COOK INLET BELUGA WHALE SUBSISTENCE HARVEST

DRAFT

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

December 2007

Prepared by
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

National Marine Mammal Laboratory

National Marine Mammal Laboratory

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

DEC 11 2007

Dear Reviewer:

In accordance with provisions of the National Environmental Policy Act (NEPA), we enclose for your review the Cook Inlet Beluga Whale Subsistence Harvest Draft Supplemental Environmental Impact Statement (DSEIS). This DSEIS is prepared pursuant to NEPA to assess the environmental impacts associated with NOAA's implementation of a management plan to govern the subsistence harvest. NOAA's proposed action is to implement the plan and based on periodic population assessments determine whether a subsistence harvest can be permitted under the terms and conditions of the management plan. Harvests will be controlled by federal regulations and co-management agreements with Alaska Native organizations.

Additional copies of the DSEIS may be obtained from the Project Manager identified below. The document is also accessible electronically through the NOAA Fisheries, Alaska Region website at http://www.fakr.noaa.gov/analyses/beluga/eis/default.htm.

Written comments should be submitted through mail, or email to the Responsible Program Manager identified below. Written comments submitted during the agency's public comment period must be received by March 4, 2008. When submitting email comments please include the following document identifier in the comment subject line: **Cook Inlet Beluga Harvest DSEIS**.

Send letters or email to:

Responsible Program Official: James W. Balsiger, Ph.D.
Regional Administrator, Alaska Region
Attn: Ellen Sebastian
National Marine Fisheries Service
709 W. 9th Street
P.O. 21688
Juneau, AK. 99802-1668
Telephone number: (907) 271-3448
Facsimile number: (907) 586-7557

Commenting Email Address: CIB-Harvest-SEIS@noaa.gov

Public meetings have been scheduled on this Draft SEIS at the following dates and locations

January 29, 2008: from 4 to 7 pm. at the Loussac Public Library, Wilda Marston Room, 3600 Denali Street, Anchorage, AK.

January 30, 2008: from 4 to 7 pm. at the Kenai Peninsula Borough Assembly chambers, 144 North Binkley Street, Soldotna, AK.

For further information or to request a copy of the DSEIS in paper or CD format contact:

Project Manager:

Barbara Mahoney
National Marine Fisheries Service
222 West 7th Ave., #43
Anchorage, AK 99513
907-271-3448

Sincerely,

for

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

Enclosure

Cook Inlet Beluga Whale Subsistence Harvest
Draft Supplemental Environmental Impact Statement

December 2007

Lead Agency: United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Protected Resources
Juneau, Alaska

Responsible Official: Dr. James W. Balsiger, Regional Administrator, Alaska Region

For Further Information Contact: Barbara Mahoney, Project Manager
National Marine Fisheries Service
Protected Resources Division
222 West 7th Avenue, Box 43
Anchorage, AK 99513
(907) 271-3448

Abstract: NOAA's National Marine Fisheries Service proposes to implement a long-term harvest plan to manage subsistence harvest of the Cook Inlet, Alaska, beluga whale (*Delphinapterus leucas*). The purpose of this action is twofold: to recover the Cook Inlet beluga stock and to fulfill the Federal Government's trust responsibility to recognize Alaska Native traditional cultural and nutritional needs for subsistence harvest. Four alternatives are evaluated for a long-term harvest plan where three alternatives allow for a subsistence harvest without preventing or unreasonably delaying the recovery of the stock. NOAA's proposed action is to implement the plan and, based on periodic population assessments, determine whether a subsistence harvest can be permitted under the terms and conditions of the management plan. Harvests will be controlled by federal regulations and co-management agreements with Native organizations residing in the Cook Inlet region.

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ACRONYMS AND ABBREVIATIONS

AAC	Alaska Administrative Code
ABWC	Alaska Beluga Whale Committee
ADF&G	Alaska Department of Fish and Game
ADN	Anchorage Daily News
ANO	Alaska Native Organization
BOF	Board of Fisheries
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulation
CIMMC	Cook Inlet Marine Mammal Council
CITT	Cook Inlet Treaty Tribes
cm	centimeter
COD	cause of death
DPS	distinct population segment
DNA	deoxyribonucleic acid
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
E.O.	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
FONSI	Finding of No Significant Impact
FR	Federal Register
ft	feet
ft^3/sec	cubic feet per second
GLG	growth layer group
Hz	Hertz
IUCN	International Union for the Conservation of Nature and Natural Resources
kHz	kilohertz
km	kilometers
lbs	pounds
m	meters
m^3/sec	cubic meters per second
ml/l	milliliter per liter
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MS4	municipal separate storm sewer systems
NAO	NOAA's Administrative Order
NEPA	National Environmental Policy Act
nm	nautical miles
NMFS	National Marine Fisheries Service

ACRONYMS AND ABBREVIATIONS (Continued)

NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
OSP	optimum sustainable population
PAH	polycyclic aromatic hydrocarbons
PBR	Potential Biological Removal
PCB	polychlorinated biphenols
POA	Port of Anchorage
PVA	Population Viability Analysis
Pub. L.	Public Law
RFFA	Reasonable Foreseeable Future Action
SEIS	Supplemental Environmental Impact Statement
TEK	traditional ecological knowledge
T/V	Tanker/Vessel
USACE	U.S. Army Corps of Engineers
U.S.	United States
U.S.C.	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish & Wildlife Service

EXECUTIVE SUMMARY

Description of the Proposed Action

The National Marine Fisheries Service (NMFS) proposes to implement a long-term plan to manage subsistence harvests of the Cook Inlet, Alaska, beluga whale stock (*Delphinapterus leucas*). The proposed action would specify annual harvest limits developed for five-year intervals and derived from abundance estimates averaged during the previous five-year interval. NMFS would implement the harvest limits through regulation, pursuant to Section 101(b) of the Marine Mammal Protection Act (MMPA), which provides for the regulation of subsistence harvests of depleted marine mammal stocks, and under co-management agreements with affected Alaska Native organizations (ANOs), in accordance with Public Laws 106-31 and 106-553, which allow the annual subsistence harvest of Cook Inlet beluga whales only under such cooperative management agreements.

Purpose and Need

The purpose of this action is to promote the recovery of this depleted stock of beluga whales, while allowing for a limited subsistence harvest by Alaska Natives. Following a significant decline in Cook Inlet beluga whale abundance estimates between 1994 and 1998, the Federal Government took a number of actions to prevent further declines in the abundance of these whales. In 1999 and 2000, Public Laws (Pub. L.) 106-31 and 106-553 established a moratorium on Cook Inlet beluga whale harvests except for subsistence hunts by Alaska Natives and conducted under cooperative management agreements between NMFS and affected ANOs. In the same years, NMFS published proposed and final rules designating the stock as depleted under the MMPA of 1972, as amended (64 Federal Register [FR] 56298, October 19, 1999 and 65 FR 34590, May 31, 2000).

Following the designation of the Cook Inlet beluga stock as depleted under the MMPA, NMFS proposed regulations to limit the subsistence harvest and use of Cook Inlet beluga whales (65 FR 59164, October 4, 2000). The proposed rule’s objective was to allow the Cook Inlet beluga stock to recover to its Optimum Sustainable Population (OSP) level, while providing for traditional use of Cook Inlet belugas by Alaska Natives to support their cultural, spiritual, social, economic, and nutritional needs. In keeping with sections 101(b) and 103(d) of the MMPA, NMFS Alaska Region convened a formal administrative hearing on the proposed harvest regulations before an Administrative Law Judge and seven interested parties in December 2000, in Anchorage, Alaska.

That administrative hearing process culminated in 2005 with the Administrative Law Judge’s final decision recommending a long-term plan for managing the subsistence harvests of Cook Inlet belugas by Alaska Natives. The Assistant Administrator for Fisheries is required under 50 Code of Federal Regulation [CFR] Part 228.20(c), immediately after receipt of a recommended decision, to give notice thereof in the FR, to send copies to all parties, and to provide opportunity to submit comments. NMFS announced the availability of the decision (71 FR 8268; February 16, 2006) and provided a 20-day comment period on the decision. Two comments were received. This action is intended to implement a long-term subsistence harvest plan such as recommended in the judge’s final decision.

The action is needed to allow Alaska Natives to continue subsistence harvests that support traditional cultural and nutritional needs without preventing or unreasonably delaying the recovery of this depleted stock of beluga whales.

The proposed harvest plan would constitute a major federal action subject to National Environmental Policy Act (NEPA) requirements. In 2003 and 2004, respectively, a Final Environmental Impact Statement (EIS) (68 FR 55604, September 26, 2003) and Final Interim Regulations Governing the Taking of Cook Inlet Beluga Whale by Alaska Natives for Subsistence Purposes (69 FR 17973, April 6, 2004) were completed to address prior beluga whale harvests. This Supplemental EIS (SEIS) supplements the earlier EIS by addressing proposed regulations that would manage all Cook Inlet beluga subsistence harvests until the need for harvest management and regulation is removed.

Alternatives

The objectives of a long-term subsistence harvest plan as evaluated in this SEIS are: 1) to allow this depleted stock to recover to its OSP (780 whales), for which it will no longer be considered depleted under the MMPA; and 2) to provide for a subsistence harvest by Alaska Natives in support of traditional, cultural, and nutritional needs.

Alternative 1: No Action

Under this alternative, no further harvest would occur until the population recovered to OSP. NMFS would neither implement harvest regulations nor enter into a co-management agreement with ANOs, as required by Pub. L. 105-31 before any Cook Inlet beluga whale can be harvested.

Alternative 2: Option A and Option B

Alternative 2, Option A and Option B, would establish federal regulations for the Cook Inlet beluga subsistence harvest. Harvest limits would be established every five years under a co-management agreement based on an assessment of the most recent Cook Inlet beluga population status, including the five-year average abundance estimate and a ten-year measure of the population growth rate. Subsistence harvest levels would be based on a Harvest Table that allows harvest when the five-year average beluga population is greater than 350 whales, increasing the harvests in proportion to the average abundance level and population growth rate. Both Options under Alternative 2 also include rules to decrease authorized harvests to compensate for unusual mortality events, should they occur in the future. The harvest levels are set so that the population of Cook Inlet belugas has a 95-percent chance of recovering to its OSP within 100 years, with only a 25-percent delay in recovery compared with the recovery time without harvest (referred to as the “95/25” criteria). However, when there is no growth or a decline in population occurs, the harvest must be reduced to zero in order to meet the 95/25 criteria. Options A and B under Alternative 2 allow some subsistence hunting until it is determined that the 95/25 criteria cannot be met to balance the goal of recovery with the need to provide a reasonable opportunity for traditional subsistence hunts by Alaska Natives.

Option A, based on the recommended decision of the Administrative Law Judge, would put the Harvest Table into effect in 2010; a proscribed strike allowance would be set for one beluga whale in 2008 and two in 2009.

Option B would put the Harvest Table into effect immediately. There would be no harvest in 2008 or 2009 unless the five-year average abundance for 2003-2007 is greater than 350 whales. All other provisions of the Administrative Law Judge's decision would be implemented as recommended. NMFS believes that implementation of the judge's decision as modified under Option B is consistent with NMFS's long-term strategy to allow the Cook Inlet beluga whales to recover to OSP and still provide for a traditional harvest. This strategy allows the harvest limit to increase as the stock increases in abundance.

Alternative 3: Conservation Priority with Progressive Harvest Level as Recovery is Demonstrated

Alternative 3 would employ the same five-year co-management and harvest assessment process as described for Alternative 2 to establish federal regulations for the Cook Inlet beluga whale subsistence harvest. Alternative 3 includes a Harvest Table that rigorously limits the harvest when the five-year averages for the beluga whale population are between 350 and 500 whales, giving highest priority to conservation concerns at smaller population levels. Hunting is only allowed after the population reaches 500 animals or if an intermediate or high growth rate was demonstrated. Alternative 3 would require that harvest mortality meet the 95/25 criteria: that no interim harvest occurs after 2007 and that no harvest occurs after 2015 from a population that cannot recover in 100 years. Alternative 3 includes the same rules as Alternative 2 to decrease authorized harvests to compensate for unusual mortality events. Under this alternative, NMFS promotes Cook Inlet beluga whale recovery while providing for traditional subsistence harvest when a high likelihood of recovery is demonstrated.

Alternative 4: Tyonek II Plan

Alternative 4 would follow the same five-year co-management and harvest assessment process as described for Alternative 2 to establish federal regulations for the Cook Inlet beluga whale subsistence harvest. Alaska Native parties argued that the 95/25 criteria does not achieve a reasonable balance of NMFS's dual goals to recover Cook Inlet belugas, while providing for continued subsistence hunts. Alternative 4, therefore, promotes a greater opportunity for the traditional harvest of Cook Inlet beluga whales while allowing for the stock's recovery at a slower rate. The Harvest Table under Alternative 4 is the same as Alternative 2 for all growth rates and population levels above 400 whales. However, Alternative 4, with a harvest floor at 250 whales, would authorize harvests when the population was between 250 and 350 whales if the growth rate was intermediate or high. As under Alternative 2, no harvests would be authorized if the growth rate was low at abundance levels below 350. Alternative 4 includes the same rules as Alternative 2 to decrease authorized harvests to compensate for unusual mortality events.

Summary of Environmental Consequences

During the Administrative Law Judge hearing process, evidence for the effects of different harvest levels on the population relied on a computer modeling program (known as the harvest model [see Appendix A]) designed to account for uncertainty in the Cook Inlet beluga whale abundance and growth rate at any specific time. The harvest model was used to calculate the probability that the population would either: 1) decline within 100 years, 2) increase but not recover to OSP (780 whales) within 100 years, or 3) recover to OSP within 100 years.

Direct and Indirect Effects on Cook Inlet Beluga Whales

Alternative 1 - No Action

Under Alternative 1 there would be no further harvest until the population recovers to OSP. Although the harvest model indicates that the population may not recover under this alternative, the magnitude and duration of mortality effects would be negligible because subsistence harvest would not contribute any mortality to the population (Table ES-1). With no beluga whale harvest under this alternative, there would be no disturbance effects from subsistence hunting activities (Table ES-1).

Alternative 2 – Options A and B

The harvest model probabilities concerning the population trajectory (i.e., the likelihood that the population will decrease, increase but not recover, or increase to recovery) are nearly identical under Option A and Option B. This is because the model results are for a 100-year period and the two options differ only with regard to harvest during the first two years. For all but those first two years, the harvest levels would be the same under Option A and Option B.

Declining Population

Under a declining population harvest model, there is a 77.5 percent probability that the population would decline from its current abundance (336 beluga whales, average abundance from 2003 to 2007 surveys) with no harvest and a 78.0 percent and 77.8 percent probability that the population would decline with harvest as specified under this alternative. For a declining population, the magnitude of mortality effects due to authorized subsistence hunting would be negligible according to the impact criteria described in Section 4.4. This implies that the population would be declining for reasons other than current or future subsistence harvests. The duration of mortality effects is not part of this assessment because the population would not recover under these conditions and any measure of delay in recovery would be meaningless.

Increasing Population without Recovery

Under the harvest model of an increasing population with recovery, there is an 13.9 percent probability that the population would increase but not recover to OSP within 100 years with no harvest and a 14.5 percent probability that the population would increase but not recover with harvest as specified under this alternative. Under these modeling conditions, the population would be between 350 and 780 whales and would be subject to subsistence harvest mortality dependent on the population size and growth rate. The magnitude of the harvest under Alternative 2 would be considered to have minor or moderate impacts from mortality. At low growth rates, the scheduled harvest would be considered moderate at most population levels. At intermediate growth rates, the scheduled harvest would be considered minor at most population levels below 500 whales and moderate at most population levels above 500 whales. At high growth rates, the scheduled harvest would be considered minor at population levels below 550 whales and moderate at population levels above 550 whales. Because the population would not recover under this set of modeling conditions, no assessment of the duration of mortality effects at these population levels was undertaken.

Increasing to OSP

Under a harvest model increasing to OSP, there is a 8.7 percent probability that the population would recover to OSP within 100 years with no harvest and a 7.5 percent and 7.7 percent probability that the population would recover with harvest as specified under this alternative. Under these modeling conditions, the population would grow from its current abundance level to greater than 780 whales. The assessment of mortality impacts when the population was between 350 and 780 whales would be the same as described above and would be considered minor to moderate. For these modeling situations that lead to recovery, the harvest model can be used to calculate the probable delay in recovery with harvest compared to a situation of no harvest mortality. Harvest mortality at the rates defined under Alternative 2 would likely cause a delay in recovery of 20.6 percent, which is considered moderate in duration according to the impact criteria.

Disturbance

The effects of disturbance because of subsistence hunting would be proportional to the number of strikes allowed per year and would thus vary with the beluga whale population abundance and growth rate according to the harvest schedule. Modeling results indicate that the beluga whale population is likely to decline over the next 100 years and, under those conditions, there would be very little, if any, harvest authorized. Therefore, disturbance effects for a declining population would be minor or negligible in magnitude, frequency, and geographic extent.

Alternative 3

The beluga whale harvest levels under Alternative 3 would change with the estimated abundance and growth rate of the population according to the impact criteria. The harvest schedule under Alternative 3 has a harvest floor of 350 whales, indicating that no harvest would be authorized if the average abundance estimate for the previous five years was less than 350 whales. In addition, no harvest would be authorized if the population had a low growth rate and was less than 500 whales.

For a declining population, the magnitude of mortality effects because of authorized subsistence hunting would be negligible (Table ES-1) according to the impact criteria. Under modeling conditions for which the population would increase but not recover with a harvest as specified under Alternative 3, the magnitude of the harvest would be considered to have negligible (low to intermediate growth rates) to moderate (intermediate to high growth rates) impacts from mortality (Table ES-1). Harvest mortality at the rates defined under Alternative 3 would likely cause a delay in recovery of 13.2 percent, which is considered moderate in duration (Table ES-1) according to the impact criteria.

Modeling results indicate that the population is likely to decline during the next 100 years and, under those conditions, there would be very little, if any, harvest authorized. Disturbance effects for a declining population would, therefore, be minor or negligible in magnitude, frequency, and geographic extent (Table ES-1). If the population increases either to OSP (780 whales) or somewhere short of that goal, regardless of whether the growth rate was low, intermediate or high, harvest levels and the number of hunting efforts would increase. However, similar to Alternative 2, the amount of hunting activity would be limited by the number of strikes allowed per year. Thus, the magnitude, frequency, and geographic extent of hunting disturbance would be considered minor (Table ES-1).

Alternative 4

The number of beluga whales that could be harvested under Alternative 4 would change with the estimated abundance and growth rate of the population. The harvest schedule under Alternative 4 is the same as Alternative 2 for all growth rates and population levels above 400 whales. However, Alternative 4 has a harvest floor of 250 whales and would authorize harvests when the population was between 250 and 350 whales if the growth rate was intermediate or high.

According to the impact criteria, any harvests authorized under Alternative 4 with the population less than 350 animals would be considered to have major impacts regardless of the growth rate (Table ES-1). However, it is much more likely there would be no harvest under the set of modeling conditions that leads to a declining population, therefore, the magnitude of mortality effects because of authorized subsistence hunting would be negligible. Because the harvest schedule under Alternative 4 is essentially the same as the harvest schedule under Alternative 2 for these population levels and growth rates, the impact analysis would be the same. At low growth rates, the scheduled harvest would be considered moderate at most population levels (Table ES-1). At intermediate growth rates, the scheduled harvest would be considered minor at most population levels below 500 whales and moderate at most population levels above 500 whales (Table ES-1). At high growth rates, the scheduled harvest would be considered minor at population levels below 550 whales and moderate at population levels above 550 whales (Table ES-1). Harvest mortality at the levels defined under Alternative 4 would likely cause a delay in recovery of 20.7 percent, which is considered moderate in duration (Table ES-1), based on the impact criteria.

At low, intermediate, and high population growth rates, the harvest schedule under this alternative would result in the same level of hunting disturbance as described for Alternative 2. Therefore, the magnitude, frequency, and geographic extent of hunting disturbance would be considered minor under Alternative 4 (Table ES-1).

Table ES-1. Summary of Direct and Indirect Environmental Consequences of the Proposed Alternatives on Cook Inlet Beluga Whales

Type of Effect	Impact Component	Population Level	Growth Rate	Alternative 1 No Action*	Alternative 2 Options A & B	Alternative 3	Alternative 4
Mortality	Magnitude or Intensity	< 350 whales	Declining	Negligible*	Negligible*	Negligible*	Negligible*
			Increasing Low		Negligible*	Negligible*	Negligible*
			Increasing Intermediate		Negligible*	Negligible*	Major
			Increasing High		Negligible*	Negligible*	Major
		350-780 whales	Declining	Negligible*	Negligible	Negligible*	Negligible*
			Increasing Low	Negligible*	Moderate	Negligible	Moderate
			Increasing Intermediate	Negligible*	Minor	Negligible (population <500); Moderate (population >500)	Minor
			Increasing High	Negligible*	Minor	Negligible to Minor (population <575); Moderate (population >575)	Minor (population <550); Moderate (population >550)
		>780 whales	Population Increasing to OSP	Negligible*	Minor to Moderate	Negligible to Moderate	Minor to Moderate
	Duration or Frequency[5] If harvest model results in recovery within 100 years	>780 whales	Population Increasing to OSP	Negligible*	Moderate	Moderate	Moderate
Disturbance	Magnitude or Intensity	<350 whales	All Growth Rates	Negligible*	Minor	Minor at low harvest levels; Moderate at higher harvest levels	Minor
		350-780 whales >780 whales	All Growth Rates	Negligible*	Minor	Minor	
	Geographic Extent	<350 whales 350-780whales >780 whales	All Growth Rates	Negligible*	Minor	Minor	Minor
	Duration or Frequency	<350 whales 350-780whales >780 whales	All Growth Rates	Negligible*	Minor	Minor	Minor

* No Harvest

Cumulative Effects on Cook Inlet Beluga Whales

The harvest model generated results that showed no appreciable difference among any of the alternatives, including the No Action (no harvest) Alternative 1, with regard to the probability of population increase or recovery. It is very unlikely that the population will recover to OSP within 100 years even without harvest. The harvest alternatives would have little effect on this statistic. If the population increases, subsistence harvests could be authorized to various extents under all the alternatives except Alternative 1. There would be no future harvests authorized under Alternative 1, therefore, it would not contribute to cumulative effects. The cumulative effects of harvest mortality are considered minor to moderate for Alternatives 2, 3, and 4, depending on the beluga whale population abundance and growth rate at the time of the harvest.

The adaptive subsistence management system assures that harvest will not contribute to future mortality when the population is below a harvest floor. Although Alternative 4 has a lower harvest floor than Alternatives 2 or 3, it is unlikely that the criteria would be met to allow harvests at these lower population levels under Alternative 4. The adaptive management system also assures that harvest would only continue as long as the population continues to increase and there is essentially no difference among the alternatives in this regard.

A number of past, present, and reasonably foreseeable future actions listed in Table 4-4, besides subsistence harvest, could individually or in a synergistic fashion have important cumulative effects on the Cook Inlet beluga whale population through mortality, disturbance, habitat changes, or reduced fecundity. The magnitude of effects from these factors is unknown. Although research into the nature of these factors and their impact on beluga whale population dynamics is likely to increase in the future, scientific understanding is likely to accumulate slowly and management strategies to mitigate potential problems will need time to be developed and implemented. The future increase or decline of the beluga whale population, especially if there is no subsistence harvest in the near future, would be the best indicator of whether other factors are having major cumulative effects at the population level.

Socio-Economic Impacts

The analysis of socio-economic impacts examines effects on subsistence use patterns and associated social and cultural practices.

Alternative 1 - No Action

Alternative 1 would eliminate subsistence beluga whale hunting opportunities for the Tyonek Dena'ina and other Cook Inlet beluga whale hunters until the population recovers to OSP. The loss of this subsistence resource would have far-reaching effects on traditional harvest practices and on the associated social and cultural practices. Given the various harvest levels for beluga whales since 1987, the loss of beluga whale foods would range from 300 to 26,000 pounds (lbs) per year. The 7,900 lbs per year of the late 1980s and early 1990s is probably closer to the longer-term average. In qualitative terms, this would represent the long-term loss of a highly culturally valued resource. For some Cook Inlet beluga whale hunting families this represents an economic loss as well. During the two decades before 1999, some hunters made money through the sales of edible portions of beluga whales. Although the levels of sale were not systematically documented, one local Anchorage retailer estimates selling approximately 1,360 kg (3,000 lbs) of beluga whale muktuk per year.

Many social and cultural practices associated with beluga whale hunting would also be disrupted or limited for an extended period. Multiple generations might pass before hunting could be reinstated, with the effect that the teaching of this hunting skill would become a matter of memory, not a living cultural practice. Cooperation in hunting, and sharing of beluga whale foods, including the exchange of these foods in ceremonial contexts, would cease. The social standing, or prestige, accorded to successful beluga whale hunters would not be possible. Finally, loss of this important subsistence activity would affect cultural identity. For the Dena'ina of Tyonek, this means loss of the unique marine mammal hunting tradition that distinguishes them among all other Alaskan Athabascan groups.

As to indirect effects, the loss of beluga whale hunting would result in redirection of subsistence effort towards other species. For the Native Village of Tyonek, this is likely to increase reliance on salmon and moose. Whereas there is a historic comparison for this redirection of effort from the 1940s (Fall et al. 1984), in the current decade the moose population has declined, necessitating a more restrictive subsistence hunt management regime, referred to as Tier II. There is little room for an increase in moose harvests as an alternate resource to beluga whale hunting.

In sum, Alternative 1 would eliminate a highly culturally valued subsistence resource for an extended period of time. This in turn would eliminate the associated social and cultural practices. These impacts would be major in magnitude and duration (Table ES-2).

Alternative 2 - Option A and Option B

Alternative 2 (both options) provides for a limited traditional subsistence harvest for Cook Inlet beluga whale hunters, provided that by 2010 the population has grown to a five-year average of 350 beluga whales or more. Option A would allow a harvest in 2008 for two belugas and in 2009 for one beluga, while Option B would put the Harvest Table into effect immediately (in 2008). With the current five-year average population at 336 belugas (2002 to 2007) this would mean there is no harvest in 2008 to 2012. In addition, the harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales shows a 77.5 percent probability that the population would decline from its current abundance with no harvest and a 78 percent and 77.8 percent probability that the population would decline with a harvest as specified under this alternative. Given this probability of continued decline, it is highly unlikely that subsistence beluga whale harvests will be authorized under this alternative within the next 10 years (2008 to 2017), defined as the reasonably foreseeable future for this analysis. Beluga whale foods would not be produced, and the social and cultural practices - cooperation, sharing, ceremony, and cultural identity - would be severely disrupted.

The harvest model indicates there is an 13.9 percent probability that the population would increase, but not recover to OSP, within 100 years with no harvest and a 14.5 percent probability that the population would increase but not recover with harvest as specified under this alternative. Although less likely, if the population growth scenario were to occur, then harvests of five to eight beluga whales would be authorized. This level of harvest would be slightly above the harvest levels by hunters from Tyonek since the moratorium in 1999, and it is likely this limited harvest opportunity would be shared between Tyonek hunters and hunters residing elsewhere in Cook Inlet. This would mean less for each group in terms of food production but a small, recurring harvest would allow the associated social and cultural practices to continue.

An indirect effect of this alternative is that hunters may redirect subsistence effort to alternate species because both scenarios of declining or growing beluga whale population would result in a reduced beluga whale harvest.

The effects of this alternative under the scenario of a stable or declining beluga whale population would be major in magnitude and duration (Table ES-1). Under the scenario of a growing population and a limited harvest opportunity, the effects would still be adverse, but at a moderate level (Table ES-1).

Alternative 3

Alternative 3 provides for a limited traditional harvest for Native beluga whale hunters, provided that the population has attained a five-year average abundance of 350 and the growth rate is high or intermediate. At a low rate of growth, no harvest would be permitted until the population exceeds 500 animals. The current population estimate is 336 (average abundance from 2003-2007 surveys) and the harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales shows a 77.5 percent probability that the population would decline from its current abundance with no harvest and 77.7 percent probability the population would decline with a harvest as specified under this alternative.

Given these probabilities of continued decline, it is highly unlikely that the population would attain the 350 minimum threshold and high or intermediate growth rates required to authorize a limited harvest under this alternative within the next 10 years (2008 to 2017), the reasonably foreseeable future for this analysis. Subsistence harvests would not occur and beluga whale food production would be lost with the important nutritional and economic value that beluga whale foods have contributed over the past two decades.

With regard to the social and cultural practices associated with beluga whale hunting, the likely cessation of harvest would eliminate the sharing, ceremonial, and cultural identity benefits associated with the local Cook Inlet hunt.

Although the probability is low, it is possible that the Cook Inlet beluga whale population would increase sufficiently to provide for a limited hunt under the harvest schedule of Alternative 3. There is an 13.9 percent probability that the population would increase, but not recover to OSP, within 100 years with harvest levels allowed under this alternative. If the population were to increase to 350 to 399 and the growth rate was intermediate or high then harvests of two to three beluga whales per five years would be authorized. This harvest level would be below the harvest levels allowed for the beluga whale hunters since the moratorium in 1999. This would allow for a low level of subsistence food production and continuation of the associate social and cultural practices, including cooperation, sharing, ceremonial exchanges, and cultural identify.

The indirect effects of Alternative 3, under either a declining or growing population, are likely to include redirection of subsistence hunting effort to other species, most likely salmon and moose, as discussed under Alternative 1.

In sum, under the more likely scenario of continued decline, the direct and indirect effects would be similar to those under Alternative 1. The long-term loss of beluga whale foods and associated social and cultural practices would have major effects in both magnitude and duration. Under the less likely scenario of beluga whale population growth and recovery, a limited harvest would be authorized producing subsistence food and providing for the associated social and cultural practices. Under this scenario, the effects would be adverse, but at a moderate level of magnitude (Table ES-2).

Alternative 4

Alternative 4 provides for a traditional harvest for Alaska Native beluga whale hunters although no harvest would occur after 2009 if the population falls below a five-year average of 250 beluga whales or shows a low growth rate. However, the current population estimate is 336 (average abundance from 2003 to 2007 surveys) and the population is currently declining at 2.7 percent since 1999. The harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales shows a 77.5 percent probability that the population would decline from its current abundance with no harvest and a 78.0 percent probability that the population would decline with a harvest as specified under this alternative.

Given these probabilities of continued decline, even though the current population abundance is above the minimum threshold of 250 animals, it is highly unlikely that the population would attain the high or intermediate growth rates required to authorize a limited harvest under this alternative within the next 10 years (2008 to 2017). Beluga whales would not contribute to subsistence food production and the associated social and cultural practices would cease.

Although the probability is low, it is possible that the Cook Inlet beluga whale population would increase sufficiently to provide for a limited hunt under the harvest schedule of Alternative 4. There is a 14.5 percent probability that the population would increase, but not recover to OSP, within 100 years with harvests as provided for in this alternative. If the population were to show an intermediate or high rate of growth from the current level of 336 animals, harvests would be authorized. For a population of 300 to 349, with an intermediate or high growth rate, Alternative 4 provides for harvests of six to seven beluga whales per five years. For a population of 350 - 399 (the minimum increment at which harvest are authorized under Alternatives 2 and 3), this alternative provides for harvests of five to eight beluga whales depending on whether the growth rate is low, intermediate, or high. Under this scenario, beluga whales would be taken for subsistence foods and the associated social and cultural practices would continue.

As to indirect effects, whether the beluga whale harvest is eliminated under a declining beluga whale population scenario or continues at a very limited level if the beluga whale population is increasing, it is likely that beluga whale hunting households would redirect their effort to other species to meet their subsistence food requirements. However, the cultural aspects of this harvest would not be replaced by other food sources.

In sum, under the more likely scenario of continued decline, the direct and indirect effects would be like those of Alternative 1. The long-term loss of beluga whale foods and associated social and cultural practices would have major effects in magnitude and duration (Table ES-2). In the less likely scenario of beluga whale population growth and recovery, a limited harvest would be authorized producing subsistence food and providing for the associated social and cultural practices. Under this scenario, the effects would be adverse, but at a moderate level of magnitude (Table ES-2).

Environmental Justice Effects

Under Executive Order 12898, the proposed action must be analyzed to examine whether a disproportionate burden of adverse effects falls upon minority or poor populations. The Cook Inlet beluga whale hunters and their families are Alaska Natives, considered a minority population under federal definitions. Moreover, some of the predominantly Alaska Native communities of Cook Inlet affected by the proposed action have higher rates of individuals living below the federally defined poverty level, including communities not connected to the road system such as Tyonek, Nanwalek, Port Graham, and Seldovia, when compared with the statewide average.

Because the effects of all alternatives under all Cook Inlet beluga whale population scenarios are adverse, this proposed action raises Environmental Justice concerns. However, the necessary conservation measures are not differentially directed at Alaska Native hunters as a result of agency discretion. Instead, when these conservation measures are required as a result of the MMPA provisions, limiting subsistence harvests by Alaska Natives when marine mammal populations are depleted, the effects are by statutory provision directed at Alaska Native hunters. Also, the Administrative Law Judge process gave affected Alaska Natives a specific voice and opportunity to minimize adverse environmental justice effects.

Table ES-2. Summary of Direct and Indirect Environmental Consequences of the Proposed Alternatives on Socio-Economic Resources

Type of Effect	Impact Component	Population Trend	Alternative 1 No Action*	Alternative 2 Preferred Alternative	Alternative 3	Alternative 4
Effects on subsistence	Magnitude or Intensity	Stable or Declining*	Major*	Major*	Major*	Major*
		Increasing		Moderate	Moderate	Moderate
	Duration or Frequency	Stable or Declining*	Major*	Major*	Major*	Major*
		Increasing		Moderate	Moderate	Moderate
Effects on social and cultural practices (cooperation, sharing, cultural identity)	Magnitude or Intensity	Stable or Declining*	Major*	Major*	Major*	Major*
		Increasing		Moderate	Moderate	Moderate
	Duration or Frequency	Stable or Declining*	Major*	Major*	Major*	Major*
		Increasing		Moderate	Moderate	Moderate

* No harvest

Cumulative Effects on Socio-Economic Resources

The cumulative effects of the alternatives on the socio-economic resources of the Cook Inlet beluga whale hunting families and communities are very similar to the cumulative effects on the beluga whale population itself. In addition to the beluga whale population modeling program referred to as the harvest model (see Appendix A), a second population modeling program known as the Population Viability Analysis (PVA) model provides for a more comprehensive analysis of potential factors affecting beluga whale population trends. Both population models attribute a higher probability to a scenario of population decline with a lesser probability of population growth. The adaptive management approaches incorporated into the harvest allocation procedures for Alternatives 2, 3, and 4, insure that subsistence harvests would not recommence until it can be conducted with minimal harm to the recovery of the beluga whale population. In other words, under these managed hunts subsistence hunting of beluga whales would not be a likely factor in future population declines.

Another component of the cumulative effects analysis for socio-economic resources focuses on whether any of the Reasonably Foreseeable Future Actions (RFFAs), identified in Table 4-4, would affect the alternate subsistence harvest activities identified as an indirect effect of the proposed action such as increased reliance on moose and salmon. It is likely that beluga whale hunters from the Native Village of Tyonek have redirected some of their subsistence harvest efforts to salmon and moose since the reduction in beluga whale hunting opportunity following the 1999 moratorium. The RFFA that may have the most notable effect on moose in the vicinity of Tyonek is the Chuitna Coal Project. The SEIS for the Chuitna Coal Project is still under development (EPA 2007), though reviews of baseline studies of moose populations show an overlap between the proposed mine location and high value breeding and rut habitat (ABR, Inc. 2006).

In sum, the cumulative effects of the proposed action on the socio-economic resources of the Cook Inlet beluga whaling families and communities are estimated to be moderate to major in magnitude (Table ES-2), depending on whether the beluga whale population remains in decline (the more probable scenario) or shows signs of recovery. When other RFFAs are taken into account, it is likely that the Chuitna Coal Mine would have some effect on moose distribution and possibly on moose abundance in the vicinity of Tyonek. The moose population in this area declined in the 1990s, requiring limitations on the subsistence harvest through the state's Tier II hunt management procedure. Additive impacts from the Chuitna Coal Mine may further reduce the reliability of moose as an alternative subsistence resource during the period when beluga whale hunting is restricted.

Next Steps

This executive summary is a snapshot of the contents of the Cook Inlet Beluga Whale Subsistence Harvest Draft SEIS. Following release of this Draft SEIS, a 60-day public comment period will occur, including a public meeting in Anchorage, Alaska to provide an overview of this study and an opportunity for public comment on the SEIS. Considering public comments received during this period, the Agency will make its final decision concerning the Preferred Alternative and produce the Final SEIS. For updates on the Draft SEIS, and for more detail on any public meetings, please visit the NMFS website at http://www.fakr.noaa.gov/protectedresources/whales/beluga.htm.

FOR FURTHER INFORMATION CONTACT: Barbara Mahoney, National Oceanic and Atmospheric Administration (NOAA)/NMFS, Alaska Region, Anchorage Field Office, (907) 271-5006, fax (907) 271-3030, or Thomas Eagle, Office of Protected Resources, (301) 713-2322, ext. 105, fax (301) 713-4060.

Chapter 1 Purpose and Need

1.1 Summary of the Proposed Action

National Marine Fisheries Service (NMFS) proposes a long-term harvest plan for managing subsistence harvests of Cook Inlet beluga whales (*Delphinapterus leucas*). This beluga stock has been declining at least since 1994, when NMFS began conducting annual aerial surveys of the population. To prevent further declines, the Federal Government implemented a number of increasingly precautionary management measures, such as imposing a temporary moratorium on harvests of Cook Inlet belugas in 1999 (Public Law [Pub. L.] 106-31) and, the following year, extending that moratorium indefinitely (Pub. L. 106-553).

Because belugas are important to the traditional culture of Alaska Natives, Native subsistence harvests are allowed only under cooperative agreements between NMFS and affected Alaska Native organizations (ANOs). NMFS determined that subsistence harvest was the only factor that could account for the observed decline of Cook Inlet beluga whales between 1994 and 1998 (65 Federal Register [FR] 38778, June 22, 2000). Accordingly, NMFS and local tribes have acted in concert to limit the number of whales harvested in annual subsistence hunts. Pursuant to Pub. L. 106-31 and 106-553, NMFS and ANOs established harvest levels and allocated harvest for 1999 and 2000 through co-management agreements. No belugas were harvested in 1999. Following the formal hearing in December 2000, NMFS and ANOs negotiated annual agreements to allocate the harvest of Cook Inlet beluga whales according to a formula that was stipulated by the parties and subsequently recommended by the court at the hearing for the period 2001 through 2004.

The purpose of the proposed action considered herein is to establish a long-term subsistence harvest plan predicated on continuing assessments of the population and estimated to allow the stock to recover to its optimum sustainable population (OSP) while permitting Alaska Natives to continue subsistence harvests that support their traditional cultural and nutritional needs without preventing or significantly delaying the stock's recovery.

Under the proposed action, annual harvest limits will be specified through regulation and implemented pursuant to Section 101(b) of the Marine Mammal Protection Act (MMPA), which provides for the regulation of subsistence harvests of depleted marine mammal stocks, and in accordance with Pub. L. 106-31.

This Draft Supplemental Environmental Impact Statement (SEIS), prepared pursuant to the National Environmental Policy Act (NEPA) (42 United States Code [U.S.C.] 4321 *et seq*.), considers four alternative harvest plans for managing the long-term subsistence harvests of Cook Inlet belugas and assesses the potential direct and indirect impacts of the alternatives on the human environment.

The following sections of this chapter provide a detailed history of recent efforts to manage the Cook Inlet beluga whale harvests.

1.2 Project Area

Cook Inlet is a shallow tidal estuary that flows into the Gulf of Alaska. Approximately 354 kilometers (km) (220 miles) long and 48 km (30 miles) wide, the inlet is surrounded by several mountain ranges (Alaska, Aleutian, Chugach, Kenai, and Talkeetna ranges) (Figure 1-1). Upper Cook Inlet is characterized by a maritime climate that gradually gives way to a continental climate in the lower reaches of Cook Inlet. The Cook Inlet region is seismically active, with five active volcanoes along the mountain ranges bordering the west side. The region is the major population center in Alaska and the state's most agriculturally developed area.

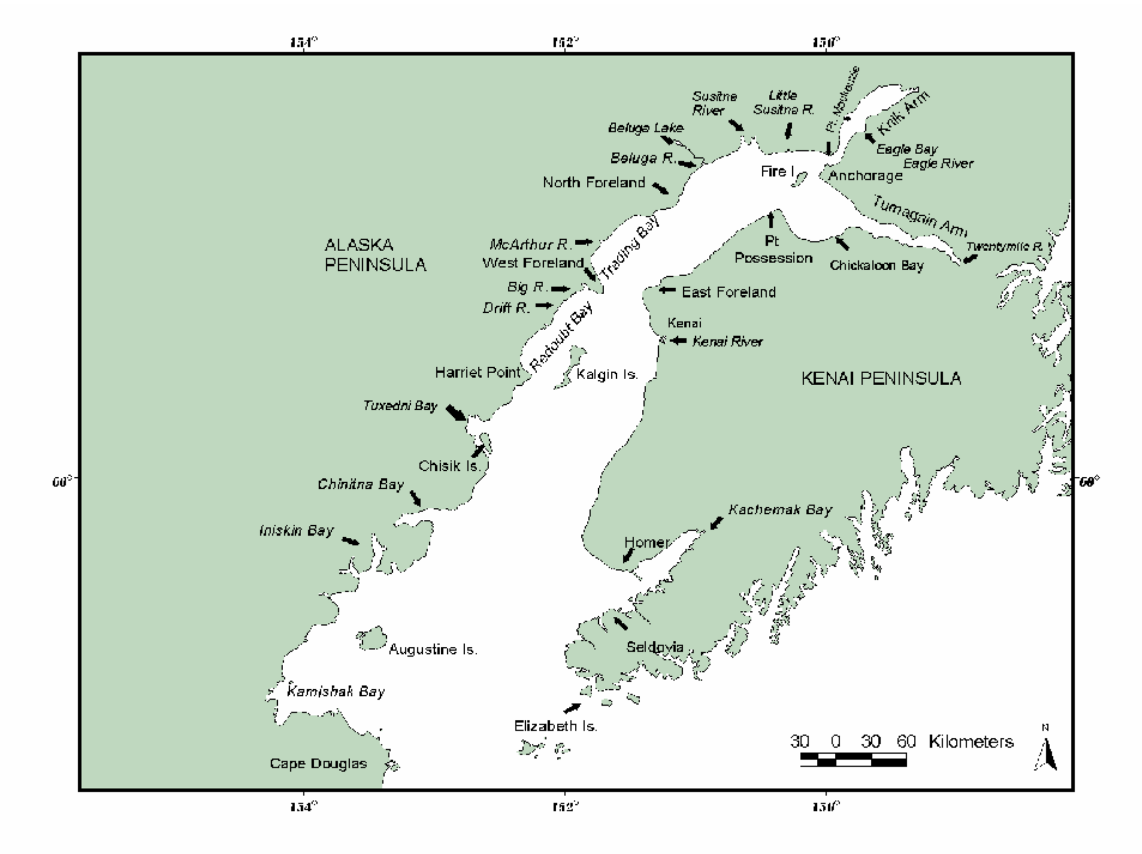

Figure 1-1. Map of Cook Inlet

1.3 Subsistence Harvest of Cook Inlet Belugas

Alaska's Cook Inlet has been home to beluga whales since before recorded history in the region. Archaeological evidence from the coastal areas of Cook Inlet shows that belugas have been hunted by Alaska Natives long before historical contact with Russian and American cultures. At first contact, Alutiiq Eskimos and Dena'ina Athabaskans inhabited areas around Cook Inlet and hunted belugas along rivers and bays, mainly in the Susitna delta area of the upper inlet, and in the Kachemak Bay area of the lower Inlet. Today, Alaska Natives who reside in communities on or near Cook Inlet and some hunters who live in other Alaska towns and villages continue to subsistence harvest belugas (Stanek 1994, Angliss and Outlaw 2005).

The subsistence beluga harvest transcends the nutritional and economic value of the whale; the harvest is an integral part of the cultural identity of the region's Alaska Native communities. Inedible parts of the whale provide Native artisans with materials for cultural handicrafts, and the hunting itself perpetuates Native traditions by transmitting traditional skills and knowledge to younger generations.

Native hunters have nevertheless been willing to reduce harvest levels to assist in the belugas' recovery—and have expressed their willingness to continue to do so (see Section 1.4.1). NMFS, in turn, is committed to managing the Cook Inlet belugas in such a way that provides for the stock's recovery and, as much as possible, allows Alaska Natives to continue subsistence harvests and thus preserve this significant aspect of their cultural identity.

1.4 Status of Cook Inlet Stock of Beluga Whales

The abundance of Cook Inlet beluga whales, a stock genetically and geographically isolated from four other Alaska beluga whale populations (O'Corry Crowe et al. 1997) has been surveyed annually by NMFS since 1994. Aerial survey results indicated that the 1998 estimate of Cook Inlet belugas (347 whales) represented a decline of 47 percent from the 1994 estimate (653 whales). The 2007 Cook Inlet beluga population estimate (375 belugas) indicates a 4.0 percent annual decline since 1994 and a 2.7 percent annual decline since 1999, when the harvests were regulated. The Cook Inlet beluga whale subsistence harvest before 1999 is believed to be the primary factor responsible for this decline. There are no reliable mortality estimates prior to 1995. However, during a study conducted by Alaska Native hunters in 1995 and 1996, the estimated annual harvest of Cook Inlet beluga whales averaged 97 whales per year, including struck but lost whales (Angliss and Lodge 2002). Applying a struck but lost rate (one beluga struck but lost for every beluga landed) to reported harvests in 1997 and 1998 resulted in an average annual harvest from 1994 through 1998 of 67 whales (Angliss and Lodge 2002). Harvest at these rates would account for the 50 percent decline observed between 1994 and 1998.

In response to this significant decline, NMFS initiated a status review of the Cook Inlet beluga whale stock in accordance with the Endangered Species Act (ESA) (63 FR 64228, November 19, 1998). In January and March 1999, NMFS received petitions to list the Cook Inlet beluga stock as "endangered" under the ESA. NMFS determined that each petition presented substantial information to indicate that the petitioned action may be warranted (64 FR 17347, April 9, 1999).

At the time of the petitions, federal regulations did not exist to manage subsistence harvest, and co-management agreements were not in place. To address this critical issue, Pub. L. 106-31 enacted the following temporary moratorium:

> Notwithstanding any other provision of law, the taking of a Cook Inlet beluga whale under the exemption provided in Section 101(b) of the Marine Mammal Protection Act [16 U.S.C. 1371 (a)] between the date of the enactment of this Act and October 1, 2000, shall be considered a violation of such Act unless such taking occurs pursuant to a cooperative agreement between the National Marine Fisheries Service and affected Alaska Native organizations. (Pub. L. No. 106-31, §3022, 113 Statute [Stat.] 57, 100 [May 21, 1999])

This moratorium was extended indefinitely on December 21, 2000 (Pub. L. No. 106-553, §1(a)(2), 114 Stat. 2762).

