowheads.	Bowhead whales – (Same as Alternative 2)	Bowhead whales – (Same as Alternative 2)
	Disturbance	The noise and disturbance to bowheads under this alternative, with no subsistence whaling, would be considered negligible in magnitude, extent, and duration.	For the bowhead population, the direct and indirect effects of noise and disturbance under this alternative would be minor in magnitude, extent, and duration.	Bowhead whales – (Same as Alternative 2)	Bowhead whales – (Same as Alternative 2)
Cumulative Effects		For bowhead whales, this alternative would contribute a negligible amount of mortality and disturbance to the cumulative effects on bowheads. Overall cumulative effects, taking into account other human activities and natural factors in the project area, are considered negligible in magnitude, extent, and duration in regard to mortality. In regard to disturbance, the cumulative effects are considered minor in magnitude, extent, and duration, at the population level.	For bowhead whales, Alternative 2 would contribute a negligible amount of mortality and a minor amount of disturbance to the cumulative effects. Overall cumulative effects are the same as for Alternative 1: negligible in regard to mortality and minor in regard to disturbance.	Bowhead whales – (Same as Alternative 2)	Bowhead whales – (Same as Alternative 2)

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Table 4.9-2
Summary of Direct, Indirect, and Cumulative Effects – Other Wildlife

Effect		Alternative 1 No Action: Do Not Grant AEWC a Quota	Alternative 2 Grant AEWC Annual Quotas (67 Strikes) with No Unused Strikes Carried Over	Alternative 3 (Preferred Alternative) Grant AEWC Annual Quotas (67 Strikes) with No More Than 15 Unused Strikes Carried Over Any One Year	Alternative 4 Grant AEWC Annual Quotas (67 Strikes) with Up to 50% of Unused Strikes Carried Over Any One Year
Direct and Indirect Effects	Mortality	For other species (especially seals, walrus, and caribou), hunting pressure would increase to compensate in part for the loss of whale harvest and could lead to reductions in game populations around the whaling villages. In magnitude, extent, and duration, these effects are considered minor to moderate, depending on the importance of the species as a subsistence resource.	For ice-dependant species, this alternative would have negligible to minor direct and indirect effects, depending on the species. For other wildlife species, this alternative would have negligible to minor direct and indirect effects, depending on the species.	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) - (Same as Alternative 2)	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) - (Same as Alternative 2)
	Disturbance	Increased hunting efforts on subsistence species other than bowheads would cause noise and disturbance to other wildlife in many areas around the whaling communities and would be considered minor to moderate, depending on the social structure of the species (aggregated or dispersed).	For ice-dependant species, this alternative would have negligible to minor direct/indirect effects, depending on the species. For other wildlife (including threatened or endangered species), this alternative would have negligible to minor direct/indirect effects, depending on the species.	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) - (Same as Alternative 2)	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) - (Same as Alternative 2)
Cumulative Effects		For ice dependant species and other wildlife, increased harvest would contribute to the adverse effects of climate change on ice-dependent species and add to the difficulty of managing game populations, especially with the uncertainty of how climate change will affect different species.	To partially compensate for the loss of bowhead hunting under Alternative 1, increased harvest of other species would contribute to the adverse effects of climate change on ice-dependent species and add to the difficulty of managing other game populations, especially with the uncertainty of how climate change will affect different species.	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) - (Same as Alternative 2)	Ice-dependent species – (Same as Alternative 2) Other wildlife species (including threatened and endangered species) - (Same as Alternative 2)

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Table 4.9-3
Summary of Direct, Indirect, and Cumulative Effects – Socio-cultural