Because of the abundance data and other information presented in the Status Review, in 2000 NMFS issued a rule designating the Cook Inlet beluga whale stock as depleted (65 FR 34590, May 31, 2000). After a second Status Review (71 FR 14836, March 24, 2006) NMFS proposed listing the Cook Inlet beluga stock as endangered under the ESA (72 FR 19854, April 20, 2007).

1.4.1 Cook Inlet Beluga Co-Management Agreements

NMFS entered into co-management agreements with the Cook Inlet Marine Mammal Council (CIMMC) in 2000 through 2003, 2005, and 2006. CIMMC is an ANO of Alaska Natives from the Cook Inlet Treaty Tribes (CITT), local Native hunters, and concerned Alaska Natives residing in the Cook Inlet region. CIMMC was organized and incorporated in 1994 to protect cultural traditions and promote conservation, management, and use of Cook Inlet marine mammals by Alaska Natives. No belugas were successfully harvested under the 2000 and 2006 agreements; CIMMC harvested one whale under the 2001, 2002, and 2003 agreements; and two whales were taken under the 2005 agreement; no agreement was signed in 2004 or in 2007 when hunters from the Native Village of Tyonek agreed to stand down from the hunt (NMFS News Release, April 16, 2007).

1.4.2 Petitions to List Cook Inlet Beluga Whales Under the Endangered Species Act

On March 3, 1999, NMFS received two petitions to list the Cook Inlet beluga population as endangered under the ESA. The petitioners requested that NMFS promulgate an emergency listing under Section 4(b)(7) of the ESA, designate critical habitat for Cook Inlet beluga whales, and immediately implement rulemaking to regulate the harvest of these whales. NMFS issued a Final Rule on May 31, 2000 (65 FR 34590), designating Cook Inlet beluga whales as depleted within the meaning of Section 3(1) of the MMPA, i.e., below its OSP. However, at that time, NMFS determined that the Cook Inlet beluga whales were not threatened or endangered under the ESA (65 FR 38778, June 22, 2000); legislative and management actions had been taken to reduce subsistence harvests to levels that would allow recovery, so the stock did not meet the definition of threatened or endangered.

The 2000 determination that ESA listing was not warranted was premised on at least two findings that justify further review. First, the only factor then known to be responsible for the decline in beluga abundance was subsistence harvest. Second, the 2000 Status Review used simulation-modeling efforts that demonstrated this stock was not likely to decline further if the harvest was reduced and the beluga population increased annually between 2 and 6 percent. Abundance estimates since harvest regulations in 1999 have declined at an average rate of 2.7 percent per year, challenging the original findings. In addition, the International Union for the Conservation of Nature and Natural Resources (IUCN) assessed the status of the Cook Inlet beluga whales in 2005 (Lowry et al., 2006) and determined that this population had a 71 percent probability of having a negative growth rate (in 2005) and met the IUCN's criteria for critically endangered status.

In consideration of these factors, NMFS initiated a second status review for the Cook Inlet beluga whale (71 FR 14836; March 24, 2006). In the 2006 Status Review, NMFS developed population models that considered various types of mortality and fecundity effects in terms of the decline or growth and recovery of the Cook Inlet beluga whale stock. In these models, NMFS scientists considered several effects: (1) an Allee effect (a description of the relation between population density and growth rate, which suggests that for smaller populations the reproduction and survival of individuals decrease); (2) a depressed per capita fecundity or survival rate, as might occur from habitat degradation or pollution; (3) a constant mortality effect independent of population size, as would occur from predation; (4) a random mortality effect, as would result from environmental perturbations or catastrophic events such as oil spills, volcanic activity, or mass strandings; and (5) the increased impact of demographic stochasticity (a variability in population growth rates arising from random differences among individuals in survival and reproduction within a season) due to reduced population size. Models with these different effects were compared to the beluga population estimates from 1994 to 2005 to determine which model best matched the data, and likely outcomes were determined for the population.

Subsequently, on April 20, 2006, NMFS received a third petition to list the Cook Inlet beluga as an endangered species and to designate critical habitat. The petitioner reviewed the biology and ecology of this population, its abundance and distribution, its designation as a distinct population segment (DPS) established through rulemaking in June 2000 (65 FR 38780), and the reasons for the Cook Inlet beluga whale’s status (organized by the factors listed in Section 4(a) (1) of the ESA). In response to this petition, NMFS published a 90-day finding that the petition presented substantial scientific or commercial information indicating that the petitioned action may be warranted (71 FR 44614, August 7, 2006). The second Status Review (Hobbs et al. 2006) has now been completed and underlies NMFS’s proposed rule to list the Cook Inlet belugas as endangered under the ESA (72 FR 19854, April 20, 2007).

1.5 Proposed Subsistence Harvest Regulations and Administrative Hearings

The MMPA was enacted to ensure the long-term survival of marine mammals by establishing federal responsibility for their conservation and management. The MMPA imposed a general moratorium, with exceptions, on the taking of marine mammals. Section 101(b) of the MMPA contains an exemption from the take prohibition, which allows Alaska Natives to harvest marine mammals for subsistence use and for purposes of traditional Native handicrafts. Sections 101(b) and 103(d) of the MMPA require that regulations prescribed to limit Alaska Native harvests be made only when the stock in question is designated as depleted pursuant to the MMPA and following an agency administrative hearing on the record.

Following the designation of the Cook Inlet beluga stock as depleted under the MMPA, NMFS proposed regulations to limit the subsistence harvest and use of Cook Inlet beluga whales (65 FR 59164, October 4, 2000). The proposed rule’s objective was to allow the Cook Inlet beluga stock to recover to its OSP level, while providing for traditional use of Cook Inlet belugas by Alaska Natives to support their cultural, spiritual, social, economic, and nutritional needs. NMFS Alaska Region convened a formal administrative hearing on the proposed harvest regulations before Administrative Law Judge, Parlen L. McKenna, in December 2000, in

Anchorage, Alaska, at the Federal Building. Seven persons or parties[1] participated in this administrative hearing.

As a result of that hearing, Judge McKenna forwarded to NMFS Alaska Region his recommended decision on the Cook Inlet beluga interim (2001-2004) subsistence harvest. This decision was based on the discussions at the December 2000 formal hearing, the administrative record, and written records submitted to the judge.

The Assistant Administrator for Fisheries is required under 50 Code of Federal Regulation [CFR] Part 228.20(c), immediately after receipt of a recommended decision, to give notice thereof in the FR, to send copies to all parties, and to provide opportunity to submit comments. NMFS announced the availability of the judge's decision (67 FR 30646; May 7, 2002) and provided a 20-day comment period on the decision. No comments were received.

Based on the administrative hearing and the recommended decision by Judge McKenna, NMFS published final regulations to limit the Cook Inlet beluga whale harvest for the years 2001 through 2004 (69 FR 17973, April 6, 2004). All parties to the administrative hearing agreed that NMFS would submit a final Cook Inlet beluga harvest plan for 2005 and subsequent years to Judge McKenna no later than March 15, 2004. NMFS submitted this long-term harvest plan to the court and interested parties, and a second formal administrative hearing was convened in August 2004, in Anchorage, Alaska, at the Federal Building.

In November 2005, Judge McKenna sent to NMFS Alaska Region his recommended decision on the proposed regulations governing takes of Cook Inlet belugas by Alaska Natives (71 FR 8268, February 16, 2006). This decision was based on discussions at the August 2004 formal hearing, the Administrative Record, and written records submitted to the court. NMFS announced the availability of the decision (71 FR 8268; February 16, 2006) and provided a 20-day comment period on the decision. Two comments were received.

Following the comment period on the recommended decision, the Assistant Administrator for Fisheries is required to make a final decision on the proposed regulations. The Assistant Administrator's decision shall: 1) include a statement containing a description on the history of the proceedings; 2) include findings on the issues of fact with the reasons therefore; 3) include rulings on the issue of law; and 4) be published in the FR, with promulgated final regulations.

[1] Parties who participated in the administrative hearing: 1) NMFS; 2) MMC; 3) Joel and Debra Blatchford; 4) Alaska Oil and Gas Association; 5) Native Village of Tyonek; 6) Trustees for Alaska; and 7) Cook Inlet Treaty Tribes.

Chronology of Actions Taken on Cook Inlet Belugas, 1998 to Present

November 1998 - ESA Status Review initiated.

March 1999 - Two listing petitions filed.

1999 - Alaska Natives propose moratorium and voluntarily suspend the 1999 hunt; Senator Ted Stevens introduces emergency legislation for moratorium on harvests, except hunts conducted under cooperative agreements; proposed rule on the marking and reporting of harvested Cook Inlet belugas.

May 2000 - NMFS signs co-management agreement with CIMMC, providing for harvest of one beluga in 2000 (subsequent co-management agreements with CIMMC in 2001-2003, 2005, and 2006); NMFS designates the stock as depleted.

June 2000 - NMFS determines that listing under ESA is not warranted.

October 2000 - Draft Environmental Impact Statement (EIS) on Federal Actions Associated with Management and Recovery of Cook Inlet Beluga Whales (six alternatives, proposed prohibition on sale of Cook Inlet beluga products); NMFS issues proposed regulations to limit harvest and use of Cook Inlet beluga whales.

December 2000 - Hearing held before Administrative Law Judge to determine harvest regulations; Administrative Law Judge recommends six strikes for period 2001-2004; harvest moratorium extended indefinitely.

May 2002 - Administrative Law Judge issues recommended decision on interim harvest regulations.

July 2003 - Final EIS on Subsistence Harvest Management of Cook Inlet Beluga Whales (2001-2004) with subsequent years subject to further deliberation by agencies, parties, and Administrative Law Judge.

April 2004 - Final interim regulations on Cook Inlet beluga subsistence harvest.

August 2004 - Administrative Law Judge hearing on long term harvest regime.

November 2005 - Administrative Law Judge issues recommended decision on long-term harvest regulations.

March 2006 - NMFS initiates a second ESA Status Review.

March 2006 – Notice of intent to prepare SEIS for the subsistence harvest management of Cook Inlet belugas by Alaska Natives.

April 2006 – Third listing petition filed.

August 2006 - NMFS determines that petition to list may be warranted.

April 2007 - NMFS publishes Notice of Proposed Rule listing Cook Inlet beluga whales as endangered.

Summer 2007 - Public hearings regarding the listing of Cook Inlet belugas.

1.6 Required Actions or Approvals

The subsistence harvests for 2005 and 2006 have been authorized under the provisions of Pub. L. 106-31 through annual agreements between NMFS and CIMMC. No harvest was allowed in 2007. Harvest allocations for 2008 and subsequent years have yet to be finalized, but will be implemented through regulations and co-management agreements pursuant to Section 119 of the MMPA and Section 627 of Pub. L. 106-31.

1.7 Related NEPA documents

A Final EIS for the Subsistence Harvest Management of Cook Inlet Beluga Whales was completed in 2003 for the years 2001 through 2004. A Final EA was last completed for the co-management agreement between NMFS and the CIMMC for the year 2005.

1.8 Public Participation

Scoping and public involvement have been integral components in this process. Over the lengthy development of this proposed action and in compliance with Executive Order (E.O.) 13175 of November 6, 2000 ("Consultation and Coordination with Indian Tribal Governments"), NMFS has continually collaborated with ANOs and representatives of the tribal governments whose constituents rely on subsistence harvests of Cook Inlet beluga whales. In addition, for the initial EIS published in 1999, NMFS held a public scoping meeting on December 16, 1999. NMFS sent letters to 120 parties announcing the meeting and soliciting participation. Section 5.1 of the 1999 EIS discusses public involvement and responds to discrete comments received from the public during this initial scoping effort.

The Council on Environmental Quality (CEQ) regulations (Section 1502.9(c)(4)) require no further scoping for the SEIS beyond the scoping conducted for the original EIS. Furthermore, National Oceanic and Atmospheric Administration's (NOAA's) Administrative Order NAO 216-6, which guides NMFS's procedures for satisfying NEPA requirements, holds that scoping may be satisfied by many mechanisms.

If the proposed action has already been subject to a lengthy development process that has included early and meaningful opportunity for public participation in the development of the proposed action, those prior activities can be substituted for the scoping meeting component in NOAA's environmental review procedures (NAO 216-6.02.c.4).

Thus, the initial scoping for the 1999 EIS and the comments received during that process were used to inform and develop this SEIS. In addition, the administrative hearings described in Section 1.5 above provided for an extraordinary amount of transparency and public involvement mediated by the Administrative Law Judge. The parties, including tribal government representations that ultimately led to the proposed action assessed herein, developed this analysis and the alternatives with full participation. Section 1.5 includes a complete list of the parties involved in the administrative hearings.

Beyond the administrative law process, NMFS has continually communicated with ANOs, tribal government representatives, and beluga hunters on development of this SEIS. Most recently, NMFS staff met with CIMMC and representatives of the Native Village of Tyonek in 2007 to discuss the SEIS process and timelines.

Continuing to provide for public involvement in managing the Cook Inlet belugas, NMFS will make this Draft SEIS available for public comments upon its completion and will consider all comments in the development of the Final SEIS.

1.9 Coordination with Other Groups and Tribal Organizations

Through the administrative hearing process, NMFS coordinated with the United States Marine Mammal Commission (MMC) and Alaska Native parties (CITT, Native Village of Tyonek, and Joel and Debra Blatchford) to develop a proposed long-term harvest plan for Cook Inlet beluga whales to submit to Judge McKenna.

1.9.1 Federal Agencies

The MMC was created as an independent agency of the U.S. Government, established under Title II of the MMPA. Congress recognized that those federal agencies with authority for managing marine mammal programs often had potentially conflicting missions. MMC was created to provide independent oversight on marine mammal conservation policies and programs being carried out by the federal regulatory agencies. MMC is responsible for developing, reviewing, and making recommendations on domestic and international actions and policies of all federal agencies with respect to marine mammal protection, conservation, and research programs. The U.S. Environmental Protection Agency (EPA) is responsible for reviewing all EISs; thus, coordination with EPA will occur throughout this EIS process.

1.9.2 Tribal Governments and Organizations

Section 101(b) of the MMPA contains an exemption from its take prohibition, which allows Alaska Natives to harvest marine mammals for subsistence use and for traditional Native handicrafts purposes. Sections 101(b) and 103(d) of the MMPA require that regulations prescribed to limit Alaska Native subsistence harvest be made only when the stock in question is designated as depleted pursuant to the MMPA and following an Agency administrative hearing on the record. E.O. 13175 of November 6, 2000 (25 U.S.C 450 note), the Executive Memorandum of April 29, 1994 (25 U.S.C. 450 note), and the American Indian and Alaska Native Policy of the U.S. Department of Commerce (March 30, 1995) outline the responsibilities of NMFS in matters affecting tribal interests. Section 161 of Pub. L. 108-199 (188 Stat. 452), as amended by section 518 of Pub. L. 108-447 (118 Stat. 3267) extends the consultation requirements of E.O. 13175 to Alaska Native corporations. NMFS will contact tribal governments and Alaska Native corporations, which may be affected by the proposed action, provide them with a copy of this SEIS, and offer them an opportunity to comment.

In February 1994, the President issued E.O. 12898 on Environmental Justice (1994). This E.O. 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.

1.10 Summary

In this chapter we have discussed the purpose and need for the action evaluated in this SEIS and the recent history of actions already taken to address the decline of the Cook Inlet beluga whales. The following chapter presents reasonable alternatives for implementing a long-term subsistence harvest plan that will accommodate traditional subsistence hunts without preventing or unreasonably delaying the recovery of this beluga stock.

Chapter 2 Alternatives Including the Proposed Action

2.1 NEPA Guidance for Alternatives

The CEQ regulations for implementing the procedural provisions of NEPA require consideration of a range of reasonable alternatives, in addition to the proposed action, and the environmental impacts of activities under each of the alternatives. Four alternatives are presented here for analytical purposes and are evaluated in Chapter 4, *Environmental Consequences*. The range of impacts represented by these alternatives provides the basis for the Agency's decision.

2.2 Development of Alternatives for this Analysis

Throughout the administrative hearing process described in Chapter 1, NMFS worked in consultation with the administrative hearing parties to develop a Cook Inlet beluga harvest regime for 2005 and subsequent years. The following parties participated in this administrative hearing: 1) NMFS; 2) MMC; 3) Native Village of Tyonek; 4) Cook Inlet Treaty Tribes; and 5) Joel and Debra Blatchford. In April 2004, NMFS filed its proposed *Subsistence Harvest Management Plan for Cook Inlet Beluga Whales* with the Administrative Law Judge and the aforementioned parties. Upon receipt of the proposed Subsistence Harvest Management Plan, the judge issued an order scheduling an administrative hearing for August 2004.

For the rulemaking, the parties stipulated the development of a science-based, long-term harvest plan that would:

1. Provide reasonable certainty that the Cook Inlet beluga population will recover, within an acceptable period of time, where it is no longer considered depleted;
2. Take into account the uncertainty of the present knowledge about the population dynamics and vital growth rates for the Cook Inlet beluga population;
3. Allow for periodic adjustment to the allowable strike levels based upon the results of the population abundance surveys and other relevant information, recognizing that the strike level and allocation regime will not be reduced below 1.5 whales per year without substantial information demonstrating that reducing subsistence takings below that level will allow recovery of the Cook Inlet beluga population from its depleted status; and
4. Be readily understood by diverse constituencies.

In consultation with the parties, NMFS developed the following principles for such a long-term Cook Inlet beluga harvest plan:

- Co-management agreements will be developed for five-year intervals, in which harvest levels will be derived from the abundance estimates averaged during the previous five-year interval. The five-year intervals allow a reasonable management period for hunters to allocate the harvest appropriately among subsistence users.
- For the harvest tables created using the harvest model described in Appendix A, the trend category will be determined every five years, for the next five-year interval. The growth rate will be determined by calculating the probabilities that the growth rate will be less

than one percent, less than two percent, or greater than three percent by comparing population model results to the time series of abundance estimates starting in 1994.

- Ten years of abundance estimates, at a minimum, are required in order to distinguish among increasing, stable, or decreasing growth trends with 95 percent certainty so interim harvest levels were set that met recovery criteria if the annual growth rate was assumed to be between two and six percent.
- An Expected Mortality Limit, identified in the Harvest Tables, is compared with the observed beluga mortalities for any one year. This limit is calculated by multiplying six percent times the median of each five-year population range. This represents the upper 95^{th} percentile of expected mortality based on mortality levels observed since 1999. If the population has experienced unusual mortalities since 1999, then the average would have included this and the Expected Mortality Limit may be higher than necessary. This provides a mechanism to reduce the harvest quickly in response to an unusual mortality event, and provides a means to continue the reduced harvest until the loss of abundance is reflected in the annual abundance estimates.
- To determine a level below which no harvest would be allowed, the harvest floor, the following issues were considered: 1) an Allee effect (reduced population growth resulting from limited mating opportunities, loss of efficiency in collective hunting or other mechanisms); 2) inbreeding depression; 3) loss of genetic variability; 4) vulnerability to environmental perturbations because of reduced range; 5) vulnerability to environmental perturbations because of reduced population size; and 6) vulnerability to demographic stochasticity (chance events such as more males than females born in a year) because of reduced population size.
    - No method currently exists that would allow the scientists to determine the absolute lower limit for harvesting below which would lead to catastrophic results. Rather, science indicates small populations are more vulnerable than larger populations. In this context, a small population is defined as a population less than a few thousand animals.
    - The current consensus among geneticists is that a population between 1,000 and 2,000 animals is necessary to protect against genetic damage from inbreeding and that a population of 200 individuals is dangerously small. If the carrying capacity is 1,300 belugas, the Cook Inlet beluga population may be vulnerable to chance fluctuations and may always require additional management, even if it recovers under the MMPA; furthermore, considering that the Cook Inlet beluga population has been below 500 animals for almost a decade, the population may have lost some genetic diversity already and may be more fragile even if it does recover with more than 780 animals. Although this rate of loss has not been measured we can conclude that the population is much more vulnerable to loss of genetic diversity at 350 animals than the population would be were it twice that size. Many species with populations greater than 200 individuals are listed under the ESA.
- The beluga harvest will meet the 95/25 criterion, in that the population harvest will not delay recovery by more than 25 percent with 95 percent certainty.

After the hearing concluded and briefs were filed with the court, the parties attempted to resolve their disagreements, but were unable to do so. Accordingly, an order was issued on March 7, 2005 establishing a schedule for the parties to file briefs. The parties resolved some of their disagreements and reached consensus on the interim harvest regime that could be in effect until 2009. The Administrative Law Judge resolved the remaining issues in his recommended decision. The alternatives represent the Administrative Law Judge recommendations and the differences presented by the parties.

2.3 Detailed Description of Alternatives

The objectives of a long-term subsistence harvest plan as evaluated in this SEIS are: 1) to allow this depleted stock to recover to its OSP, where it will no longer be considered depleted under the MMPA; and 2) to provide for a subsistence harvest by Alaska Natives in support of traditional cultural and nutritional needs.

The alternatives considered in this analysis were developed with a harvest model described in detail in court filings by NMFS and the parties (see Appendix A). The harvest model is an algebraic representation of the Cook Inlet beluga numbers that keeps track of the total number of animals in the population but does not account for gender, age, or size. The model uses the information on the population size and the belugas that were harvested from the population that year, to calculate the population size in the following year[1]. This model was used to test a harvest matrix to see whether proposed harvests would actually allow the population to meet the goal of recovering to OSP. The model is based on the following assumptions: 1) the population will grow to maximum size, referred to as the carrying capacity, if the per capita growth rate of increase is positive and no harvest occurs; 2) the per capita rate of increase of the population declines as the population increases in size; 3) hunting related mortality does not affect reproduction in the year that it occurs and equally impacts males and females; 4) migration and emigration do not occur; and 5) there is not a population size below which the birth rate collapses. The harvest model requires a value for carrying capacity. However, the carrying capacity of this stock is unknown. For purposes of evaluating the harvest performance alternatives, NMFS used a proxy for carrying capacity by multiplying the maximum historical count of beluga during a survey in Cook Inlet and a correction factor (to account for beluga present in the area but not seen in the survey) developed for beluga abundance estimates in other parts of Alaska. The carrying capacity estimated value used in these analyses was 1,300 beluga whales.

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[1] Although there is considerable uncertainty regarding the growth rate and the current population size, the harvest model algebraically is written as:

$$N_{t+1} = (N_t - H_t)(1 + R_{max}(1 - ((N_t - H_t) / K)^z))$$

N_t	= abundance in year t
H_t	= harvest in year t
R_{max}	= maximum percentage annual growth
K	= carrying capacity (1,300 whales)
Z	= 2.39

The equation states that the population size (N) in the following year (t +1) is calculated by subtracting the harvest (H) in year t from the population size (N) in year t and multiplying by 1 plus the percentage of annual growth in the population. The annual growth in the population is determined by the maximum growth possible (R_{max}), multiplied by a function, $(1-((N_t-H_t)/K)^z)$, that depends on the size of the population in year t so that when the population is small, the growth rate is $R_{max;}$ and when the population is near carrying capacity (K), the annual growth rate is zero and the population remains the same.

The alternatives considered in this analysis (except Alternative 1, the No Action [no harvest] alternative) were developed with this framework approach.

Alternatives 2, 3, and 4 would allow a Cook Inlet beluga harvest and would have the following requirements:

1. Subject to the provisions of 16 U.S.C. 1371(b) and any further limitations set forth in 50 CFR 216.23, any taking of a Cook Inlet beluga whale by an Alaska Native must be authorized under an agreement for the co-management of subsistence uses between NMFS and ANOs.
2. Authentic Native articles of handicraft and clothing made from non-edible by-products of beluga taken in accordance with the provisions of co-management agreements may be sold in interstate commerce. The sale of any other part or product, including food stuffs, from Cook Inlet beluga is prohibited, provided that nothing herein shall be interpreted to prohibit or restrict customary and traditional subsistence practices of barter and sharing of Cook Inlet beluga parts and product by Alaska Natives.
3. The taking of a calf or an adult beluga accompanied by a calf is prohibited.
4. All beluga hunting activity authorized under 50 CFR 216.23(f) shall occur no earlier than July 1 of each year.

2.3.1. Alternative 1: No Action

Under this alternative, no harvest would occur. NMFS would neither implement regulations nor enter into a co-management agreement with ANOs, as required by Pub. L. 105-31 before any Cook Inlet beluga whales can be harvested.

2.3.2 Alternative 2: Option A and Option B

Alternative 2 Option A and Option B, would establish federal regulations for the Cook Inlet beluga subsistence harvest. Harvest levels would be established every five years under a co-management agreement based on an assessment of the most recent Cook Inlet beluga population status, including the five-year average abundance estimate and a 10-year measure of the population growth rate. Subsistence harvest levels would be based on a Harvest Table that allows harvest when the five-year average beluga population is greater than 350 whales and increasing the harvests in proportion to the average abundance level and population growth rate. Both Options under Alternative 2 also include rules to decrease authorized harvests to compensate for unusual mortality events, should they occur in the future. The harvest levels are set so that if the population of Cook Inlet belugas could recover in 100 years there is a 95 percent chance the population would recover to its OSP (780 whales) with only a 25 percent delay in recovery compared with the recovery time without harvest (referred to as the “95/25” criteria). However, when there is no growth or a decline in population occurs, the harvest must be reduced to zero in order to meet the 95/25 criteria. Options A and B under Alternative 2 allow subsistence hunting even when the 95/25 criteria cannot be met in order to balance the goal of recovery with the need to provide a reasonable opportunity for traditional subsistence hunts by Alaska Natives.

Development of Option A and Option B

In 2005, the Administrative Law Judge's Recommended Decision on Alternative 2 (which at the time did not include options A and B) allowed for an interim harvest of eight whales between 2004 and 2009 with the harvest schedule (outlined below) being implemented in 2010. However, the most recent 5-year period for which there are survey data (2003-2007) indicates that the average population abundance has fallen to 336 whales since the Administrative Law Judge's decision was made. Thus, to reflect the changing status of the Cook Inlet beluga whale population since the Administrative Law Judge proceedings, NMFS has further developed Alternative 2 into two options, A and B, as described below.

2.3.2.1 Alternative 2 Plan Under Option A

Under Option A, the recommended decision of the Administrative Law Judge, the Harvest Table would not be put into effect until 2010 and there would be a prescribed strike allowance for one beluga in 2008 and two belugas in 2009. When the prescribed harvests for 2008 and 2009 were established during the Administrative Law Judge proceedings, the average population abundance from the previous five years (2000-2004) was 371 whales, a level above the harvest floor of 350 belugas that was established as a general safeguard for a low and declining population.

I. The annual strike limitations for the initial planning period, years 2005 through 2009, are set as follows:

Year	Strikes
2005	2
2006	1
2007*	2
2008	1
2009	2

* Canceled

II. Beginning in 2010, co-management agreements will be developed for five-year intervals, in which harvest levels will be derived from abundance estimates averaged over the previous five-year interval and from the population growth rate.

III. Strike/harvest levels for each five-year planning interval beginning in 2010 shall be determined by the recovery of this stock as measured by the average abundance in the prior five-year interval and the probability of growth estimated for the population using the abundance starting in 1994. Because of the current depleted abundance of this stock and the uncertainty in the potential growth rate, there are three "growth" categories. Criteria for categorizing growth rates are presented in Section 2.3.3 as an algorithm using the estimated abundance, the distribution statistics for growth rates, and the date. Harvest levels are subject to the Expected Mortality Limit. The established harvest/strike levels are presented in Table 2-1 and the algorithm described in Section 2.3.3 will be used to determine harvest levels after 2009.

2.3.2.2 Alternative 2 Plan Under Option B: The Preferred Alternative

Under Option B, the harvest table would be put into effect immediately. There would be no harvests in 2008 and 2009 unless the 5-year average abundance for 2003-2007 was greater than 350 whales. Alternative 2 Option B has been identified as NMFS's preferred alternative. The main rational for Option B is that the current five-year average abundance is below 350 belugas, with a decline at 2.7 percent per year. All provisions of the Administrative Law Judge's Decision by the Court in 2005 would be implemented as recommended; however, given the concern over the continued decline in the Cook Inlet beluga whale population, NMFS believes implementation of the decision recommended by the Administrative Law Judge as modified under Option B is consistent with NMFS's long-term management strategy to allow the Cook Inlet beluga stock to recover to OSP and still provide for a traditional harvest. This strategy allows for an increase in the harvest level as the stock increases.

2.3.2.3 Alternative 2 Harvest Schedule Under Options A and B

Other than the differences in timing when the harvest schedule is implemented, Options A and B are exactly the same as described in Steps A – C. References to Alternative 2 in the following pages of this chapter therefore refer to the details presented in Table 2-1.

A. NMFS will calculate the average stock abundance during the previous five-year period.

B. NMFS will calculate the likely distribution of growth rate from the previous 10 years.

C. Using the abundance and growth figures obtained through steps A. and B., NMFS will calculate the probabilities that the growth rate within the population would be a) less than one percent, b) less than two percent, or c) greater than three percent. NMFS will then follow the decision tree below to select the proper category and harvest level outlined in Table 2-1.

    a. Is the average stock abundance over the previous five-year period less than 350 beluga whales?

       If yes, Table 2-1 provides that the harvest is zero over the next five-year period.

       If no, go to b.

    b. Is the current year 2035 or later, and is there more than a 20 percent probability the growth rate is less than one percent?

       If yes, the harvest is zero over the next five-year period.

       If no, go to c.

    c. Is the current year between 2020 and 2034, and is there more than a 20 percent probability the growth rate is less than one percent?

       If yes, the harvest is three whales over the next five-year period.

       If no, go to d.

    d. Is the current year 2015 or later, and is there more than a 25 percent probability the growth rate is less than two percent?

If yes, go to Table 2-1 using the “Low” growth rate column.

If no, go to e.

e. Is the current year before 2015 and is there more than a 75 percent probability the growth rate is less than two percent?

If yes, go to Table 2-1 using the “Low” growth rate column.

If no, go to f.

f. Is there more than a 25 percent probability the growth rate is more than three percent?

If yes, go to Table 2-1 using the “High” growth rate column.

If no, go to the Table 2-1 using the “Intermediate” growth rate column.

Table 2-1. Alternative 2 Harvest Levels Under Options A* and B

Five-year population averages	“High” growth rate	“Intermediate” growth rate	“Low” growth rate	Expected Mortality Limit
Less than 350	0	0	0	-
350-399	8 belugas in 5 years	5 belugas in 5 years	5 belugas in 5 years	21
400-449	9 belugas in 5 years	8 belugas in 5 years	5 belugas in 5 years	24
450-499	10 belugas in 5 years	8 belugas in 5 years	5 belugas in 5 years	27
500-524	14 belugas in 5 years	9 belugas in 5 years	5 belugas in 5 years	30
525-549	16 belugas in 5 years	10 belugas in 5 years	5 belugas in 5 years	32
550-574	20 belugas in 5 years	15 belugas in 5 years	5 belugas in 5 years	33
575-599	22 belugas in 5 years	16 belugas in 5 years	5 belugas in 5 years	35
600-624	24 belugas in 5 years	17 belugas in 5 years	6 belugas in 5 years	36
625-649	26 belugas in 5 years	18 belugas in 5 years	6 belugas in 5 years	38
650-699	28 belugas in 5 years	19 belugas in 5 years	7 belugas in 5 years	39
700-779	32 belugas in 5 years	20 belugas in 5 years	7 belugas in 5 years	42
780 +	Consult with co-managers to expand harvest levels while allowing for the population to grow			

* Option A would not be implemented until 2010.

IV. At the beginning of each five-year period, an Expected Mortality Limit is determined from Table 2-1 using the five-year average abundance. During each calendar year, NMFS’s number of carcasses will be the mortality number for that year. If at the end of each calendar year this number exceeds the Expected Mortality Limit, then an unusual mortality event, as defined for these purposes, has occurred. The Estimated Excess Mortalities will be calculated as twice the number of reported dead whales above the Expected Mortality Limit. The harvest will then be adjusted as follows:

A. The harvest level for the remaining years of the current five-year period will be recalculated by reducing the five-year average abundance from the previous five-year period by the Estimated Excess Mortalities. The revised abundance estimate would then be used in Table 2-1 for the remaining years and the harvest level adjusted accordingly.

B. For the subsequent five-year period, for the purpose of calculating the five-year average, the Estimated Excess Mortalities would be subtracted from the abundance estimates of the years before and including the year of the excess mortality event so that the average would reflect the loss to the population. This average then would be used in Table 2-1 to set the harvest level.

V. If the Cook Inlet beluga population continues to experience less than one percent growth and well before the five-year abundance average reaches 350 whales, NMFS will commit to seek funding for studies designed to determine whether the population is being affected by any of the following: 1) habitat destruction, modification, or curtailment; 2) over-utilization for commercial, recreational, scientific, or education purposes; 3) disease or predation; 4) inadequate regulatory mechanism; or 5) other natural or manmade factors affecting the continued existence of the Cook Inlet belugas.

2.3.3 Alternative 3: Progressive Harvest Level as Recovery is Demonstrated

Alternative 3 would follow the same five-year harvest assessment and co-management process as described for Alternative 2 in order to establish federal regulations for the Cook Inlet beluga subsistence harvest. Alternative 3 includes a Harvest Table that severely restricts the harvest when the five-year beluga population averages are between 350 and 500 whales, giving highest priority to conservation concerns at smaller population levels. Hunting is only allowed either after the population reaches 500 animals or a medium or high growth rate was demonstrated. Alternative 3 would require that harvest mortality meet the 95/25 criteria; that no harvest occur after 2015 from populations that cannot recover in 100 years; and that no harvest occur after 2008 from declining populations. Alternative 3 includes the same rules as Alternative 2 to decrease authorized harvests to compensate for unusual mortality events. Under this alternative, NMFS promotes the Cook Inlet beluga recovery while providing for traditional subsistence harvest when a high likelihood of recovery is demonstrated.

The Plan

I. The annual strike limitations for the initial planning period, years 2005 and 2006 are set as follows: two strikes are allocated for 2005 and one strike for 2006.

II. SAME as in Alternative 2, except the co-management agreements developed for five-year intervals will start in 2008.

III. SAME as in Alternative 2, except the strike/harvest levels for each five-year planning interval shall begin in 2008. The established harvest/strike levels are presented in Table 2-2 and the following algorithm will be used to determine the harvest levels after 2007.

   A. SAME as Alternative 2.

   B. SAME as Alternative 2.

   C. SAME as Alternative 2.

Table 2-2. Alternative 3 Harvest

Five-year population averages	"High" growth rate	"Intermediate" growth rate	"Low" growth rate	Expected Mortality Limit
Less than 350	0*	0*	0*	-
350-399	3 belugas in 5 years	2 belugas in 5 years	0	21*
400-449	7 belugas in 5 years	5 belugas in 5 years	0	24*
450-499	11 belugas in 5 years	7 belugas in 5 years	0	27*
500-524	15 belugas in 5 years	10 belugas in 5 years	1 belugas in 5 years	30*
525-549	16 belugas in 5 years	11 belugas in 5 years	1 belugas in 5 years	32*
550-574	18 belugas in 5 years	12 belugas in 5 years	2 belugas in 5 years	33*
575-599	20 belugas in 5 years	13 belugas in 5 years	3 belugas in 5 years	35*
600-624	22 belugas in 5 years	15 belugas in 5 years	3 belugas in 5 years	36*
625-649	24 belugas in 5 years	16 belugas in 5 years	4 belugas in 5 years	38*
650-699	26 belugas in 5 years	17 belugas in 5 years	5 belugas in 5 years	39*
700-779	30 belugas in 5 years	20 belugas in 5 years	6 belugas in 5 years	42*
780 +	Consult with co-managers to expand harvest levels while allowing for the population to grow*			

* Shaded cells are the same as Alternative 2

IV. SAME Expected Mortality Limit as Alternative 2 using Table 2-2.

A. SAME as Alternative 2.

B. SAME as Alternative 2.

V. SAME as Alternative 2, NMFS will seek funding for beluga studies should the population continue to experience less than one percent growth.

2.3.4 Alternative 4: Tyonek II Plan

Alternative 4 would follow the same five-year harvest assessment and co-management process as described for Alternative 2 in order to establish federal regulations for the Cook Inlet beluga subsistence harvest. Alaska Native parties argued that the 95/25 criteria does not achieve a reasonable balance of the dual goals of recovery and providing for continued subsistence hunts. Alternative 4 therefore promotes a greater opportunity for the traditional harvest of Cook Inlet beluga while allowing for the recovery of the stock at a slower rate. The Harvest Table under Alternative 4 is the same as Alternative 2 for all growth rates and population levels above 400 whales. However, Alternative 4 has a harvest floor of 250 whales and would authorize harvests when the population was between 250 and 350 whales if the growth rate was intermediate or high. No harvests would be authorized if the growth rate was low at these abundance levels. Alternative 4 includes the same rules as Alternative 2 to decrease authorized harvests to compensate for unusual mortality events.

The Plan

VI. SAME as Alternative 2.

VII. SAME as Alternative 2.

VIII. SAME as Alternative 2. The established harvest/strike levels are presented in Table 2-3 and the following algorithm will be used to determine the harvest levels after 2009.

A. SAME as Alternative 2.

B. SAME as Alternative 2.

C. SAME as Alternative 2.

   a. Is the average stock abundance over the previous five-year period less than 250 beluga whales?

      If yes, Table 2-3 provides that the harvest is zero over the next five-year period.

      If no, go to b.

   b. SAME as Alternative 2.

   c. SAME as Alternative 2.

   d. SAME as Alternative 2.

   e. SAME as Alternative 2.

   f. SAME as Alternative 2.

Table 2-3. Alternative 4 Harvest

Five-year population averages	"High" growth rate	"Intermediate" growth rate	"Low" growth rate	Expected Mortality Limit
Less than 250	0	0	0	0
250-299	5 belugas in 5 years	5 belugas in 5 years	0	15
300-349	7 belugas in 5 years	6 belugas in 5 years	0	18
350-399	8 belugas in 5 years*	8 belugas in 5 years	5 belugas in 5 years*	21*
400-449	9 belugas in 5 years*	8 belugas in 5 years*	5 belugas in 5 years*	24*
450-499	10 belugas in 5 years*	8 belugas in 5 years*	5 belugas in 5 years*	27*
500-524	14 belugas in 5 years*	9 belugas in 5 years*	5 belugas in 5 years*	30*
525-549	16 belugas in 5 years*	10 belugas in 5 years*	5 belugas in 5 years*	32*
550-574	20 belugas in 5 years*	15 belugas in 5 years*	5 belugas in 5 years*	33*
575-599	22 belugas in 5 years*	16 belugas in 5 years*	5 belugas in 5 years*	35*
600-624	24 belugas in 5 years*	17 belugas in 5 years*	6 belugas in 5 years*	36*
625-649	26 belugas in 5 years*	18 belugas in 5 years*	6 belugas in 5 years*	38*
650-699	28 belugas in 5 years*	19 belugas in 5 years*	7 belugas in 5 years*	39*
700-779	32 belugas in 5 years*	20 belugas in 5 years*	7 belugas in 5 years*	42*
780 +	Consult with co-managers to expand harvest levels while allowing for the population to grow*			

* Shaded cells are the same as Alternative 2

2.4 Alternatives Considered and Eliminated from Detailed Study

During development of the alternatives for analysis in this SEIS, NMFS considered several other possible alternatives, but after careful review decided that none of these alternatives were viable and eliminated each from further analysis herein. Alternatives considered but not carried forward are as follows:

- Allocate harvests based on Potential Biological Removal (PBR) in which an increasing fraction of the population is allowed to be harvested as the population increases. This approach follows the same guidelines in estimating the PBR levels used to evaluate fisheries interactions with marine mammals. Although this approach was considered, it was not sophisticated enough to meet the imposed performance criteria; instead, it was used as a starting point for the development of Alternatives 2, 3, and 4.
- Allocate a harvest between NMFS and affected ANOs through the co-management process only (Pub. L. 105-31). This would allow NMFS to coordinate directly with Alaska Natives on the Cook Inlet beluga harvest; however, the MMPA process for establishing harvest regulation on a depleted stock would not be followed. This approach does not meet the needs of Alaska Natives through a deliberative process for determining beluga harvest levels; nor does it meet the needs of the public through a public process and comment period.
- Allocate a fixed percentage of belugas to be harvested based on the recruitment rate. Under this alternative NMFS would promulgate regulations to set an annual harvest at one half the estimated maximum growth rate (e.g., if the growth rate is estimated at four percent per year, the harvest would be two percent per year of the population). Depending on the method used to estimate the annual growth rate, this alternative could have a major adverse impact on the Cook Inlet beluga recovery if the population growth rate is four percent or lower, although it would not allow harvest if

the population was declining. This harvest level could cause the Cook Inlet beluga stock to remain at or near its present low population size for a long period of time. Because the method for estimating the maximum growth rate was not specified, this method was not fully defined and the impact on recovery could not be fully evaluated.

- Allocate a harvest not to exceed two strikes annually, until the stock has recovered to a population of no less than 780 whales (maximum net productivity level for a stock with carrying capacity of 1,300 whales). This alternative allows a beluga harvest of two whales without consideration of population abundance or growth rate. This would not allow the harvest level to adjust downward with low populations, nor would it increase harvest level when the population increases. Thus, this approach would not be consistent with the long-term regime to which the parties in the formal hearing process agreed.

2.5 Environmentally Preferred Alternative

The environmentally preferred alternative (40 CFR 1505.2(b)) will promote the national environmental policy as expressed in Section 101 of NEPA. This is often characterized as the alternative that causes the least damage to the physical and biological environment and is the alternative that best protects, preserves, and enhances historic, cultural, and natural resources.

In this particular instance, NMFS has identified Alternative 1 as the environmentally preferred alternative, because this alternative would result in no beluga whale harvests.

Chapter 3 Affected Environment

This chapter describes the environment affected by the alternatives, beginning with an overview of Cook Inlet and the human activities and marine resources in the area. It then describes Cook Inlet beluga biology and various potential natural and anthropogenic influences on the health of this stock. The chapter will provide readers with a baseline for understanding the potential environmental consequences analyzed in Chapter 4.

3.1 Geographic Location

The summary of Cook Inlet's physical environment provided in this section is intended to give readers a context for understanding the habitat of Cook Inlet beluga whales.

3.1.1 Cook Inlet Climate and Geology

Cook Inlet is a large tidal estuary flowing into the Gulf of Alaska (Figure 1-1). This shallow estuary is approximately 354 km (220 miles) long and 48 km (30 miles) wide. Upper Cook Inlet, north of the Forelands, is generally less than 36 meters [m] (120 feet [ft]) deep, with channels south of Kalgin Island that deepen to 146 m (480 feet). Surrounded by several mountain ranges (the Alaska, Aleutian, Chugach, Kenai, and Talkeetna ranges), Cook Inlet lies within a transition zone; the upper inlet is characterized by a maritime climate that changes to a continental climate in the lower reaches. The upper inlet is also generally drier and cooler than the lower inlet. Anchorage, on upper Cook Inlet, experiences average winter temperatures at 15^{o} Fahrenheit (F) and a summer average at 55^{o} F; while Homer, on the lower inlet, has winter and summer average temperatures of 20^{o} F and 50^{o} F, respectively.

Cook Inlet is a seismically active region, categorized as seismic risk zone four, which are areas susceptible to earthquakes with magnitudes 6.0 to 8.8 and where major structural damage will occur (U.S. Army Corps of Engineers [USACE] 1993). Five active volcanoes are found along the mountain ranges bordering the western side of the inlet, all of which are considered to be capable of major eruptions. In addition to volcanoes, several faults underlie the region and have caused more than 100 earthquakes since 1902 (Hampton 1982). The March 1964 earthquake caused considerable damage to the region and altered many waterways. Such events cause large scale displacement of the inlet's waters and can subject the area to tsunamis and seiches.

The Cook Inlet region contains substantial quantities of mineral resources, including coal, oil and natural gas, sand and gravels, copper, silver, gold, zinc, lead, and other minerals. The inlet's coal is principally lignite, and the largest lignite field—the Beluga River deposit in the vicinity of the Beluga and Yentna rivers—is estimated to contain 2.3 billion tons of coal (USACE 1993). With six active oil or natural gas fields in Cook Inlet, five are located offshore in the middle inlet: Granite Point, Trading Bay, and McArthur River; Middle Ground Shoal and Redoubt Shoal fields. Oil and gas deposits throughout the region hold estimated reserves of 76.9 billion barrels of petroleum and 14.6 trillion cubic ft of natural gas (USACE 1993).

3.1.2 Cook Inlet Water Quality and Properties

Cook Inlet is a complex estuary in the Gulf of Alaska. The relatively fresh, turbid waters of Cook Inlet come from several tributaries, with some of the region's largest waterways emptying into the northern reaches. The three primary rivers are the Knik, Matanuska, and Susitna rivers with a combined peak discharge from July through August of 90,000 cubic meters per second (m^3/sec) (295,276 ft^3/sec) (Minerals Management Service [MMS] 1996). Upper inlet waters meet and mix near mid-inlet with more saline waters from the northern Gulf of Alaska. This mixture then flows along the western inlet to Shelikof Strait. The salinity, temperature, and suspended sediment levels vary significantly within the upper inlet as freshwater input decreases in winter.

With some of the highest tides in North America, exceeded only by those in the Bay of Fundy in Nova Scotia and Ungava Bay, Quebec, Cook Inlet's extreme tidal fluctuation is the main force driving surface circulation in the inlet. Mean diurnal range of tides at Anchorage is 8.8 m (29 ft). Mid-inlet currents may reach 2.4 m (8 ft) per second or more. Such strong currents in upper Cook Inlet can make navigation difficult.

During winter months, ice is a dominant physical force within the inlet, forming sea ice, beach ice, stamukhi ice[1], and river ice. In the upper inlet, sea ice generally forms in October to November, developing through February from the West Forelands to Cape Douglas. The southern portion of the inlet is generally open in winter. By January, much of the upper inlet may experience 70 to 90 percent ice cover, although this reach rarely freezes solid because of the enormous tidal range. Ice generally leaves upper Cook Inlet by April, but may persist into May.

Surface waters in the region typically carry high silt and sediment loads, particularly during summer. Marine waters are well oxygenated, with concentrations in surface waters from about 7.6 milliliter per liter (ml/l) in the upper inlet to 10 ml/l in the southwest inlet (MMS 1996). Mean annual freshwater input to Cook Inlet exceeds 70 trillion liters (18.5 trillion gallons). Freshwater sources often are glacially born waters, which carry high-suspended sediment loads, as well as a variety of metals such as zinc, barium, mercury, and cadmium. MMS (1996) conducted four water quality studies in Cook Inlet and found that hydrocarbon levels in the water column were generally low, often less than the method detection limit. Elevated methane levels were observed in waters from Trading Bay in the upper inlet, an area with oil and natural gas fields. Although saturated hydrocarbons were detected in treated production waters from Trading Bay in 1993, levels from upper Cook Inlet waters were below detection limits. Polynuclear aromatic hydrocarbons were often less than detection or reporting limits, although treated production waters again held elevated levels. *In situ* bioassay of sand dollar fertilization rates from eight sampling locations in Cook Inlet found decreased fertilization rates among sand dollars between tests using waters from the two northernmost stations, although suspended sediment material may have contributed to some toxicity. Larval survival was not greatly different from the control, except for one station in Kachemak Bay, which had a survival rate less than 10 percent of the control.

3.2 Cook Inlet Beluga Whales

The following sections detail various aspects of beluga whale biology, and the possible natural and anthropogenic factors currently affecting the Cook Inlet stock.

[1] Stamukhi ice is formed by overhanging pieces of deposited beach ice breaking off with tidal action, to be re-deposited along the shoreline, and adding subsequent layers of new ice.

3.2.1 Biology and Life History

3.2.1.1 General Description of the Species

A small, toothed whale in the family Monodontidae, the beluga whale, also known as the white whale may reach a length of 5 m (16 ft), although average adult size is more often 3.6 to 4.3 m (12 to 14 ft). However, local Native hunters have reported that some Cook Inlet belugas may reach lengths of 6 m (20 ft) (Huntington 2000). Males weigh about 1,500 kg (3,307 pounds [lbs]) and females 1,360 kg (2,998 lbs) (Nowak 1991). Calves are born dark gray to brownish gray and become lighter with age. Adults become white to yellow-white at sexual maturity, although Burns and Seaman (1986) report females may retain some gray coloration for as long as 21 years.[2] Beluga whales lack a dorsal fin, and the "blow" they typically produce upon surfacing is only visible at short range. Native hunters report that these whales often surface with only the blowhole out of the water. Consequently, they are often difficult to see.

Beluga whales are covered with a thick blubber layer that accounts for as much as 40 percent of body mass (Sergeant and Brodie 1969). This fat stores energy and provides thermal protection. Native hunters in Cook Inlet report that beluga whale blubber is thinner in early spring than later in the summer. This suggests that their spring feeding in upper Cook Inlet, principally on fat-rich fish such as eulachon and salmon, is very important to the energetics of these animals. NMFS has measured blubber thickness in excess of 10 cm on a Cook Inlet beluga whale.

Beluga whales have a well-developed sense of hearing and echolocation. They hear over a large range of frequencies, from low-pitched sounds at about 40 to 75 Hertz (Hz) to high-pitched sounds from 30 to 100 kilohertz (kHz) (Richardson 1995), although their hearing is most acute at middle frequencies between about 10 and 75 kHz (Fay 1988). A healthy young human being, in comparison, typically can hear over a range of approximately 20 Hz to 20 kHz. For the beluga, most sound reception takes place through the lower jaw, which is hollow at its base and filled with fatty oil. Sounds are conducted through the lower jaw to the middle and inner ears and then to the brain. Belugas modify their vocalizations in response to noise levels (Scheifele et al. 2005). They have acute vision both in and out of water, and because their retinas contain both rods and cones, they are believed to see in color (Herman 1980).

The beluga whale is a northern hemisphere species, ranging primarily over the Arctic Ocean and some adjoining seas, where they inhabit fjords, estuaries, and shallow water in Arctic and subarctic oceans. Belugas seek out shallow coastal waters in summer, and in winter remain near the ice edge (O'Corry Crowe 2002). Except for a small population in the Gulf of Saint Lawrence, Canada, this species is exclusively a subarctic and Arctic inhabitant.

Belugas are found seasonally throughout Alaskan waters, except the Aleutian Islands and the Southeast panhandle region. Alaskan waters are home to five beluga stocks distinguished by

[2] Contrary to age estimates for most other animals in which it is assumed that one bipartite growth increment forms annually, beluga whale age estimates have been calculated assuming that two growth layer groups (GLGs) form each year. Stewart et al. (2006) determined that comparison of beluga aged determined by bomb radiocarbon with age determined by GLG counts indicated that GLGs form annually, not semiannually, and provide an accurate indicator of age for belugas up to at least 60 years old.

their respective summer range: the Beaufort Sea, the eastern Chukchi Sea, the eastern Bering Sea, Bristol Bay, and Cook Inlet (Angliss et al. 2005).

The degree of genetic differentiation between Cook Inlet and other Alaska beluga stocks indicates the Cook Inlet belugas are the most isolated (O'Corry-Crowe et al. 1997). The lack of beluga observations along the southern Alaska Peninsula suggests that the Alaska Peninsula is an effective geographic barrier to genetic exchange (Laidre et al. 2000). Murray and Fay (1979) theorized that Cook Inlet belugas have been isolated for several thousand years, an idea which has since been corroborated by genetic data (O'Corry-Crowe et al. 1997).

Beluga whales are extremely social animals, typically migrating and hunting together, and with a high degree of general interaction. Nowak (1991) reports the average pod size as 10 animals, although beluga whales may occasionally form much larger groups, often during migration. Groups of 10 to more than 100 belugas have often been observed during summers in Cook Inlet. It is not known whether these beluga groups represent distinct social divisions.

3.2.1.2 Cook Inlet Beluga Whale Distribution and Movement

Beluga whales are often found in shallow, coastal areas, frequently in water barely deep enough to cover their bodies (Ridgway and Harrison 1981). Some beluga whale populations make seasonal migrations, while others remain in relatively small areas year round (O'Corry Crowe 2002). Sightings from: 1976 to 1979 (Calkins 1983), 1997 (MMS 1999), and from 1999 to 2007 (NMFS unpublished data); satellite tracking data during August through May (Hobbs et al. 2005, NMFS unpublished data); and monthly aerial surveys conducted between June 2001 and June 2002 (Rugh et al. 2004) show that belugas are present in Cook Inlet year round.

Beluga whales are often sighted in the upper inlet beginning in late April or early May. Their movements are concurrent with eulachon runs in the Susitna River and Twenty Mile River Turnagain Arm. Alaska Natives attribute this spring movement into the upper inlet to whales following the whitefish migration (Huntington 2000). Native hunters reported that beluga whales once reached Beluga Lake from the Beluga River (about 90 miles) and that beluga whales regularly swim upstream in the Kenai and Little Susitna rivers (Huntington 2000). Beluga whales use the Susitna River delta, Knik Arm, and Turnagain Arm throughout the summer. They also use the smaller streams along the west side of the inlet, moving with the tides, following first the eulachon and salmon runs throughout the summer.

In Knik Arm, beluga whales are first observed in May, and often use the area all summer, feeding on salmon runs and moving with the tides. More intensive use of Knik Arm by belugas in August through November coincides with the Coho run. Belugas gather in Eagle Bay and sometimes in Goose Bay, along the west side. Belugas usually retreat to the lower portion of Knik Arm during low tides and may swim to the Susitna delta during these low tides. Satellite tracking has recorded belugas within Knik Arm for 10 months of the year and identified daily and weekly movement throughout the area (Hobbs et al. 2005). Eighteen years of aerial surveys in the first weeks of June show a high variability of whale abundance within Knik Arm, ranging from zero belugas in 1994 and 2004, to 224 belugas in 1997 (Hobbs et al. 2000; Rugh et al. 2004). Monthly aerial surveys were also conducted from June 2001 to June 2002 indicating beluga movements into and out of Knik Arm on a monthly basis. The satellite telemetry data and long-term aerial data show that beluga whales use Knik Arm 12 months of the year, often entering and leaving the Knik Arm on a daily basis.

Knik Arm Bridge and Toll Authority confirmed that belugas use Knik Arm, as observed in their studies from July 2004 to October 2005 (Funk et al. 2005), although beluga sightings at this time were highly variable. In 2004, boat-based surveys in Knik Arm reported that belugas ranged from five to 130 whales in August, from zero to 70 whales in September, and from zero to 105 whales in October (Figure 3-1) (Funk et al. 2005).

Land based sightings from Cairn Point, Birchwood, and Eklutna indicated that whale movements were strongly related to tide stages, with whales moving north into Knik Arm at higher tides and moving south at lower tides (Figure 3-2) (Funk et al. 2005). Many belugas were sighted south of Cairn Point, indicating movement out of Knik Arm.

In Turnagain Arm, beluga whales follow the spring eulachon run that start in April or early May and continue into June. Beluga use of upper Turnagain Arm decreases in the summer and then increases in August through October, coinciding with the Coho salmon run. Belugas appear to use the Chickaloon Bay area throughout the year. As in Knik Arm, beluga whales move in and out of Turnagain Arm with the rising and falling tides, probably due to the extreme tides and extensive mudflats.

Satellite transmitters successfully recorded on 14 beluga whales in upper Cook Inlet in 2000 to 2003 (Hobbs et al. 2005) provided location and movement data through the fall and winter, into early spring. Belugas congregated in upper Cook Inlet at rivers and bays during the summer and fall, and tended to disperse offshore during winter. All tagged whales remained in Cook Inlet during the tracking period. Figure 3-3 shows the movements from three individual belugas carrying satellite tags.

While in the upper inlet, whales often made rapid movements between distinct bays or river mouths (Figure 3-4). The data also show that in August beluga whales were concentrated in Knik Arm, Little Susitna River mouth, and near Fire Island, Point Possession, and Turnagain Arm. In summer and early fall, whales traveled back and forth between Knik Arm (Eagle Bay), Chickaloon Bay (Chickaloon River), and upper Turnagain Arm; although some whales spent time offshore (Hobbs et al. 2005).

In September belugas continued to use Knik Arm and increased their use of the Susitna River delta, Turnagain Arm, and Chickaloon Bay. In October, beluga whales ranged widely down the coastal areas, reaching Chinitna Bay, Tuxedni Bay, and Trading Bay (MacArthur River); and continued to use Knik Arm, Turnagain Arm, and Chickaloon Bay. November use was similar to September (ranging between Knik and Turnagain Arms), including all of Knik Arm and a larger area in Chickaloon Bay. In December, beluga whales moved offshore to locations throughout the upper to mid inlet. In January, February, and March, beluga whales used the central offshore waters, moving further than Kalgin Island. Belugas also ranged widely during February and March, with excursions to Knik and Turnagain Arms, with more than 90 percent ice coverage (Hobbs et al. 2005).

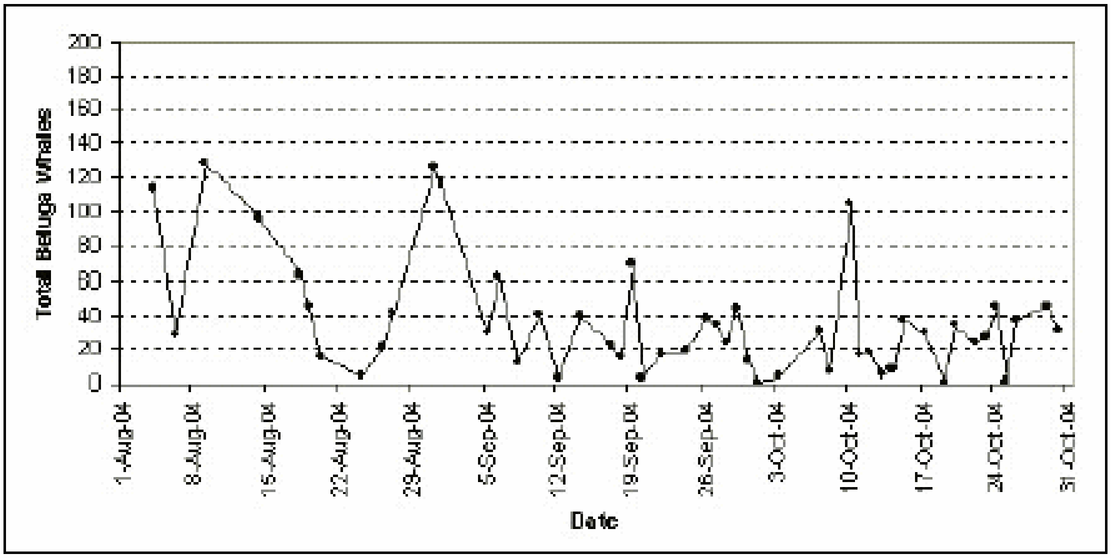

Figure 3-1. Total number of beluga whales sighted during boat-based surveys in upper Cook Inlet during the period of 4 August 2004 through 30 October 2004. Data are based on the "best" count of each group for those groups sighted more than once on the same day. Repeated sightings of the same whales on the same day and sightings where observers were unsure if they had previously sighted the group that same day, are excluded (Funk et al. 2005).

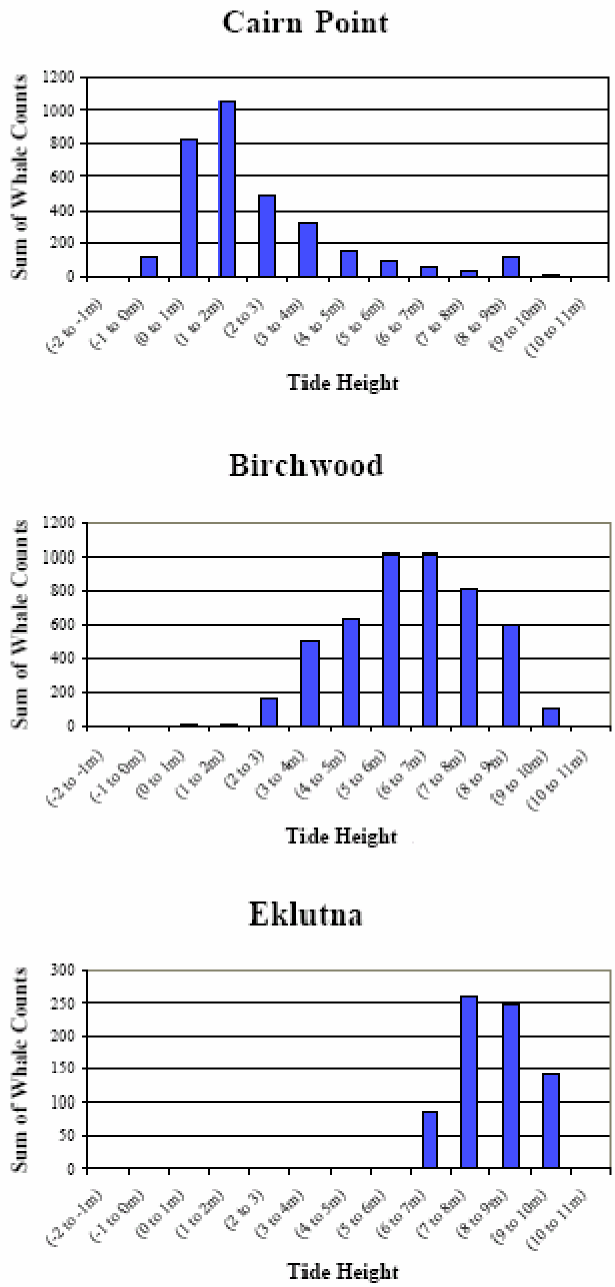

Figure 3-2. Total number of beluga whale sightings from Cairn Point, Birchwood, and Eklutna in relation to tide height (Funk et al. 2005).

Figure 3a. Movements of beluga CI-0001 tracked between September and January 2001

Figure 3b. Movements of beluga CI-0107 tracked between August 2001 and March 2002

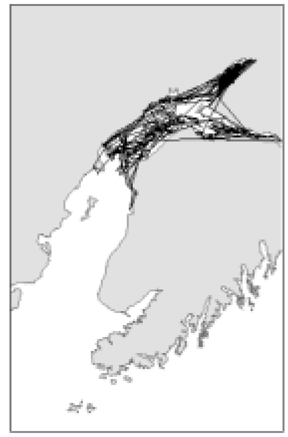

Figure 3c. Movements of beluga CI-0208 tracked between August 2002 and March 2003

Figure 3-3. Movement tracklines derived from satellite tags from three beluga whales tracked from 2001 to 2003. Whales were tracked beginning in late August through as late as March the following year (Hobbs et al. 2005).

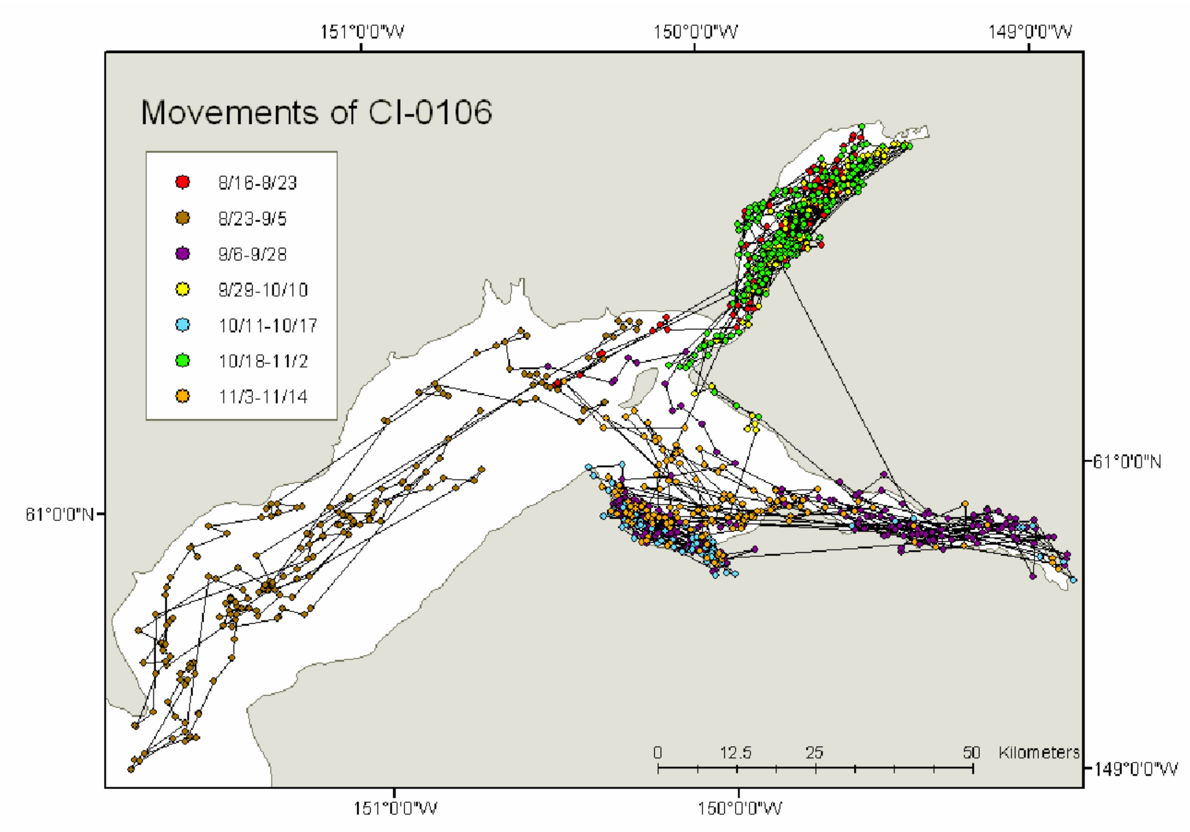

Figure 3-4. Movements in upper Cook Inlet for beluga CI-0106 between August and November 2001. Note the rapid shifts between areas in the upper inlet, often occurring within a single day, particularly the movements between the Knik Arm and Turnagain Arm/Chickaloon Bay areas (Hobbs et al. 2005).

Monthly concentration areas are summarized in Figures 3-5 and 3-6 (Hobbs et al. 2005). The telemetry data do not document areas and habitat used by the pre-exploited beluga population and areas that could be used by a larger population in the future (Hobbs et al. 2005). Prior to satellite tagging data, the winter distribution of this stock was poorly understood because winter ice conditions made beluga detection difficult (Rugh et al. 2004). Calkins (1983) postulated that the whales leave the inlet entirely, particularly during heavy ice years. Eight dedicated aerial surveys in Cook Inlet between February 12 and March 14, 1997, resulted in only a few beluga group sightings. The number of animals represented by these sightings has not been estimated and it is likely that the same group of whales were sighted repeatedly (MMS 1999).

Beluga whales were observed during monthly surveys (July through April) conducted by NMFS in upper Cook Inlet during 2001 and 2002 (Rugh et al. 2004). The number of whales observed ranged from 204 belugas (August) to 10 belugas (January); whales were observed in Knik and Turnagain Arms during all months except February, when no whales were observed. However, low beluga counts generally correlated to days with high ice density, so it is believed the counts were a function of low visibility of white whales amidst sea ice rather than the whales leaving the inlet (Rugh et al. 2004). Satellite data showed that tagged whales used Knik and Turnagain Arms for much of the tracked time, ventured as far south as Redoubt Bay (October), Kalgin Island (January), and East Foreland (December and January). Therefore, the available information indicates that Cook Inlet belugas stay in the inlet during winter months with greater use of the mid inlet and occasional movement into upper Cook Inlet including both Knik and Turnagain Arms. Winter beluga distribution does not appear to be associated with river mouths as it is during the warmer months. Spatial dispersal of winter prey probably accounts for the whales' winter range.

The traditional ecological knowledge (TEK) of Alaska Natives (Huntington 2000) and systematic aerial survey data (Rugh et al. 2000) indicate that the Cook Inlet beluga summer range has contracted, especially since the mid 1990s. TEK reports historically had groups of up to 50 belugas using the Kenai River; "great numbers" in Trading Bay in June and July; so many in the MacArthur River that boaters had to be careful not to hit them; many whales far up the Beluga River; and frequent sightings of beluga whales in Kachemak Bay with some whales staying all summer. An Alaska Department of Fish and Game (ADF&G) survey conducted in August 1979 did not include Knik and Turnagain Arms, but surveyed most areas in the upper and mid inlet, near the Forelands and on the west side (Calkins 1989). Rugh et al. (2000) reported several beluga sightings in the lower inlet during surveys from 1993 to 1995. Surveys have shown that beluga whales still continue to congregate in the upper inlet. This shrinking distribution is probably a function of a reduced population with the remaining whales using the preferred habitat that offers the most abundant and accessible food, the best calving areas, and the best escape from predation.

Goetz et al. (2007) modeled the importance of selected environmental parameters in structuring the beluga whale habitats in Cook Inlet (Figure 3-7). The model was based on summer aerial surveys conducted from 1993 to 2004. Bathymetries, proximity to mudflats, and distance from rivers classified by water flow accumulation values were evaluated with respect to beluga presence or absence. The models suggest that mudflats and flow accumulation (medium and high flow rivers) are important environmental features in the distribution of this population (Goetz et al. 2007). This may be due to prey availability and distribution.

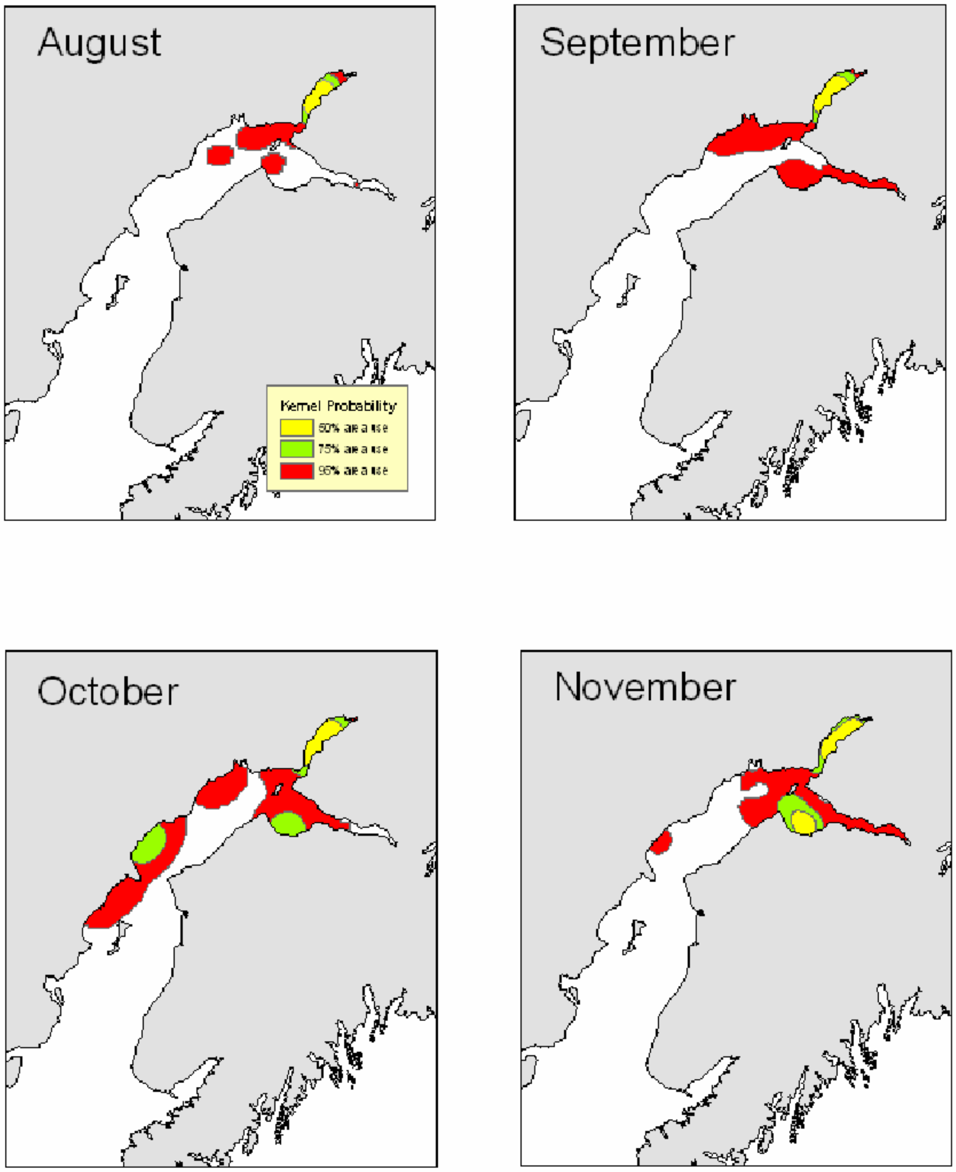

Figure 3-5. Cook Inlet beluga whale area use by month (August-November) from NMFS satellite tagging data (Hobbs et al. 2005).

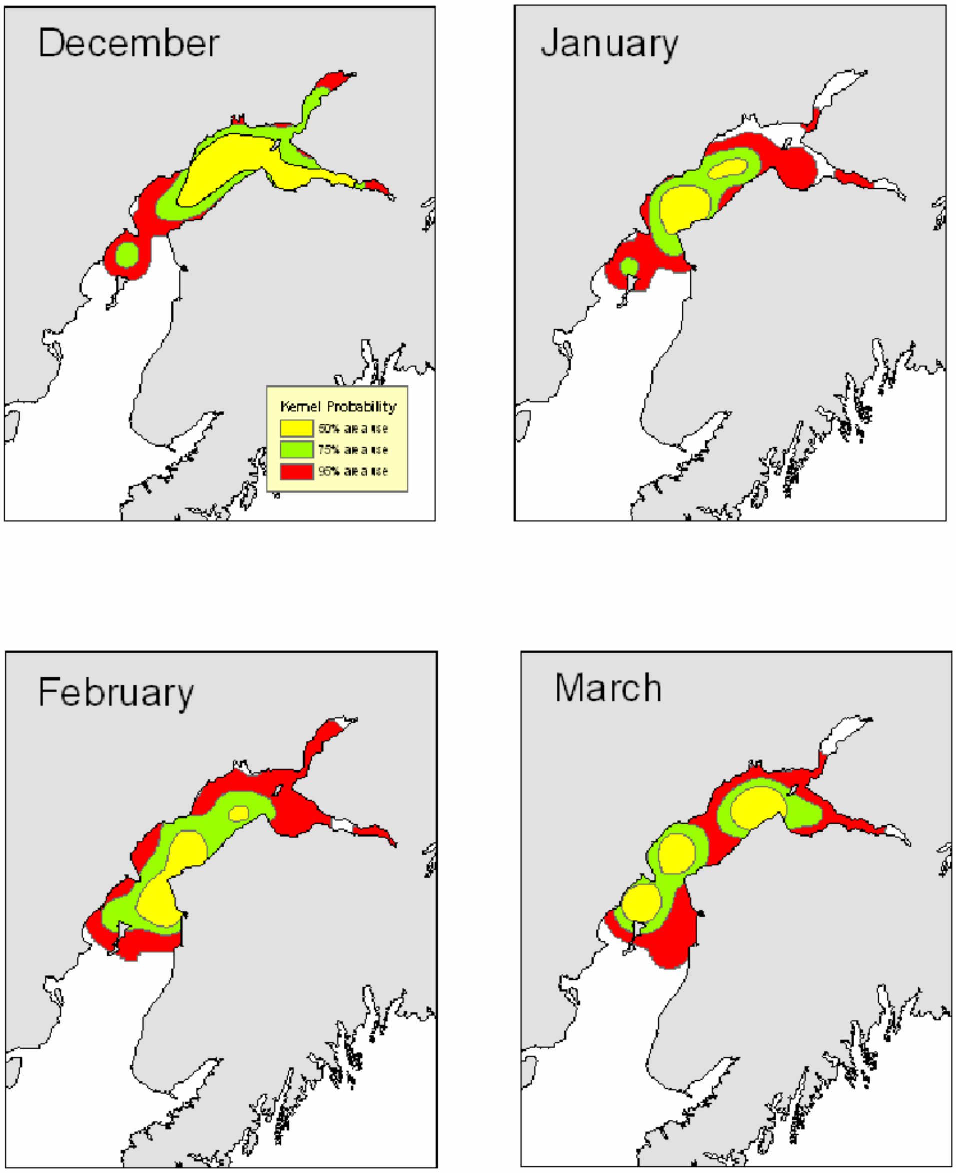

Figure 3-6. Cook Inlet beluga whale area use by month (December-March) from NMFS satellite tagging data (Hobbs et al. 2005).

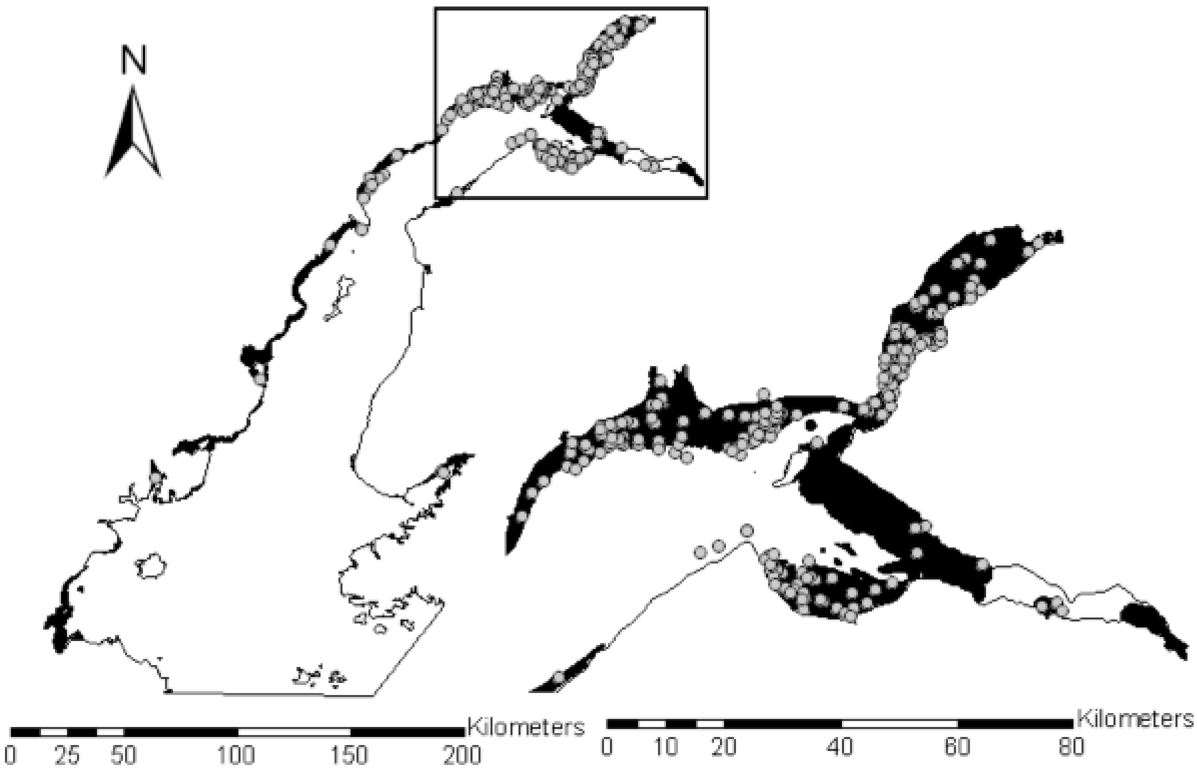

Figure 3-7. Habitat (black) predicted by the Resource Selection Function model with beluga sightings shown in gray.

Beluga sightings in the Gulf of Alaska and adjacent inside waters are considered rare (less than 30 reports) relative to the more than 150,000 km (93,206 nautical miles [nm]) of survey effort and the many thousands of non-beluga cetacean sightings documented for the region during the past 30 years (Laidre et al. 2000). There have been a few beluga sightings in Prince William Sound, around Kodiak Island, and in Shelikof Strait. Sightings of 6 to 12 beluga whales in the Yakutat area (approximately 640 km east of Cook Inlet) have been reported more often (see below). On the other hand, belugas are consistently found in upper Cook Inlet, as evidenced by satellite tagging studies (Hobbs et al. 2005), TEK (Huntington 2000), systematic surveys (Rugh et al. 2000), archaeological studies (Mahoney and Shelden 2000), opportunistic reports (Rugh et al. 2000; NMFS unpublished data), and stranding records (Moore et al. 2000; Vos and Shelden 2005).

There are indications that the beluga sightings in Yakutat Bay are a group that remains in the area throughout the year (O'Corry Crow et al. 2006). In May 1976, 26 beluga whales were seen near Yakutat (Fiscus et al. 1976); MMS winter surveys observed 10 beluga whales off Hubbard Glacier near Yakutat (MMS 1997); the U.S. Coast Guard (USCG) reported 10 to 11 beluga whales in November 1998; the U.S. Geological Survey reported six beluga whales in August 2000, and the U.S. Forest Service reported four beluga whales in June and September 2002 (O'Corry-Crowe et al. 2006). Consiglieri and Braham (1982) also reported annual beluga observations in Yakutat by local fishermen. However, Laidre et al. (2000) described many studies in Yakutat Bay that should have reported beluga sightings but did not, including aerial surveys by trained teams searching for belugas and field camps that had a good view of the waters where beluga whales were seen in some years, but not in others. Calkins (1986) believed the Yakutat sightings to be beluga whales visiting from Cook Inlet.

Six genetic samples from Yakutat belugas have been analyzed, representing five individual whales (O'Corry-Crowe et al. 2006). They all share the same mitochondrial deoxyribonucleic acid (DNA) haplotype, one that has also been found in other areas of Alaska, including Cook Inlet. The microsatellite analysis suggests that the Yakutat whales may be relatively more closely related to each other than other Alaska belugas. These preliminary genetic results indicate that the sampled whales are unlikely to be a random sample of the Cook Inlet beluga population. This, taken with the sighting data and behavioural observations, suggests that a small beluga group resides in the Yakutat Bay region year round. These whales are reproductive, have a unique ecology, and a restricted seasonal home range. The Yakutat belugas are the only beluga group in Alaska associated with cold, glacial waters. As such, they likely have a unique ecology, and management decisions for this group cannot be made using information from other stocks (O'Corry-Crowe et al. 2006).

3.2.1.3 Population Status and Trends

Cook Inlet belugas have probably always numbered fewer than several thousand animals, but have critically declined from the stock's historical abundance. It is difficult to accurately determine the magnitude of decline, because there is no available information on the beluga population that existed in Cook Inlet prior to development of the Southcentral Alaska sub-region or prior to modern subsistence whaling by Alaska Natives. A TEK survey by Huntington (2000) did not contain any historic population estimates. Cook Inlet beluga abundance surveys prior to 1994 were often incomplete, highly variable, and involved non-systematic observations or surveys concentrated in river mouths and along the upper inlet. Based on aerial surveys in 1963 and 1964, Klinkhart (1966) estimated the Cook Inlet stock at 300 to 400 animals, but the methodology for the survey was not described. Sergeant and Brodie (1975) present an estimate for the Cook Inlet stock as 150 to 300 animals, but offer no source for this abundance number. Murray and Fay (1979) counted 150 beluga whales in the central inlet on three consecutive days in August 1978 and estimated the total abundance would be at least three times that number to account for poor visibility. Calkins (1984), based on surveys in the upper inlet between May and August of 1982, estimated that 200 to 300 beluga whales were seen in one area. Hazard (1988) stated that an estimate of 450 whales might be conservative because much of Cook Inlet was not surveyed in these efforts.

In an attempt to find a documented estimate of the Cook Inlet beluga total population, scientists looked to the survey with the greatest coverage of Cook Inlet. This effort was conducted by ADF&G in August 1979. The aerial survey consisted of transects from Anchorage to Homer, covering much of the upper, middle, and lower inlet on August 21, 1979. The beluga counts totalled 376 belugas (N. Murray, unpublished field notes). On August 22, 97 belugas sighted in Bruin Bay (an area not surveyed the previous day due to low clouds) were added to the count for a total of 479 belugas (N. Murray, unpublished field notes). This survey is considered incomplete because Knik Arm, Turnagain Arm, and Chickaloon Bay were not surveyed. Using a correction factor of 2.7 developed for estimating submerged whales under similar conditions in Bristol Bay (Fried et al. 1979; Frost et al. 1985), Cook Inlet beluga abundance was estimated at 1,293 whales (Calkins 1989). Although this survey did not include all of upper Cook Inlet, the area where almost all belugas are currently found, it is the most complete survey of Cook Inlet prior to 1994 and it incorporated a correction factor for belugas missed during the survey. Therefore, the ADF&G (Calkins 1989) summary provides the best available estimate for the historical beluga abundance in Cook Inlet. NMFS has adopted 1,300 belugas as the value for the carrying capacity to be used for management purposes (65 FR 34590) in Cook Inlet.

NMFS began comprehensive, systematic aerial surveys on beluga whales in Cook Inlet in 1993. Unlike previous efforts, these surveys included the upper, middle, and lower inlet. These surveys documented a decline in abundance of nearly 50 percent between 1994 and 1998, from an estimate of 653 to 347 whales (Hobbs et al. 2000b). In response to this decline, NMFS initiated a status review on the Cook Inlet beluga stock pursuant to the MMPA and the ESA in 1998 (63 FR 64228). NMFS has since designated the Cook Inlet beluga stock as below its OSP of 780 whales and, hence, depleted under the MMPA (65 FR 34590, May 31, 2000). Additional surveys documented a 4.0 percent annual decline in abundance from 1994-2007. NMFS initiated a second status review in 2006 (71 FR 14836) and proposed endangered status under the ESA for the Cook Inlet beluga in 2007 (72 FR 19854).

The annual abundance surveys conducted each June since 1999 provide the following abundance estimates: 367 belugas in 1999, 435 belugas in 2000, 386 belugas in 2001, 313 belugas in 2002, 357 belugas in 2003, 366 belugas in 2004, 278 belugas in 2005, 302 belugas in 2006, and 375 belugas in 2007 (Figure 3-8) (Hobbs et al. 2000b; Rugh et al. 2005; NMFS unpublished data).

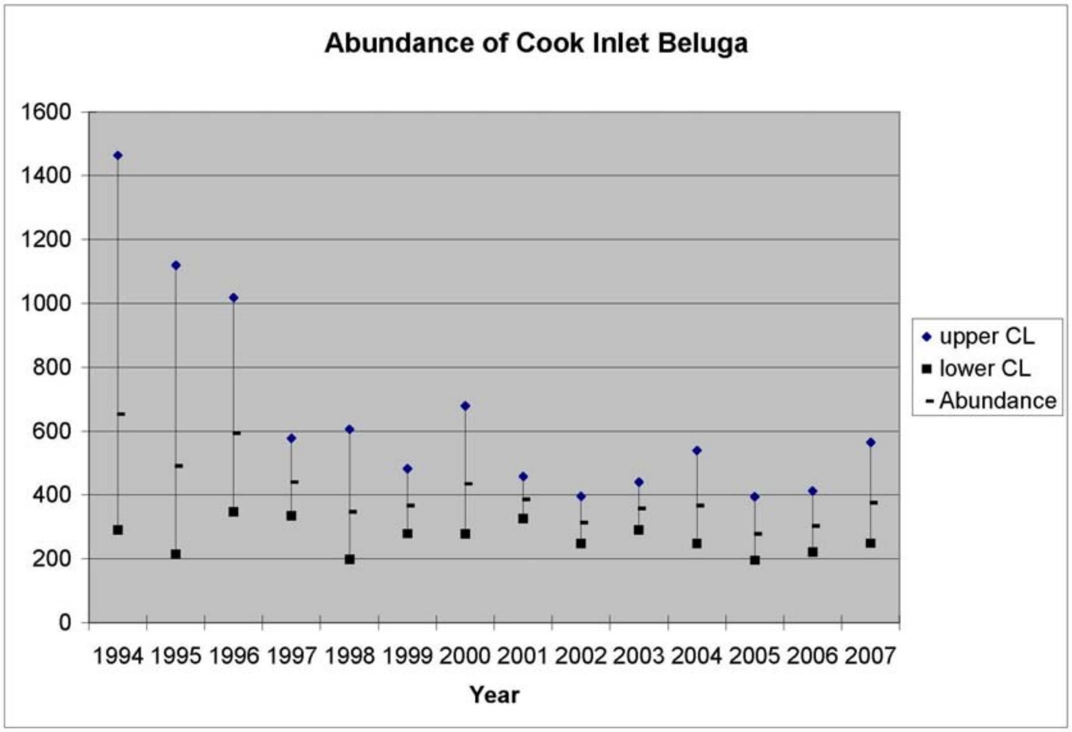

Figure 3-8. Annual estimates of abundance for Cook Inlet beluga whales as determined by aerial surveys in June and July. The vertical bar with each estimate represents the 95 percent confidence interval for the estimate (Hobbs et al. 2000b, NMFS unpublished data).

Harvests from this stock have been restricted to one or two whales annually since 1999, with only five belugas landed (1999 to 2007), due to cooperative efforts with Native hunters and federal law. Despite these efforts, the population has continued to decline 2.7 percent annually since 1999, when the harvest was regulated. Considerable concern remains regarding the population biology for small cetacean stocks such as Cook Inlet belugas, both for recovery and continued existence. NMFS has worked extensively with experts, including Native hunters, to employ the best available science and traditional knowledge in our management and conservation efforts. This includes workshops by the Alaska Beluga Whale Committee (ABWC), the Alaska Scientific Review Group, and a technical working group appointed by an administrative law judge to consider a harvest management plan that would provide for both the continuation of traditional subsistence practices and the Cook Inlet beluga recovery.

Population growth can be modeled using several factors, including population size, population demographics (age and gender), maximum per capita growth rate, its carrying capacity, and extraneous factors (i.e., environmental, unusual mortality, subsistence take), among others. NMFS estimates carrying capacity as 1,300 belugas and the maximum theoretical net productivity rate between two and six percent. However, continued aerial surveys documented annual declines of 4.0 percent (1994 to 2007) and 2.7 percent (1999 to 2007). Differences in survey design and analytical techniques prior to 1994 rule out a precise statistical assessment of trends using the first available population estimate. Simply comparing the estimate of 1,293 belugas in 1979 to 375 belugas in 2007 indicates a 77 percent decline in 27 years, but with unspecified confidence. Based on the 1994 to 2007 aerial surveys done by NMFS, there is a 2.7 percent annual decline since 1999, when the harvest was regulated and only five whales landed between 2000 and 2007.

The viability of small populations is further compromised by the increased risk of inbreeding and loss of genetic variability through drift, which reduces a population's ability to cope with disease and environmental change (Lacy 1997; O'Corry-Crowe and Lowry 1997). Genetic variation estimates do not, at present, suggest that Cook Inlet belugas are highly inbred or that a critical amount of genetic variation has been lost through drift (O'Corry-Crowe et al. 1997; G. O'Corry-Crowe, unpublished data in Lowry et al. 2006), but this population is already in a size range where eventual genetic variability loss is expected (Lowry et al. 2006).

3.2.1.4 Reproduction

Most beluga calving in Cook Inlet is assumed to occur from mid-May to mid-July (Calkins 1983), although Native hunters have observed calving from April through August (Huntington 2000). Alaska Natives described calving areas within Cook Inlet as the northern side of Kachemak Bay in April and May, off the mouths of the Beluga and Susitna rivers in May, and in Chickaloon Bay and Turnagain Arm during the summer (Huntington 2000). The warmer waters from these freshwater sources may be important to newborn calves during their first few days of life (Calkins 1989; Katona et al. 1983). Mating follows the calving period.

Although some reproductive information is available for Cook Inlet belugas, sample sizes are not sufficient to estimate model parameters. However, reproduction data from several other beluga populations are available in the literature (Table 3-1). Birth interval is thought to be typically three to four years depending on the age of the mother, but in some cases it may be as short as two years (Table 3-1). The age at sexual maturity is thought to be between four and eight years; gestation lasts more than a year, so that the age at first birth is between five and nine years (Table 3-1). The lactation period is known to last longer than one year, so calf survival is likely to depend on the mother's survival during the first year after birth. Survival rates and age at maturity have been estimated for males; however, these estimates were not significantly different from those for females (Table 3-1).