Effect		Alternative 1 No Action: Do Not Grant AEWC a Quota	Alternative 2 Grant AEWC Annual Quotas (67 Strikes) with No Unused Strikes Carried Over	Alternative 3 (Preferred Alternative) Grant AEWC Annual Quotas (67 Strikes) with No More Than 15 Unused Strikes Carried Over Any One Year	Alternative 4 Grant AEWC Annual Quotas (67 Strikes) with Up to 50% of Unused Strikes Carried Over Any One Year
Direct and Indirect Effects	Effects on Subsistence	Direct effects include: ▪ loss of an annual average of one million pounds of bowhead *maktak* and meat, a highly valued food, ▪ diminished social cohesion occasioned by the shared work among whaling crews and others cooperating in the year round work of preparation for whaling, ▪ disruption in the bonds established through food sharing, and ▪ diminished opportunity for young people to continue to learn the knowledge, practice, and beliefs associated with this central cultural institution. Indirect effects include: ▪ redirection of subsistence harvest effort to other subsistence resources, and ▪ greater recourse to purchased food, with adverse nutritional and economic implications, would result. These direct and indirect effects are adverse and of major magnitude and extent, but of unknown duration.	Direct effects include continuation of existing subsistence practices such as: ▪ the subsistence food contribution of bowhead whales, ▪ the cooperative work and food sharing practices, and ▪ the crucial cultural learning opportunities for young people. Indirect effects include: ▪ continuation of the current levels of diversity in subsistence resource uses, and continuing levels of reliance on subsistence foods, supplemented by purchased foods. These direct and indirect effects are positive and major in magnitude, extent, and duration.	(Same as Alternative 2)	(Same as Alternative 2)
	Effects on public health and safety	Direct and indirect effects include: ▪ elimination of exposure to very low levels of contaminants in bowhead whale foods, ▪ adverse effects on diet and health as nutritious bowhead foods are replaced to some extent by less nutritious purchased foods, and ▪ elimination of exposure to the safety risks associated with whaling, but increased exposure to risks in hunting of other subsistence resources, such as seals and walrus. These direct and indirect effects of this alternative on health are adverse and major in magnitude and extent, but of unknown duration. The effects on safety would be minor.	Direct and indirect effects include: ▪ continued high levels of reliance on nutritious bowhead whale foods, and ▪ continued exposure to the current levels of risk inherent in bowhead whaling and other subsistence pursuits. Taken together, the highly beneficial nutritional effects outweigh the infrequent and therefore minor safety risks. This alternative has positive effects of major magnitude, extent, and duration.	(Same as Alternative 2)	(Same as Alternative 2)
Cumulative Effects		Given the important nutritional and cultural role of bowhead whale foods, under this alternative, in magnitude, extent, and duration, the cumulative effects on subsistence practices and nutrition and health would be adverse and major. This alternative would make a major contribution to overall cumulative effects on subsistence practices, when considered alongside other activities in the project area. Cumulative effects of climate change are increasing the risks associated with weather, open water and unstable, unpredictable ice. Subsistence harvest effort redirected to other resources would involve similar risks on the ice and open water, though not through the use of harpoon guns and large block and tackle equipment. This alternative makes a minor contribution to the cumulative effects on public safety which overall would be minor to moderate.	Given the important nutritional and cultural role of bowhead whale foods, under this alternative, in magnitude, extent, and duration, the cumulative effects on subsistence practices and nutrition and health would be adverse and major. This alternative would make a major contribution to overall cumulative adverse effects on subsistence practices, when considered alongside other activities in the project area. Cumulative effects of climate change are increasing the risks associated with weather, open water, and unstable, unpredictable ice. Subsistence harvest effort redirected to other resources would involve similar risks on the ice and open water, though not through the use of harpoon guns and large block and tackle equipment. This alternative makes a minor contribution to the cumulative adverse effects on public safety which overall would be minor to moderate.	For spring whaling, the cumulative effects of other activities, notably those associated with oil and gas exploration and development would be rated as adverse and minor. For fall whaling, the likely magnitude of impacts from these activities is less certain, because it turns on the timing, location and extent of oil and gas related activities and on the effectiveness of mitigative measures. Taking into account magnitude and likelihood, these impacts would be adverse and could be moderate, based on the effectiveness of current mitigation measures. The beneficial contribution of the proposed activities to cumulative effects, in authorizing the subsistence whale hunt, would be a greater proportion of overall cumulative effects than the contribution of noise from oil and gas exploration and development. Overall, cumulative effects on subsistence patterns would be positive and minor to moderate.	(Same as Alternative 2)

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6.0 COOPERATION AND CONSULTATION

NEPA requires federal agencies to reduce delay in the NEPA process by cooperating with other affected agencies before an EA or EIS is prepared. Cooperative planning is encouraged when more than one agency (Federal, state, tribal, or local) is involved in the project or program. The USFWS and NMFS were consulted regarding potential effects on ESA listed species under their jurisdiction. A reply from the USFWS is pending. NMFS has prepared a Biological Opinion concerning issuance of annual quotas authorizing the harvest of bowhead whales to the Alaska Eskimo Whaling Commission for the period of 2008 through 2012 and concluded that the proposed action is not likely to jeopardize the continued existence of the bowhead whale. No critical habitat has been designated for bowhead whales so no critical habitat will be affected by the proposed action (NMFS, 2007b). This concludes the consultation with NMFS concerning ESA listed species. The AEWC was consulted during the scoping process and the development of alternatives. Additionally, although NMFS is the lead agency in this process and the agency with expertise on the biological aspects of bowhead whales, the AEWC was consulted about the social, economic, and cultural impacts of various alternatives. The AEWC also had an opportunity to comment on the Preliminary Draft and Preliminary Final EIS documents.

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