Table 3-1 Review of female beluga life history parameters found in published literature.[3]

Parameters	Data		Source(s)
Age at sexual maturity	4–7 years (8-15 dentinal layers) 0% at 4 years and younger (8-9 dentinal layers) 33% at 5 years (10-11 dentinal layers) 94% at 6 years (12-13 dentinal layers)		1,2,3,4,5,6, 6[a]
Age at 1st conception	54% at 4 years and younger (8-9 dentinal layers) 41% at 5 years (10-11 dentinal layers) 94% at 6 years (12-13 dentinal layers)		6[b]
Age at senescence	21 years (42-43 dentinal layers)		1
Pregnancy and birth rates	With small fetuses: 0.055 at 0-5 years (0-11 layers) 0.414 at 6-10 years (12-21 layers) 0.363 at 11-22 years (22-45 layers) 0.267 at 23-28 years (46-57 layers) 0.190 at 29-38 years (58-77 layers)	With full-term fetuses or neonates: 0.000 at 0-5 years (0-11 layers) 0.326 at 6-10 years (12-21 layers) 0.333 at 11-22 years (22-45 layers) 0.278 at 23-25 years (46-51 layers) 0.182 at 26-28 years (52-57 layers) 0.125 at 29-38 years (58-77 layers)	6
Lifespan	>30 years (oldest female estimated at 35+ years or 70+ dentinal layers) 32 years (64-65 dentinal layers) 30 years (60-61 dentinal layers) 25 years (50-51 dentinal layers)		6 7 1 2
Adult annual survival	0.96-0.97 0.955 (based on pilot whale data) 0.935 0.91-0.92 0.906 (includes both natural and human-caused mortality) 0.84-0.905 (based on body length and lifespan)		8 9 10 11 6 12
Immature annual survival	.0905 (for neonates in the first half year of life)		2
Reproductive rate	0.010-012 0.11 (based on annual calf production rates) 0.13 (based on annual calf production rates) 0.09 (based on annual calf production rates) 0.09-0.12 (based on annual calf production rates) 0.09-0.14 (based on calf counts) 0.12 (based on calf counts) 0.08-0.14 (based on calf counts) 0.06-0.10 (based on calf counts) 0.08-0.10 (based on calf counts) 0.08 (unknown)		13[c] 6 2 1 5 5 14, 2 15 16 10 17
Calving interval	< 3 years (< 6 dentinal layers) 2 years and 3 years (4-5 dentinal layers and 6-7 dentinal layers)		6[d] 2[e]

[1].Brodie 1971. [2] Sergeant 1973. [3] Ognetov 1981. [4] Seaman and Burns 1981. [5] Braham 1984. [6] Burns and Seaman 1985. [7] Khuzin 1961 (cited in Ohsumi 1979). [8] Béland et al. 1992. [9] Brodie et al. 1981. [10] Lesage and Kingsley 1998. [11] Allen and Smith 1978.

[3] Beluga whale age estimates herein have been calculated assuming that two GLGs form each year. Stewart et al. (2006), however, have determined that GLGs form annually, not semiannually, and provide an accurate indicator of age for belugas up to at least 60 years old. In our data we provide the number of dentinal layers to allow for calculation of age based on this new understanding of growth layer development.

[12] Ohsumi 1979. [13] Perrin 1982. [14] Ray et al. 1984. [15] Davis and Evans 1982. [16] Davis and Finley 1979. [17] Breton-Provencher 1981 (in Perrin 1981).
[a] Alaska samples (52 whales). Sampling occurred in June, a time when most Alaskan belugas are born. It is possible that non-pregnant four-year-old belugas would have conceived prior to their fifth birth date.
[b] Alaska samples (22 whales).
[c] Based on a literature review and adopted by the International Whaling Commission.
[d] For some female belugas. This was a tentative conclusion based on high conception rates noted in some females between the ages of 6 and 22 years.
[e] Two-year intervals were for 25 percent of mature female belugas in eastern Canada (7 of 29 sampled); presumed after noting pregnancies occurred during lactation. Three-year intervals were for 75 percent of mature females in eastern Canada. Sergeant (1973) concludes that "overlap of pregnancy and previous lactation is infrequent so that calving occurs about once in three years."

3.2.1.5 Survival

Initial efforts to understand the Cook Inlet beluga decline focused on subsistence harvest effects. This line of inquiry is consistent with direct observations and self-reporting by subsistence hunters. A modeling study was developed to test alternative harvest strategies.

Modeling by Hobbs (2000) suggested that the observed decline in the Cook Inlet beluga stock between 1994 and 1998 was consistent with the estimated harvest mortality and a population growth rate between two and six percent. Although harvest mortality was not the only possible explanation, it was considered the most likely and it implied that should the harvest be limited, the population would begin to recover. Abundance estimates in the nine years since the harvest was severely restricted in 1999 have not demonstrated the expected recovery, but indicates a continued 2.7 percent annual decline.

Subsistence harvest is no longer thought to be the only factor influencing the Cook Inlet beluga decline. However, at present, survival rates, reproductive rates, and other life history parameters cannot be estimated with sufficient precision to determine if those rates have changed over time, or are somehow affected to the extent that population growth and recovery are compromised.

It was expected that the population would increase after the harvest was reduced (Pub. L. 106-553). NMFS has been very concerned that recovery has not happened as expected and recognizes that other factors may be impacting the population. NMFS further recognizes that merely stabilizing the population at its current small size (375 belugas in 2007) is only a partial solution, as a small population size over the long-term increases the population's vulnerability to external events and to factors intrinsic to small populations.

3.2.1.6 Age and Growth

Teeth from harvested and stranded Cook Inlet belugas, collected from 1992 to 2001, were used to establish growth layer group (GLG)/length curves for female and male Cook Inlet belugas (Vos 2003) (Figure 3-9). A total of 372 teeth from 58 whales were cut and analyzed. Growth curves were developed for females and males (Vos 2003). Sexual dimorphism was exhibited, with males being longer than females at equal GLG counts.

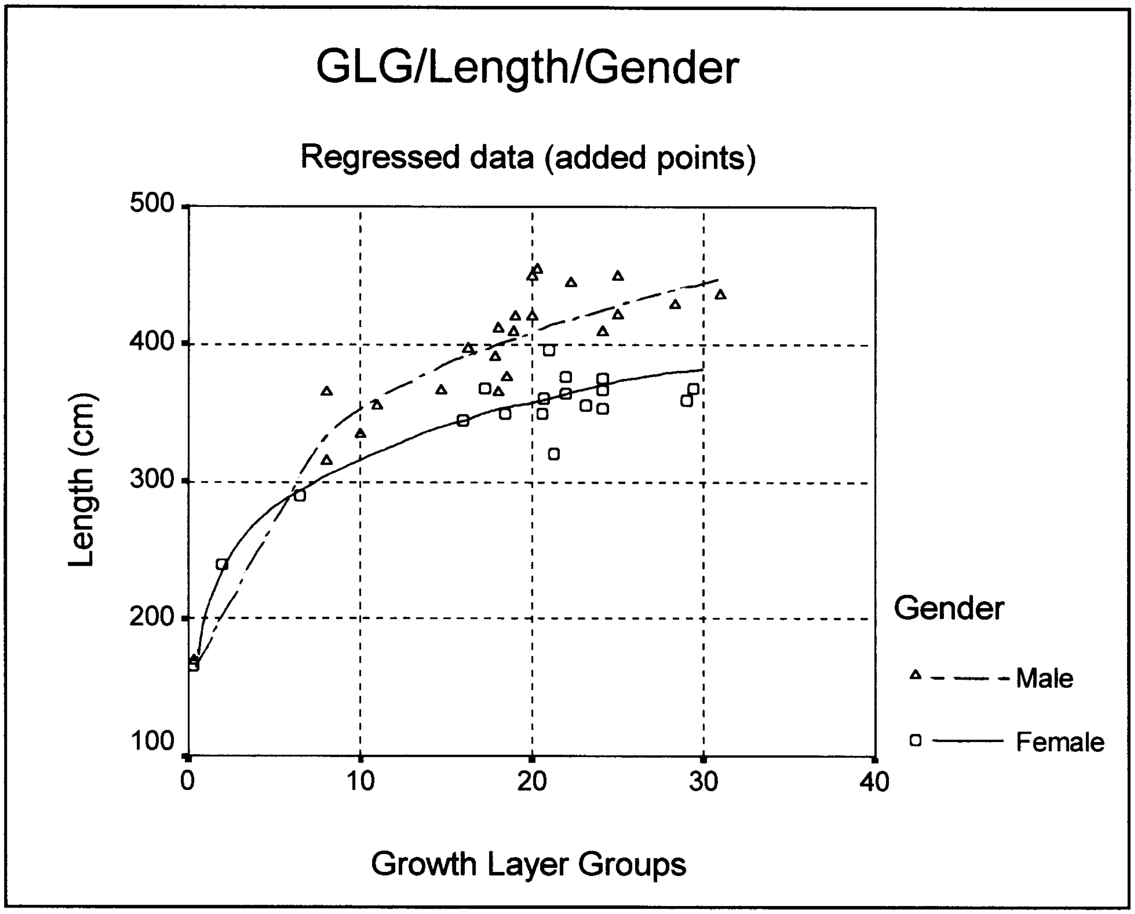

Figure 3-9. Cook Inlet beluga Growth Layer Groups/length curves (Vos 2003).

There is some discussion as to whether one GLG per year or two GLGs per year are laid down by belugas. The initial hypothesis that two GLGs per year were deposited by belugas was made by Sergeant (1959) and this hypothesis has been supported by many successive studies (Brodie 1969, 1982; Sergeant 1973; Goren et al. 1987; Brodie et al. 1990; and Heide-Jorgensen et al. 1994). The deposition of two layers per year would make belugas unique among odontocetes. Evaluation of previous work and analysis of two captive belugas (Hohn and Lockyer 1999), and radiocarbon signatures (Stewart et al. 2006) indicates that one GLG per year is more appropriate.

3.2.1.7 Prey and Foraging Behavior

Beluga whales are opportunistic feeders known to prey on a wide variety of animals. They eat octopus (*Enteroctopus dofleini*), squid, crabs (*Chionoecetes* spp.), shrimp (*Crangon* spp.), clams, mussels, snails, sandworms (*Trichodon* spp.), and fish such as capelin (*Mallotus villosa*), cod, herring (*Clupea pallasi*), smelt (*Spirinchus thaleichthys*), flounder (*Platichthys* spp.), sole, sculpin, lamprey (*Lampetra* spp.), lingcod (*Ophiodon elongates*), and salmon (*Oncorhynchus* spp.) (Perez 1990; Haley 1986; Klinkhart 1966). Alaska Natives also report that Cook Inlet beluga whales feed on freshwater fish: trout (*O. mykiss*), whitefish (*Coregonus oidschian*), northern pike (*Esox lucius*), eulachon (*Thaleichthys pacificus*), and grayling (*Thymallus arcticus*) (Huntington 2000), and on tomcod (*Microgadus proximus*) during the spring (Fay et al. 1984). Beluga whales in captivity may consume 4 to 7 percent their body weight daily (Sergeant 1969). Wild beluga whale populations faced with an irregular food supply or with increased metabolic needs may easily exceed these amounts while feeding on eulachon and salmon.

Beluga whales in Cook Inlet often aggregate near river and stream mouths where salmon runs occur. Calkins (1989) recovered 13 salmon tags from an adult beluga stomach found dead in Turnagain Arm. These salmon had been tagged in upper Susitna River. Beluga whale hunters in Cook Inlet reported one whale having 19 adult Chinook salmon in its stomach (Huntington 2000) and that one adult male beluga had 12 adult Coho salmon with a total weight of 27.8 kg (61.5 lbs) in its stomach (61.5 lbs) (NMFS unpublished data). Cook Inlet beluga stomach analysis has identified eulachon, Chinook salmon, chum salmon, and Coho salmon, saffron cod, walleye pollock, Pacific cod, yellowfin sole, starry flounder, crab, shrimp, polychaetes jaws and eggs, and Pacific staghorn sculpin (NMFS unpublished data).

The eulachon (also named hooligan and candlefish) is a very important food source for beluga whales in Cook Inlet. Eulachon may contain as much as 21 percent oil (total lipids) (Payne et al. 1999). These fish enter the upper inlet in May. Two major eulachon spawning migrations occur in the Susitna River, in May and July. The early run is estimated at several hundred thousand fish and the later run at several million (Calkins 1989). Harvested beluga stomachs from the Susitna area in spring have been filled with eulachon (NMFS unpublished data).

Data on the spring diet are limited to a beluga necropsy on April 1, 2003, which had thinner blubber than beach cast beluga whales found in summer. The stomach contained saffron cod (*Eleginus gracilis*), walleye pollock (*Theragra chalcogramma*), Pacific cod, eulachon, tanner crab (*Chionoecetes bairdi*), bay shrimp (*Crangon franciscorum*), and polychaetes. One whale necropsied on October 15, 2003 contained saffron cod, Pacific staghorn sculpin (*Leptocottus armatus*), yellowfin sole, and starry flounder (*Platichthys stellatus*); indicating a change from the summer salmon diet. This is consistent with other beluga populations that are known to feed on a wide variety of food. The thin blubber of the April whale suggests that winter prey resources are not as rich as summer prey and/or the belugas don't feed as much. Cook Inlet belugas may be in a caloric deficit during winter, depending on blubber stored during summer to supplement the limited food resources. However, more samples are required to confirm this hypothesis.

Beluga whales capture and swallow their prey whole, using their blunt teeth only to grab. These whales often feed cooperatively. Cook Inlet beluga concentrations offshore from several important salmon streams in the upper inlet are thought to represent a feeding strategy that takes advantage of the shallow bathymetry. The fish are funnelled into the channels formed by the river mouths, and the shallow waters act as a gauntlet for salmon as they move past waiting beluga whales. Dense concentrations of prey appear to be essential to beluga whale feeding behavior. Hazard (1988) hypothesized that beluga whales were more successful feeding in rivers where prey were concentrated than in bays where prey were dispersed. Fried et al. (1979) noted that beluga whales in Bristol Bay feed at the mouth of the Snake River, where salmon runs are smaller, than in other rivers in Bristol Bay. However, the Snake River mouth is shallower and, hence, may concentrate prey.

3.2.2 Known and Possible Factors Influencing the Population

Anthropogenic, or human-caused, sources of mortality can occur incidentally to other actions, or through direct takes. Successful Cook Inlet beluga recovery depends on identifying factors that cause this stock to continue to decline and implementing measures to control those factors. A review of anthropogenic factors that potentially affect Cook Inlet beluga whales indicates that subsistence harvest likely caused the decline observed between 1994 and 1998.

This document also examines the impacts of anthropogenic factors other than just subsistence harvest on Cook Inlet beluga whales. Important beluga habitat is located in upper Cook Inlet, therefore activities in this area that potentially affect beluga habitat will require continued monitoring and continued assessment on whether these activities adversely affect beluga recovery, with appropriate management measures implemented as necessary. Information on factors influencing the population is also described in detail in the 2005 Draft Conservation Plan for Cook Inlet Beluga Whales (NMFS 2005).

3.2.2.1 Human-Induced Factors

<u>Subsistence Harvest</u>

Cook Inlet belugas have traditionally been hunted by Alaska Natives for subsistence purposes and for handicrafts. With passage of the MMPA in 1972, Alaska Natives in Cook Inlet continued to legally harvest beluga whales, since the MMPA provides an exemption to its general prohibition on the taking of marine mammals to allow the harvest of marine mammals by Alaska Natives for subsistence purposes. The effect of past harvest practices on the present Cook Inlet beluga population is substantial, particularly the harvests of the mid-to late-1990s. While harvests occurred at traditional, but undocumented levels for decades, NMFS believes the subsistence harvest removals increased substantially in the 1980s. Subsistence harvest estimates between 1994 and 1998 account for the stock's sharp decline during that time. The observed decline and the reported harvest estimates (including estimates of whales which were struck but lost, and assumed to have perished) indicate these harvest levels were unsustainable.

Table 3-2 summarizes subsistence harvest data from 1993 to 1999 (Angliss and Lodge 2002). A study conducted by ADF&G estimated the subsistence harvest of belugas in Cook Inlet in 1993 at 30 whales without identifying struck but lost. However, in consultation with Native hunters from the Cook Inlet region, the Cook Inlet Marine Mammal Council (CIMMC) estimated the annual number of belugas taken by subsistence hunters prior to 1995 to be greater than what was reported (DeMaster 1995).

Table 3-2. Summary of subsistence harvest data from 1993 to 1999 (Angliss et al. 2001).

Year	Reported total number taken	Estimated range of total take	Reported number taken	Estimated number struck and lost
1993	30[1]	n/a	n/a	n/a
1994	21[1]	n/a	19[1]	2[1]
1995	70	n/a	42	26
1996	123	98-147	49	49-98
1997	70[2]	n/a	35[2]	35[2]
1998	44[2]	n/a	21	21
1999	0	0	0	0
Mean annual take (based on 1996-1999)	65			

[1] Estimated value
[2] Represents a minimum value

There was no systematic Cook Inlet beluga harvest survey in 1994. Instead, harvest data were compiled at the November 1994 Alaska Beluga Whale Committee (ABWC) meeting. CIMMC representatives, ADF&G Division of Subsistence, and an active Cook Inlet hunter presented harvest information they knew about. They discussed the information among themselves to eliminate redundancy, and agreed upon a final 1994 harvest estimate of 19 belugas retrieved and two struck but lost. This included two belugas taken in Cook Inlet by hunters from Kotzebue Sound. The ADF&G representative estimated that there were 35 to 50 active beluga-hunting households in the Cook Inlet region. Figure 3-10 provides a summary of Cook Inlet beluga whale subsistence harvest data for 1987 through 2007 (ABWC unpublished data; CIMMC unpublished data; Mahoney and Shelden 2000; NMFS unpublished data). The most thorough Cook Inlet beluga subsistence harvest surveys were completed by CIMMC for 1995 and 1996. While some local hunters believe the 1996 estimate of struck but lost is positively biased, CIMMC's 1995 and 1996 take estimates are considered reliable (Angliss et al. 2001). The annual subsistence take by Alaska Natives during 1995 through 1998 averaged 77 whales each year.

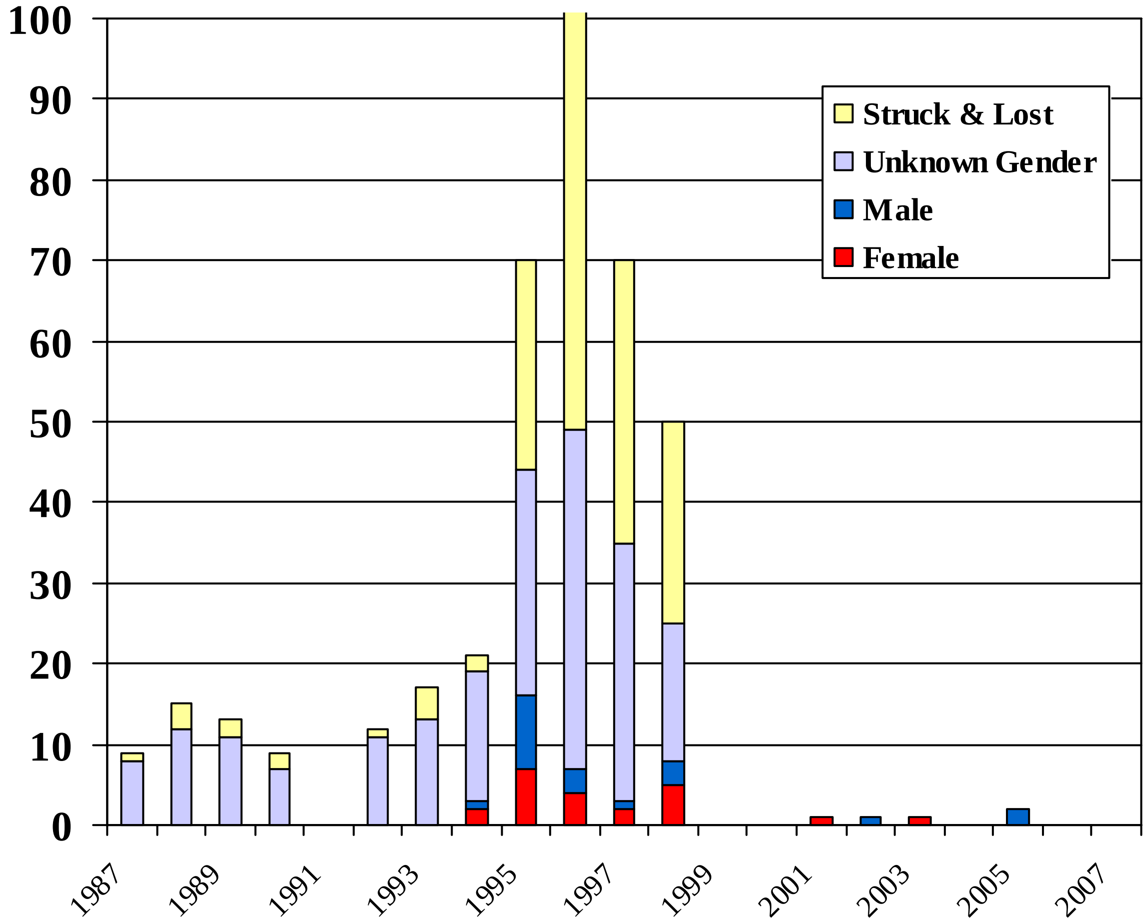

Figure 3-10. Known subsistence harvest of CI beluga from 1987 to the present. (Stanek 1994; CIMMC 1997 and 1996; Angliss and Lodge 2002; NMFS unpublished data).

The harvests, which were as high as 20 percent of the stock in 1996, were sufficiently high to account for the 14 percent annual decline in the stock during the period from 1994 through 1998 (Hobbs et al. 2000). In spring 1999 there was no harvest as a result of a voluntary moratorium by the hunters and Pub. L. 106-31. From 2000 through 2006 (except 2004) NMFS entered into annual co-management agreements for the subsistence harvest of Cook Inlet belugas. Subsistence harvests from 2000 to 2003 and from 2005 and 2006 were 0, 1, 1, 1, 0, 2, and 0 whales, respectively.

Additional historical perspective and information about Cook Inlet beluga subsistence harvest, and their effects to the stock's recovery are presented in three NMFS documents: the Final Environmental Impact Statement for Subsistence Harvest Management of Cook Inlet Beluga Whales (NOAA Fisheries 2003) and the 2005 Environmental Assessment for a co-management agreement between NMFS and the CIMMC (NOAA Fisheries 2005). For more detail on subsistence harvest of Cook Inlet beluga whales, please see Section 3.6.3.

Commercial Fisheries

State and federal directed commercial fisheries for shellfish, groundfish, herring, and salmon occur in Cook Inlet waters. Federally managed fisheries active in Cook Inlet during the summer period are in lower Cook Inlet/Northern Gulf of Alaska waters, for groundfish and crab. State-managed commercial fisheries in upper Cook Inlet include razor clams, a herring gillnet fishery, and salmon drift and set gillnet fisheries. Prior to 1998, the herring fishery had been closed for five years, and in 1998 was open briefly during April-May to gillnet gear. Harvests of herring have generally been concentrated in Tuxedni and Chinitna Bay areas in lower Cook Inlet (Ruesch and Fox 1999).

The largest fisheries, in terms of participant numbers and landed biomass, in Cook Inlet are the state-managed salmon drift and set gillnet fisheries concentrated in the Central and Northern districts of Cook Inlet. Operation times change depending upon management requirements, but in general the drift fishery operates from late June through August, and the set gillnet fishery during June through September. Belugas in Cook Inlet have been documented feeding on salmon (Chinook, chum, Coho, and sockeye) during June through September, while the state-managed salmon fisheries occur.

Salmon purse seine fisheries in lower Cook Inlet operate south of a line drawn west from Anchor Point within two districts, Kamishak Bay and Southern (divided at 152°20' West longitude), with most of the catch coming from the Southern District. Seine nets are infrequently employed in Chinitna Bay.

Other fisheries also occur in lower Cook Inlet for herring, lingcod and rockfish, and salmon. The lower Cook Inlet herring sac roe fishery is of extremely short duration (often minutes to hours) taking place sometime in or near April within Kamishak Bay. Landed herring biomass has fluctuated greatly since 1977, and this fishery was closed from 1999 through 2002. A mechanical/hand jig fishery for lingcod and rockfish also occurs in lower Cook Inlet state and federal waters.

Eulachon (smelt) commercial harvest occurred in 1978, 1980, 1998, 1999, 2006, and 2007 with catches of 136 kg (300 lbs), 1,814 kg (4,000 lbs), 8,573 kg (18,900 lbs), 45,359 kg (100,000 lbs), 41,187 kg (90,800 lbs) (Shields, personal communication, 2006), and 56,700 kg (125,000 lbs) (Shields, personal communication, 2006) respectively. All harvests took place in salt water near the Susitna River. While no quantitative assessment of Susitna River smelt stocks has been conducted, they would undoubtedly be measured in thousands of tons, likely even tens of thousands of tons (Shields 2005). NMFS made recommendations to the Board of Fisheries (BOF) to discontinue this commercial fishery, which has not operated since 2000. These recommendations were made, in part, because little data existed on the eulachon runs into the Susitna River, nor had any evaluation occurred as to the effect this fishery may have on beluga whales in terms of disturbance, harassment, or competition for prey. Additionally, it was noted that beluga whales may rely heavily on this oil-rich food source early in the spring (preceding salmon migrations) and that large eulachon runs occur in only a few upper Cook Inlet rivers. At the 2005 BOF meetings, a commercial fishery for smelt was reopened, beginning with the 2005 season. This fishery is allowed in salt water only from May 1 to June 30, from the Chuitna River to the Little Susitna River. Legal gear for the fishery was limited to a hand-operated dip net as defined in 5 Alaska Administrative Code (AAC) 39.105. The total harvest is not to exceed 100 tons of smelt. Any salmon caught during the fishery are to be released immediately and returned to the water unharmed. To participate in this fishery, a miscellaneous finfish permit is required as well as a commissioner's permit. Belugas in Cook Inlet have been documented feeding on eulachon during April through June in Susitna River and Turnagain Arm.

NMFS designed a rotational observer program to identify potential interaction ‘hot spots’ among commercial fisheries operations in Alaska. With the heightened concern in Cook Inlet, the program observed two Cook Inlet fisheries, salmon drift net and upper and lower Cook Inlet set gill net, in 1999 and 2000. Manly (2006) reported that the Cook Inlet drift net fishery had a total of 5,709 permit days (one permit fished for one day) of fishing in 1999 and 3,889 permit days of fishing in 2000, with all or part of 241 permit days of fishing observed for both years. The upper Cook Inlet set net fishery had a total of 5,455 permit days of fishing in 1999 and in 2000 there was a total of 3,239 permit days of fishing, with all or part of 668 permit days observed for both years. The lower Cook Inlet set net fishery had an estimated total for 968 permit days of fishing in 1999, with all or part of 28 permit days observed. No interactions with belugas were reported in the Cook Inlet fisheries in 1999 and 2000 (Manly 2006).

Personal Use Fisheries

Personal use gillnet fisheries also occur in Cook Inlet and have been subject to many changes since 1978 (Ruesch and Fox 1999) that are summarized in Brannian and Fox (1996). The most consistent recent personal use fishery is the use of single, 10-fathom gillnets for salmon in the Tyonek Subdistrict of the Northern District (Ruesch and Fox 1999). Personal use gillnets have been allowed within waters approximately 2.4 km (1.5 miles) of the Kasilof River. In 1995, personal use gillnets were allowed in most areas open to commercial salmon set gillnet fishing. Most areas were closed to personal gillnet use in 1996. Personal use salmon set gillnet fisheries are found in the Port Graham subdistrict in lower Cook Inlet.

Personal use fishing for eulachon (smelt) also occurs, with no bag or possession limits. The two primary areas where smelt are harvested in personal use fisheries are the Twenty Mile River (and nearby shore areas in Turnagain Arm) and Kenai River. Other areas where smelt are harvested include the Little Susitna and Susitna rivers and their tributaries, the Placer River, and shoreline areas of Cook Inlet, north of Ninilchik River. Annual harvests have ranged from 2.2 to 5 tons during the past decade. The personal use smelt harvest is possibly underreported as some participants may confuse their harvests as being subsistence and not personal use. Currently, no subsistence records are kept for smelt or herring harvests (Shields 2005).

Vessel Traffic and Shipping

Most of Cook Inlet is navigable and is used by various classes of watercraft. Commercial shipping occurs year round, with containerships traveling between the Pacific Northwest (Seattle, Puget Sound) and Anchorage. Other commercial shipping includes bulk cargo freighters and tankers. Various commercial fishing vessels operate throughout Cook Inlet, with some intensive use areas associated with the salmon drift and setnet fisheries. Sport fishing and recreational vessels are also common, especially within Kachemak Bay, along the eastern shoreline of the lower Kenai Peninsula, and between Anchorage and several popular fishing streams, which enter upper Cook Inlet. Port facilities in Cook Inlet are found at Anchorage, Port Mackenzie, Tyonek, Drift River, Nikiski, Kenai, and Homer. The Drift River facility, designed to accommodate tankers in the 150,000 deadweight-ton class, is used primarily as a loading platform for the shipment of crude oil. The Port of Nikiski has three medium draft piers and two shallow draft wharves. Activities here include service to offshore drilling platforms, and the shipping of anhydrous ammonia, dry bulk urea, liquefied natural gas, portable modules, and petroleum products.

The Port of Anchorage (POA), which began operations in 1961, is the state’s largest seaport and main port of entry. This deep draft facility serves 80 percent of Alaska, including major military installations, with rail, road, and air cargo connections. The POA handles more than 90 percent of all consumer goods sold in Southcentral and Interior Alaska. The facility stages 100 percent of the refined petroleum product exports from the state’s largest refinery in Fairbanks. It also connects directly with the Anchorage International Airport for competitive supplies of jet fuel and sea-air movement of cargo to Bush communities. The POA is currently expanding its size and capabilities to handle container traffic and cruise ships. The POA is located along lower Knik Arm, in an area heavily used by beluga whales.

Port MacKenzie, west of the POA in lower Knik Arm, is in another area used by belugas. The port consists of a 152 m (500 ft) bulkhead barge dock and a 366 m (1,200 ft) long deep draft dock. The Matanuska-Susitna Borough plans to provide services for bulk commodity storage, and a floatplane basin to serve Anchorage air taxi and private pilots. A ferry, bridge, and railroad spur are all planned for Port MacKenzie.

Several improved and unimproved small boat launches exist along the shores of upper Cook Inlet. The Municipality of Anchorage maintains a ramp and float system for small watercraft near Ship Creek. Other launches are: Knik River Bridge; old Knik, along the western shore of Knik Arm; Tyonek; Deshka Landing, Susitna River, and Little Susitna River Public Access at Burma Landing.

Fire Island Shoals, the POA and Port MacKenzie, are currently the only large vessel routes or port facilities in important Cook Inlet beluga whale habitat. While large vessels generate in-water noise, which may adversely affect beluga whales, they are not expected to have a major impact on belugas in regards to ship strikes.

<u>Tourism</u>

Tourism, wildlife viewing in particular, is a growing component of Alaska's state and regional economies. Visitors highly value the opportunity to view Alaska's wildlife and the belugas' uniqueness to northern waters makes opportunities to view them especially valuable. Beluga whales are commonly seen in upper Cook Inlet, typically in large groups (20 to 50 belugas). Because these waters are easily accessible from Anchorage, visitors often take the opportunity to whale watch. Many tour buses routinely stop at wayside sites along Turnagain Arm in the summer, where beluga whales are seasonally observed. Although several commercial whale-watching ventures were attempted during the last decade, at present no vessel-based whale watching companies operate in upper Cook Inlet.

<u>Coastal Development</u>

Southcentral Alaska is the state's most populated and industrialized area. Many cities, villages, ports, airports, treatment plants, refineries, highways, and railroads are situated on or very near to Cook Inlet. Belugas are not uniformly distributed throughout Cook Inlet, but instead are predominantly found in nearshore waters. Here, beluga whales must compete with people to use near shore habitats. Coastal development such as landfills, docks, wharves, etc. leads to direct loss of beluga habitat, while indirect alteration of habitat may occur due to bridges, boat traffic, in-water noise, prey availability, and discharges that affect water quality. Bulkheads may reduce shallow feeding habitat, but may concentrate fish and provide beluga whales with a feeding advantage. Despite insufficient information, it seems reasonable to advocate some standards related to coastal development.

Knik Arm Development

While approximately 98 percent of Knik Arm remains undeveloped, there are several planned or proposed projects in the lower portion of Knik Arm including: a commercial ferry and docking facility between Port McKenzie and Anchorage; a major expansion of the POA and additional dredging to support deep-draft vessels; expansion of Port McKenzie; and a causeway and bridge crossing north of the existing POA. Knik Arm is an important feeding area for beluga whales during much of the summer, especially mid and upper Knik Arm. Whales ascend to upper Knik Arm on the flood tides, feed on anadromous fish, and then retreat with the outgoing tide to waters around the POA. The primary concern for belugas is to insure unrestricted passage in Knik Arm; however, the potential to impact these whales has risen with the increasing number and size of projects planned for Knik Arm.

Dredging

Dredging along coastal waterways has been identified as a concern with respect to the Saint Lawrence River belugas in Canada (Department of Fisheries and Oceans 1995). There, dredging up to 600,000 m^3 (184,770 cubic yards) of sediments has re-suspended contaminants into the water column. The Saint Lawrence River belugas have been seriously affected by such pollutants and, because of this, the recovery plan for the Saint Lawrence River whales contains recommendations to reduce dredging amount and to develop more environmentally sound dredging techniques. While the volume of dredging in Cook Inlet is comparable to Saint Lawrence River (more than 458,733 m^3 [844,000 cubic yards] in 2003 at the POA), the material does not contain harmful contaminant levels. Chemical analysis of these sediments in 2003 found that pesticides, polychlorinated biphenyls (PCBs), petroleum hydrocarbons were below detection limits, while levels of arsenic, barium, chromium, and lead were well below management levels (USACE 2003). Cadmium, mercury, selenium, and silver were not detected.

Road Construction

Potential development, road construction, and upgrade projects include: Seward Highway improvements along Turnagain Arm, the south coastal trail extension in Anchorage, Knik Arm Bridge in Knik Arm, Chuitna Coal project with a marine terminal off Ladd Point (south of Beluga River), and Pebble Mine with a marine terminal in Iniskin Bay.

Oil and Gas Activities

Much of the Cook Inlet region overlies important oil and natural gas reserves. Petroleum industry activity in upper Cook Inlet and on the Kenai Peninsula dates back to the 1950s. At the peak of oil and gas development there were 15 offshore production and three onshore treatment facilities, and approximately 370 km (230 miles) of undersea pipelines (129 km [80 miles] of oil pipeline and 241 km [150 miles] of gas pipeline) in Cook Inlet. Due to a continuous production decline, some of these facilities closed in 1992. Between 1962 and 1994, about 546 wells were drilled in Cook Inlet (MMS 2003). One Continental Offshore Stratigraphic Test well and 11 exploration wells were drilled in federal waters; and 75 exploration and 459 development and service wells were drilled in state waters, primarily in mid to upper Cook Inlet. Approximately six to seven new wells are drilled annually, of which four or five are oil or gas production wells. EPA regulates the discharges from these offshore platforms, which include drilling muds, drill cuttings, and production (formation) waters. Drilling fluids (muds and cuttings) discharged into Cook Inlet average 89,000 barrels annually (about 244 barrels a day) and contain several pollutants.

Alaska Department of Natural Resources has held an annual Cook Inlet Areawide Oil and Gas Lease Sale since 1999, and will do so through 2009. These annual sales offer lease tracts throughout state waters in Cook Inlet, including the Susitna River delta.[4] The 2001 through 2005 spring sales did not include 122 “beluga whale tracts” that were deferred as a result of litigation on the Cook Inlet Areawide final finding (Slemmons, personal communication, 2006). These deferred tracts were located in the Susitna River delta, mouths of the Kenai and McArthur River, and Chickaloon Bay. Lease sales also meet restriction and mitigation measures in state-designated critical habitat/conservation areas.

[4] The Susitna delta area is defined as the mud flat area that extends from Beluga River to Little Susitna River.

On May 19, 2004, MMS conducted Sale 191, a federal Oil and Gas lease sale within the Cook Inlet portion of Alaska's Outer Continental Shelf. Sale 191 offered 10,117 km^2 (2.5 million acres) between 4.8 and 48 km (3 and 30 miles) offshore. This lease area is in lower Cook Inlet, largely between Kalgin Island and Cape Douglas. Beluga whales are sometimes found in the sale area, but there is little information on their seasonal presence, movements, or habitat use.

Seismic operations occurred in-water in the upper Cook Inlet near 1) Beluga River between April 8 and May 13, 2007, where a total of approximately 83.5 km (52 miles) of trackline was shot from the seismic vessel; and 2) Granite Point between September 28 and October 22, 2007, where a total of approximately 418 km (260 miles) of trackline was shot from the seismic vessel. Seismic operation also occurred in lower Cook Inlet at North Ninilchik between October 25 and November 12, 2007, where a total for approximately 150 km (93 miles) of trackline was shot from the seismic vessel.

Oil and gas activities may include marine geophysical (seismic) surveys; vessel operations; low altitude aircraft operations; well drilling; and marine discharge of: drilling muds and cuttings; produced waters; gray waters; sanitary wastes; and oil spills (which are low probability events).

Drilling Muds and Cuttings

EPA's NPDES general permit authorizes the discharge of approved generic drilling muds and additives into waters of Cook Inlet. Drilling muds consist of water and a variety of additives; 75 to 85 percent of the volume of most drilling muds currently used in Cook Inlet is water (Neff 1991).

When released into the water column, the drilling muds and cuttings discharges tend to separate into upper and lower plumes (Menzie 1982). The upper plume contains the solids and water soluble components that separate from the material of the lower plume and are kept in suspension by turbulence. Marine organisms have limited exposure to drilling muds discharged at the surface, which disperse rapidly (National Research Council [NRC] 1983). Most discharged solids, more than 90 percent, descend rapidly to the sea floor in the lower plume. The sea floor area where the discharged materials are deposited depends on water depth, currents, and material particle size and density (NRC 1983). In most outer continental shelf areas, the particles are deposited within 152 m (500 ft) below the discharge site; however in Cook Inlet, which is considered to be a high energy environment, the particles are deposited in an area that is more than 152 m (500 ft) below the discharge site (NRC 1983).

Since 1962, there have been about 546 wells drilled in Cook Inlet. One Continental Offshore Stratigraphic Test Well and 11 exploration wells were drilled in federal waters and 75 exploration and 459 development and service wells were drilled in state waters, mainly in upper Cook Inlet (Alaska Oil and Gas Conservation Commission 1993). From 1962 through 1970, 292 wells were drilled (62 exploration and 230 development and service wells) (Alaska Oil and Gas Conservation Commission 1993). From 1971 through 1993, the drilled wells ranged from three to 20 wells per year; the average drilling rate is about 11 wells per year.

Industrial Pollutants

Oil Spills

Petroleum production, refining, and shipping in Cook Inlet present a possibility for oil and other hazardous substances to be spilled, and to affect the Cook Inlet beluga whale stock. The Outer Continental Shelf Environmental Assessment Program estimated that 3,339 cubic meters (21,000 barrels) of oil were spilled in the inlet between 1965 and 1975, while 1,590 cubic meters (10,000 barrels) were spilled from 1976 to 1979 (MMS 1996). In July 1987, the Tanker/Vessel (T/V) *GLACIER BAY* struck an uncharted rock near Nikiski, Alaska, discharging an estimated 214.6 to 604.2 cubic meters (1,350 to 3,800 barrels) of crude oil into Cook Inlet (USCG 1988). Beluga whales are found in the area where this spill occurred. In February 2005, T/V *SEABULK PRIDE* was torn from its moorings by heavy ice and tides in mid Cook Inlet. Approximately 302.8 liters (80 gallons) of product was spilled before the tanker was safely retrieved.

Contaminants

Contaminants are a concern for beluga whale health and subsistence use (Becker et al. 2000). The principal sources of pollution in the marine environment are: 1) direct discharges from industrial activities (petroleum, seafood processing, and ship ballast); 2) discharges from municipal wastewater treatment systems; 3) runoff from urban, mining, and agricultural areas; and 4) accidental spills or discharges of petroleum and other products (Moore et al. 2000). EPA regulates the discharges from these offshore platforms, which include drilling muds, drill cuttings, and production waters (the water phase of liquids pumped from oil wells). Drilling fluids (muds and cuttings) discharged into Cook Inlet average 89,000 barrels annually (244 barrels daily), containing several pollutants (MMS 1996). At the peak of infrastructure development, there were 15 offshore production facilities, three onshore treatment facilities, and approximately 368 km (230 miles) of undersea pipelines in upper Cook Inlet (MMS 1996).

Produced Waters

In this section, the characteristics of the produced waters, as well as other discharges described, except drilling muds and cuttings, are based on information obtained during the Cook Inlet Discharge Monitoring Study conducted between April 10, 1988, and April 10, 1989 (Ebasco Environmental 1990a, 1990b). These waters are part of the oil/gas/water mixture produced from oil wells, and contain a variety of dissolved substances. In oil drilling activities, chemicals are added to the fluids used in processes including: water flooding; well work-over, completion, and treatment; and the oil/water separation process. Before discharging into Cook Inlet, produced waters pass through separators to remove oil. The treatment process removes suspended oil particles from the wastewater, but the effluent contains dissolved hydrocarbons or those held in colloidal suspension (Neff and Douglas 1994).

Municipal Waste and Runoff

Cook Inlet is the major population center in Alaska, with a 2006 estimated population (U.S. Census Bureau) for the Anchorage Borough exceeding 280,000, the Matanuska-Susitna Borough at 77,174 and the Kenai Peninsula Borough at 51,350. Ten communities currently discharge treated municipal wastes into Cook Inlet. Wastewater entering these plants may contain a variety of organic and inorganic pollutants including: metals, nutrients, sediments, drugs, bacteria, and viruses. Wastewater from the Municipality of Anchorage, Nanwalek, Port Graham, Seldovia, and Tyonek receives only primary treatment, while wastewater from Homer, Kenai, and Palmer receives secondary treatment (NOAA 2003). Eagle River and Girdwood have modern tertiary treatment plants (Moore et al. 2000).

Anchorage Wastewater Treatment Facility was built in 1972 and serves the entire Anchorage area. This facility has been upgraded twice: in 1982 to a 105,992 m^3 (28 million gallons) per day facility and in 1989 to a 219,554 m^3 (58 million gallons) per day facility. Plant influent is primarily of domestic origin, although an industrial component is included. The existing facility provides primary treatment for a design average flow of 219,554 m^3 (58 million gallons) per day and a maximum hourly flow of 582,953 m^3 (154 million gallons) per day. An average daily discharge of 136,275 m^3 (36 million gallons) per day was projected for 2005, with the exiting outfall discharged to Knik Arm. The outfall extends 245 m (804 ft) from shore and terminates as a trifurcated diffuser in water with a mean lower low water depth of 4.5 m (15 ft). The discharge depth of the diffuser during the typical 24 hour tidal cycle studies range from 3.5 to 12.3 m (11.5 ft to 40.5 ft). Existing treatment units provide screening, grit removal, sedimentation, skimming, and chlorination. Sludge from the primary clarifiers is thickened and dewatered. The dewatered sludge and skimmings are incinerated and the ash disposed in a sanitary landfill. Within the permit period, sludge volume is expected to increase above incinerator capacity. The excess sludge will be dewatered and disposed at the city's landfill. Chlorinated primary effluent is discharged through a 305 cm (120-inch) diameter chlorine contact tunnel and then through a 213 cm (84-inch) diameter outfall to Cook Inlet.

The Municipality of Anchorage operates under a National Pollutant Discharge Elimination System (NPDES) storm water permit to discharge storm water to U.S. receiving waters. The Stormwater Phase I Rule (55 FR 47990; November 16, 1990) requires all operators of medium and large municipal separate storm sewer systems (MS4) to obtain a NPDES permit and develop a stormwater management program designed to prevent harmful pollutants from being washed by stormwater runoff into the MS4 (or from being dumped directly into the MS4), then discharged from the MS4 into local water bodies.

The Municipality of Anchorage's NPDES stormwater permit (AKS05255) is a five-year term permit to discharge stormwater to U.S. receiving waters issued jointly to the Municipality of Anchorage and the Alaska Department of Transportation and Public Facilities by the USEPA Region 10. An annual report to EPA is required by the permit (Municipality of Anchorage 2006). The stormwater NPDES program addresses many aspects of stormwater management. The 2005 report (Municipality of Anchorage Watershed Management Program 2006) addresses coordination and education, land use policy, new development management, construction site runoff management, flood plain management, street maintenance, and best management practices for pollutant sources and controls, illicit discharge management, industrial discharge management, pesticides management, pathogens management, watershed mapping, hydrology, water quality, ecology and bioassessment, and watershed characterization.

Scientific Research

NMFS has conducted research on Cook Inlet beluga whales since 1993, which has resulted in extensive publications and research papers, significantly improving our understanding of Cook Inlet beluga ecology and biology. However, many important aspects of Cook Inlet beluga biology remain unknown or incompletely studied. Management of this stock through recovery will require knowledge on annual abundance levels, life history parameters and ecology, and habitat requirements. As funding is available, NMFS will continue current research projects and when possible expand these projects or develop new research programs to address critical issues. High priority will be given to continuing NMFS' annual abundance surveys, as an index of population trajectory.

Other research goals are to investigate seasonal and tidal movements, dive patterns, and habitat use, and to relate these to available prey, risk of predation, and reproductive activities; to identify genetic diversity and patterns within the population and distance from other beluga populations; to identify and monitor human activity effects on beluga behaviour, either by disturbance of behaviours or avoidance of human activities; identify health concerns (contaminants, parasites, etc.) and to develop a population age and growth model to relate life history, habitat parameters, and anthropogenic disturbance to population recovery.

Techniques may include the following: aerial surveys; shore based observations; acoustic studies; live capture to attach satellite transmitters and time-depth recorders; skin and blubber biopsies; blood and mucous samples; beluga necropsies to collect stomach contents, reproductive tracts, and other biological samples, for aging, genetic, diet, parasitology, pathology, and other studies; stable isotope and fatty acid analysis; literature review; remote sensing data analysis and other sources of habitat data; and computer-based modeling. All Cook Inlet beluga studies and monitoring are conducted with appropriate permits and in association with interested Native hunter organizations. Research may be conducted at federal, state, and/or private levels.

NMFS conducts aerial surveys under MMPA Scientific Research Permit No. 782-1438. Satellite tagging has been conducted under MMPA Scientific Research Permit No. 957 and 782-1438. LGL research is under MMPA Scientific Research Permit No. 481-1795.

Noise

Beluga whales are known to be among the most adept users of sound of all marine mammals. Beluga whales use sound rather than sight for many important functions, and have evolved this use to very sophisticated levels. This is, perhaps, not startling considering that belugas are often found in waters with very poor visibility and live in northern latitudes where darkness extends for many months. Beluga whales use sound to communicate, locate prey, and navigate, and may make different sounds in response to specific stimuli. Beluga whales produce high frequency sounds which they use as a type of sonar, producing a series of signals that are concentrated and directed through a structure located on the whale's head (the melon), and whose returning echoes are received through the lower jawbone and transmitted to the brain. This echolocation is used for finding and pursuing prey, and is probably useful in navigating through ice and silt laden waters.

In Cook Inlet, beluga whales must compete acoustically with natural and anthropogenic sounds. Noise in Cook Inlet includes large and small vessels, aircraft, oil and gas drilling, marine seismic surveys, pile driving, and dredging. Particular concern may be warranted for certain activities in Knik Arm that produce noise, including: the POA expansion, large and small vessels, a proposed causeway and bridge across lower Knik Arm, annual dredging, and a marine ferry. Manmade noise effects depend on several factors including: the noise intensity, frequency and duration; beluga location and behavior; and the acoustic nature of the environment. High frequency noise diminishes more rapidly than lower frequency noise. Sound also attenuates more rapidly in shallow waters and over soft bottoms (sand and mud). Much of upper Cook Inlet is generally a poor acoustic environment because its shallow depth, sand/mud bottoms, and high background noise from currents and glacial silt (Blackwell and Greene 2002).

Research on captive animals has found that beluga whales hear best at relatively high frequencies between 10 and 100 kHz (Blackwell and Greene 2002). This is generally above the level of many industrial noises. However, beluga whales may hear sounds down to 40 to 75 Hz, although this noise would have to be very loud. The beluga's hearing falls off rapidly above 100 kHz. Whenever noise exceeds background or ambient levels, it may be detectable by whales. Anthropogenic noise above ambient levels and within the same frequencies used by belugas may mask communication between these animals. In fact, belugas modify their vocalizations in response to noise levels (Scheifele et al. 2005). At louder levels, noise may result in disturbance and harassment, or cause temporary or permanent damage to the whales' hearing.

Aircraft Noise

Richardson et al. (1995) and Richardson and Malme (1993) provided aircraft sound summaries in water. When reporting a source level for an aircraft, the standard range of 300 m (984 ft), rather than 1 m (3.2 ft), is assumed, because "the concept of a 1 m source underwater noise level from an aircraft is not very meaningful" (Richardson et al. 1995). The sound transmission surface area, from air to water, is described by a cone where the cone's apex is the aircraft, and the cone has an aperture of 26 degrees. In general, underwater noise from aircraft is loudest directly beneath the aircraft and just below the water's surface, and sound level from the same aircraft is much lower underwater than the sound level in air. The noise duration is short, because noise is generally reflected off the water surface at angles greater than 13 degrees from the vertical. Helicopters tend to be noisier than fixed wing aircraft. The noise amount entering the water depends primarily on aircraft altitudes and the resultant 26-degree cone, sea surface conditions, water depth, and bottom conditions (Richardson et al. 1995).

Ship and Boat Noise

Ships and boats create high levels of noise both in frequency range and intensity level. Ship traffic noise can be detected at great distances. High speed diesel-driven vessels tend to be much noisier than slow speed diesel or gasoline engines. Small commercial ships are generally diesel-driven, and the highest 1/3-octave band is in the 500 to 2,000 Hz range, within the known audible range for belugas. Tugs can emit high levels of underwater noise at low frequencies.

Offshore Drilling and Production Noise

Sound produced by oil and gas drilling may be a significant component to the noise in the local marine environment, but underwater noise from the drilling platforms is expected to be relatively weak because of the small surface area in contact with the water, namely the four legs (Richardson et al. 1995). However, through the columns and into the bottom, machinery vibrations may be notable, accounting in part for the high sound levels observed at low frequencies (less than 30 Hz) (Blackwell and Greene 2002). Gales (1982) summarized noise from 11 production platforms. Four production platforms produced the strongest tones at very low frequencies, between 4.5 and 38 Hz, at ranges of 6 to 31 m (19.7 to 101.7 ft).

Seismic Exploration Noise

Cook Inlet geophysical explorations are often accomplished using vessel-based seismic surveys. Seismic surveys produce some of the loudest noises in the marine environment, caused by intense, underwater bursts of compressed air, which may propagate energy for great distances. These surveys produce noise at very low frequencies, often below 100 Hz. In 2003 a seismic exploration program occurred in offshore areas near Tyonek, the Forelands, Anchor Point, and west of the Clam Gulch Habitat Area. Another seismic program occurred near Anchor Point in fall 2005. Seismic exploration occurred in spring 2007 by Beluga River and fall 2007 off Granite Point and Ninilchik. Seismic exploration is associated with both state and federal offshore tracts.

3.2.2.2 Natural Factors

Predators

The only known non-human predators of Cook Inlet belugas are killer whales. Three killer whales types are currently recognized: resident, transient, and offshore. Only transients feed exclusively on marine mammals. NMFS has received reports of killer whales throughout Cook Inlet but they are more commonly found in lower Cook Inlet and the Gulf of Alaska (Shelden et al. 2003), where both transient and resident ecotypes have been observed. In upper Cook Inlet, sightings have been reported in Turnagain and Knik Arms, between Fire Island and Tyonek, and near the mouth of the Susitna River (Shelden et al. 2003). Native hunters report that killer whales are usually found along the tide rip that extends from Fire Island to Tyonek (Huntington 2000). Killer whales have been stranded along Turnagain Arm on at least two occasions. Six killer whales were found alive and stranded in Turnagain Arm in May 1991, and five were stranded alive in August 1993 (Shelden et al. 2003). During the stranding event in August 1993, a large male vomited a large piece of beluga whale flesh, as well as some harbor seal tissue (Shelden et al. 2003). In September 2000, a NOAA Enforcement agent observed about four killer whales chasing a beluga group in Turnagain Arm (Shelden et al. 2003). Within the next two days, two lactating females became stranded, exhibiting teeth marks, internal hemorrhaging, and other injuries consistent with killer whale attack.

The number of killer whales visiting upper Cook Inlet appears to be small, with only five and six whales involved in each observed stranding (Shelden et al. 2003). This may be a single killer whale pod that extends its feeding territory into Cook Inlet. Photographs of the stranded killer whales in upper Cook Inlet suggest that they were unidentified transients, based on morphology of the dorsal fin (Shelden et al. 2003). Resident killer whales may also follow fish runs into upper Cook Inlet, where they compete with belugas for available prey. Therefore, sighting of killer whales in proximity to belugas in upper Cook Inlet does not necessarily mean that the killer whales are feeding on belugas.

Parasitism and Disease

Nearly every wild animal has some parasites, and the role of parasites in causing disease and mortality is often difficult to interpret. Similarly, bacterial agents are part of normal flora, and presence of these organisms needs to be interpreted cautiously as to whether they are commensals or pathogens or secondary invaders. According to some reports, bacterial infection, particularly in the respiratory tract, is one of the most common diseases encountered in marine mammals, including small cetaceans.

Between 1998 and 2007, varying degrees of necropsies and sampling were performed on 18 stranded Cook Inlet beluga whales. Seven were young or subadult belugas and 11 whales were adults. Ten belugas were male, seven belugas were female (one pregnant), and the gender of one was not identified. In many cases, carcasses were in advanced autolysis, so minimal diagnostics could be performed. However, some information and data on parasites and possible diseases were determined.

Information on parasites, disease agents, and pathology in belugas populations is available in the literature. In a review paper by Measures (2001) lung worms (nematodes) described in belugas include: *Pharurus pallasii, Stenurus artomarinus, Halocercus monoceris,* and possibly *Stenurus minor*. *P. pallasii* are reported to be very common in some beluga populations (85 to 88 percent) in Canada. "Lungs worms" can often not only parasitize the lungs, but sinuses, ears, auditory tubes, and potentially the cranial vault. Lung worms seem to be common in Cook Inlet belugas, although this is primarily based upon histologic findings. Six out of nine belugas, with a histological examination of the lung, had inflammation suggestive of parasitic etiology and one of these cases had intralesional parasites. More intensive gross examinations will most likely reveal the extent of lungworm infestation; adult parasites are required to identify the genus and species. Subsistence harvested belugas in Point Hope and Point Lay, Alaska were also found to have similar lung worm lesions. Gross evidence of pulmonary nematode infection was observed in 56 percent (14 of 25) beluga lungs examined in the two villages, with Point Hope belugas (85 percent) more severely infected than those in Point Lay (38 percent) (Woshner 2000).

Parasites of the stomach (most likely *Contracecum* or *Anisakis*) are often present in Cook Inlet beluga whales. These infestations were not considered to be extensive enough to cause clinical signs, although *Anisakis* worms associated with stomach ulcers in Saint Lawrence Estuary belugas were attributed as cause of death in two animals (DFO 1995). In most cases in which the stomach was examined, there were either nematodes grossly evident, or an eosinophilic gastritis suggestive of parasitism.

Approximately 80 percent of examined Cook Inlet belugas have had the nematode *Crassicauda giliakiana* in the kidney, with associated inflammatory reaction to this parasite. Similar parasites are rarely mentioned in belugas from Point Lay, Alaska (O'hara and Woshner, personal communication, 2006) or in published reports from the Saint Lawrence Estuary (Martineau et al. 1988) and Mackenzie River, but are mentioned in eastern Canadian beluga and bowhead whales (Vlasman and Campbell 2003). Although the life cycle is not completely understood for the *Crassicauda* nematodes, one hypothesized life cycle involves an intermediate host. Thus, the presence of the parasite in a large proportion of the Cook Inlet belugas and not in other areas, most likely indicates that Cook Inlet and eastern Canadian belugas are feeding on an intermediate host not available or common to other beluga populations. If the life cycle is direct, there must be other reasons why there is such a difference in the prevalence of this parasite. Although extensive damage and replacement to tissues are associated with this infection in some Cook Inlet belugas, it is unclear whether this results in functional damage to the kidney (Burek 1999a) or whether it is affecting the population status. Secondary effects of thromboembolism to other organs typical of infection with *Crassicauda boopsis*, a related parasite seen in large cetaceans, were not observed in Cook Inlet belugas with *C. giliakiana*. Under usual circumstances and infestation levels, these animals most likely live with this parasite with no clinical effect. However, it is possible that with heavy infestation, there could be replacement of enough of the kidney (2/3 to 3/4 of the kidney tissue) to affect function or obstruct urine outflow. This severe case has not been observed in the small number of Cook Inlet beluga carcasses examined.

Cook Inlet belugas commonly have encysted protozoal organisms within muscle tissue. The parasite is consistent with *Sarcocystis* sp., which is thought to be incidental and non-pathogenic. This parasite was also reported in the Saint Lawrence Estuary belugas (DeGuise et al. 1993).

One Cook Inlet beluga demonstrated a grossly evident lesion in the liver histologically, due to a liver trematode (Burek, personal communication, 2007). This trematode was not identified, but was most likely a *Campulid* type trematode. The *Hadwenius* sp. trematodes have been described in the pancreas and pancreatic ducts in other populations.

Burek reported two Cook Inlet belugas with skin lesions suggestive of a viral etiology, such as herpes virus (Burek, personal communication, 2007). Several subsistence harvested belugas were examined; however, there is no confirmation on the viral etiology at this time. Ongoing investigations include viral polymerase chain reaction. Other differentials for skin lesions include poxvirus, papillomavirus, caliciviruses, drug reactions, and a variety of bacterial agents including Erysipelothrix, Vibrio sp., and Dermatophilus sp.

A young (130 cm [51 in]) female found stranded on September 17, 2000 was necropsied and found to have severe parasitic pneumonia, with likely secondary bacterial involvement, hepatic tremotodiasis, ulcerative dermatitis, linguitis, and probable sepsis. Although the death was attributed to probable infectious disease, since this was a single stranding, it was probably not of significance to the population.

Alaska beluga whale populations appear to be relatively free of ectoparasites, although both the whale louse, *Cyamus* sp., and acorn barnacles, *Coronula reginae*, are recorded from stocks outside of Alaska (Klinkhart 1966). Endoparasitic infestations are more common, such as *Pharurus oserkaiae* in Alaskan belugas, *Anisakis simplex* in eastern Canadian belugas, and *Coryosoma* sp. (Klinkhart 1966).

Necropsies have found heavy infestations in adult Cook Inlet beluga whales of the nematode *Crassicauda giliakiana*. Approximately 90 percent of examined kidneys have been infected by *C. giliakiana*. This parasite also occurs in other cetaceans, such as Cuvier's beaked whale. Although extensive damage and replacement of tissues have been associated with this infection, it is unclear whether this results in functional damage to the kidney (Burek 1999a). Stomach parasites (most likely *Contracecum* or *Anisakis*) are often present in Cook Inlet beluga whales. These infestations have not, however, been considered to be extensive enough to have caused clinical signs. *Sarcocystis* sp. has also been found in muscle tissue from Cook Inlet beluga whales. This organism's encysted (muscle) phase is thought to be benign.

Trichenella spiralis (a parasitic nematode) has an arctic form that is known to infect many northern species including polar bears, walrus, and to a lesser extent ringed seals and beluga whales (Rausch 1970). "Arctic trichinosis" literature is dominated by reports of periodic outbreaks among Native people (Margolis et al. 1979). The organism's effect to the host marine mammal is not known (Geraci and St. Aubin 1987).

Only basic information exists on the occurrence of diseases in Cook Inlet beluga whales, while a considerable amount of information exists on diseases and their effects on other beluga whale populations. Respiratory tract bacterial infection is one of the most common diseases encountered in marine mammals.

Bacterial pneumonia, either alone or in conjunction with parasitic infection, is a common cause of beach stranding and death in belugas (Howard et al. 1983). From 1983 to 1990, 33 percent of stranded beluga whales in the Saint Lawrence estuary (n = 45 sampled) were affected by pneumonia (Martineau et al. 1994). One beluga apparently died from the rupture of an "aneurysm of the pulmonary artery associated with verminous pneumonia" (Martineau et al. 1986).

Stranding Events

Beluga whale strandings in upper Cook Inlet are not uncommon. NMFS has reports on 817 strandings (both individual and mass strandings) in upper Cook Inlet since 1988 (Vos and Shelden 2005; NMFS unpublished data). Mass strandings primarily occur in the Turnagain Arm mudflats and often coincide with extreme tidal fluctuations ("spring tides") and/or killer whale sighting reports (Shelden et al. 2003). These mass strandings involve both adult and juvenile beluga whales that are apparently healthy, robust animals. Gender ratios for stranded belugas were approximately 50:50. In 2003, an unusually high number of beluga whale live strandings (five events) and mortalities (20 confirmed) occurred in Cook Inlet (Table 3-3).

Table 3-3 Cook Inlet beluga yearly summaries of live strandings and total mortality events (Vos and Shelden 2005; NMFS unpublished data).

Year	Live stranded belugas			Dead stranded belugas*
	Number of reported live belugas per event	Date of live stranding	Location of live strandings	Total reported beluga mortalities per year
1988	27	23 Oct	Turnagain Arm	0
1989	0	-	-	4
1990	0	-	-	2
1991	70-80	31 Aug	Turnagain Arm	2
1992	0	-	-	5
1993	10+	06 July	Turnagain Arm	1
1994	186	14 June	Susitna River	7
1995	0	-	-	2
1996	63 60 20-30 01 10-20	12 June 28 Aug 02 Sept 08 Sept 02 Oct	Susitna River Turnagain Arm Turnagain Arm Knik Arm Turnagain Arm	12
1997	0	-	-	3
1998	30 05	14 May 07 Sept	Turnagain Arm Turnagain Arm	10
1999	58 12-13	29 Aug 09 Sept	Turnagain Arm Turnagain Arm	12
2000	08 02 15-20	27 Aug 24 Oct 24 Sept	Turnagain Arm Turnagain Arm Turnagain Arm	13
2001	0	-	-	10
2002	0	-	-	13
2003	02 46 26 32 09	18 April 28 Aug 06 Sept 14 Sept 06 Oct	Turnagain Arm Turnagain Arm Turnagain Arm Turnagain Arm Turnagain Arm	20
2004	0	-	-	13
2005	07	24 Aug	Knik Arm	7
2006	12	12 Sept	Knik Arm	8
2008	0	-	-	13

* Known harvested belugas are not included in the total and total beluga mortalities are not directly associated with stranding dates

In 1996, approximately 60 belugas live stranded in Turnagain Arm, which resulted in the known deaths of four adult whales. Five additional adult belugas died during a mass live stranding in August 1999. Although four of these were examined, the cause of death (COD) could not be determined due to post mortem state. In September 2000, 15 to 20 belugas live stranded in Turnagain Arm. This stranding may have been related to the three to four killer whales observed chasing a beluga pod in August 2000. Although no beluga mortalities were associated with this stranding event, two lactating belugas were found dead with injuries from killer whales. In total, three dead stranded belugas were necropsied in 2000. All three belugas were young with some degree of lungworm infestation. For two belugas, the COD was unknown. The third beluga had severe lungworm pneumonia, liver trematodes, ulcerative skin disease, and was most likely septicemic, which was identified as COD. In August 2003, at least 46 belugas live stranded in Turnagain Arm, which resulted in the known deaths of five adult belugas. One male beluga was necropsied the following day; however, COD could not be determined due to autolysis (rotting). Another 58 live beluga whales were reported stranded in two events in Turnagain Arm the following month with no mortalities identified in these events. In August 2005, seven whales stranded in Knik Arm and one week later, a necropsy was completed on a dead beluga in Knik Arm. COD could not be determined due to post mortem state, but trauma and some infectious diseases were ruled out. Death was most likely related to cardiovascular collapse during the stranding event. In September 2006, 12 belugas were observed stranded in Knik Arm and swam off with the high tide.

The cause of stranding is not known, however, beluga whales are known to intentionally strand themselves while rubbing their skin against rocky bottoms (molting). Belugas may also strand themselves on purpose or accidentally to avoid killer whales. Several stranding events in upper Cook Inlet have coincided with killer whale sightings. As cited above, NMFS has observed stranded Cook Inlet belugas that displayed evidence of killer whale predation.

Without infectious, traumatic or toxic causes, death in a stranded cetacean may result from stress, cardiovascular collapse due to the animal's own body weight, and/or hyperthermia from prolonged exposure out of water. Whales stranded at higher elevations during an outgoing tide may be out of the water for ten hours or more. During this exposure, the whales may have difficulty regulating body heat. An extensive network of capillaries within the flukes and flippers allows beluga whales to lose excess body heat to the environment. If these structures are not in the water, this mechanism cannot function properly and internal body temperature rises. Without the buoyancy maintained in the water, the whale's weight places additional stress on internal organs and compromises breathing and cardiovascular return, especially for larger belugas.

Stranding data are also reported for the Saint Lawrence River belugas (DFO 1995). Reports from the Saint Lawrence River beluga whale recovery team contain certain similarities to Cook Inlet: gender ratios for stranded whales were approximately 50:50; few Saint Lawrence River stranded belugas were emaciated; and most appeared similar to freshly killed arctic beluga whales. A very high percentage of the Saint Lawrence River belugas were found to have some pathology attributed as cause of death. These include multi-systemic lesions, cancers, pneumonia, ulcers, and peritonitis.

3.3 Other Wildlife

Cook Inlet supports a wide variety of marine wildlife. The following sections discuss the fish, birds, and marine mammal species (other than belugas) found in Cook Inlet.

3.3.1 Anadromous Fish

Five species of Pacific salmon (*Oncorhynchus* spp.), eulachon (*Thaleichthys pacificus*), longfin smelt (*Spirinchus thaleichthys*), Dolly Varden (*Salvelinus malma malma*), and rainbow trout (*O. mykiss*) occur in Cook Inlet and its tributary waters: Chinook (*O. tshawytscha*), chum (*O. keta*), Coho (*O. kisutch*), pink (*O. gorbuscha*), and sockeye (*O. nerka*) salmon spawn and rear within freshwater Cook Inlet drainages, and migrate, rear, and feed in marine waters. The importance of these species as prey for the beluga is discussed in further detail in the Status and Extinction Report (NMFS 2006). LGL (2006) provided a review of literature on fish in upper and lower Cook Inlet and their importance to beluga whales.

Salmon in this region are a mainstay of the commercial fishing industry and considered the primary prey species for beluga whales. The sockeye (red) salmon is probably the most important commercial salmon species in the Cook Inlet region. Adult sockeye salmon spawn in Cook Inlet beginning in late June, and the runs continue through early August. The sockeye salmon harvest in Cook Inlet totalled 5,238,306 fish in 2005, with 26,553 from the Northern District.

The eulachon, or hooligan, an anadromous, short-lived member of the family Osmerididae (smelts), spawns in the lower reaches of coastal rivers and streams from northern California to Bristol Bay. Eulachon spawn in the spring in rivers along the Alaska Peninsula and possibly in other rivers draining into the southeastern Bering Sea. Eulachon can live to age five years and grow to 25 cm (10 inch), but most die following their first spawning, by three years of age. Eulachon are seasonally found throughout much of Cook Inlet and move nearshore in May where they spawn in river drainages. The larvae then move downstream to enter marine waters. There are currently no biomass estimates for this species in Cook Inlet.

3.3.2 Non-Anadromous Marine Fish

Seven marine fish species found in upper Cook Inlet have been identified in Cook Inlet beluga stomachs. These include Pacific herring (*Clupea pallasi*), walleye pollock (*Theragra chalcogramma*), Pacific cod, Pacific staghorn sculpin (*Leptocottus armatus*) saffron cod (*Eleginus gracilis*), yellowfin Sole, and starry flounder (*Platichthys stellatus*). Additional fish available to belugas in upper Cook Inlet include pacific sandfish (*Trichodon trichodon*), Pacific sandlance (*Ammodytes hexapterus*), and capelin (*Mallotus villosa*) (Moulton 1997, Houghton et al 2005).

Lower Cook Inlet support a much higher diversity of marine fish in addition to these species, but their importance to beluga is unknown (LGL 2006).

3.3.3 Freshwater Fish

Several freshwater fish species, common in local rivers, have reportedly been found in beluga stomachs. These include humpback whitefish (*Coregonus oidschian*), Arctic grayling (*Thymallus arcticus*) and northern pike (*Esox lucius*) (Huntington 2000). The importance of these species to the beluga whale is unknown.

3.3.4 Marine Mammals

Fifteen species of non-endangered marine mammals are residents or are found seasonally in Cook Inlet. Of these species, only harbor seals (*Phoca vitulina*) are commonly observed in upper Cook Inlet, while killer whales (*Orcinus orca*) and harbor porpoise (*Phocoena phocoena*) are observed in the upper inlet, these sightings are sporatic. These species are discussed in greater detail in the following sections.

3.3.4.1 Harbor Seal

Harbor seals are present in coastal waters throughout Cook Inlet. Although primarily a nearshore species, harbor seals have been sighted up to 100 km (62 miles) offshore (Fiscus et al. 1976). Present in almost all nearshore marine habitats, they congregate in estuarine and other protected waters (Pitcher and Calkins 1979). Harbor seals most frequently haul out in secluded areas, including cobble and sand beaches, offshore rocks and reefs, tidal mudflats and sandbars, and floating and shorefast ice (Pitcher 1977; Pitcher and Calkins 1979; Frost et al. 1982). Major harbor seal haulout sites in Cook Inlet are found in the lower portion of the inlet (Montgomery 2005). The reproductive period (pupping and breeding) occurs in the inlet from May through July. Harbor seals molt following the reproductive period. The peak season for molting in the Gulf of Alaska is from July to September (Pitcher and Calkins 1979).

Harbor seals seasonally frequent freshwater streams and lakes during anadromous fish runs. They are commonly observed and hunted along the Susitna River delta and other tributaries to the upper inlet during eulachon and salmon migrations. During the summer months, upper inlet haulout sites include mudflats along the Chickaloon, McArthur, Beluga, Theodore, Lewis, Susitna, and Little Susitna rivers (Rugh et al. 2005).

Harbor seals are opportunistic feeders whose diet varies with season and location. The harbor seals' preferred diet in the Gulf of Alaska consists of pollock, octopus, capelin, eulachon, and herring. Other prey species include cod, flatfishes, shrimp, salmon, and squid (Hoover 1988).

Harbor seals have declined in some areas of the northern Gulf of Alaska by 78 percent during the past two decades (Fadely et al. 1997). Causes of this decline may include natural population fluctuations or cycles, reduced environmental carrying capacity and prey availability due to natural or human causes, predation, harvests, direct fisheries related mortality, entanglement in marine debris, pollution, and emigration (Hoover-Miller 1994). Alaska Natives report that fewer harbor seals are presently found in the Susitna River delta than were observed in the past (Huntington 2000).

3.3.4.2 Harbor Porpoise

Harbor porpoise, the smallest cetaceans in the eastern North Pacific, reach a maximum length of five ft (Leatherwood et al. 1972). This porpoise is most often found in bays, river mouths, and nearshore areas.

Three stocks are currently recognized in Alaska: the Bering Sea, the Southeast Alaska, and the Gulf of Alaska stocks (Angliss and Outlaw 2005). The current abundance estimate for the Gulf of Alaska stock is 30,506 (Angliss and Outlaw 2005), based on surveys conducted in 1998. Those same surveys estimated the harbor porpoise abundance in Cook Inlet as 249 individuals (Hobbs and Waite, in review). In lower Cook Inlet, harbor porpoise have been observed along the west coast from Cape Douglas to West Foreland, in Kachemak Bay, and offshore waters (Rugh et al. 2005). They have also been reported in the upper inlet along Turnagain Arm (e.g., off the Placer and Twenty Mile rivers) in the spring and early summer (NMFS unpublished data), possibly feeding on eulachon.

3.3.4.3 Killer Whale

Killer whales are found worldwide (Leatherwood and Dahlheim 1978). These whales usually travel in small pods, numbering fewer than 40 individuals. Braham and Dahlheim (1982) noted killer whale concentrations in Alaska near landmasses, along the continental shelf, in Prince William Sound, near Kodiak Island, around the Aleutian Islands, and in southeast Alaska.

Estimates of Alaska killer whale abundance are based on direct counts of individually identifiable animals (e.g., Dahlheim 1997). This approach results in a minimum population count, which is considered conservative. Other estimates of the overall population size are not currently available. Three killer whale ecotypes have been described: resident, transient, and offshore. Resident and offshore killer whales generally are found in larger groups and eat fish. Transient whales travel in smaller groups and eat marine mammals. Differences in morphology include dorsal fin shape and saddle patch placement. Killer whale minimum population estimate for: Eastern North Pacific Alaska Resident stock is 1,123 animals; Eastern North Pacific Northern Resident stock is 216 animals; and Gulf of Alaska, Aleutians Island, and Bering Sea Transient stock is 314 animals; AT1 Transient stock is 11 individuals; and West Coast Transient Stock is 314 animals (Angliss and Outlaw 2007). All estimates include killer whales found in Canadian waters.

Killer whales in Cook Inlet have not been well documented (Shelden et al. 2003). Their presence in upper Cook Inlet is thought to be sporadic and not considered a common event. Both resident and transient killer whales have been observed in Cook Inlet. Most sightings of resident whales occur in the lower inlet (Shelden et al. 2003). Small groups of killer whales, believed to be transient whales, have been seen in upper Cook Inlet and during the 1990s, were documented by NMFS from stranding events and public reports. Six killer whales were stranded in Turnagain Arm in May 1991 and another five killer whales were stranded in August 1993. Killer whales in upper Cook Inlet have been observed in Turnagain Arm, the Kenai River, the Susitna River delta, and Knik Arm (Shelden et al. 2003). Killer whales have been documented feeding on beluga whales and harbor seals in upper Cook Inlet.

3.3.5 Birds

The marine and coastal bird community of Cook Inlet is diverse and subject to considerable variability throughout the year. However, the estuarine water of upper Cook Inlet, with its heavy silt load, provide little offshore foraging habitat for many marine birds, with most of the bird activity found along the tideflats and shorelines near rivers and streams.

Three major groups are represented: 1) seabirds, which make their living primarily on the open ocean; 2) waterfowl (ducks, geese, and swans), which inhabit a variety of freshwater and nearshore marine habitats; and 3) shorebirds, which feed mainly on marine and freshwater shorelines (MMS 2003). More than 100 species may occur in this area, including approximately 40 seabird species; 35 loon, grebe, and waterfowl species; and 30 shorebird species (Erikson 1976, Agler et al. 1995, West 2002). Many of these species are afforded protection under the Migratory Bird Treaty Act of 1918, with only the Steller's eider and Kittlitz's murrelet protected under the Endangered Species Act (see Section 3.4.2). Bald eagles are protected by the Bald and Golden Eagle Protection Act.

General descriptions of the distribution, abundance, and biology of marine and coastal birds that occur in the Cook Inlet and are found in the Cook Inlet Planning Area Oil and Gas Lease Sales 149, and 191 and 1999 Final EISs (MMS, 1995 and 2003), the Gulf of Alaska/Cook Inlet Sale 88 Final EIS (1984), and Knik Arm Bridge DEIS (2006). These documents are incorporated by reference and updated.

Breeding seabirds are an important component of the Cook Inlet bird population (Sowls, Hatch, and Lensink 1978; Piatt 2002). Large seabird colonies are found at the Chisik and Duck Islands on the west side of the inlet (about 30,000 birds) and on Gull Island in Kachemak Bay (about 20,000 birds) (Piatt, 2000). The most abundant waterfowl species in the lower Cook Inlet include the three species of scoter, long-tailed ducks, eiders, and goldeneyes (Agler et al.1995). Among the shorebirds, western sandpipers and dunlins numerically dominate in the lower inlet during spring and fall migration (West 2002). One species of shorebird, the rock sandpiper, predominates in Cook Inlet during the winter when as many as 20,000 may be present (Gill and Tibbitts 1999).

3.4 Endangered Species Act-Listed Species

3.4.1 Marine Mammals

Seven large whale species, several salmonid species, one pinniped, and one mustelid species that occur in Alaska are listed under the ESA. The large whales include the following: blue whale (*Balaenoptera musculus*), bowhead whale (*Balaena mysticetus*), fin whale (*Balaenoptera physalus*), humpback whale (*Megaptera novaeangliae*), northern right whale (*Eubalaena glacialis*), sei whale (*Balaenoptera borealis*), and sperm whale (*Physeter macrocephalus*). The range and seasonal distribution of several of these species (fin, sei, and humpback whales) include the lower portions of the inlet. However, the whales are uncommon or rare in the upper inlet. The other ESA species are generally found in deeper offshore waters of the Gulf of Alaska, excluding Cook Inlet, or in the Bering Sea and Beaufort Sea.

3.4.1.1 Steller Sea Lion

The western population of Steller sea lions (*Eumetopias jubatus*) is found in Cook Inlet, most frequently in lower Cook Inlet. In November 1990, NMFS listed Steller sea lions as "threatened" range-wide under the ESA (55 FR 49204). In 1997, two populations were formally recognized (Bickham et al. 1996, Loughlin 1997). The western population, which occurs from 144^{o}West longitude (approximately at Cape Suckling) westward to Russia and Japan (including Cook Inlet), was listed as "endangered" in June 1997 (62 FR 24345). The eastern population, which occurs from southeast Alaska southward to California, remains classified as threatened. Critical habitat for Steller sea lions was designated in 1993 (50 CFR 226.202) and is primarily associated with rookeries and haulouts. However, there are no haulouts or rookeries or other critical habitat for Steller sea lions designated in either the upper or lower Cook Inlet.

3.4.1.2 Sea Otter

Sea otters (*Enhydra lutris*) in lower Cook Inlet include both the Southcentral and Southwest Alaska population stocks. The sea otters inhabiting lower, western Cook Inlet (Kamishak Bay) are part of the Southwest stock, which was listed as threatened under the ESA in 2005. The stocks ranges are defined as follows: Southcentral Alaska stock extends from Cape Yakataga to Cook Inlet including Prince William Sound, the Kenai Peninsula coast, and Kachemak Bay; and Southwest Alaska stock includes the Alaska Peninsula and Bristol Bay coasts and the Aleutian, Barren, Kodiak, and Pribilof Islands.

Because of concerns about the severity and unknown cause(s) of the population decline in the southwest Alaska stock, the U.S. Fish and Wildlife Service (USFWS) published a notice in the FR on November 9, 2000, designating the southwest Alaska stock of sea otters as a candidate species for protection under the ESA. On February 11, 2004, the USFWS proposed listing this stock as threatened under the ESA due to their precipitous decline in numbers (69 FR 6600-6630). Threatened status was granted to this stock by the USFWS on August 9, 2005 (70 FR 46365 46386). Critical habitat for these otters has not been designated under the proposed rule.

3.4.2 Birds

3.4.2.1 Steller's Eider

Steller's eiders (*Polysticta stelleri*) are a diving duck species that spend most of the year in shallow, near-shore marine waters. Most Steller's eiders breeding in Alaska and Russia migrate south after breeding to molt along the coast of Alaska, including specific area in lower Cook Inlet (USFWS 2005). The shoals and reefs near Douglas River in Kamishak Bay are believed to be an important molting habitat in Cook Inlet (Larned 2005). Eider concentrations have also been documented south of Ninilchik on the eastern side of Cook Inlet during this period (Larned et al. 2004). Steller's eiders are also a winter resident along the eastern shoreline of the inlet to Kachemak Bay (West 2002, Larned et al. 2004).

Steller's eiders were listed as "threatened" under the ESA on June 11, 1997 (62 FR 31748) due to a substantial decrease in its nesting range in Alaska. Under the requirements of the ESA Section 7, the USFWS is responsible for determining whether proposed federal actions are likely to jeopardize the recovery of the species. The USFWS designated critical habitat for Steller's eiders on Feb. 2, 2001 (66 FR 8849), including breeding habitat on the Yukon-Kuskokwim Delta, and marine waters in northern Kuskokwim Bay, Seal Islands, Nelson Lagoon, and Izembek Lagoon on the north side of the Alaska Peninsula. No critical habitat was designated in Cook Inlet.

3.4.2.2 Kittlitz's Murrelet

Kittlitz's murrelet (*Brachyramphus brevirostris*) is a small, diving seabird and is one of the rarest seabirds in North America. It is a solitary nester that prefers to nests in rugged mountainous areas near glaciers (Kulitz 2004). The population estimate for Kittlitz's murrelet was about 20,000 birds in 1993, 90 percent of which were in the GOA area (van Vliet 1993). However, surveys since the Exxon Valdez oil spill have also shown major and continuing declines in two large concentrations of Kittlitz's murrelets: PWS and Glacier Bay (Day et al. 1999, USGS 2001, Kulitz, et al. 2005). This trend has resulted in a recent petition to the USFWS to list the species as "endangered" under the ESA (Center for Biological Diversity 2001). Recent surveys have confirmed a declining trend along the south side of the Kenai Peninsula and suggest that the Kittlitz's murrelet population is declining on a regional scale (Van Pelt and Piatt 2003, Speckman et al. 2005, Kulitz 2005). Distribution of Kitlitz's murrelet in Cook Inlet is limited to Kachemak Bay and Kamishak Bay areas of lower Cook Inlet (Speckmen et al. 2005).

3.5 Essential Fish Habitat

Essential Fish Habitat (EFH) provisions are set forth by the Magnuson-Stevens Act (Section 305) as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." In Alaska, EFH is the general distribution of a species described by life stage (NMFS 2005). EFH includes aquatic areas and their associated physical, chemical, and biological properties used by fish, and may include areas historically used by fish where appropriate. "Substrate" includes sediment, hard bottom, and structures underlying the water and associated biological communities. "Necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem. "Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

EFH has been described for several species of groundfish and salmon in Cook Inlet. Specific information for these species can be found with the EFH EIS (NOAA 2005). Further, detailed EFH species life history information is located in the EFH EIS Appendix (April 2005). Life history information includes habitat associations, reproductive traits, and predator-prey relationships. For this document, EFH has not been identified as an issue for beluga whale harvest in Cook Inlet.

3.6 Socio-Economic Environment

The socio-economic environment of the proposed action is primarily the Cook Inlet region, which hosts the largest population and economic centers in Alaska, including the Municipality of Anchorage, the Kenai Peninsula Borough, and the Matanuska-Susitna Borough. Subsistence harvests of beluga whales have a long and intricate history, entwined with the historic and contemporary social and cultural practices of the Dena'ina of upper Cook Inlet, the historic practices of the Alutiiq people of lower Cook Inlet, and the more recent practices of Inupiaq and

Yup'ik hunters who have moved to the Cook Inlet region in recent decades. In this section, a general overview of demographic and economic features of the Cook Inlet Region is first provided. The next section provides a more detailed account on the subsistence harvest of beluga, focusing on the well-documented subsistence harvest patterns of Tyonek as a principle example. Subsequently the history of co-management of Cook Inlet beluga whales is briefly described.

3.6.1 Demographic and Economic Characteristics

This section describes the population, ethnic composition, and economic status of the Cook Inlet region. This provides the socio-economic information required to conduct the Environmental Justice analysis found in Section 4.8.2. Under E.O. 12898, the Environmental Justice analysis examines the extent to which disproportionate adverse impacts fall upon minority and poor communities. Accordingly, the information below identifies the predominant Alaska Native communities within the Anchorage Municipality, the Matanuska-Susitna Borough and the Cook Inlet portion of the Kenai Peninsula Borough. The communities with a significant proportion of Alaska Native residents include nine of the ten federally recognized tribes in the Cook Inlet region. The exception is the Kenaitze Tribe, which is largely, but not completely concentrated in Kenai. Kenaitze tribal members also live in several other communities in Cook Inlet. The proportion of households living below the federally defined poverty rate is also shown in Table 3-4.

The Cook Inlet region is a major population center in the State of Alaska. The Municipality of Anchorage is the largest city within the Cook Inlet area, and in the State of Alaska (42 percent of the state's population), with a 2006 population exceeding 280,000 people (See Table 3-4). The Kenai Peninsula Borough, which encompasses most of Cook Inlet, has a population of 51,350 residents (representing 7.6 percent of the statewide total). Large population centers include Kenai, Soldotna, and Homer. The Matanuska-Susitna Borough, with 77,174 residents in 2006, is one of the most rapidly growing areas in the state, current representing 11.5 percent of the statewide total population.

Table 3-4
Cook Inlet Socioeconomic Characteristics

Community	2006 Population	2006 Percent Alaska Native	2000 Percent of Residents Living in Poverty
Municipality of Anchorage	282,813	10.4%	7.4%
Eklutna	368	13.2%	2.4%
Kenai Peninsula Borough	51,350	10.2%	10.0%
Tyonek	199	95.3%	14.0%
Ninilchik	784	16.6%	13.9%
Seldovia	159	40.3%	23.5%
Nanwalek	228	93.2%	17.5%
Salamatof	906	22.3%	11.9%
Port Graham	136	88.3%	18.8%
Matanuska-Susitna Borough	77,174	8.6%	11.0%
Knik (Fairview)	11,238	8.7%	11.1%
Chickaloon	282	16.9%	2.8%
State of Alaska	670,053	16.0%	10.0%

Source: 2000 Census, DCCED 2007

For the Municipality of Anchorage and the two boroughs, the percentage of the population with Alaska Native heritage is generally below the statewide average (8.6 to 10.4 percent versus 16 percent statewide). However, when the nine places of residence associated with Federally Recognized Tribes (denoted in the table above by indentation) are considered separately, three villages are majority Alaska Native, four villages are at or above the statewide average (i.e. 16 to 40 percent) and two villages are less than the Statewide average (8 to 13 percent). Those with the highest percentage Alaska Native ethnicity are traditional Alaska Native settlements located off the road system, namely Tyonek, Nanwalek, Port Graham, and Seldovia. The smallest percentages are associated with a rapidly growing portion of the Matanuska-Susitna Borough (Knik) and traditional Dena'ina settlement (Eklutna), which has been surrounded by new growth in the Municipality of Anchorage. Importantly, the Municipality of Anchorage has attracted many new Alaska Native residents in the past two decades, and is now home to more than 20,000 Alaska Natives, the largest number found in a single community. Alaska Natives have moved to Anchorage from all parts of Alaska, drawn by education, health care, and economic opportunities. Among the Alaska Natives drawn to reside in Anchorage and the Matanuska-Susitna valley are Inupiat families with experience as beluga whale hunters in their home communities.

The economic strength and dynamism of the Cook Inlet region arises from several sources including trade, services, and government, with contributions from mining, agriculture, and fishing. The Municipality of Anchorage is Alaska's center of trade, finance, transportation, and government. The Kenai Peninsula Borough economy is supported by the private sector from retail trade, manufacturing, oil and gas operations, and commercial fishing. The Matanuska-Susitna Borough is the state's most agriculturally developed area. Located close to the larger Anchorage area, approximately 40 percent of the borough's work force commutes to Anchorage.

The percentage of Anchorage residents with incomes below the Federal defined poverty level is below the statewide average, a sign of the economic vigor of this large community (7.4 percent versus 10.0 percent statewide). The other two boroughs have rates very close to the statewide average (10.0 and 11.0 percent). When the smaller settlements with significant Alaska Native populations are taken into consideration, it becomes clear that the places off the road system with high percentages of Alaska Native residents also have high rates of residents living with incomes below the poverty level. Thus, Tyonek, Nanwalek, Port Graham, and Seldovia have rates ranging from 13.9 to 23.5 percent.

3.6.2 Subsistence and Traditional Harvest Patterns

For nearly 4000 years, Alaska Native people have occupied Cook Inlet, adapting to this complex ecology, and successfully wresting a living from the resources of the region. Two major cultural and language groups are recognized. Up until about 1000 years ago, Cook Inlet was occupied by an Eskimo cultural group referred to as the Kachemak Tradition. About 1000 years ago, in a period of climatic change, the Kachemak Tradition bearers withdrew to the outer Kenai Peninsula and merged with another pre-historic Eskimo cultural group termed the Norton tradition, to form the Alutiiq culture. The Alutiiq Eskimos are still represented today in the outer Cook Inlet, Kodiak Island, the Alaska Peninsula, and Prince William Sound (Stanek et al., 2006).

As the people of the Kachemak Tradition left upper Cook Inlet, the Dena'ina Athabascans entered from the inland areas of the Stony River area and the South Fork of the Kuskokwim River, archeologists have estimated. Historic trade and travel routes linked the Cook Inlet settlements to the inland Dena'ina of Lake Iliamna, Lake Clark, and the upper Kuskokwim, as well as to the Ahtna, north to the Copper River basin. During the Russian and American Territorial periods, the Dena'ina occupied a number of settlements long the west side of Cook Inlet, but following epidemic diseases, by about the 1930's the Dena'ina of Cook Inlet consolidated in the contemporary communities, particularly at Tyonek on the western side of Cook Inlet. The Dena'ina of Cook Inlet, are today found in Tyonek, Knik, and the Kenaitze Tribe of the northern Kenai Peninsula. Among the Northern Athabascan groups of Alaska and Canada, the coastal Dena'ina of Cook Inlet are unique in having adopted the semi-maritime subsistence adaptation, adopting sea mammal hunting technology and techniques of their Alutiiq neighbors in lower Cook Inlet, while retaining the inland adaptation of the larger Dena'ina group (Stanek et al., 2006).

For the contemporary period, documentation of subsistence harvest practices takes two forms. In the first type, comprehensive baseline descriptions of the subsistence lifeways of a community have been prepared by the ADF&G Division of Subsistence to document the entire annual cycle of subsistence harvest activities and to show the relationships among the seasonal components. Unfortunately, these are comparatively time and resource intensive studies, and generally have been implemented only once, often during the 1980's. These community baseline studies have the benefit of providing a holistic account, but the limitation of representing a snapshot in time without information on the trends, dynamics, and changes in patterns in more recent decades. A baseline study of Tyonek subsistence practices was conducted in 1983 to 1984 (Fall et al., 1984). This will be cited extensively in the following discussion in order to situate beluga whale hunting within the larger pattern of the subsistence lifeways of this community. Baseline community studies of this sort are also available for Nanwalek and Port Graham in lower Cook Inlet (Stanek 1985), but no such holistic account is available for the Cook Inlet beluga hunters who have moved to or visit the region from other parts of Alaska.[5]

The second type of study is focused specifically on beluga whale hunting and describes on-going levels of harvest and take, as well as harvest areas and techniques. Stanek (1994) provides a focused survey of Cook Inlet beluga hunters for the period 1987 to 1993, with a very high sample size (17 of 20 known hunters) that includes both the long-standing traditional users of Tyonek and the newer users who have come to the Cook Inlet region from elsewhere in Alaska. From 1994 to 1998, harvest and take information was compiled and reported by the CIMMC and the Alaska Beluga Whale Committee (see Mahoney and Shelden, 2000, for a summary of these data.) These data document rapidly changing harvest levels with relatively high sample sizes and validity. However, there is little information about how this changing practice of beluga whale hunting is linked to larger patterns of subsistence harvest.

Contemporary subsistence harvest practices represent an integrated, strategic, and flexible seasonal round of harvest activities throughout the year. Subsistence hunters have a significant body of strategic knowledge about the seasonal abundance and distribution of wild resources,

[5] However, detailed accounts of Inupiat beluga whale hunting practices in the community of Buckland in the 1970s and 1980s, are available in Feldman (1986) and Morseth (1997).

enabling them to focus their harvest efforts at particularly efficient times and places. No part of this seasonal round, and no species, can be seen as unimportant, nor taken in isolation. The beluga whale hunting of primary interest in this analysis occurs in summer, concurrent with other marine mammal hunting, using boats that are also important in salmon fishing. An example of the seasonal round in the early 1980s for the village of Tyonek is shown in Figure 3-11.

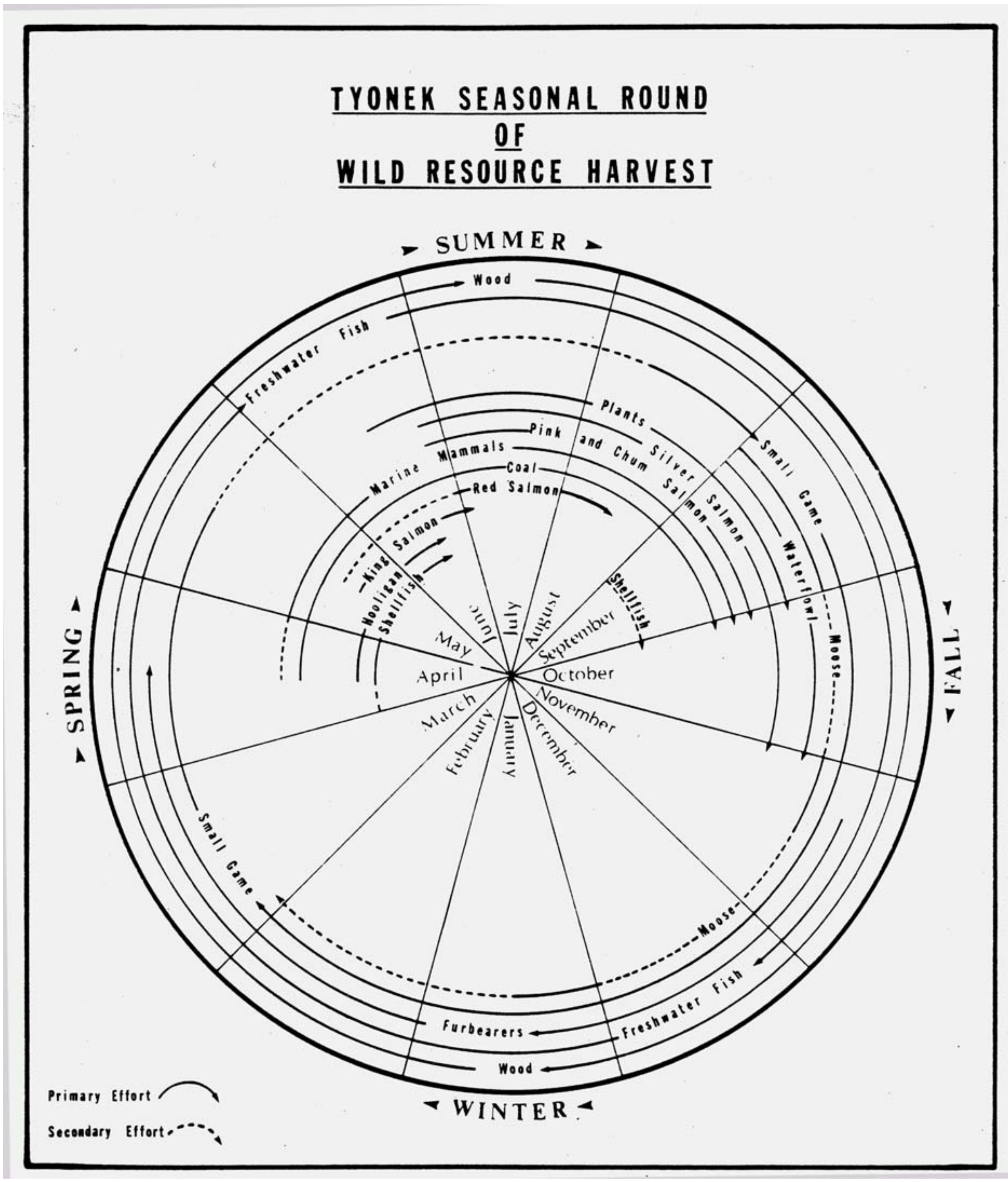

Figure 3-11. Seasonal Round of Resource Harvest Activities, Tyonek, 1978-1984.
Source: Fall et al 1984: 53.

The species composition of the subsistence harvest shows how the coastal Dena'ina ecological adaptation includes a wide variety of resources, while some resources are particularly productive. In the early 1980's, Tyonek residents attempted or actually harvested a total of 26 types of wild resources, including 5 species of salmon, other fish, and shellfish; 2 species of marine mammals (beluga and seal), 2 species of large land mammals (moose and black bear); 5 species of birds and waterfowl; 1 species of small mammal (porcupine), 2 species of furbearer (red fox and beaver), a variety of berries and other plants; fire wood, and local coal. However, salmon were by far the most productive source of subsistence foods, followed by moose. Together these two species accounted for 92 percent of all food harvests, as shown in Figure 3-12.

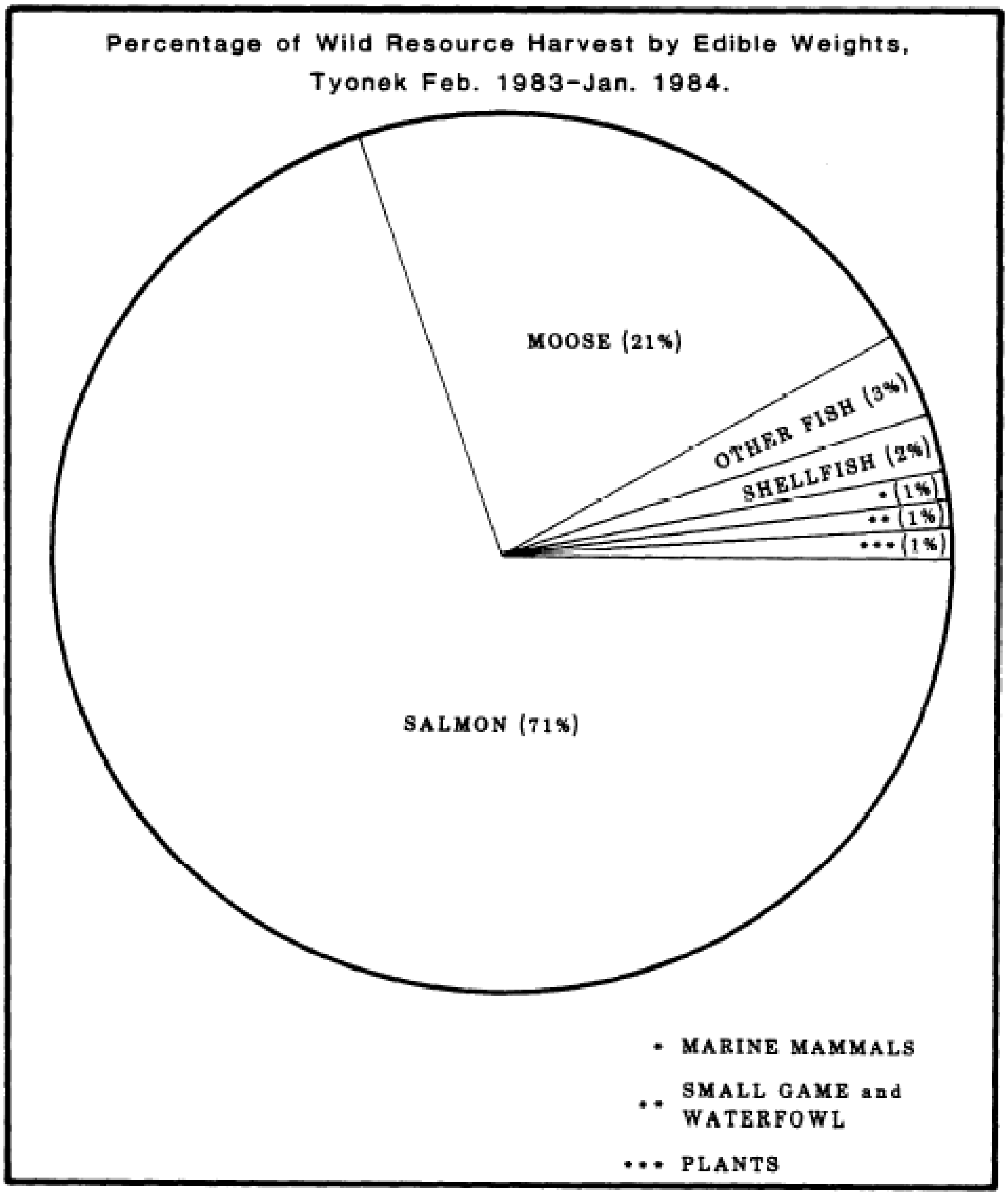

Figure 3-12 Composition of Wild Resource Harvests by Percentage of Edible Weight Contributed by Each Resource Category, Tyonek, February 1983-1984.
Source: Fall et al. 1984: 65.

A third way to identify the place of marine mammal hunting within the overall round of subsistence activities is to consider the patterns of participation in various harvest activities by Tyonek households. Some especially productive activities garner the participation of nearly all households, (i.e., salmon, moose, plants and firewood) while a smaller proportion of households pursue others. During the 1983 to 1984 study at Tyonek, for example, marine mammals were sought by 11 percent of households (See Figure 3-13).

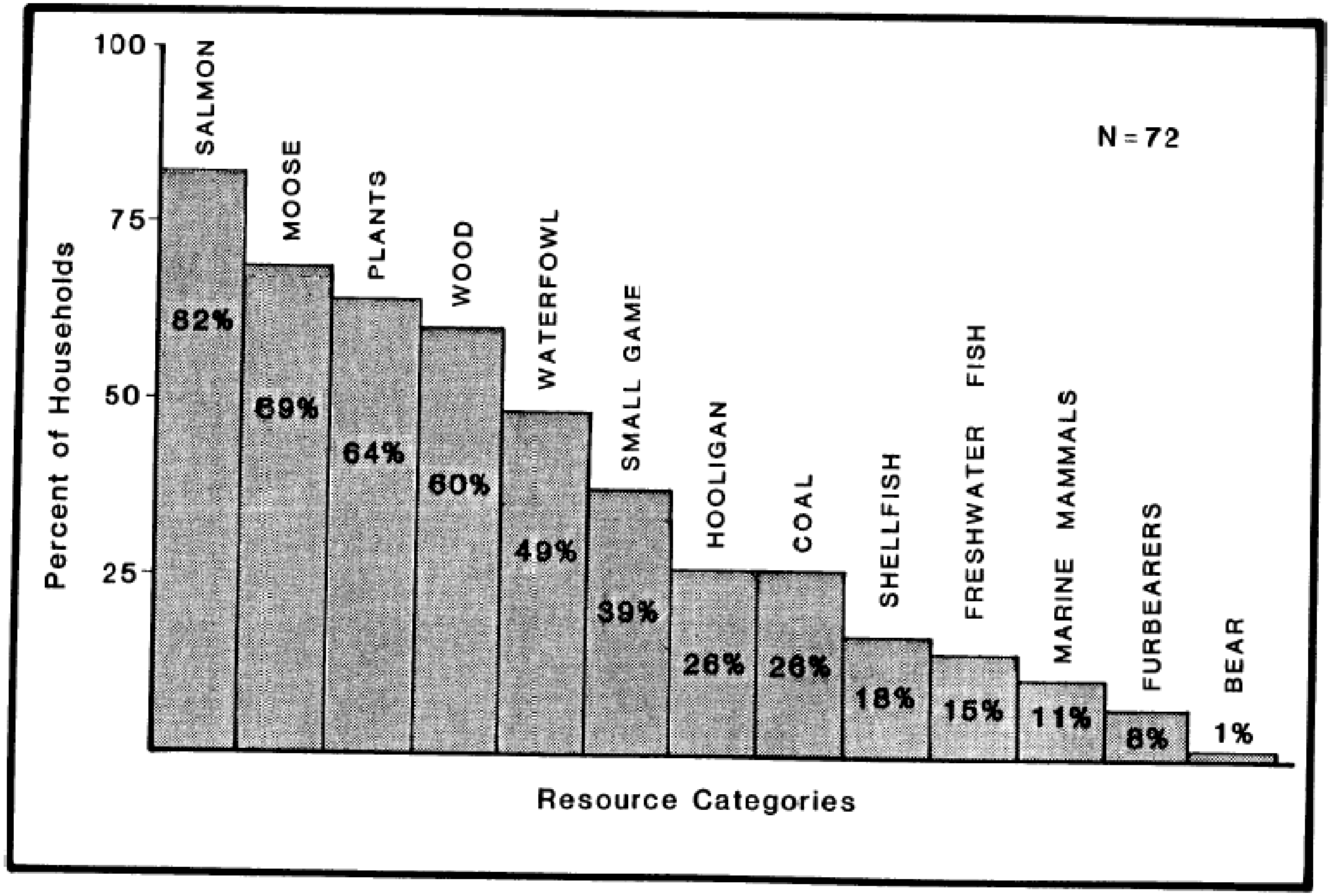

Figure 3-13 Percentage of Tyonek Households attempting to harvest resources, by resource category. February 1983 - January 1984.
Source: Fall et al. 1984: 61.

Before turning to a more focused discussion on the recent historic beluga harvest levels, it is also useful to characterize the spatial dimension of the Tyonek subsistence harvest practices. Traditional use areas have an ecological dimension, in that this is an area in which the hydrology, topography, and habitat support the variety of resources sought by Tyonek families throughout the annual seasonal round of harvests. However, traditional use areas are also social and cultural creations. Through generations of harvesting in the same region, Tyonek hunters have developed a sophisticated body of knowledge on weather, tide and current, in addition to their biological knowledge of seasonal abundance and distribution. Traditional place names identify important historic sites and events, often conveying important information about the natural environment and resources as well (See Stanek et al., 2006:1, 53 for historic camps and trails, and settlement place names respectively.)

In the late 1970s and early 1980s, the Tyonek traditional use area includes a 135-mile stretch of coastline that extended along the western side of Cook Inlet from the mouth of the Susitna River to the north, to Tuxedni Bay to the south. The inland areas were concentrated in the Chuitna, Chakachamna, and McArthur river valleys (see Figure 3-14).

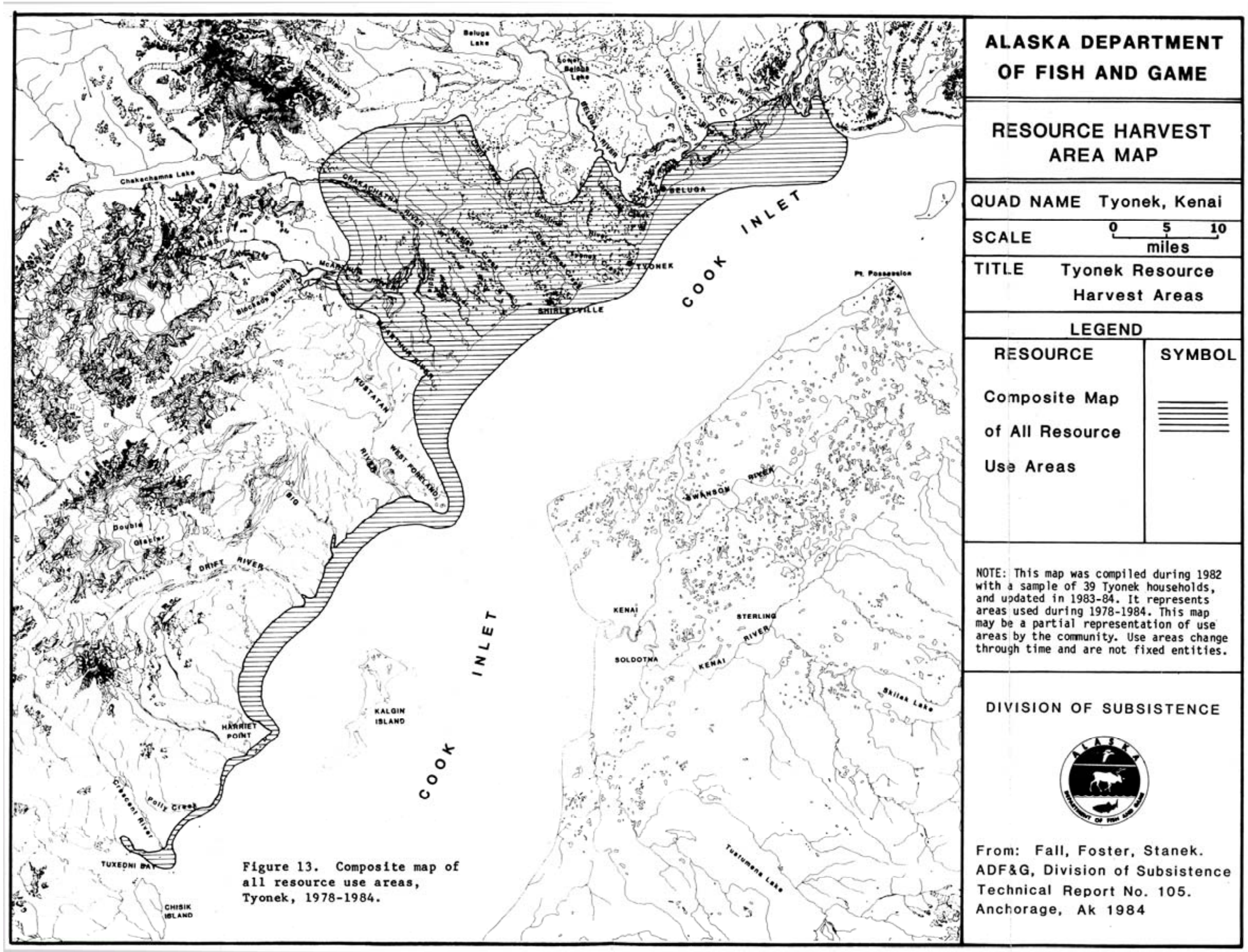

Figure 3-14 Tyonek Resource Harvest Area Map 1978-1984

Source: Fall et al., 1984: 62

3.6.3 Beluga Whale Subsistence Harvest Levels Prior to and After 1999

From aboriginal times, through the Russian, Territorial, and Statehood eras, Cook Inlet indigenous people took Cook Inlet belugas as part of the annual cycle of subsistence activities. Commercial and sport harvests by non-Native hunters occurred intermittently up to the 1960's (See Mahoney and Shelden 2000). After passage of the MMPA in 1972, marine mammal hunting was limited to Alaska Natives. Moreover, non-wasteful subsistence harvests were not subject to regulation, though the MMPA provided for regulation by the Federal government if a species were to decline to the point of depletion.

By the 1980's, Cook Inlet belugas were hunted by two groups: a small group of hunters from Tyonek (of Dena'ina Athabascan descent); and hunters living in or visiting the Cook Inlet region from northern and western Alaska tribes and villages (of Inupiat and Yup'ik Eskimo descent). The number of Eskimo hunters, or non-area hunters, in the 1980s and 1990s was significantly greater than that of Cook Inlet tribal hunters, although no precise enumeration exists. Writing in 1994, Stanek stated that 33 households were known to participate in beluga whale hunting, and that the total might be "somewhat larger" (Stanek 1994). However, not all hunting households were active each year. Stanek reports a range of 8 - 19 active hunting households, with an average of 12 per year, for the period 1987 to 1993 (Stanek 1994).

NMFS thought there were at least 16 Alaska Native whaling crews in 1997, consisting of two to four hunters in each crew. CIMMC estimated that approximately 50 people were hunting beluga whales in 1997. It is common for whalers to be accompanied by friends and relatives while on hunting trips. Of the six Cook Inlet treaty tribes and villages, only Tyonek harvested beluga whales in recent history. Tyonek's beluga harvest has always been modest. Tyonek residents report that about six to seven whales were taken annually during the 1930's and 1940's, but little beluga hunting occurred between the 1940s and the 1970s (Stanek 1994). About three belugas were harvested in 1979 and one whale was harvested annually between 1981 and 1983 (ADF&G undated). Recently, Tyonek's harvest has averaged one to two beluga whales each year. The Beluga and Susitna rivers are the beluga hunting areas for this village.

The primary hunting areas for beluga whales are within upper Cook Inlet, off the mouths of a few river systems. Native hunting camps exist on two islands in Susitna River delta. Beginning in April, hunters used small motorboats launched from Anchorage to access these camps and hunt in or near the river mouths. Boat crews were often small, with two to four hunters, although several boats may hunt together. A common hunting technique is to isolate a whale from a group and pursue it into shallow waters (DeMaster et al. 1999). Belugas are shot with high-powered rifles and harpooned to help with retrieval of the whale. Belugas are mostly used for human consumption. The hunters retain portions of the belugas, type and quantity of which are largely determined by the hunters' customs and practices, which may be culturally determined. While some beluga hunters remove muktuk (skin and attached fat) and muscle, other hunters do not like the taste of beluga meat and retain only the muktuk. The flukes and flippers are highly valued and are kept. The muktuk is usually desired above other beluga parts. Muktuk is dried and/or frozen and is eaten raw or cooked (usually by boiling). Drying or freezing preserves the meat. Beluga teeth and bones have been used for carving and the creation of traditional handicrafts.

Tyonek residents described their customary use of belugas as follows (ADF&G undated): “The flippers and tail were removed. The skin and blubber were removed by making parallel cuts the length of the carcass about 40.6 cm (16 inches) apart. As these strips of blubber were fleshed from the animal, they were cut into blocks approximately 60.9 cm (24 inches) in length. After the blubber was removed exposing the flesh, the back strap was cut from the backbone. The ribs with the meat remaining on them were then separated from the backbone, exposing the internal organs. The liver, heart, and inner tenderloins were then removed. The remaining skeleton and internal organs were either used for dog food or returned to the inlet. The blubber and meat were cut into smaller portions and shared throughout the village.”

Historically, Cook Inlet beluga harvest levels have been unreported or under-reported. There are no reliable estimates of total harvest by all Cook Inlet hunters prior to 1994, although the documentation of Tyonek harvests from 1979 through 1983 is methodologically sound (Fall et al., 1984). Estimated harvests of all Cook Inlet beluga hunters for the years 1987 through 2007 are presented in Figure 3-10. The 1987 through 1994 estimates were from ADF&G and ABWC hunter reports, with struck but lost belugas identified. The 1995 through 1998 estimates were compiled by CIMMC and reported to NMFS and ABWC. Data compiled from hunter interviews by CIMMC for the 1995 harvest identified 44 Cook Inlet beluga whales landed and 26 whales struck but lost (CIMMC 1996). Data compiled by CIMMC for the 1996 harvest stated that 49 belugas were landed; but estimated that between one and two whales were struck but lost for each beluga landed. NMFS stock assessment reports included an estimate of animals struck but lost, using a ratio of 1.5 beluga whales lost for each one landed (1996). In 1997 and 1998, hunter reports to NMFS estimated that one whale was struck but lost for each beluga landed. It is common for beluga harvest efficiencies to be low; and struck but lost rates vary, depending on the weather conditions and individual hunters.

Native hunters reported an increase in the number of struck but lost beluga whales, evidenced by whales observed along shore in west Cook Inlet (Huntington 2000). An efficient harvest in Cook Inlet is confounded by the turbidity of the water, large tidal fluctuations and currents, and changing mudflats.

Based on this information, NMFS estimated that the average annual take, including harvest for human consumption and whales that were struck but lost, was 65 whales per year from 1994 through 1998. However, the middle years in this series showed a substantially higher level of take. The estimated annual average take from 1995 through 1996 (including harvests for food and struck but lost) was 97 whales (CIMMC 1996, 1997). Estimates of take for 1994 through 1998, including harvests for food and struck but lost, were: 21 whales (1994), 70 whales (1995), 123 whales (1996), 70 whales (1997), and 42 whales (1998). The harvest, which was as high as 20 percent of the stock in 1996, was sufficiently high to account for the 14 percent annual rate of decline in the stock during 1994 through 1998.

As described in detail in Chapter 2, in May 1999, a moratorium was enacted (Pub. L. No. 106-31) that prohibits a Cook Inlet beluga harvest except through a cooperative agreement between NMFS and affected ANOs. This moratorium was made permanent in December 2000 (Pub. L. No. 106-553). As a result, the only harvests authorized since 1999 have been through a co-management agreements.

Since the protective legislation was put in place, NMFS has entered into several co-management agreements with CIMMC to allow for one or two whales to be taken annually by beluga hunters. No beluga whales were harvested in 1999, 2000, 2004, and 2007; one whale was harvested in 2001, 2002, and 2003; and two belugas were harvested in 2005. Thus a total of five beluga whales were harvested in the nine years since the moratorium of 1999, an average of just more than one beluga whale every other year.

3.6.4 Co-Management

As described in Chapter 2, by 1999 it was clear that measures were urgently needed to conserve the Cook Inlet beluga population. NMFS entered into the first co-management agreement with CIMMC in 2000 for one beluga for the Native Village of Tyonek. CIMMC is an Alaska Native organization consisting of Alaska Natives from the six Cook Inlet Treaty Tribes, local Native hunters, and concerned Alaska Natives who reside in the Cook Inlet region. CIMMC was organized and incorporated in 1994 to protect cultural traditions and promote conservation, management, and use of Cook Inlet marine mammals by Alaska Natives. Additional co-management agreements were signed following the interim harvest regulations for 2001-2003, and the long-term harvest regulations in 2005 and 2006.

The co-management agreements provide for a structured relationship between NMFS and the CIMMC in jointly managing the subsistence take of Cook Inlet beluga whales. The provisions on authorities indicate that NMFS has legal authority to enter into this agreement under the terms of Section 119 of the MMPA, Pub. L. No. 106-553, and Executive Orders on consultation with Tribal Governments, and a Memorandum on negotiations of Section 119 agreements concluded in 1997. CIMMC is authorized to act on behalf of the member tribes, by authorizing resolutions of the constituent Tribal governments.

An extensive set of provisions govern harvest practices, specifying that whaling captains must be registered with and receive a permit from CIMMC and that qualified and experienced hunters must direct the harvest. No hunt shall occur prior to 1 July. Minimum equipment is specified, and hunters are prohibited from taking a calf, or a female accompanied by a calf. A harpoon and float must be attached to the beluga whale before shooting. Harvest reporting to NMFS and biological sampling of the harvested beluga whale is mandatory. No beluga whale foods may be sold, under the provision of these agreements. CIMMC and NMFS are responsible for jointly managing the hunt, with frequent communication as needed. Both parties are able to enforce the terms of the agreement, and both agree to notify the other if an enforcement action is initiated (NMFS and CIMMC 2005).

Chapter 4 Environmental Consequences

This chapter evaluates the probable environmental, biological, cultural, social, and economic consequences of the four alternatives and reviews those activities that, in addition to authorizing a harvest, may contribute to cumulative effects on Cook Inlet beluga whales and the environment. Both direct and indirect effects, and potential cumulative impacts, are reviewed. The recent 2007 population information does not change the results in Chapter 4.

4.1 Project Area and Scope for Analysis

The spatial scope of the effects analysis is Cook Inlet, a shallow tidal estuary that flows into the Gulf of Alaska. When this spatial scope is not applicable to a given resource, a relevant geographic sub-area is defined in the analysis (e.g., upper Cook Inlet and lower Cook Inlet).

Evaluation of cumulative effects requires an analysis of the potential direct and indirect effects of the proposed harvest alternatives, in combination with other past and present actions and reasonably foreseeable future actions. The time frame or temporal scope for the past and present effects analysis was defined as the period beginning in 1979 when an aerial survey of the inlet estimated the population to be approximately 1,300 whales (Calkins 1989). This estimate has been adopted by NMFS as the carrying capacity of the population and was used to determine OSP. In 1994, NMFS began conducting consistent surveys of the population. The 1994 data have been used in the harvest model (see Appendix A) to evaluate the harvest schedule and provides the basis for the range of probabilities that the Cook Inlet beluga whale population would recover within the next 100 years.

As described in detail in Section 3.6.2, baseline studies of subsistence practices have been conducted for some communities since the 1980s but no such holistic account is available for all Cook Inlet beluga whale hunters and studies have not been continuous. For more detail on the geographic and temporal scope of the socio-economic analysis, please see Section 4.4.2. Reasonably foreseeable future actions considered in the cumulative effects analysis consist of projects, actions, or developments that can be projected, with a reasonable degree of confidence, to occur over the next 10 years (from 2008 to 2017) and are likely to affect the resources described.

4.2 Methodology

4.2.1 Definition of Terms

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

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

Indirect Effects – also caused by the proposed action and reasonably likely to occur, but may occur later and farther from the location of direct effects (40 CFR 1508.8). Indirect effects may include induced changes to habitat use or patterns of use, population density or growth rate, and effects on air, water, and other natural systems, including ecosystems (40 CFR 1508.8). For example, the harvest alternatives have a *direct* effect on the Cook Inlet beluga whale recovery rate and on local Alaska Native communities that traditionally rely on Cook Inlet beluga whales for subsistence. However, the harvest alternatives could have an *indirect* effect on subsistence harvest of moose within the project area.

Cumulative Effects – additive or interactive effects that could result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions regardless or what agency (federal or non-federal) or person undertakes such actions (40 CFR 1508.7 and 1508.25(c)). Interactive effects may be either countervailing (the net cumulative effect is less than the sum of the individual effects) or synergistic (the net cumulative effect is greater than the sum of individual effects). This SEIS addresses cumulative effects that are reasonably foreseeable rather than speculative. For example, a certain level of beluga whale harvest may not in itself impede recovery of the stock; but that same harvest level, when combined with other sources of mortality or other factors that affect the population, may have a cumulative effect that could compromise the stock's ability to achieve its OSP.

Reasonably Foreseeable Future Actions – this term is used in concert with the 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 or impacts are those likely (or reasonably certain) to occur within the timeframe used for analyzing environmental consequences and are not purely speculative. Our determination of "reasonably foreseeable" is based on documents such as existing plans, permit applications, or announcements such as Federal Register notices.

The following sections consider the potential environmental consequences of each alternative. A subsequent section provides a concise comparison of the alternatives and potential consequences, to facilitate the reader's determination of the relative merits of the alternatives.

4.3 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 relevant to evaluating the adverse impacts.

- The agency's evaluation of adverse impacts based on generally accepted scientific methods.

In the analysis, the SEIS identifies those areas where information is unavailable to support a thorough evaluation of the environmental consequences of the alternatives. Efforts have been made to obtain all relevant information; however, where data gaps still exist, the implication is that these areas qualify for the CEQ guidelines.

4.4 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. CEQ regulations implementing NEPA state that an EIS should discuss the significance 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' population, ecosystem, or region) and any special conditions, such as endangered species status or other legal status. The intensity of an effect 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 impact level on each 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 among negligible, minor, moderate, and major 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 through 4-3 provide guidelines for rating each alternative's projected effects on the scale described, thereby drawing conclusions about the impact level of the alternative. The criteria used to assess effects of the alternatives vary for the different resource types analyzed. The impact criteria tables use terms and thresholds that are quantitative for some components and qualitative for others. The terms used for 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" as described in more detail in the following section.

Effects are also evaluated according to their temporal context (i.e., duration or frequency). "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 occur twice per year or less. "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 analysis for each species or resource.

This assessment also evaluates the *likelihood* of an effect. "Likely" effects are those that could arise from reasonable or demonstrated mechanisms when the probability of those mechanisms arising from the alternative is greater than 50 percent. This does not imply that the analysts perform a formal probability calculation. Instead, analysts use professional judgment to make a qualitative determination that an effect has a more likely probability of occurring than not. The likelihood of occurrence is considered when assessing magnitude, extent, and duration. Determination of impact level for each of these three factors is made for those effects deemed more likely to occur than not.

4.4.1 Impact Criteria for Cook Inlet Beluga Whales

The following analysis of effects on Cook Inlet beluga whales is structured somewhat differently than the analysis conducted for the 2003 Harvest EIS. Although the current document is considered a “supplement” to the 2003 EIS, NMFS has decided the impact criteria needed to be updated to reflect the current environment and recent events such as the Administrative Law Judge proceedings. The 2003 EIS used “delay in recovery time” as the primary impact criteria based on the assumption that the population would increase at two to four percent per year if no harvest occurred. However, as described in Section 3.2, the population has decreased 2.7 percent per year since the hunting moratorium began (NMFS, unpublished data) and modeling efforts indicate it is much more likely that the population would not recover even without harvest in the future, making measures of delay in recovery meaningless. Since impact criteria should apply to all potential future situations, including decreasing and slowly increasing populations, NMFS has adopted the following impact criteria for this SEIS.

The terminology used to categorize effects has also been changed from the 2003 EIS, which used the terms “significant,” “conditionally significant,” and “insignificant.” NMFS has decided that the use of these terms may be confused with their use in other contexts (e.g. statistical significance) and has chosen to use the terms “negligible,” “minor,” “moderate,” and “major” as described in Section 4.4.1.1.

4.4.1.1 Mortality

<u>Harvest Model</u>

The levels of subsistence harvest considered acceptable were determined through the formal rulemaking process with an Administrative Law Judge (see Chapters 1 and 2). This Administrative Law Judge process attempted to balance the needs of NMFS to fulfill their regulatory responsibilities under the MMPA to promote the recovery of the population from a depleted status and the needs of Alaska Natives to preserve their subsistence hunting culture. The parties involved in the Administrative Law Judge hearings proposed different harvest schedules and presented population modeling results and testimony to support their positions. The harvest levels included in the recommended decision by the Administrative Law Judge were therefore not based solely on Alaska Native subsistence needs or a policy of maximum recovery potential, but were a compromise which attempted to balance species conservation with preserving Native culture.

During the Administrative Law Judge process, evidence for the effects of different harvest levels on the population relied on a computer modeling program designed to account for uncertainty in the Cook Inlet beluga whale abundance and growth rate at any given time (known as the harvest model, see description in Appendix A). This harvest model used Bayesian statistics to calculate the probability of the population either increasing or decreasing under a given set of conditions. Since several key factors were not known precisely, i.e. there was uncertainty about the population abundance and their reproductive and mortality rates, the computer program chose different starting points from within the range of values that have been measured during the years with survey data along with the statistical confidence intervals of those census results. The computer program was run tens of thousands of times with different starting points for those key variables, using a Monte Carlo technique, which produced different results depending on what starting conditions, were selected. The results of these multiple computer runs were then analyzed statistically to see how the population responded to different modeling conditions. The effects of the alternative harvest schedules were determined by this modeling exercise and are presented in terms of probabilities that the population would either increase or decrease in the next 100 years.

Harvest Floor

The Administrative Law Judge's recommended decision for the harvest plan included several thresholds to address potential situations where the population does not recover as expected. The first threshold is a policy that no harvest would occur if the five-year average abundance is less than 350 whales (referred to as the harvest floor). During the Administrative Law Judge hearings, NMFS testified that they modeled the potential outcomes of this harvest rule and found that a floor of 350 whales was the best compromise between continuation of subsistence harvests and conservation management. Another party argued the harvest floor could be as low as 250 whales without jeopardizing the population's recovery. The Administrative Law Judge determined that there was no scientific methodology to determine the absolute floor below which a subsistence harvest would lead to irreversible adverse effects on the population. The Administrative Law Judge concluded that a harvest floor must therefore be resolved as a matter of law. The Administrative Law Judge cited Congressional intent when it enacted the moratorium on Alaska Native subsistence hunts of Cook Inlet beluga whales (unless the taking occurred pursuant to a cooperative/co-management agreement between NMFS and affected ANOs). The Administrative Law Judge ruled that a harvest floor below the approximate population level in 1999 (367 whales) would allow a subsistence harvest below the point at which Congress believed a moratorium on subsistence hunting of Cook Inlet beluga whales was necessary. Given that there is a degree of uncertainty in abundance estimates, the Administrative Law Judge ruled that NMFS's proposed harvest floor at a five-year average of 350 whales was a reasonable reflection of Congressional intent.

Harvest Levels

Because this SEIS presents a long-term harvest and recovery plan that covers a wide range of potential population levels and three defined growth rates, the relative impact of a given level of harvest mortality would vary with specific population levels and growth rates. For this SEIS, the impact criteria that were developed to analyze mortality effects from subsistence harvest are, therefore, based on a percentage of the five-year average abundance estimate and a 10-year measure of the population growth rate (Table 4-1). The population abundance (N) used in this table is the average mean abundance estimate from the previous five census surveys. Growth rates are determined by the probability distribution of growth rates from the previous 10 years census data (determined by the statistical confidence intervals around the mean value). “Low growth” is defined as the situation with a greater than 75 percent probability that the growth rate is less than two percent per year during the previous 10-year period (including negative growth rates). “High growth” is defined as the situation with a greater than 25 percent probability that the growth rate is greater than three percent per year during the previous 10-year period. “Intermediate growth” is defined as all other growth rates between the low and high growth rate thresholds. The harvest levels used in Table 4-1 (measured as a percentage of the population abundance) approximate the amount of harvest mortality discussed under various harvest plans proposed during the Administrative Law Judge process. These levels of “acceptable” mortality for this specific beluga whale population resulted from a balance between the cultural interests of Alaska Native hunters and recovery goals as defined in the MMPA.

Table 4-2 is provided to describe the range of beluga whale strikes within each five-year period that are considered to have negligible, minor, moderate, or major impacts at different population levels and growth rates. Examples of how the range of strikes is calculated for each impact category are provided in Table 4-2. The actual number of strikes considered to have a specific impact depends on the percentage of the average five-year population estimate (N) given in the impact criteria Table 4-1. In Table 4-2, the number of strikes per five years is rounded *down* to the nearest whole number but is never rounded *up*. There is some overlap in numbers provided in this table for different impact levels because of rounding protocol. Note that the number of strikes listed in each cell is for a five-year period.

<u>Delay in Recovery</u>

One element that was the subject of substantial disagreement during the Administrative Law Judge hearings was the degree to which hunting mortality may delay recovery of the population and whether recovery to a particular level (i.e. OSP) or within a particular time period (i.e. within 100 years) was a worthwhile goal for subsistence harvest management. The alternative harvest plans considered in this SEIS differ in how they approach this issue. The analysis therefore compares alternatives using delay in recovery to the population’s OSP as a metric to analyze the duration of harvest mortality effects on the population. These statistics were derived from the harvest model (Appendix A).

A 10 percent delay in recovery would be considered negligible based on the Zero Mortality Rate Goal that NMFS has used in other NEPA documents and regulations to measure the impacts of fishery related mortality on a depleted species (69 FR 43338-43345). The level of a major impact, more than 25 percent delay in recovery, was taken from the Administrative Law Judge recommended decision that a delay in recovery of less than 25 percent was an acceptable balance of the competing interests. The thresholds for minor and moderate impacts split the difference between these 10 percent and 25 percent thresholds. The Administrative Law Judge further recommended that, because of the high probability that the population would not recover within 100 years even without harvest, any benchmarks used to define an acceptable delay in recovery should be viewed as goals rather than mandatory rules.

Additional Factors

The Administrative Law Judge ruled on several other aspects of the proposed harvest plans, including measures of acceptable certainty for vital parameters and rules to adjust the harvest in instances of excessive natural mortality. These elements have not been included in the impact criteria because they are common to all three action alternatives and do not provide a useful basis for comparing the alternatives.

4.4.1.2 Disturbance

Disturbance from human activities can cause numerous responses in animals depending on many factors, including the animals' nutritional needs, health status, alternative habitat availability, disturbance magnitude and type, and disturbance frequency or duration. The most easily observable response to disturbance is when animals move away from the source or change their normal distribution within their habitat to avoid the disturbance. The impact criteria (Table 4-1) include several components of disturbance effects that relate to the potential for subsistence hunting to alter Cook Inlet beluga whale behavior and distribution. The criteria are qualitative and the analysis will be based on documented examples of past behavior and the likelihood that different harvest level activities would result in different disturbance effects.

Whales pursued during a hunt and whales in the immediate vicinity of a hunt are subject to disturbance. Whale responses exhibited during pursuit have been reported in hunting accounts and research activities that involve chasing and following beluga whales (e.g., suction cup tags, satellite tags, boat surveys, and photo identification).

Beluga whale responses to a subsistence hunt are thought to be dependent on beluga whale behavior before the hunt (e.g., feeding, migrating, milling, etc.), hunt duration, and whether the beluga whales are in an actively pursued group or not. When hunted, beluga whales dive and swim away, and will often surface with only their blowholes visible above the water (head lifts), presenting a small target to the hunter (Huntington 2000). This head lift behavior is distinct from the slow-roll breath, where a substantial portion of the beluga whale's head and back breaks the surface of the water (Lerczak et al. 2000). In the spring, while beluga whales fed at the Susitna River, the hunter(s) could separate one beluga whale from the group to hunt, and the other beluga whales would move away but would not leave the area (Blatchford 2007). However, later in the summer the beluga whales would leave the area when a boat came near, so successful hunting was a bit more challenging. Individual beluga whales chased by a boat will swim toward deeper water, so the hunter must keep the whale in shallow water to successfully harpoon it (Merryman, personal communication, 2007).

Beluga whale tagging operations, similar to hunting, require the boat to approach a beluga whale group to isolate and pursue one individual whale. A suction cup tag is placed on a pole used to secure the suction cup tag to the beluga whale's back, similar to the motions of a harpoon (Lerczak et al. 2000). Beluga whale response to vessel activity in tagging operations followed a typical pattern (Lerczak et al. 2000). Beluga whales seem to ignore vessels farther away than 46 m (150 ft) (Moore 2003). They did not appear to change their behavior when approached slowly, but would consistently move in a direction away from the boats (Vos 2007). This is consistent with behavior observed during photo identification surveys, when research boats approached beluga whales at no-wake speed and paralleled whale groups for 50 minutes (mean duration); the beluga whales seem habituated to the presence of the vessel. When a tagging operation vessel approaches a beluga whale group within about 10 m, the whales tend to make a series of quick surfacings and then submerge for longer periods of time as they try to move rapidly away towards deeper water (Moore 2003), creating a wake. Beluga whale wakes were easily visible when the water was no deeper than five m (15 ft), which made tide levels important to successful tagging operations (Markowitz 2007). Before an individual whale is isolated for a tagging attempt, the fleeing whales are more likely to head lift (92 percent) than slow-roll (eight percent) (Lerczak et al. 2000). The whales' initial burst of speed at the start of each tagging bout lasts for less than two minutes, after which the whales slow and surface more frequently (Lerczak et al. 2000).

Groups of beluga whales have been observed returning to areas previously disrupted by hunting activities and vessel traffic in as little as two hours after a disturbance (Caron and Smith 1990). However, this recovery time varies significantly among individual beluga whales, and has also been reported as ranging from 33 to 574 hours (Caron and Smith 1990).

Research on many animal species indicates that stress from disturbance may result in physiological changes that affect the health of the animal (Fowler 1986; Fair and Becker 2000). However, research that tests various stressors and their potential mechanisms for affecting the survival or reproductive success of Cook Inlet beluga whales has not been conducted and might be impossible to do without causing considerable stress to the animals. Any attempts to distinguish among the alternatives based on these types of potential physiological effects would therefore be speculative and are not included in the impact criteria.

Table 4-1. Criteria for determining impact level for effects on beluga whales

Harvests levels are set for five-year periods according to the co-management process described in Chapter 2. Every five years the co-management partners would assess the status of the population in terms of its current abundance and growth rate estimates.

Type of Effect	Impact Component		Negligible	Minor	Moderate	Major
Mortality	Magnitude or Intensity	If N[1] < 350 whales	No harvest	Not applicable (NA)	NA	Any harvest
		If N = 350-780 whales AND declining or "low growth"[2]	Harvest < 0.1% of N per year	Harvest = 0.1% - 0.2% of N per year	Harvest = 0.2% - 0.3% of N per year	Harvest > 0.3% of N per year
		If N = 350-780 whales AND "intermediate growth"[3]	Harvest < 0.2% of N per year	Harvest = 0.2% - 0.4% of N per year	Harvest = 0.4% - 0.6% of N per year	Harvest > 0.6% of N per year
		If N = 350-780 whales AND "high growth"[4]	Harvest < 0.4% of N per year	Harvest = 0.4% - 0.7% of N per year	Harvest = 0.7% - 1.0% of N per year	Harvest > 1% of N per year
		If N >780 whales (OSP)	Harvest < 1.0% of N per year	Harvest = 1.0% - 1.5% of N per year	Harvest = 1.5% - 2.0% of N per year	Harvest > 2% of N per year
	Duration or Frequency[5] If harvest model results in recovery (>780 whales) within 100 years		Less than 10% delay in recovery time	10%-17% delay in recovery time	17%-25% delay in recovery time	More than 25% delay in recovery time
Disturbance	Magnitude or Intensity		No measurable disturbance	Disturbance effects but distribution similar to baseline	Noticeable change in localized distribution	Enough to cause shift in Cook Inlet distribution
	Geographic Extent		No measurable disturbance	Effects limited to one location in Cook Inlet	Effects distributed among several locations in Cook Inlet	Effects distributed across Cook Inlet
	Duration or Frequency		No measurable disturbance	Periodic, temporary, or short-term	Moderately frequent or intermittent	Chronic and long-term

[1] The population level (N) used in this table is the average mean abundance estimate from the previous five census surveys.
[2] Growth rates are determined by the probability distribution of growth rates from the previous ten years census data (determined by the statistical confidence intervals around the mean value). "Low growth" is defined as the situation with a greater than 75% probability that the growth rate is less than 2% per year during the previous 10-year period (including negative growth rates).
[3] "Intermediate growth" is defined as all growth rates between the low and high growth rate thresholds.
[4] "High growth" is defined as the situation with a greater than 25% probability that the growth rate is greater than 3% per year during the previous 10-year period.
[5] This component only applies to the subset of model runs that lead to recovery (population > OSP, 780 whales) within 100 years. Recovery times are calculated to be less than or equal to a given time period with 95% probability.

Table 4-2. Range of strikes per five-year period at each impact level

The number of strikes considered to have a specific impact level is the product of the average five-year population estimate (N) and the percentage of N at different growth rates given in the impact criteria Table 4-1. For example: if N = 375 whales and there was an intermediate growth rate, using the impact criteria listed in Table 4-1, a "major" impact would be a harvest greater than 0.6 percent of N per year. For a five-year period, this calculates to (375 whales x 0.006 per year x 5 years) = 11.25 whales. This is rounded down to the nearest whole number so a "major" impact would be any harvest level more than 11 whales (strikes) per five-year period. Note that the number of strikes listed in each table cell is for a five-year period.

5-year population average	Low growth rate				Intermediate growth rate				High growth rate			
	Negligible	Minor	Moderate	Major	Negligible	Minor	Moderate	Major	Negligible	Minor	Moderate	Major
200-249	0	Not applicable (NA)	NA	1 strike or more	0	NA	NA	1 strike or more	0	NA	NA	1 strike or more
250-299	0	NA	NA	1 strike or more	0	NA	NA	1 strike or more	0	NA	NA	1 strike or more
300-349	0	NA	NA	1 strike or more	0	NA	NA	1 strike or more	0	NA	NA	1 strike or more
350-399	1 strike or less	1-3 strikes	3-5 strikes	> 5 strikes	3 strikes or less	3-7 strikes	7-11 strikes	> 11 strikes	7 strikes or less	7-13 strikes	11-19 strikes	> 19 strikes
400-449	2 strikes or less	2-4 strikes	4-6 strikes	> 6 strikes	4 strikes or less	4-8 strikes	8-13 strikes	> 13 strikes	8 strikes or less	8-15 strikes	13-22 strikes	> 22 strikes
450-499	2 strikes or less	2-4 strikes	4-7 strikes	> 7 strikes	4 strikes or less	4-9 strikes	9-14 strikes	> 14 strikes	9 strikes or less	9-17 strikes	15-24 strikes	> 24 strikes
500-549	2 strikes or less	2-5 strikes	5-8 strikes	> 8 strikes	5 strikes or less	5-10 strikes	10-16 strikes	> 16 strikes	10 strikes or less	10-19 strikes	17-27 strikes	> 27 strikes
550-599	2 strikes or less	2-5 strikes	5-8 strikes	> 8 strikes	5 strikes or less	5-11 strikes	11-17 strikes	> 17 strikes	11 strikes or less	11-20 strikes	19-29 strikes	> 29 strikes
600-649	3 strikes or less	3-6 strikes	6-9 strikes	> 9 strikes	6 strikes or less	6-12 strikes	12-19 strikes	> 19 strikes	12 strikes or less	12-22 strikes	21-32 strikes	> 32 strikes
650-699	3 strikes or less	3-6 strikes	6-10 strikes	> 10 strikes	6 strikes or less	6-13 strikes	13-20 strikes	> 20 strikes	13 strikes or less	13-24 strikes	22-34 strikes	> 34 strikes
700-779	3 strikes or less	3-7 strikes	7-11 strikes	> 11 strikes	7 strikes or less	7-15 strikes	14-23 strikes	> 23 strikes	14 strikes or less	14-27 strikes	24-38 strikes	> 38 strikes
780^{+}	39 strikes or less	39-58 strikes or more	58-78 strikes or more	78 or more strikes	39 strikes or less	39-58 strikes or more	58-78 strikes or more	78 strikes or more	39 strikes or less	39-58 strikes or more	58-78 strikes or more	78 strikes or more

4.4.2 Impact Criteria for the Socio-Economic Environment

The analysis of socio-economic impacts examines effects on subsistence use patterns and associated social and cultural practices. The impact criteria provide a framework within which the four alternatives of the proposed action may be assessed for impacts by comparison to the subsistence practices of the past 20 years. This baseline for comparison will include both the 1980s and 1990s, and the years since 1999 when subsistence harvests were severely restricted as a necessary and urgent conservation measure.

The magnitude and intensity of effects to the subsistence harvest practices are based on the premise that beluga whales harvested are highly culturally-valued, although beluga whale foods may be a small portion of the total subsistence food production. Impacts to social and cultural practices include effects on cooperation in marine mammal harvesting and processing, sharing of beluga whale foods within kin groups and the community, and the role of marine mammal hunting in the cultural identity of the Tyonek Dena'ina and other Cook Inlet beluga whale hunters. The magnitude of effects to social and cultural practices is based on the proportion of a community affected. The impact criteria for the socio-economic environment are summarized in Table 4-3.

The geographic scope for this analysis of socio-economic effects is based on those communities and households harvesting Cook Inlet beluga whales since the late 1980s. The Native Village of Tyonek, a Dena'ina Athabascan community, is the only traditional Cook Inlet village which continued to pursue beluga whales in recent decades. Since 1999, hunters have been legally required to enter into co-management agreements with NMFS to conduct their subsistence harvest of Cook Inlet beluga whales. The limited subsistence harvest has been exclusively committed to the Tyonek hunters and Cook Inlet community hunters. The impacts to Tyonek and other beluga whale hunting households of Cook Inlet, generally composed of Inupiat or Yup'ik hunters now residing or born in Cook Inlet, are considered in this analysis. In addition, because both the Tyonek and other hunters have traditionally shared beluga whale subsistence foods with other communities, socio-economic effects could indirectly extend to other areas throughout Alaska.

The temporal scope for this analysis of socio-economic effects takes the status-quo of the past 20 years (1987 to 2007) as the baseline. This includes nearly a decade before and after 1999, when a precipitous decline in the Cook Inlet beluga whale population necessitated a dramatic reduction in the subsistence harvest. Direct and indirect effects are assessed in relation to the incremental changes from this status quo. The cumulative effects analysis offered in Section 4.10 in contrast, will examine past, present, and RFFAs relating to the subsistence harvest of beluga whales in Cook Inlet.

Table 4-3 summarizes the criteria for determining the level of impact of the alternatives on the social and cultural environment, based on the magnitude and duration. Magnitude, as detailed in the table, refers to the degree of disruption in harvest success (ranging from reduced possibilities for harvest to complete elimination of a food resource), and to the number of subsistence resource harvests disrupted (ranging from one to many). For this analysis, magnitude of impact is assessed for subsistence resources based on their cultural importance to the community, not just on the lbs of food produced. Beluga whales have not been a resource accounting for a high percentage of total lbs of food produced by subsistence users in Cook Inlet since the 1940s (see discussion in Section 3.8, taken from Fall et al. 1984). However, beluga whales are a highly culturally-valued subsistence resource to Cook Inlet beluga whale hunting households. In particular, the sea mammal harvest practices of the Dena'ina of Tyonek are unique among Alaska Athabascan communities and so this is an important element of cultural adaptation and identity.

In regard to the geographic extent of impacts, all alternatives uniformly affect the entire hunting area of the Cook Inlet beluga whaling households. So there is no differentiation in geographic extent among the alternatives, therefore, this criterion does not distinguish the impact levels of the alternatives. For this reason, geographic extent is not included as a row in Table 4-3.

Table 4-3. Criteria for Determining Impact Level for Effects on the Socio-economic Environment

Type of Effect	Impact Component	Impact Level			
		Negligible	Minor	Moderate	Major
Effects on subsistence	Magnitude or Intensity	No decline in production of culturally valued subsistence resources	Decline in production of up to 30% affecting one or several culturally valued resources.	Decline in production of up to 60% affecting one or several culturally valued resources.	Decline in production of greater than 60%, or elimination of production of one or several culturally valued resources.
	Duration or Frequency	No measurable effects	Periodic, temporary, or short-term, generally less than one year.	Moderate-term or intermittent, generally less than 10 years.	Chronic and long-term, generally more than 10 years.
Effects on social and cultural practices (cooperation, sharing, cultural identity)	Magnitude or Intensity	No measurable effects	Affects key social and cultural practices of <10% of the population in the community.	Affects key social and cultural practices of 10% - 50 % of the population in the community.	Affects key social and cultural practices of >50% of the population in the community.
	Duration or Frequency	No measurable effects	Periodic, temporary, or short-term, generally less than one year.	Moderately frequent or intermittent, generally less than 10 years.	Long-term and/or frequent, generally more than 10 years.

4.5 Steps for Identifying Cumulative Impacts

To meet the requirements of NEPA, an EIS must include an analysis of the potential 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:

> "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 SEIS, assessment of cumulative effects requires an analysis of the potential direct and indirect effects of the proposed harvest alternatives, in combination with other past, present, and reasonably foreseeable future actions potentially affecting Cook Inlet beluga whales and the socio-economic environment. 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 potential additive and synergistic result of the harvest alternatives as they interact with actions external to the proposed actions. The ultimate goal of identifying potential cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of the alternatives.

The methodology used for cumulative effects analysis consists of the following steps:

- *Identify issues, characteristics, and trends within the affected environment that are relevant to assessing cumulative effects of the harvest alternatives* – include lingering effects from past activities, and demonstrate how they have contributed to the current baseline for each resource. This information, summarized in Chapter 3, comes from the 2005 Draft Conservation Plan for Cook Inlet Beluga Whales (NMFS 2005), which is incorporated by reference into this Draft SEIS.
- *Describe the potential direct and indirect effects of the harvest alternatives.* This information is presented in detail in Chapter 4, Sections 4.7 and 4.8.
- *Define the spatial (geographic) and temporal (time) scope for the analysis*. This timeframe may vary among 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 2017) for the purposes of this SEIS.
- *Identify past, present, and reasonably foreseeable future 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 reasonably foreseeable future actions 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. Most of the past and present actions, and reasonably foreseeable future actions analyzed in this SEIS were identified in the 2005 Draft Conservation Plan for Cook Inlet Beluga Whales (NMFS 2005) incorporated by reference.
- *Screen all of the direct and indirect effects, when combined with the effects of future 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 potential 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.

4.5.1 Analysis of 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 SEIS, past and present actions include both human controlled events (such as subsistence harvest, oil and gas exploration and development activities, pollution, coastal development, and commercial fisheries), and natural events (such as predation, stranding events, climate change, parasitism and disease).

Past actions are described in more detail in Section 3.2.2 and were identified using agency documentation, the 2005 Draft Cook Inlet Beluga Whale Conservation Plan, NEPA documentation, reports, resource studies, and peer reviewed literature. Table 4.4 lists relevant past and present actions.

As described in detail in Section 3.2.2, subsistence harvest of Cook Inlet beluga whales has occurred for thousands of years and has been documented intermittently since the 1980s. The intense harvest that occurred in the mid-1990s has had lingering effect on the Cook Inlet population. Since protective legislation (Pub. L. 106-31) was put in place, NMFS has entered into several co-management agreements with CIMMC to allow for one or two whales to be taken annually. No beluga whales were harvested in 1999, 2000, 2004, 2006, and 2007; one whale was harvested in 2001, 2002, and 2003; and two beluga whales were harvested in 2005.

4.5.2 Analysis of Reasonably Foreseeable Future Actions

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 (40 CFR 1502.22(b)). RFFAs to be considered must also fall into the temporal and geographic scope described in Section 4.1. Section 3 of the 2005 Draft Conservation Plan for the Cook Inlet Beluga Whale (NMFS 2005) identified several factors which may be influencing the growth or stability of the population. The Draft Conservation Plan provides considerable detail on these factors and is therefore incorporated by reference into this SEIS. The list of reasonably foreseeable future actions is also based, in large part, on the factors listed in the Draft Conservation Plan. Many of these factors are also summarized in Chapter 3 of this SEIS.

Reasonably foreseeable future human controlled and natural actions were screened for their relevance to the alternatives proposed in this SEIS. The following list presents a general overview of actions to be considered in the cumulative effects analysis. At this time, effect of these actions remain unknown. The Draft CP recommends research priority to better understand these anthropogenic and natural effects. Table 4-4 provides more specific detail on these actions.

- *Subsistence activities:* Alaska Natives have traditionally hunted the Cook Inlet beluga whale for subsistence purposes and for traditional handicrafts.
- *Commercial fisheries:* Federal and state directed commercial fisheries for shellfish, groundfish, herring, and salmon have occurred and will continue to occur in Cook Inlet. Personal-use fisheries also occur within the project area.
- *Vessel traffic:* Most of Cook Inlet is navigable and will continue to be used by various classes of vessels, including containerships, bulk cargo freighters, tankers, commercial and sport fishing vessels, and recreational vessels.
- *Coastal development*: The south-central region of Alaska is the state's most populated and industrialized area. Cities, villages, ports, airports, treatment plants, refineries, highways, and railroads are located on or within close proximity to Cook Inlet. Future development is likely to occur as the need for marine support services and shipping capacity increases.
- *Oil and gas activities*: Oil and gas leases in Cook Inlet will result in continued and future offshore production facilities and pipelines, drilling activities, seismic programs, transportation and barging.
- *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 may occur because of industrial activities, waste disposal, and atmospheric deposition. Marine species may accumulate contaminants such as PCBs and polycyclic aromatic hydrocarbons (PAHs).
- *Scientific research:* Activities related to the scientific research of the physical environment, beluga 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.
- *Other Mortality:* Disease, parasites, and predation will continue to result in mortality of beluga whales, other 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. Stranding events of Cook Inlet beluga whales, some of which result in mortality, have been documented and are expected to continue.
- *ESA Listing:* On August 7, 2006, NMFS published a finding in the FR that listing the Cook Inlet beluga whale stock may be warranted (71 FR 44614). A second Status Review (NMFS 2006) has been completed and underlies NMFS's proposed rule to list the Cook Inlet belugas as endangered under the ESA (72 FR 19854, April 20, 2007). The decision to list will be determined in April 2008. The population-level effects of these actions are unknown. The Draft Conservation Plan outlines research priorities for better understanding the impacts of the various activities, actions, and environmental factors on Cook Inlet belugas.

Table 4-4. Past, Present and Reasonably Foreseeable Future Actions Identified for the Cumulative Effects Analysis

Activity	Past and Present Action	Reasonably Foreseeable Future Action
Human-Caused		
Subsistence activities	• Unregulated harvest before 1999 • Limited harvest 1999-present	• Regulated harvest
Commercial harvest	• Periodic commercial whaling	• None
Commercial/Personal fisheries	• Shellfish • Groundfish • Herring • Salmon • 1999-2000 eulachon • Personal	• Present actions to continue • Increased hatcheries (Cook Inlet Aquaculture Association)
Vessel traffic	• Container ships • Cargo/freight • Tankers • Commercial and personal fisheries vessels • Ferries (Knik Arm) • Recreation vessels • Wildlife viewing vessels	• Present actions to continue and/or increase • Increased cruise ship calls at Port of Anchorage
Coastal development	• Communities along Cook Inlet • Port facilities in Cook Inlet o Anchorage o Point MacKenzie o Tyonek o Drift River o East Foreland/Nikiski o Kenai o Anchor Point o Homer o Drift River (primarily crude oil platform) • Small-boat launch facilities o Ship Creek o Knik River bridge • Mining o Placer miners near West Fork River and Hope o Small placer mines at Canyon Creek, Yentna-Cache Creek, Lake Creek, Willow Creek o Beluga coal fields	• Port of Anchorage Expansion • Chuitna Coal Project • Knik Arm Bridge and Toll Authority • Knik Arm Ferry • Ship Creek construction (Swan Bay Holdings, Inc.) • Port MacKenzie development • Knik Arm railroad bridge • 200-MW coal-fired power plant at Beluga (Chugach Electric Association) • Fish Creek multiple use development • Alaska Railroad Corporation (ARRC) multi-modal facility in Ship Creek area • ARRC and Municipality of Anchorage development in Ship Creek area • Susitna River bridge • Hydroelectric dam on the Big Susitna River • Alyeska Alloys ore reduction plant at Tyonek
Oil and gas activities	• Development of Kenai Peninsula and upper Cook Inlet oil and natural gas (1970s) • Offshore oil production facilities in Cook Inlet (546 wells drilled since 1962; 238 current wells) • Currently approximately 230 miles of undersea pipelines • Minerals Management Service Sale 191 (lower Cook Inlet) • DNR annual Cook Inlet oil and gas lease sale (1999-2009)	• Beluga River 3D Seismic Project (ConocoPhillips and Union Oil Company) • Granite Point 3D Seismic Survey (Chevron/Union Oil Company) • Natural gas drilling in Susitna Flats Game Refuge (Forest Oil Corporation) • Alaska Intrastate Gas Company's Liquid Natural Gas plant at Whittier

Table 4-4. (Continued) Past, Present and Reasonably Foreseeable Future Actions Identified for the Cumulative Effects Analysis

Activity	Past and Present Action	Reasonably Foreseeable Future Action
Human-Caused		
Industrial pollutants	• Industrial activities discharge o Petroleum o Seafood processing o Ship ballast • Municipal wastewater treatment discharge (10 communities) o Anchorage Water and Wastewater Utility (AWWU) o Nanwalek o Port Graham o Seldovia o Tyonek o Eagle River o Girdwood o Homer o Kenai o Palmer • Urban runoff • Accidental oil spills	• Present actions to continue and/or increase with increased population • 2007-2012 EPA NPDES permits for small suction dredge placer miners • 2007-2012 EPA NPDES permit for Cook Inlet oil and gas exploration (increase discharge)
Scientific research	• Research on beluga whales • Oceanographic • Geophysical/chemical (see oil and gas)	• Research on beluga whales • Oceanographic • Geophysical/chemical (see oil and gas)
Species Management	• Draft Conservation Plan • Co-Management Agreements	• Potential to list the species under the ESA to be determined in April 2008
Natural Events		
Climate variability	• Global warming	• Global warming
Other mortality	• Predation • Disease and parasitism • Stranding events	• Predation • Disease and parasitism • Stranding events

4.6 Resources and Characteristics Not Carried Forward for Further Analysis

Several of the resources and factors described in Chapter 3 may be affected directly or indirectly by subsistence harvest of beluga whales or contributes to cumulative effects, as discussed below, but would themselves not be affected measurably by any of the alternative harvest scenarios, and additional analysis would not be useful to decision makers or the public.

Direct harvest activities are categorized as small boat activity, pursuit, and stranding of animal groups, harvest of individual animals, and butchering of the carcass on the beach or tide flats. None of these activities would have a measurable effect on the resources described in this section of the SEIS. The following subsections present each resource or factor not carried forward for detailed analysis for Environmental Consequences.

4.6.1 Cook Inlet Climate, Geology, and Water Quality

The four alternatives identified in Chapter 2 of this document would have no measurable effect on the physical environment of Cook Inlet, including climate, geology, oceanography, or water quality. These physical factors would remain the same across all alternatives over the time period covered by this analysis.

4.6.2 Freshwater, Marine and Anadromous Fish and Essential Fish Habitat

As described in Chapter 3, the fish resources found in Cook Inlet provide several prey species for beluga whales. Subsistence beluga whale hunting activities using open skiffs can result in short-term disturbance to EFH while landing and processing beluga whale carcasses on the tide flats after a successful hunting trip. However, this habitat would be expected to quickly recover within a few tide cycles. This potential effect would be localized and temporary and, therefore, negligible across all alternatives. Because there would be no substantial effects on EFH from subsistence hunting activities and further detailed analysis under each alternative would not be expected to influence the decision to be made, EFH is not carried forward for analysis.

The alternatives identified in Chapter 2 would have no measurable effect on prey species of the Cook Inlet beluga whales. As beluga whale populations increase to historic levels, consumption of prey species such as and salmon and eulachon would increase, but this level of predation is not expected to be substantially different from levels consumed before 1993. Beluga whale subsistence hunting practices in Cook Inlet at the levels specified under any of the action alternatives would have no appreciable effect on prey species of the beluga whale.

4.6.3 Other Marine Mammals

Other species described in Chapter 3 that would not be affected directly or indirectly by beluga whale subsistence hunting activities include the endangered fin whales and humpback whales, minke whales, killer whales, endangered Steller sea lions, and either the southwest or south-central stock of sea otters. These species were not considered for further analysis because the regulated subsistence hunts occur only in upper Cook Inlet, where these species rarely occur. Harbor porpoises and harbor seals can occur in some of the same areas in upper Cook Inlet as beluga whales, such as mouths of major rivers. Subsistence harvest activities could disturb harbor porpoises and harbor seals located in the hunting area, but the level of this disturbance, if any is thought to be short-term and negligible across all alternatives.

4.6.4 Marine Birds

Beluga whale harvest activities specified under the action alternatives could potentially attract some gulls and bald eagles to feed on beluga whale remains after a successful hunt. However, the low level of harvest under these alternatives would provide relatively few opportunities for these scavengers and represent a very short-term feeding opportunity for relatively few birds. The short-term availability of this food source would be similar across all alternatives and is considered negligible.

The threatened Steller’s eider and candidate Kittlitz’s murrelet would not be expected to be disturbed by or even interact with subsistence hunting activities based on their seasonal occurrence and geographic distribution primarily in lower Cook Inlet. Therefore, Steller’s eider and Kittlitz’s murrelet are not carried forward for analysis.

Disturbance or displacement of other marine birds during subsistence hunting activities would be similar to other activities such as sport or commercial fishing in Cook Inlet, but the frequency of hunting activity would be considerably less. Marine birds in upper Cook Inlet, where beluga hunting occurs, are most often found along very shallow water and on the mud flats, away from most beluga hunting activities. Because effects on marine birds are not expected, they are not carried forward for detailed analysis.

4.6.5 ESA-Listed Species

ESA listed species within the project area include endangered fin whales, humpback whales, endangered Steller sea lions, and the threatened Southwest stock of sea otters. The only listed species, other than the listed birds in Section 4.6.4, that would have any potential interaction with subsistence harvests is the Steller sea lion. However, Steller sea lions are rarely found in upper Cook Inlet and therefore, an interaction between beluga whale hunters and Steller sea lions is unlikely to occur as a result of these alternatives. Although Steller sea lions and sea otters are taken for subsistence in lower Cook Inlet, these alternatives would not result in a change in the level of subsistence harvest of Steller sea lions or sea otters. Therefore, the four alternatives considered for this proposed action would have no effect on the Steller sea lions due to geographic separation. The four alternatives considered in this proposed action would have no direct or indirect effects on any other ESA-listed whales, sea otters, or birds because beluga hunting activity would be outside the range of these ESA-listed species.

4.7 Cook Inlet Beluga Whales

4.7.1 Direct and Indirect Effects of Alternative 1 – No Action

Mortality (Direct Effect)

Under Alternative 1 there would be no harvest. NMFS would not take any action to establish a harvest plan for Cook Inlet beluga whales and no harvest limits or guidelines would be established under this “no action” alternative. NMFS would not issue regulations to govern this harvest, nor would NMFS sign any cooperative agreement with any ANO that includes provisions for the harvest of Cook Inlet beluga whales. Pub. L. 106-31, the moratorium on hunting Cook Inlet beluga whales without a co-management agreement, would remain in effect, and therefore, no hunting would be allowed until new legislation removed Pub. L. 106-31. Although the harvest model indicates that the population may not recover under this alternative (Table 4-5), the magnitude and duration of mortality effects because of authorized subsistence hunting would be negligible because subsistence harvest would not contribute any mortality to the population.

Disturbance (Indirect Effect)

Because there would be no beluga whale harvest under this alternative, there would be no disturbance effects from subsistence hunting activities.

4.7.2 Direct and Indirect Effects of Alternative 2: Options A and B

Mortality

The number of beluga whales that could be harvested under Options A and B of Alternative 2 would vary with the estimated abundance and growth rate of the population according to Table 4-2 and the decision-making process described in Section 2.3.2. The harvest schedule under Options

A and B of Alternative 2 has a harvest floor of 350 whales, indicating that no harvest would be authorized if the average abundance estimate for the previous five years was less than 350 whales. The harvest model was used to calculate the probability of the population either declining within 100 years, increasing but not recovering to OSP (780 whales), or recovering to OSP (Table 4-5). For those situations where the harvest model predicted recovery of the population, the duration of mortality effects from subsistence harvest was assessed by calculating the delay in recovery time attributable to subsistence harvest.

Differences Between Options A and B

As described in more detail in Section 2.3.2, Alternative 2 has been divided into two options that reflect the changing status of the Cook Inlet beluga whale population since the Administrative Law Judge proceedings were concluded in 2005. Under Option A, the recommended decision of the Administrative Law Judge, the Harvest Table would not be put into effect until 2010 and there would be a prescribed strike allowance on one beluga whale in 2008 and two beluga whales in 2009. When the prescribed harvests for 2008 and 2009 were established during the Administrative Law Judge proceedings, the average population abundance from the previous five years (2000-2004) was 371 whales. At that abundance level, one or two strikes per year would have been considered to have a minor or negligible impact at a low growth rate according to the impact criteria in Table 4-1. However, the most recent five-year period for which there are survey data (2003-2007) indicates that the average population abundance has fallen to 336 whales since the Administrative Law Judge decision was made. According to the impact criteria in Table 4-1, any harvest while the 5-year population average was below 350 whales would be considered to have a major impact. The assessment of effects for Option A after 2009 would be the same as for Option B.

Under Option B, the Harvest Table would be put into effect immediately; there would be no harvests in 2008 and 2009 unless the five-year average abundance for 2003 to 2007 was greater than 350 whales. The assessment of effects for implementing the harvest schedule immediately (Option B) is described in the following section.

Alternative 2 Harvest Table (Option A and Option B after 2009)

The harvest model probabilities concerning the population trajectory (i.e. the likelihood that the population will decrease, increase but not recover, or increase to recovery) are nearly identical under Option A as they are under Option B (Table 4-5). This is because the model results are for a 100 year period and the two options differ only with regard to harvest during the first two years. For all but those first two years, the harvest levels would be the same under Option A as they would be under Option B. To avoid confusion from using two sets of slightly different numbers, the statistics used in the analysis are for Option B. The conclusions about impact levels would be the same for both Option A and Option B after 2009 as described below.

Declining Population

The harvest model indicates there is a 77.5 percent probability that the population would decline from its current abundance (336 beluga whales, average abundance from 2003 to 2007 surveys) with no harvest and a 78 percent and a 77.8 percent probability that the population would decline with harvest as specified under this alternative. The closeness of these probability estimates reflects the fact that the harvest floor rule of this alternative would be in effect for almost all of the modeling runs that result in a declining population over the next 100 years. The modeling results under this alternative are, therefore, essentially the same as the no harvest alternative when the population declines. For a declining population, the magnitude of mortality effects due to authorized subsistence hunting would be negligible according to the impact criteria in Table 4-1. This implies that the population would be declining for reasons other than current or future subsistence harvests. The duration of mortality effects is not part of this assessment because the population would not recover under these conditions and any measure of delay in recovery would be meaningless.

Increasing Population without Recovery

The harvest model indicates there is a 13.9 percent probability that the population would increase but not recover to OSP within 100 years with no harvest and a 14.5 percent probability that the population would increase but not recover with harvest as specified under this alternative. Under these modeling conditions, the population would be between 350 and 780 whales and would be subject to subsistence harvest mortality dependent on the population size and growth rate. Comparing the harvest schedule to the impact criteria in Table 4-1 (see Table 4-2 for the number of strikes at different population levels and growth rates that would apply to each impact level), the magnitude of the harvest under Alternative 2 would be considered to have minor or moderate impacts from mortality. At low growth rates, the scheduled harvest would be considered moderate at most population levels. At intermediate growth rates, the scheduled harvest would be considered minor at most population levels below 500 whales and moderate at most population levels above 500 whales. At high growth rates, the scheduled harvest would be considered minor at population levels below 550 whales and moderate at population levels above 550 whales. Because the population would not recover under this set of modeling conditions, no assessment of the duration of mortality effects at these population levels was undertaken.

Increasing to OSP

The harvest model indicates there is a 8.7 percent probability that the population would recover to OSP within 100 years with no harvest and a 7.5 percent and 7.7 percent probability that the population would recover with harvest as specified under this alternative. Under these modeling conditions, the population would grow from its current abundance level to greater than 780 whales. The assessment of mortality impacts when the population was between 350 and 780 whales would be the same as described above and would be considered minor to moderate. For these modeling situations that lead to recovery, the harvest model can be used to calculate the probable delay in recovery with harvest compared to a situation of no harvest mortality (see Section 4.4 for methodology). Harvest mortality at the rates defined under Alternative 2 would likely cause a delay in recovery of 20.6 percent, which is considered moderate in duration according to the impact criteria in Table 4-1.

Disturbance

The effects of disturbance because of subsistence hunting would be proportional to the number of strikes allowed per year and would thus vary with the beluga whale population abundance and growth rate according to the harvest schedule. Modeling results indicate that the beluga whale population is likely to decline over the next 100 years and, under those conditions, there would be very little, if any, harvest authorized. Therefore, disturbance effects for a declining population would be minor or negligible in magnitude, frequency, and geographic extent.

If the beluga whale population increases, either to recovery (780 whales) or somewhere short of that goal, harvest levels and the number of hunting efforts would increase. At low population growth rates, the harvest schedule under this alternative allows only one or two strikes per year. This amount of hunting activity would likely take place over a matter of a few days and in a limited geographic location. Since beluga whales have been observed returning to areas previously disrupted by hunting activities and vessel traffic that were more intensive than this minimal hunting effort (Caron and Smith 1990, Shelden 1994), it is likely that there would be no permanent change in their distribution as a result of this level of hunting disturbance. The magnitude, frequency, and geographic extent of hunting disturbance at low population growth rates would be considered minor according to the impact criteria (Table 4-1).

At intermediate population growth rates, the number of authorized strikes would be one or two strikes per year until the beluga whale population reached at least 550 animals, at which point it would rise to three or four strikes per year. At the lower population levels, the effects of disturbance would be the same as described above. At the higher population levels, it is possible that hunting activity could be distributed over several different geographic areas as the authorized strikes are allocated among different beluga whaling groups. As the beluga whale population expands to these abundance levels, the animals may also expand into areas of their range not currently occupied, so hunting opportunities may exist in areas other than upper Cook Inlet. However, it is likely that these relatively few hunts would still be concentrated in the traditional gathering areas for the whales such as the Susitna River delta. These different hunts could take place over a period of days or weeks but individual whales would likely be disturbed infrequently by these relatively few hunts. These temporary and infrequent disturbances are not likely to cause a change in the distribution of the whales. The magnitude, frequency, and geographic extent of hunting disturbance at intermediate population growth rates would be considered minor according to the impact criteria (Table 4-1).

At high population growth rates, the harvest progresses from one or two strikes per year at low abundance to more than six strikes per year as the population grows to 700 animals. At the higher harvest levels, hunting activity is likely to be distributed in several locations within Cook Inlet for the reasons described above. This geographic distribution of disturbance would be considered moderate according to the impact criteria. Some individual whales could be harassed more than once a year in popular hunting areas so the frequency component of disturbance could be considered moderate, at least in some locations. Considering that hunting pressure in the 1990s was much higher than six strikes per year and the beluga whales did not abandon their preferred habitats, it is unlikely that this level of hunting disturbance would have a measurable effect on the distribution of whales within Cook Inlet. The magnitude of the disturbance would therefore be considered minor. This is consistent with observations of strong site tenacity in this species in Cook Inlet and other regions (Shelden 1995). Despite hunting pressures, tagging activities, and other chronic disturbances (e.g., fishing and other vessel activities), beluga whales have not abandoned the Susitna River delta or Knik Arm.

4.7.3 Direct and Indirect Effects of Alternative 3

Mortality

The number of beluga whales that could be harvested under Alternative 3 would vary with the estimated abundance and growth rate of the population according to Table 4-2 and the decision-making process described in Section 2.3.3. The harvest schedule under Alternative 3 has a harvest floor of 350 beluga whales, indicating that no harvest would be authorized if the average abundance estimate for the previous five years was less than 350 whales. In addition, no harvest would be authorized if the population had a low growth rate and was less than 500 whales. The harvest model was used to calculate the probability of the population either declining within 100 years, increasing but not recovering to OSP (780 whales), or recovering to OSP (Table 4-5). For those situations where the harvest model predicted recovery of the population, the duration of mortality effects from subsistence harvest was assessed by calculating the delay in recovery time attributable to subsistence harvest.

Declining Population

The harvest model indicates that there is a 77.5 percent probability that the population would decline from its current abundance (336 beluga whales, average abundance from 2003 to 2007 surveys) with no harvest and a 77.7 percent probability that the population would decline with harvest as specified under this alternative. For instance, with Alternative 2, the equality of these probability estimates reflects the fact that the harvest floor rule would be in effect for almost all of the modeling situations that result in a declining population over the next 100 years. The modeling results under this alternative are, therefore, essentially the same as the no harvest alternative when the population declines. For a declining population, the magnitude of mortality effects because of authorized subsistence hunting would be negligible according to the impact criteria in Table 4-1. This implies that the population would be declining for reasons other than current or future subsistence harvests. The duration of mortality effects is not part of this assessment because the population would not recover under these conditions and any measure of delay in recovery would be meaningless.

Increasing Population without Recovery

The harvest model indicates that there is an 13.9 percent probability that the population would increase but not recover to OSP within 100 years with no harvest and an 13.9 percent probability that the population would increase but not recover with harvest as specified under this alternative. Under these modeling conditions, the population would be between 350 and 780 whales and would therefore be subject to subsistence harvest mortality dependent on the population size and growth rate. Comparing the harvest schedule to the impact criteria in Table 4-1 (see also Table 4-2), the magnitude of the harvest under Alternative 3 would be considered to have negligible to moderate impacts from mortality.

At low growth rates, the scheduled harvest would be considered negligible at population levels below 575 whales and either minor or negligible at higher abundance. At intermediate growth rates, the scheduled harvest would be considered negligible or minor at population levels below 500 whales and moderate at population levels above 500 whales. At high growth rates, the scheduled harvest would be considered negligible or minor at population levels below 575 whales and moderate at population levels above 575 whales. Because the population would not recover under this set of modeling conditions, no assessment of the duration of mortality effects at these population levels was undertaken.

Increasing to OSP

The harvest model indicates that there is a 8.7 percent probability that the population would recover to OSP within 100 years with no harvest and a 8.4 percent probability that the population would recover with harvest as specified under this alternative. Under these modeling conditions, the population would grow from its current abundance level to greater than 780 whales. The assessment of mortality impacts when the population was between 350 and 780 whales would be the same as described above and would be considered negligible to moderate. For these modeling situations that lead to recovery, the harvest model can be used to calculate the probable delay in recovery with harvest compared to a situation of no harvest mortality (see Section 4.4 for methodology). Harvest mortality at the rates defined under Alternative 3 would likely cause a delay in recovery of 13.2 percent, which is considered minor in duration according to the impact criteria in Table 4-1.

Disturbance

The effects of disturbance because of subsistence hunting would be proportional to the number of strikes allowed per year and would thus vary with the beluga whale population abundance and growth rate according to the harvest schedule. Modeling results indicate that the population is likely to decline over the next 100 years and, under those conditions, there would be very little, if any, harvest authorized. Therefore, disturbance effects for a declining population would be minor or negligible in magnitude, frequency, and geographic extent.

If the beluga whale population increases, either to recovery (780 whales) or somewhere short of that goal, harvest levels and the number of hunting efforts would increase. At low population growth rates, the harvest schedule under this alternative allows no strikes or less than one strike per year (less than five strikes per five-year period). This minimal amount of hunting activity would likely take place over one day or a few days and in a limited geographic location. The magnitude, frequency, and geographic extent of hunting disturbance at low population growth rates would be considered minor according to the impact criteria (Table 4-1).

At intermediate population growth rates, the number of authorized strikes would be one or two strikes per year until the population reached at least 525 animals, two or three strikes per year until the beluga whale population reached 600, and then three or four strikes per year above 600. This is essentially the same amount of hunting disturbance as described under Alternative 2 and the analysis would be the same. The magnitude, frequency, and geographic extent of hunting disturbance at intermediate population growth rates would be considered minor according to the impact criteria.

At high population growth rates, the harvest progresses from one or two strikes per year at low abundance to six strikes per year as the beluga whale population grows to 700 animals. This is essentially the same amount of hunting disturbance as described under Alternative 2 and the analysis would be the same. The geographic and frequency components of disturbance would be considered moderate and the magnitude of disturbance would be considered minor according to the impact criteria.

4.7.4 Direct and Indirect Effects of Alternative 4

Mortality

The number of beluga whales that could be harvested under Alternative 4 would vary with the estimated abundance and growth rate of the population according to Table 4-2 and the decision-making process described in Section 2.3.4. The harvest schedule under Alternative 4 is the same as Alternative 2 for all growth rates and population levels above 400 whales. However, Alternative 4 has a harvest floor of 250 whales and would authorize harvests when the population was between 350 and 250 whales if the growth rate was intermediate or high. No harvests would be authorized if the growth rate was low at these abundance levels. The harvest model was used to calculate the probability of the population either declining within 100 years, increasing but not recovering to OSP (780 whales), or recovering to OSP (Table 4-4). For those situations where the harvest model predicted recovery of the population, the duration of mortality effects from subsistence harvest was assessed by calculating the delay in recovery time attributable to subsistence harvest.

Declining Population

The harvest model indicates that there is a 77.5 percent probability that the population would decline from its current abundance (336 beluga whales, average abundance from 2003-2007 surveys) with no harvest and a 78.0 percent probability that the population would decline with harvest as specified under this alternative. The low-growth, zero-harvest rule would likely be in effect for most of the modeling situations that result in a declining population after 100 years so there would be no harvest authorized under this alternative. The exception to this is the scenario where the population declines from the current level and then begins to increase at an intermediate or high growth rate for a sustained period. According to the impact criteria in Table 4-1, any harvests authorized under Alternative 4 with the population less than 350 animals would be considered to have major impacts regardless of the growth rate. However, it is much more likely that there would be no harvest under the set of modeling conditions that leads to a declining population and the magnitude of mortality effects because of authorized subsistence hunting would therefore be negligible according to the impact criteria in Table 4-1. This implies that the population would be declining for reasons other than current or future subsistence harvests. The duration of mortality effects is not part of this assessment because the population would not recover under these conditions and any measure of delay in recovery would be meaningless.

Increasing Population without Recovery

The harvest model indicates that there is an 13.9 percent probability that the beluga whale population would increase but not recover to OSP within 100 years with no harvest and a 14.5 percent probability that the population would increase but not recover with harvest as specified under this alternative. Under these modeling conditions, the population would be between 350 and 780 whales and would therefore be subject to subsistence harvest mortality dependent on the population size and growth rate. Since the harvest schedule under Alternative 4 is essentially the same as the harvest schedule under Alternative 2 for these population levels and growth rates, the impact analysis would be the same. At low growth rates, the scheduled harvest would be considered moderate at most population levels. At intermediate growth rates, the scheduled harvest would be considered minor at most population levels below 500 whales and moderate at most population levels above 500 whales. At high growth rates, the scheduled harvest would be considered minor at population levels below 550 whales and moderate at population levels above 550 whales. Because the population would not recover under this set of modeling conditions, no assessment of the duration of mortality effects at these population levels was undertaken.

Increasing to OSP

The harvest model indicates that there is a 8.7 percent probability that the beluga whale population would recover to OSP within 100 years with no harvest and a 7.5 percent probability that the population would recover with harvest as specified under this alternative. Under these modeling conditions, the population would grow from its current abundance level to greater than 780 whales. The assessment of mortality impacts when the population was between 350 and 780 whales would be the same as described above and would be considered minor to moderate. For these modeling situations that lead to recovery, the harvest model can be used to calculate the probable delay in recovery with harvest compared to a situation of no harvest mortality (see Section 4.4 for methodology). Harvest mortality at the rates defined under Alternative 4 would likely cause a delay in recovery of 20.7 percent, which is considered moderate in duration according to the impact criteria in Table 4-1.

Disturbance

The effects of disturbance because of subsistence hunting would be proportional to the number of strikes allowed per year and would thus vary with the beluga whale population abundance and growth rate according to the harvest schedule. Modeling results indicate that the population is likely to decline over the next 100 years and, under those conditions, there would be no harvest authorized unless the population started to grow again at intermediate to high growth rates. Therefore, disturbance effects for a declining population would be minor or negligible in magnitude, frequency, and geographic extent.

If the beluga whale population increases, either to recovery (780 whales) or somewhere short of that goal, harvest levels and the number of hunting efforts would increase. At low population growth rates, the harvest schedule under this alternative allows only one or two strikes per year. This is the same amount of hunting disturbance as described under Alternative 2 and the analysis would be the same. The magnitude, frequency, and geographic extent of hunting disturbance at low population growth rates would be considered minor according to the impact criteria (Table 4-1).

At intermediate population growth rates, the number of authorized strikes would be one or two strikes per year until the beluga whale population reached at least 550 animals, at which point it would rise to three or four strikes per year. This is essentially the same amount of hunting disturbance as described under Alternative 2 and the results of the analysis are the same. The magnitude, frequency, and geographic extent of hunting disturbance at intermediate population growth rates would be considered minor according to the impact criteria.

At high population growth rates, the harvest progresses from one or two strikes per year at low abundance to more than six strikes per year as the beluga whale population grows to 700 animals. This is essentially the same amount of hunting disturbance as described under Alternative 2 and the results of the analysis are the same. The geographic and frequency components of disturbance would be considered moderate and the magnitude of disturbance would be considered minor according to the impact criteria.

Table 4-5. Summary of effects of the alternatives on the Cook Inlet beluga whale population. This table summarizes the statistical analysis of 10,000 runs of the population harvest model under each alternative harvest plan (see Appendix A).

Statistics for each set of 10,000 model runs	Alternative 1 No harvest	Alternative 2 Option A	Alternative 2 Option B	Alternative 3	Alternative 4
Probability of the population declining in 100 years	77.5%	78.0%	77.8%	77.7%	78%
Probability of the population increasing but not recovering in 100 years	13.9%	14.5%	14.5%	13.9%	14.5%
Probability of the population recovering to 780 beluga whales within 100 years	8.7%	7.5%	7.7%	8.4%	7.5%
For those model runs that resulted in recovery of the stock within 100 years with no harvest (8.7% of all model runs), this is the probability that those model runs would still result in recovery within 100 years if you added harvest according to the rules outlined in each alternative.	98.5%	86.1%	89.4%	96.8%	85.9%
For those model runs that still resulted in recovery even with harvest, 95% of them would have a delay equal to or less than this percent delay in recovery compared to the model run without harvest.	0.0%	20.6%	18.4%	13.2%	20.7%

4.8 Socio-Economic Environment

In all alternatives, reducing the harvest could affect the social, economic, cultural, and traditional harvest practices of subsistence users.

4.8.1 Effects on Subsistence and Traditional Harvest Practices

In this section, each alternative is evaluated for effects on the traditional subsistence harvest practices and associated social and cultural practices of Cook Inlet beluga whale hunters. The scale for rating of these effects is described in Section 4.4. The subsistence patterns of the Dena'ina community of Tyonek are more fully documented, so greater reliance is placed on this source of information. Harvest, sharing, and cultural practices of other Cook Inlet beluga whale hunters are cited where available.

4.8.1.1 Direct and Indirect Effects of Alternative 1: No Action

Alternative 1, the no action alternative, would eliminate the opportunity for subsistence harvests of Cook Inlet beluga whales for the Tyonek Dena'ina and other Cook Inlet beluga whale hunters until the population recovers to OSP. The cessation of traditional hunting for a period of more than 100 years would have far-reaching effects on the social and cultural practices associated with beluga whale hunting. Considering first the effect on subsistence harvest practices, the loss of subsistence foods from beluga whales may be quantified by comparison with harvest levels over the past two decades. Harvest levels have been highly variable over the last two decades, so the estimated loss of food production under the no action alternative would vary depending on the period for comparison. As noted in Table 4-6, the loss of beluga whales as food under the no action alternative would be on the order of 300 lbs per year, when compared to the very limited harvest levels since the 1999 moratorium. However, if the comparison is drawn with the high harvest period of the 1995 to 1998, the lost food resource is just over 26,000 lbs per year. If the period 1987 to 1994 is used as the basis of comparison, the lost food resource is close to 7,900 lbs per year. In qualitative terms, the loss of beluga whale hunting would represent the complete elimination of a highly valued subsistence resource in the affected community of Tyonek, and households of other Cook Inlet beluga whale hunters.

Table 4-6. Estimated Average Cook Inlet Beluga Whale Harvest Levels and Food Produced 1987 – 2007

1987 - 1994	1995 - 1998	1999 - 2007
• 79 harvests for food reported or estimated[1]. • Annual average of 11.3 beluga whales	• 150 harvests for food during four years. • Annual average of 37.5 beluga whales	• 5 harvests over nine years. • Annual average of 0.55 beluga whales.
An estimated 7,910 lbs of food produced per year	An estimated 26,250 lbs of food per year.	An estimated 385 lbs of food per year.

Notes: 1. This analysis is based on seven years for which data are available. No data available for 1991.
Source: Harvest data from Mahoney and Sheldon, 2000. Conversion factor for food produced taken from ADF&G Community Profile Data Base quantification of Tyonek 1983 harvest levels. (ADF&G 2001)

Some Cook Inlet beluga whale subsistence hunters assert a financial necessity for their subsistence harvests of beluga whales. All the hunters and their families relied on beluga whale muktuk and meat to supply vital nutrition, and to offset the need to purchase other foods. The quantities of food provided by beluga whales has varied from 1987 to 2007 (Table 4-6). A long lasting prohibition on the subsistence harvest of Cook Inlet beluga whales would adversely affect the families that rely on beluga whales for nutritional and economic purposes.

Since 1999, other sources of beluga whale muktuk may be substituting for Cook Inlet beluga whales. In recent years, muktuk from beluga whales taken from the Naknek and Nushagak rivers in Bristol Bay has been quickly sold in Anchorage. Interest is high in the Bristol Bay region, where inquiries were made on the legalities of shipping Bristol Bay beluga whale products to Anchorage. Some level of importation of beluga whale products into the Cook Inlet region is expected to continue.

Turning to effects on social and cultural practices, the no action alternative may mean that multiple generations would pass before beluga whale subsistence hunting could continue in Cook Inlet. Knowledge of the whales and how to hunt them would become a memory, not a living cultural practice. Sharing practices and ceremonially elaborated exchanges of beluga whale foods would also cease for this period. Social standing within the Alaska Native community is based, in part, on the place an individual holds in the networks for harvesting and sharing traditional foods. Successful beluga whale hunters are highly regarded, as are other hunters who secure and distribute subsistence foods.

In addition, traditional people find identity and place in the world—values and understanding passed from generation to generation—in hunter/harvester relationships with the world around them and the animals they have always relied upon. More specifically to the community of Tyonek, the upper Cook Inlet Dena'ina are unique among Alaskan Athabascan peoples in their historic incorporation of marine mammal hunting in Cook Inlet into their subsistence adaptation. Beluga whale hunting forms an important part of their distinctive cultural identity.

With no harvest authorized, the cultural aspects of Cook Inlet beluga whale harvest would continue to erode under this alternative, if the traditional skills and knowledge associated with this hunt are lost through time. Alaska Native hunters have expressed the belief that such knowledge must be passed on first-hand and that the tradition would die if no hunting occurs for many years. Without direct experience in this harvest, these skills may not be taught and passed on. The consequences of this could be that when hunting resumed after the beluga whale stock recovers, hunters who have not participated in harvesting the whales may lack sufficient skill to avoid inefficient and wasteful harvest practices. Another concern would be that interest in subsistence harvest of these whales would die out entirely. The permanent loss of the Cook Inlet beluga whale hunt would result in many changes to Alaska Native society and culture, and the communities involved would see this as a loss.

As an indirect effect of loss of opportunity for subsistence beluga whale hunts, the families affected would redirect effort to other subsistence resources. This is particularly likely for the Native Village of Tyonek, where beluga whale hunting is one component of an integrated seasonal round of subsistence activities. Based on the composition of the Tyonek subsistence rounds (see

Figure 3-11), it is most likely that salmon and moose would fill in for the reduction in beluga whale foods. This corresponds, in part, with the historic pattern described for the 1940's, in which elders say there was a shift with less harvest effort on marine mammals, and a greater effort directed at moose hunting since the moose population increased in that period (Fall et al., 1984:168). The historic comparison is not the same as the current circumstance in that hunters at that time made voluntary choices about preferences to hunt some species over others, whereas in the present day, hunters must adapt to the drastic decline in beluga whale availability. A second distinction arises in that since the 1980s the moose population in Game Management Unit 16B the vicinity of Tyonek has declined, resulting in the adoption of a predator control project (ABR, Inc. 2006:9). In addition, the state has had to implement limits on the subsistence hunting, through an application and permit program referred to as Tier II. It is not known whether other beluga whale hunting families residing elsewhere in Cook Inlet would also redirect subsistence harvest effort to other species in Cook Inlet.

The direct and indirect effects of the no action alternative are major in magnitude because this would eliminate harvest of a highly culturally valued subsistence resource and disrupt the associated social and cultural practices for most of the community of Tyonek and the other Cook Inlet beluga whale hunting households. These effects would be major in duration, extending for as long as 100 years.

4.8.1.2 Direct and Indirect Effects of Alternative 2: Options A and B

As described in more detail in Section 2.3.2, Alternative 2 has been divided into two options that reflect the changing status of the Cook Inlet beluga whale population since the Administrative Law Judge proceedings were concluded in 2005. Under Option A, the recommended decision of the Administrative Law Judge, the harvest table would not be put into effect until 2010 and there would be a prescribed strike allowance on one beluga whale in 2008 and two beluga whales in 2009. This alternative most closely resembles NMFS's stated objectives, in that it allows recovery of the beluga whale population while recognizing the Alaska Native cultural traditions. This alternative also allows for a review of the harvest level every five years based on the current abundance estimates and population trends.

Under both options of Alternative 2, Alaska Native beluga whale hunters would have the opportunity to harvest Cook Inlet beluga whales, when the population exceeds 350 animals. However, the current population estimate is 336 (average abundance from 2003 to 2007 surveys). In addition, the harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales shows a 77.5 percent probability that the population would decline from its current abundance with no harvest, and a 78 percent and 77.8 percent probability that the population would decline with harvest as specified under this alternative. The harvest model indicates that there is an 13.9 percent probability that the population would increase but not recover to OSP within 100 years with no harvest and a 14.5 percent probability that the population would increase but not recover with harvest as specified under this alternative. (For discussion of the harvest model see Section 4.4.1.1 and Appendix A.)

Alternative 2 Options A and B

As described in more detail in Section 2.3.2, Alternative 2 has been divided into two options that reflect the changing status of the Cook Inlet beluga whale population since the Administrative Law Judge proceedings were concluded in 2005. Under Option A, the recommended decision of the Administrative Law Judge, the harvest table would go into effect in 2010 and until then, there would be a strike allowance of one beluga whale in 2008 and two beluga whales in 2009.[1] Under Option B, the harvest table would be put into effect immediately; there would be no harvests in 2008 and 2009 unless the five-year average abundance for 2003 to 2007 was greater than 350 whales.

Under Alternative 2 Option A, the three beluga whale strikes authorized prior to 2010 would have positive effects on the subsistence harvest patterns and associated social and cultural practices. If hunters were successful in taking the beluga whales as authorized, this would represent 1.5 beluga whales per year, compared to a rate of 0.55 beluga whales per year for the period from 1999 to 2007. Using the conversion rate developed by ADF&G (2001), this would represent up to 1,050 lbs of beluga whale food for consumption in the beluga whale hunting families. In addition, beluga whale foods could be redistributed in community ceremonial occasions and shared within and beyond the hunting communities. These effects are generally comparable to those of Alternative 2 Option B with a scenario of a growing population.

The remainder of this section examines the effects of Alternative 2 Option B, which involves implementation of the harvest table starting in 2008. The harvest table prescribes different levels of harvest authorizations, based on the population level and growth rate of the Cook Inlet beluga whales. In the discussion below, the scenario of a stable or declining population is examined first, followed by the scenario of an increasing population.

Stable or Declining Population

For Alternative 2 Option B, as a result of these probabilities of continued decline, it is highly likely that the Cook Inlet beluga whale population would not attain the 350 minimum threshold required to authorize a limited harvest under this alternative within the next ten years (2008 to 2017) defined as the reasonable foreseeable future for this analysis. Subsistence harvests would not occur and beluga whale food production would be lost along with its nutritional and economic value, an important role it has played over the past two decades. With regard to the social and cultural practices associated with beluga whale hunting, the likely cessation of harvest would eliminate the sharing, ceremonial, and cultural identity benefits associated with beluga whale hunting.

[1] When the prescribed harvests for 2008 and 2009 were established during the Administrative Law Judge proceedings, the average population abundance from the previous five years (2000 to 2004) was 371 whales. However, the most recent 5-year period for which there are survey data (2003 to 2007) indicates that the average population abundance has fallen to 336 whales since the Administrative Law Judge decision was made. Thus, the current population estimate is below that established as the minimum in the harvest table that would go into effect in 2010 under the recommended decision of the Administrative Law Judge.

Increasing Population

While the probability is much lower, it is possible that the Cook Inlet beluga whale population could increase sufficiently to provide for a limited hunt under the harvest schedule of Alternative 2. There is a 14.5 percent probability that the population would increase but not recover to OSP within 100 years with harvests as provided for in this alternative. As shown in Table 2-1, if the population were to increase to 350 - 399, then harvests of five to eight beluga whales per five years would be authorized. This level of harvest would be slightly above the harvest levels in Tyonek since the moratorium in 1999, and it is likely that this limited harvest opportunity would be shared between Tyonek hunters and hunters residing elsewhere in Cook Inlet. This would still represent a loss of beluga whale food production when compared to the late 1980s and early 1990s, and a greater reduction in food production when compared to the mid-to-late 1990s, as noted in Table 4-6. However, the small but recurring subsistence hunt would provide opportunity for the associated social and cultural practices to continue. Hunters would cooperate in conducting the hunt, beluga whale foods would be shared with kin and friends, and in ceremonial meals. Successful hunters would continue to receive the high regard of their community, and marine mammal hunting would continue to figure in the cultural identity of these families and communities.

The indirect effects of Alternative 2, under the scenarios of either a stable or declining, or growing beluga whale population, are likely to include the redirection of subsistence hunting effort to other species, most likely salmon and moose, as discussed under Alternative 1. Whether the beluga whale harvest is eliminated under the stable or declining beluga whale population scenario, or continues at a very limited level under an increasing beluga whale population scenario, it is likely that beluga whale hunting households would redirect their effort to other species to meet their subsistence food requirements. In the more likely scenario of a declining Cook Inlet beluga whale population, the direct and indirect effects of Alternative 2 are comparable to those of Alternative 1. The effects of elimination of beluga whale harvests for an extended period until the population meets the 350 animal threshold would be major. A highly culturally-valued subsistence activity would be eliminated, along with the associated social and cultural practices of cooperation, sharing, ceremonial distributions, and contributions to unique cultural identity.

In the less probable scenario of a growing Cook Inlet beluga whale population, the effects would be less severe than those of Alternative 1. A very limited subsistence beluga whale hunt would provide for subsistence production and consumption, with the associated social and cultural practices at reduced levels. Under this scenario, the overall effect would be moderate.

4.8.1.3 Direct and Indirect Effects of Alternative 3

Alternative 3 provides for a limited traditional harvest for Native beluga whale hunters, provided that the population has attained a five-year average abundance of 350 whales, and the growth rate is high or intermediate. At a low rate of growth, no harvest would be permitted until the population exceeds 500 animals.[2] Compared to Alternative 2, lower harvest levels are authorized

[2] As noted in Table 4-1, growth rates are determined by the probability distribution of growth rates from the previous ten years census data (determined by the statistical confidence intervals around the mean value). "Low growth" is defined as the situation with a greater than 75% probability that the growth rate is less than 2% per year during the previous 10-year period (including negative growth rates). "Intermediate growth" is defined as all growth rates between the low and high growth rate thresholds. "High

when the population is below 500 and the growth rate is high or intermediate. Similar to Alternative 2, this alternative would negligibly increase the time to recovery for the Cook Inlet beluga whale stock. This alternative allows for a review of the harvest level every five years based on current abundance estimates and population trends, and minimally recognizes the needs of Alaska Natives.

The current population estimate is 336 beluga whales (average abundance from 2003 to 2007 surveys) and the harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales show a 77.5 percent probability that the population would decline from its current abundance with no harvest, and a 77.7 percent probability that the population would decline with harvest as specified under this alternative. The harvest model indicates that there is an 13.9 percent probability that the population would increase but not recover to OSP within 100 years with no harvest and an 13.9 percent probability that the population would increase but not recover with harvest as specified under Alternative 3. (For discussion of the harvest model see Section 4.4.1.1 and Appendix A.)

Stable or Declining Population

Given these probabilities of continued decline, it is highly likely that the Cook Inlet beluga whale population would not attain the 350 minimum threshold and high or intermediate growth rates required to authorize a limited harvest under this alternative within the next ten years (2007 to 2017), the reasonably foreseeable future for this analysis. Subsistence harvests would not occur, and beluga whale food production would be lost along with the important nutritional and economic value beluga whale foods have contributed over the past two decades.

With regard to the social and cultural practices associated with beluga whale hunting, the likely cessation of harvest would eliminate the sharing, ceremonial, and cultural identity benefits associated with beluga whale hunting.

Increasing Population

While the probability is much lower, it is possible that the Cook Inlet beluga whale population would increase sufficiently to provide for a limited hunt under the harvest schedule of Alternative 3. There is an 13.9 percent probability that the population would increase but not recover to OSP within 100 years with harvest levels allowed under this alternative. As shown in Table 2-2, if the population were to increase to 350 - 399, and the growth rate is intermediate or high, then harvests of two to three beluga whales per five years would be authorized. This level of harvest would be slightly below the harvest levels in Tyonek since the moratorium in 1999. This would still represent a loss of beluga whale food production when compared to the late 1980s and early 1990s, and a greater reduction in food production when compared to the mid-late 1990s, as noted in Table 4-6. However, the small but recurring subsistence hunt would provide opportunity for the associated social and cultural practices to continue. Hunters would cooperate in conducting the hunt, and beluga whale foods would be shared with kin and friends, and in ceremonial meals.

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growth" is defined as the situation with a greater than 25% probability that the growth rate is greater than 3% per year during the previous 10-year period.

Successful hunters would continue to receive high regard in their community, and marine mammal hunting would continue to contribute to the cultural identity of these families and communities.

The indirect effects of Alternative 3, under either a declining or growing beluga whale population, are likely to include redirection of subsistence hunting effort to other species, most likely salmon and moose, as discussed under Alternative 1. Whether the beluga whale harvest is eliminated under a declining beluga whale population scenario, or continues at a very limited level under an increasing beluga whale population scenario, it is likely that beluga whale hunting households would redirect their effort to other species to meet their subsistence food requirements. In the more likely scenario of a declining Cook Inlet beluga whale population, the direct and indirect effects of Alternative 3 are comparable to those of Alternative 1. The effects of eliminating beluga whale harvests for an extended period, until the population meets the 350 animal threshold and shows a high or intermediate growth rate, would be major. A highly culturally-valued subsistence activity would be eliminated, along with the associated social and cultural practices of cooperation, sharing, ceremonial distributions, and contributions to unique cultural identity.

In the less probable scenario of a growing Cook Inlet beluga whale population, the effects of Alternative 3 would be less severe than those of Alternative 1. A very limited subsistence beluga whale hunt would provide for subsistence production and consumption, with the associated social and cultural practices at reduced levels. Under this scenario, the overall effect would be moderate.

4.8.1.4 Direct and Indirect Effects of Alternative 4

Alternative 4 provides for a traditional harvest for Native whale hunters, although no harvest would occur, beginning in 2010, if the population falls below a five-year average of 250 beluga whales, or shows a low growth rate. The time to recovery for the beluga whale stock would moderately increase under Alternative 4. Alternative 4 recognizes the needs of Alaska Natives to hunt Cook Inlet beluga whales, even when the population average is low; however, this harvest is allowed at a greater cost to recovery of the Cook Inlet beluga whale stock than under other alternatives.

Under Alternative 4, Alaska Native beluga whale hunters have the opportunity to harvest Cook Inlet beluga whales, as long as the five-year average is above 249 whales and the growth rate is high or intermediate. The current population estimate is 336 (average abundance from 2003-2007 surveys) and the population is currently estimated to show continuing decline (2.7 percent per year since 1999). The harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales show a 77.5 percent probability that the population would decline from its current abundance with no harvest, and a 78.0 percent probability that the population would decline with harvest as specified under this alternative. The harvest model indicates there is an 13.9 percent probability that the population would increase but not recover to OSP within 100 years with no harvest (i.e., Alternative 1) and a 14.5 percent probability that the population would increase but not recover with harvest as specified under Alternative 4. (For discussion of the harvest model see Section 4.4.1.1 and Appendix A.)

Stable or Declining Population

Given these probabilities of continued decline, while the population abundance is above the minimum threshold of 250 animals, it is highly likely the population would not attain high or intermediate growth rates required to authorize a limited harvest under this alternative within the next ten years (2007 to 2017), the reasonably foreseeable future for this analysis. Subsistence harvests would not occur, and beluga whale food production would be lost along with the important nutritional and economic value beluga whale foods have contributed over the past two decades.

With regard to the social and cultural practices associated with beluga whale hunting, the likely cessation of harvest would eliminate the sharing, ceremonial, and cultural identity benefits association with beluga whale hunting.

Increasing Population

While the probability is much lower, it is possible that the Cook Inlet beluga whale population would increase sufficiently to provide for a limited hunt under the harvest schedule of Alternative 4. There is a 14.5 percent probability that the population would increase but not recover to OSP within 100 years with harvests as provided for in this alternative. As shown in Table 2-3, if the population were to show an intermediate or high rate of growth from the current level of 336 animals, harvests would be authorized. For a population of 300 - 349, with an intermediate or high growth rate, Alternative 4 provides for harvests of six to seven beluga whales per five years. For a population of 350 - 399, (the minimum increment at which harvests are authorized under Alternatives 2 and 3), this alternative provides for harvests of five to eight beluga whales, depending on whether the growth rate is low, intermediate, or high. This would still represent a loss of beluga whale food production when compared to the late 1980s and early 1990s, and a greater reduction in food production when compared to the mid-late 1990s, as noted in Table 4-6. However, the small but recurring subsistence hunt would provide opportunity for the associated social and cultural practices to continue. Hunters would cooperate in conducting the hunt, and beluga whale foods would be shared with kin and friends, and in ceremonial meals. Successful hunters would continue to receive the high regard of their community, and marine mammal hunting would continue to figure in the cultural identity of these families and communities.

The indirect effects of Alternative 4, under the scenarios of both a declining and a growing population, are likely to include the redirection of subsistence hunting effort to other species, most likely salmon and moose, as discussed under Alternative 1. Whether the beluga whale harvest is eliminated under a declining beluga whale population scenario, or continues at a very limited level if the beluga whale population is increasing, it is likely that beluga whale hunting households would redirect their effort to other species to meet their subsistence food requirements.

Under the more likely scenario of a declining Cook Inlet beluga whale population, the direct and indirect effects of Alternative 4 are comparable to those of Alternative 1. The effects of eliminating beluga whale harvests for an extended period until the population shows a high or intermediate growth rate would be major. A highly culturally-valued subsistence activity would be eliminated, along with the associated social and cultural practices of cooperation, sharing, ceremonial distributions, and contributions to unique cultural identity.

In the less probable scenario of a growing Cook Inlet beluga whale population, the effects of Alternative 4 would be less severe than those of Alternative 1. A very limited subsistence beluga whale hunt would provide for subsistence production and consumption, with the associated social and cultural practices at reduced levels. Under this scenario, the overall effect would be moderate.

4.8.2 Environmental Justice

In February 1994, the President issued E.O. 12898 on Environmental Justice (1994). This E.O. 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, because of 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 in Section 4.8.2.1. The analysis of benefits and adverse effects from the proposed action alternatives on minority and low-income populations is presented in Section 4.8.2.2.

4.8.2.1 Affected Populations

The population affected by the proposed action to conserve and authorize a sustainable, limited, subsistence harvest of Cook Inlet beluga whales includes the Alaska Native families of the Cook Inlet region. Alaska Natives are classified as an ethnic minority for the purpose of the Environmental Justice analysis. As noted in Section 3.6 of this SEIS, the Municipality of Anchorage, the Kenai Peninsula Borough, and the Matanuska Susitna Borough have Alaska Native populations ranging from 8.6 percent to 10.4 percent of their total populations. When the analysis focuses on places associated with the ten Federally Recognized Tribes, a wider range is found for the Alaska Native proportion of the population. Those with the highest percentage Alaska Native ethnicity are traditional Alaska Native settlements located off the road system: Tyonek, Nanwalek, and Port Graham with populations ranging from 88.3 percent to 95.3 percent; and Seldovia with a smaller proportion at 40.3 percent.

Concerning low-income populations, for the Cook Inlet region as a whole, the proportion of families with incomes below the federally defined poverty level is below the statewide average for Anchorage, and very close to the state-wide average for the Kenai Peninsula and Matanuska-Susitna boroughs. When the smaller settlements with significant Alaska Native populations are taken into consideration, it becomes clear that the places off the road system with high percentages of Alaska Native residents also have high rates of residents living with incomes below the poverty level. Thus, Tyonek, Nanwalek, Port Graham, and Seldovia have poverty rates ranging from 13.9 percent to 23.5 percent, compared to a statewide average of 10.0 percent.

4.8.2.2 Environmental Justice Effects Analysis

As described in Section 4.8.1, because of current abundance levels and predicted population trends, it is highly unlikely that subsistence harvests of Cook Inlet beluga whales can be authorized for the reasonably foreseeable future (2007 to 2017). The harvest model used to estimate future population trends showed a 77.5 percent probability of continued decline, even with no subsistence harvest. For all alternatives, it is highly likely that no subsistence harvest would be authorized. This would result in major adverse effects on the Alaska Native beluga whaling families and those who have previously shared in the re-distribution of beluga whale foods. The duration of this loss cannot be precisely calculated, but it is likely to extend far beyond the period considered in this analysis (i.e. 2007 to 2017).

The loss of subsistence beluga whale harvests, although required to address the depletion of the population, would nonetheless have major adverse impacts on the Cook Inlet beluga whaling community of Tyonek, the other beluga whale hunting families in Cook Inlet, and those who have previously received beluga whale foods as gifts and exchanges with the beluga whale hunters. This is an adverse effect that falls disproportionately on the Alaska Native population in Cook Inlet. The Native Village of Tyonek is a minority and low-income community. Cessation of beluga whale hunting in this community would result in major adverse effects. The other Alaska Native beluga whale hunting families in Cook Inlet also bear the burden of this adverse effect. As a result, the proposed action in all alternatives seems to raise Environmental Justice concerns.

However, the MMPA directs that only Alaska Natives are eligible to harvest marine mammals, and further requires that urgent conservation measures be taken when a marine mammal population is depleted. Thus the statutory framework results in a situation in which conservation measures are disproportionately affecting the Alaska Native population. However, the disproportionate result is not an effect of a proposed agency action, policy, or practice which differentially directs an adverse impact to a minority or low-income population. The Administrative Law Judge process gave affected Alaska Natives a specific voice and opportunity to minimize any adverse environmental justice effects.

4.9 Cumulative Effects on Cook Inlet Beluga Whales

4.9.1 Summary of Direct and Indirect Effects

The effects of different levels of harvest on the Cook Inlet beluga whale population were estimated by using a computer modeling program designed to account for uncertainty in the abundance of whales and growth rate of the population at any given time (known as the harvest model, see description in Section 4.4). The harvest model used Bayesian statistics to calculate the probability of the population either increasing or decreasing under a given set of conditions.

The harvest model indicates that there is a 77.5 percent probability that the population will decline from its current abundance (336 beluga whales, average abundance from 2003 to 2007 surveys) with no harvest (Alternative 1). Under the harvest rules specified in all the other alternatives, there would be very little or no subsistence harvest authorized if the population continues to decline. Because of this, the harvest model indicates that there is essentially the same probability that the population would decline with or without harvest as specified under Alternatives 2, 3, or 4.

The harvest model indicates that there is an 13.9 percent probability that the population would increase but not recover to OSP (780 whales) within 100 years with no harvest (Alternative 1). With harvest as specified under the different alternatives, the harvest model indicates that the probability that the population would increase but not recover is 14.5 percent under Alternative 2, 13.9 percent under Alternative 3, and 14.5 percent under Alternative 4.

The harvest model indicates that there is a 8.7 percent probability that the population would recover to OSP within 100 years with no harvest (Alternative 1). With harvest as specified under the different alternatives, the harvest model indicates that the probability that the population will increase to OSP is 7.7 percent under Alternative 2 (Option B), 8.4 percent under Alternative 3, and 7.5 percent under Alternative 4. For those harvest model situations that resulted in recovery, Alternative 2 (Option B) would delay the time to recovery by 18.4 percent compared to the time it would take without harvest. Alternative 3 would delay the time of recovery by 13.2 percent and Alternative 4 would delay recovery by 20.7 percent.

Using the impact criteria described in Section 4.4.1 and Table 4-1, the effects of harvest mortality under Alternative 2 were considered negligible if the population declines and minor to moderate if the population increases, whether or not it increases to OSP. Disturbance effects under Alternative 2 were considered negligible to minor. The effects of harvest mortality under Alternative 3 were considered negligible if the population declines and negligible to moderate if the population increases, whether or not it increases to OSP. Disturbance effects under Alternative 3 were considered negligible to minor. The effects of harvest mortality under Alternative 4 could be considered major if harvest occurs with a population under 350 animals, although it is more likely that there would be no harvest if the population declined and the effects would be considered negligible under those conditions. The effects of harvest mortality would be considered minor to moderate if the population increases, whether or not it increases to OSP. Disturbance effects under Alternative 4 were considered negligible to minor.

4.9.2 Cumulative Effects of the Alternatives

NMFS has recently conducted a Status Review and extinction assessment for the Cook Inlet beluga whale population (Hobbs et al. 2006) to support a decision-making process concerning whether or not the population should be listed under the ESA (see Section 1.4.2). This Status Review considered all the known and potential factors that could be affecting the population's decline and ability to recover, including all the factors listed in Table 4-4. Each factor was assessed for its potential contribution to the risks faced by individual whales and to the overall health of the beluga whale population. Therefore, the Status Review provides an appropriate foundation for the following cumulative effects analysis.

Status Review and Population Viability Analysis Model

In the Status Review (Hobbs et al. 2006), the risk of extinction was assessed with a Population Viability Analysis (PVA), a population dynamics model similar to the harvest model used to assess the direct and indirect effects of the harvest alternatives. The PVA model is considerably more complex than the harvest model because it was designed to assess the overall risk of extinction for the Cook Inlet beluga whale population. Some components of the PVA model were included in the cumulative effects analysis because they have significant effects at population sizes of 200 or less and were necessary to determine the probability of extinction. Because the harvest model was used to explore the effects of harvest mortality only from populations greater than 250 whales and only from increasing populations, the simple two parameter harvest model (Appendix A) was considered adequate to test the alternative harvest policies during the Administrative Law Judge hearings.

The PVA model was developed using the population and harvest estimates from 1994 through 2005. The PVA model was similar to the harvest model in that it is based on Bayesian statistics and a Monte Carlo approach to account for uncertainty in a number of variables such as population abundance and growth rates. Both models also included elements to account for density-dependent growth rates and natural variations in survival and fecundity (i.e., demographic stochastic effects). However, the PVA model was focused on the range of abundance between 500 whales and extinction, and the projections were extended out to 300 years. In contrast, the harvest model examined the potential for the population to recover to 780 whales within 100 years. The PVA model did not project any harvest mortality after 2005. The PVA model also contained elements to account for a number of factors not considered in the harvest model, including:

- Age structure of the population (accounting for juvenile/adult ratios, time lags before juveniles reach reproductive age, annual probability of individual females giving birth).
- Sex ratios of the population (adjusting potential fecundity to account for unequal harvest of males and females).
- Allee effects for small populations (reduced fecundity).
- Mortality from killer whale predation.
- Unusual mortality events (mass stranding mortality).

The results of the PVA analysis were stated in terms of the probability that the population would increase or decrease (including going extinct) after different time periods up to 300 years. The probabilities varied with the assumptions and variables selected for the parameters defined in the PVA model. The Status Review looked at ten different variations of the PVA model, including four variations that included parameters considered to be outside the range of data available for Cook Inlet beluga whales. The Status Review concluded that the variation that most closely reflected the current conditions for Cook Inlet beluga whales was "model h," called the Baseline model. This Baseline model included a constant mortality factor (C) of one whale per year (considered the minimum average contribution of killer whale predation to overall mortality) and an annual five percent probability that an unusual mortality event (P_{Me}) would kill 20 percent of the population.

Although the PVA model was more complex than the harvest model, their basic results were similar in that both models found a much higher probability that the future population will decline rather than increase from its current abundance. If the population continues to decline, there would be no subsistence harvest authorized under any of the alternatives considered in this SEIS. Future declines would, thus, have no contribution from future hunting mortality and would be driven by other factors. If the population starts to increase, harvest could be authorized at various levels depending on its abundance and growth rate. The PVA model does not include an explicit harvest mortality element but the constant mortality factor could be interpreted as being a combination of killer whale predation and other mortality, including harvest mortality, although it would be somewhat different from the variable harvest mortalities described in the alternative harvest schedules. Therefore, the potential level of harvest mortality will be compared to various PVA model results, which are based on different sets of assumptions and variables, to assess the contribution of harvest mortality to the cumulative effects on the Cook Inlet beluga whale population.

Declining Population

The PVA Baseline model predicts a 26 percent probability that the population would go extinct in 100 years and a 68 percent probability that the population would go extinct in 300 years. The results also indicate a 76 percent probability that the population would decline in the next 300 years (between 2005 and 2305). If the population declined steadily from the 2005 level, there would be no harvest authorized under any of the alternatives. If the five-year average population increased above 350 whales before it declined, the alternative harvest schedules would allow one or two whales to be taken per year, depending on how quickly the population was growing. This mortality would be in addition to the mortality factors considered in the PVA Baseline model. The eventual decline of the population below 350 whales may be attributable to harvest mortality, unusual mortality events, or other factors, but the eventual decline would halt future harvests.

Alternative 4 would allow harvest of one or two whales per year if the population was between 350 and 250 whales but only if the population was increasing at a rate of two percent or more per year, which would be very unlikely for an overall declining population. There are no probability statistics to measure the likelihood of this situation actually occurring.

If subsistence harvest was authorized under any of the alternatives, the assumptions tested within the PVA Baseline model may not hold with regard to constant mortality (i.e., the combination of predation and harvest mortality may be greater than one whale per year). This additional mortality would tend to further increase the chances that the population would decline. Again, under the rules of all the alternative harvest schedules, no subsistence harvests would be authorized if the population declined from a five-year average of 350 whales so any harvest from an overall declining population would likely be short-term and would take place only during a relatively brief period of population growth.

Increasing Population

The PVA Baseline model predicted a three percent probability that the population would be between 350 and 500 whales over the next 300 years and a 21 percent probability that it would increase above 500 whales. The PVA model did not calculate this probability over 100 years, as did the harvest model, nor did it distinguish between increases above 500 whales and recovery (increases above 780 whales). These statistics indicate that there is a relatively small probability that the Cook Inlet beluga whale population will increase to the point that subsistence harvest could be authorized under any of the alternatives.

If the population does increase, any authorized harvest would be in addition to the mortality factors included in the Baseline PVA model, effectively increasing the constant mortality factor to two or more whales per year (assuming one beluga mortality per year from killer whale predation). The PVA "model i" was the same as the Baseline model except that it had a constant mortality factor of five whales per year, which would exceed the authorized harvest levels under the alternatives for population levels below 500 whales. PVA "model i" predicts a one percent probability that the population would be between 350 and 500 whales over the next 300 years and a 15 percent probability that it would increase above 500 whales. Under this scenario, the additional mortality because of harvest would hamper the ability of the population to increase compared to the Baseline model. Thus, future harvest could be authorized but such mortality would decrease the chance that harvests could continue.

Unusual Mortality Events

The PVA Baseline model includes the assumption of a five percent probability that an unusual mortality event (i.e., a mass stranding) would kill 20 percent of the population in any given year. With the history of mass strandings and subsequent mortalities in Cook Inlet (see Section 3.2.2.2), it is more likely that future stranding mortalities would involve less than 20 percent of the population at a time but they would occur on a more regular basis than once every 20 years. If the unusual mortality risk used in the PVA Baseline model is averaged across all years, it would be equivalent to the loss of one percent of the population each year. According to the impact criteria in Table 4-1, this level of mortality would be considered a major effect at all population levels below OSP.

All of the harvest alternatives have the same schedule of "expected mortality limits", about half the level that would qualify as an unusual mortality event in the PVA model. If an unusual mortality event occurs that exceeds the expected mortality limit, the harvest rules established in the Administrative Law Judge process would effectively limit or halt future harvests and require the population status to be reassessed. This rule would apply regardless of the population abundance at the time or whether it was increasing or decreasing. Future harvests would be moderated or eliminated in response to unusual mortality events. If the population declines below 350 whales as a result of an unusual mortality event, harvest would be halted and would not contribute to any further population declines or failures to recover.

Factors Not Included in the Models

There are several factors not included in the PVA model or harvest model that have been identified as having potential effects on fecundity and/or survival rates and could affect the population growth potential. These factors (Table 4-4) have been described in Chapter 3 of this SEIS, the Draft Conservation Plan (NMFS 2005), and in the Cook Inlet beluga whale Status Review (Hobbs et. al. 2006). Although the PVA model has elements that could be used to examine potential effects of some additional factors (e.g., reduced survival or fecundity caused by ship strikes or toxic pollution), these factors were not fully explored in the modeling process because there is no direct evidence that any factors beside uncontrolled harvest have had population-level effects in the past. At present, the impacts of the past and present actions listed in Table 4-4 are unknown. However, there has been very little research directed at whether or not any of these factors are important to the health of individual whales or the population in general. The Draft Conservation Plan (NMFS 2005) and Status Review (Hobbs et. al. 2006) have both identified research needs to examine these potential factors on the premise that one or more may account for the difference between the expected growth rate of the population (two to six percent increase) and what has been observed over the past nine years since subsistence harvest was controlled (2.7 percent decline).

NMFS issued a proposed rule to list the Cook Inlet beluga whale population under the ESA in April 2007. Final action on this matter is expected to occur on or after April 2008. If NMFS decides to list the Cook Inlet beluga whale as threatened or endangered under the ESA, that action would also be accompanied by critical habitat designation, development of a recovery plan, and ESA Section 7 consultations on future activities that involve federal funding, regulatory authority, or administration. Section 7 consultation is designed to prevent federal actions from putting the listed species in jeopardy of extinction or adversely affecting their critical habitat. The intent of ESA listing would be to recover the population through various efforts, including prohibitions on actions which may harm or harass these whales, protection and conservation of their habitat, and adopting management strategies to promote recovery. The ESA provides a qualified exemption for subsistence hunting of listed species by Alaska Natives, as does the MMPA. However, if the Cook Inlet beluga whale population is listed under the ESA, the ESA's Section 7 formal consultation provisions may require, before any hunt could occur, preparation of a Biological Opinion on whether or not the proposed harvest placed the population in jeopardy of extinction.

Conservation measures could be implemented to eliminate or mitigate threats to the population in the future, either through the MMPA or through the ESA. The structure of these conservation measures is unknown because they would depend on the nature of the threats facing the population under investigation. The ability of any future conservation measures to have beneficial effects on the Cook Inlet beluga whale population would also depend on NMFS's ability and authority to mitigate potential threats. ESA listing would give NMFS more authority to protect beluga whales and their habitat than it currently has under the MMPA. Future conservation measures were not included in the PVA model because there was no way to quantify their potentially beneficial effects but they would tend to decrease the probability that the beluga whale population would decline further.

<u>Cumulative Effects Conclusion</u>

The cumulative effects analysis was based on the results of two different population models for Cook Inlet beluga whales, the harvest model (Appendix A) and the PVA model used in the Status Review (Hobbs et al. 2006). Both models were built using information from past population surveys and harvest levels. The PVA model included a number of elements to account for important small population effects but did not include specific elements for subsistence harvest or other potentially adverse effects (e.g., habitat degradation, ship strikes) or potentially beneficial effects (e.g., conservation measures). The effects of the alternative harvest schedules on the population were determined by the harvest model, which was less complicated than the PVA model but adequate to examine the effects of the alternatives. These models reported results in terms of the probabilities that the beluga whale population would increase or decrease under a specified set of conditions. The cumulative effects analysis was divided into two basic scenarios, a declining population and an increasing population, because 1) there is substantial uncertainty about what factors other than past harvest are currently affecting the beluga whale population and whether the population will actually increase or decrease in the future, and 2) the harvest alternatives are dependent on an adaptive management system that periodically assesses the beluga whale population status.

The PVA and harvest models both show the Cook Inlet beluga whale population is much more likely to decline in the future than to increase, even without future subsistence harvest. Pub. L. 106-31 and the Administrative Law Judge’s recommended decision established an adaptive, co-management framework for setting subsistence harvest levels in the future. It requires the co-management parties to reassess the abundance and growth rate of the population every five years and adjust harvest levels accordingly. It also includes procedures for adjusting harvest levels within a five-year management period to compensate for unusual mortality events. This adaptive management system assures that subsistence harvest will only be authorized in the future if the population is above certain abundance levels and is growing. If the population continues to decline, there would be no difference among the alternatives because none of them would authorize a subsistence harvest. Although past harvest mortality could have lingering effects on the population, there would be no future harvests to contribute to the cumulative effects on the population. At this time, harvest is the only action believed to be having a population-level impact on the Cook Inlet Belugas.

The harvest model indicated that there was no appreciable difference among any of the alternatives, including the No Action (no harvest) Alternative 1, with regard to the probability of population increase or recovery. It is very unlikely that the population will recover to OSP within 100 years even without harvest, and the harvest alternatives would have little effect on this statistic. If the population increases, subsistence harvests could be authorized to various extents under all the alternatives except Alternative 1. There would be no future harvests authorized under Alternative 1; therefore, it would not contribute to cumulative effects. The cumulative effects of harvest mortality are considered minor to moderate for Alternatives 2, 3, and 4, depending on the beluga whale population abundance and growth rate at the time of the harvest. Although any authorized hunting mortality would tend to slow the population growth rate, the Administrative Law Judge’s recommended decision determined that this population-level effect was an acceptable balance between the cultural interests of Alaska Native hunters and recovery goals as defined in the MMPA.

The adaptive subsistence harvest management system assures that harvest will not contribute to future mortality when the population is below a harvest floor. Although Alternative 4 has a lower harvest floor than Alternatives 2 or 3, it is unlikely that the criteria would be met to allow harvests at these lower population levels under Alternative 2. The adaptive management system also assures that harvest would only continue as long as the population continues to increase and there is essentially no difference among the alternatives in this regard.

There are a number of factors listed in Table 4-4 besides subsistence harvest that, individually or in a synergistic fashion, could be having important cumulative effects on the Cook Inlet beluga whale population through mortality, disturbance, habitat changes, or reduced fecundity. The magnitude of effects from these factors is unknown. Although research into the nature of these factors and their impact on beluga whale population dynamics is likely to increase in the future, scientific understanding is likely to accumulate slowly, and management strategies to mitigate potential problems will require time to develop and implement. The future growth or decline of the beluga whale population, especially if there is no subsistence harvest in the near future, would be the best indicator of whether other factors are having major cumulative effects at the population level.

4.10 Cumulative Effects on the Socio-economic Environment of Cook Inlet Beluga Whale Hunting Communities and Families

4.10.1 Summary of Direct and Indirect Effects on Socio-economic Environment

The direct and indirect effects of the proposed action on the socio-economic features of the Cook Inlet beluga whale hunting families and communities depend on whether the beluga whale population continues to decline or instead begins to show signs of recovery and growth. As summarized in Section 4.9.1, a computerized population modeling program, referred to as the harvest model, has been used to estimate probabilities of Cook Inlet beluga whale population growth or decline. Alternative 1, the No Action Alternative would provide no harvest opportunity, independent of population scenarios. The direct effects of Alternative 1 would result in elimination of a beluga whale harvest for an extended period and severe, long-term disruption of the social and cultural practices of cooperating, sharing, and cultural identity tied to beluga whale hunting. The principal indirect effect would result in hunters redirecting their efforts to other subsistence species. This would likely include salmon and moose for the Native Village of Tyonek. These direct and indirect effects would be major in magnitude.

For the action alternatives, Alternatives 2, 3, and 4, various harvest schedules were developed, with different allocations based on the estimated size of the population and the rate of population growth. Alternatives 2 and 3, for example, require a population of 350 - 399 and a growing population before any harvest is authorized. Alternative 3 includes the more stringent requirement that the growth rate must be intermediate or high. Alternative 4 provides for a limited harvest starting at a lower population threshold, greater than 250 beluga whales, with an intermediate or high growth rate, and limited harvest when the population is above 350 animals and has a low, intermediate, or high growth rate. None of these action alternatives would permit a harvest on a population that remained at current levels or declined. Since the current population estimate is 336 beluga whales (average abundance from 2003 to 2007) and has continued to decline since 1999, no harvests would be authorized for any of the three action alternatives under the current conditions.

The harvest model indicates a 77.5 percent probability of continued decline in the Cook Inlet beluga population, even with no additional human harvest. Thus, the most likely scenario would be no authorized subsistence beluga whale harvests under any of the three action alternatives. As with the no action alternative, this would result in the elimination of beluga whale subsistence harvests, and the long-term loss of the associated social and cultural practices. These effects would be major.

The probabilities indicated by the model that the population would increase are much lower. For Alternative 1 with no harvest, there is an 13.9 percent probability that the population would increase but not recover to OSP (780 whales) within 100 years. With the harvest levels provided for under Alternative 2, the harvest model indicates a 14.5 percent probability of the same growth scenario, whereas for Alternative 3 the probability is 13.9 percent and for Alternative 4 the probability is 14.5 percent. Still lower probabilities are estimated for the prospect of growth and recovery to OSP within 100 years.

If the Cook Inlet beluga whale population were to show growth to the abundance levels and growth rates specified in Alternatives 2, 3, and 4, then limited harvests would resume. Even though these harvest levels would be comparatively small, hunting families would consume and share beluga whale food, and the associated social and cultural practices would continue on a limited basis. The effects of the three action alternatives, in a population growth scenario, are less severe than the no growth and no harvest scenarios. For Alternatives 2, 3, and 4, under the population growth scenario, the direct and indirect effects would still be adverse, but of moderate magnitude.

4.10.2 Cumulative Effects of the Alternatives on the Socio-economic Environment

The cumulative effects of the alternatives on the socio-economic environment of the Cook Inlet beluga whale hunting families and communities follow closely from the cumulative effects on the beluga whale population. Section 4.10.2 analyzes the estimates of beluga whale population dynamics when all potential factors influencing population growth are taken into account. The PVA model takes into account a wider array of potential sources of mortality, including unusual mortality events like strandings. The analysis of cumulative effects on beluga whale populations notes that both the harvest model and the PVA model attribute a higher probability to a scenario of population decline, with a lesser probability of population growth. The adaptive management approaches incorporated into the harvest allocation procedures for Alternatives 2, 3, and 4, insure that subsistence harvests would not recommence until they can be conducted without harm to beluga whale population recovery. In other words, under these managed hunts, subsistence hunting of beluga whales would not likely be a factor in future population declines.

Another component of the cumulative effects analysis for the socio-economic environment focuses on whether any of the reasonably foreseeable future actions, identified in Table 4-4, would affect the alternate subsistence harvest activities identified as an indirect effect of the proposed action such as increased reliance on moose and salmon. It is likely beluga whale hunters from the Native Village of Tyonek have redirected some of their subsistence harvest efforts to salmon and moose, since the reduction in beluga whale hunting opportunity following the 1999 moratorium. The RFFA that may have the most notable effect on moose in the vicinity of Tyonek is the Chuitna Coal Project. The SEIS for the Chuitna Coal Project is still under development (EPA 2007). However, a review of previous baseline studies on terrestrial mammals in the vicinity of the proposed Chuitna Coal Mine has been posted to the project website, and provides information on moose distribution in various seasonal habitats (1983 to 1984) as related to the proposed mine and conveyor belt locations (ABR, Inc. 2006). This review noted a high concentration of moose during the breeding season in the Lone Ridge/Denslow Lake area largely coinciding with the proposed mine site (ABR, Inc. 2006:8). The review does not estimate potential impacts to the moose population.

In conclusion, the cumulative effects of the proposed action on the socio-economic environment of the Cook Inlet beluga whaling families and communities are estimated to be moderate to major in magnitude, depending on whether the beluga whale population remains in decline (the more probable situation) or shows signs of recovery. When other reasonably foreseeable future actions are taken into account, it is likely that the Chuitna Coal Mine would have some effect on moose distribution, and possibly on moose abundance, in the vicinity of Tyonek. The moose population in this area declined in the 1990s, requiring limitations on the subsistence harvest through the state's Tier II hunt management procedure. Additive impacts from the Chuitna Coal Mine may further reduce the reliability of moose as an alternative subsistence resource during the period when beluga whale hunting is restricted.

4.11 Summary of Effects

During the Administrative Law Judge hearing process, evidence for the effects of different harvest levels on the population relied on a computer modeling program (known as the harvest model) designed to account for uncertainty in the Cook Inlet beluga whale abundance and growth rate at any specific time. The harvest model was used to calculate the probability that the population would either 1) decline within 100 years, 2) increase but not recover to OSP (780 whales) within 100 years, or 3) recover to OSP within 100 years.

Cook Inlet Beluga Whales

Alternative 1 - No Action

Under Alternative 1 there would be no harvest. Although the harvest model indicates that the population may not recover under this alternative, the magnitude and duration of mortality effects would be negligible because subsistence harvest would not contribute any mortality to the population. With no beluga whale harvest under this alternative, there would be no disturbance effects from subsistence hunting activities.

Alternative 2 – Options A and B

The harvest model probabilities concerning the population trajectory (i.e., the likelihood that the population will decrease, increase but not recover, or increase to recovery) are nearly identical under Option A and Option B. This is because the model results are for a 100 year period and the two options differ only with regard to harvest during the first two years. For all but those first two years, the harvest levels would be the same under Option A as they would be under Option B.

Declining Population

The harvest model indicates there is a 77.5 percent probability that the population would decline from its current abundance (336 beluga whales, average abundance from 2003 to 2007 surveys) with no harvest and a 78 percent and 77.8 percent probability that the population would decline with harvest as specified under this alternative. For a declining population, the magnitude of mortality effects due to authorized subsistence hunting would be negligible according to the impact criteria. This implies that the population would be declining for reasons other than current or future subsistence harvests. The duration of mortality effects is not part of this assessment because the population would not recover under these conditions and any measure of delay in recovery would be meaningless.

Increasing Population without Recovery

The harvest model indicates there is an 13.9 percent probability that the population would increase but not recover to OSP within 100 years with no harvest and a 14.5 percent probability that the population would increase but not recover with harvest as specified under this alternative. Under these modeling conditions, the population would be between 350 and 780 whales and would be subject to subsistence harvest mortality dependent on the population size and growth rate. The magnitude of the harvest under Alternative 2 would be considered to have minor or moderate impacts from mortality. At low growth rates, the scheduled harvest would be considered moderate at most population levels. At intermediate growth rates, the scheduled harvest would be considered minor at most population levels below 500 whales and moderate at most population levels above 500 whales. At high growth rates, the scheduled harvest would be considered minor at population levels below 550 whales and moderate at population levels above 550 whales. Because the population would not recover under this set of modeling conditions, no assessment of the duration of mortality effects at these population levels was undertaken.

Increasing to OSP

The harvest model indicates there is a 8.7 percent probability that the population would recover to OSP within 100 years with no harvest and a 7.5 percent and 7.7 percent probability that the population would recover with harvest as specified under this alternative. Under these modeling conditions, the population would grow from its current abundance level to greater than 780 whales. The assessment of mortality impacts when the population was between 350 and 780 whales would be the same as described above and would be considered minor to moderate. For these modeling situations that lead to recovery, the harvest model can be used to calculate the probable delay in recovery with harvest compared to a situation of no harvest mortality. Harvest mortality at the rates defined under Alternative 2 would likely cause a delay in recovery of 20.6 percent, which is considered moderate in duration according to the impact criteria.

Disturbance

The effects of disturbance because of subsistence hunting would be proportional to the number of strikes allowed per year and would thus vary with the beluga whale population abundance and growth rate according to the harvest schedule. Modeling results indicate that the beluga whale population is likely to decline over the next 100 years and, under those conditions, there would be very little, if any, harvest authorized. Therefore, disturbance effects for a declining population would be minor or negligible in magnitude, frequency, and geographic extent.

Alternative 3

The beluga whale harvest levels under Alternative 3 would change with the estimated abundance and growth rate of the population according to and the decision-making process described in Section 2.3.3. The harvest schedule under Alternative 3 has a harvest floor of 350 whales, indicating that no harvest would be authorized if the average abundance estimate for the previous five years was less than 350 whales. In addition, no harvest would be authorized if the population had a low growth rate and was less than 500 whales.

For a declining population, the magnitude of mortality effects because of authorized subsistence hunting would be negligible according to the impact criteria. Under modeling conditions for which the population would increase but not recover with a harvest as specified under Alternative 3, the magnitude of the harvest would be considered to have negligible (low to intermediate growth rates) to moderate (intermediate to high growth rates) impacts from mortality. Harvest mortality at the rates defined under Alternative 3 would likely cause a delay in recovery of 13.2 percent, which is considered moderate in duration according to the impact criteria.

Modeling results indicate that the population is likely to decline during the next 100 years and, under those conditions, there would be very little, if any, harvest authorized. Disturbance effects for a declining population would, therefore, be minor or negligible in magnitude, frequency, and geographic extent. If the population increases either to OSP (780 whales) or somewhere short of that goal, regardless of whether the growth rate was low, intermediate or high, harvest levels and the number of hunting efforts would increase. However, similar to Alternative 2, the amount of hunting activity would amount of hunting activity would be limited by the number of strikes allowed per year. Thus, the magnitude, frequency, and geographic extent of hunting disturbance would be considered minor.

Alternative 4

The number of beluga whales that could be harvested under Alternative 4 would change with the estimated abundance and growth rate of the population. The harvest schedule under Alternative 4 is the same as Alternative 2 for all growth rates and population levels above 400 whales. However, Alternative 4 has a harvest floor of 250 whales and would authorize harvests when the population was between 250 and 350 whales if the growth rate was intermediate or high.

According to the impact criteria, any harvests authorized under Alternative 4 with the population less than 350 animals would be considered to have major impacts regardless of the growth rate. However, it is much more likely there would be no harvest under the set of modeling conditions that leads to a declining population, therefore, the magnitude of mortality effects because of authorized subsistence hunting would be negligible. Because the harvest schedule under Alternative 4 is essentially the same as the harvest schedule under Alternative 2 for these population levels and growth rates, the impact analysis would be the same. At low growth rates, the scheduled harvest would be considered moderate at most population levels. At intermediate growth rates, the scheduled harvest would be considered minor at most population levels below 500 whales and moderate at most population levels above 500 whales. At high growth rates, the scheduled harvest would be considered minor at population levels below 550 whales and moderate at population levels above 550 whales. Harvest mortality at the levels defined under Alternative 4 would likely cause a delay in recovery of 20.7 percent, which considered moderate in duration is based on the impact criteria.

At low, intermediate, and high population growth rates, the harvest schedule under this alternative would result in the same level of hunting disturbance as described for Alternative 2. Therefore, the magnitude, frequency, and geographic extent of hunting disturbance would be considered minor under Alternative 4.

Cumulative Effects on Cook Inlet Beluga Whales

The harvest model generated results that showed no appreciable difference among any of the alternatives, including the No Action (no harvest) Alternative 1, with regard to the probability of population increase or recovery. It is very unlikely that the population will recover to OSP within 100 years even without harvest. The harvest alternatives would have little effect on this statistic. If the population increases, subsistence harvests could be authorized to various extents under all the alternatives except Alternative 1. There would be no future harvests authorized under Alternative 1, therefore, it would not contribute to cumulative effects. The cumulative effects of harvest mortality are considered minor to moderate for Alternatives 2, 3, and 4, depending on the beluga whale population abundance and growth rate at the time of the harvest.

The adaptive subsistence management system assures that harvest will not contribute to future mortality when the population is below a harvest floor. Although Alternative 4 has a lower harvest floor than Alternatives 2 or 3, it is unlikely that the criteria would be met to allow harvests at these lower population levels under Alternative 4. The adaptive management system also assures that harvest would only continue as long as the population continues to increase and there is essentially no difference among the alternatives in this regard.

A number of past, present, and reasonably foreseeable future actions listed in Table 4-4, besides subsistence harvest, could individually or in a synergistic fashion have important cumulative effects on the Cook Inlet beluga whale population through mortality, disturbance, habitat changes, or reduced fecundity. The magnitude of effects from these factors is unknown. Although research into the nature of these factors and their impact on beluga whale population dynamics is likely to increase in the future, scientific understanding is likely to accumulate slowly and management strategies to mitigate potential problems will need time to be developed and implemented. The future increase or decline of the beluga whale population, especially if there is no subsistence harvest in the near future, would be the best indicator of whether other factors are having major cumulative effects at the population level.

Socio-Economic Resources

The analysis of socio-economic impacts examines effects on subsistence use patterns and associated social and cultural practices.

Alternative 1 - No Action

Alternative 1 would eliminate subsistence beluga whale hunting opportunities for the Tyonek Dena'ina and other Cook Inlet beluga whale hunters until the population recovers to OSP. The loss of this subsistence resource would have far-reaching effects on traditional harvest practices and on the associated social and cultural practices. Given the various harvest levels for beluga whales since 1987, the loss of beluga whale foods would range from 300 to 26,000 lbs per year. The 7,900 lbs per year of the late 1980s and early 1990s is probably closer to the longer-term average. In qualitative terms, this would represent the long-term loss of a highly culturally-valued resource. For some Cook Inlet beluga whale hunting families this represents an economic loss as well. During the two decades before 1999, some hunters made money through the sales of edible portions of beluga whales. Although the levels of sale were not systematically documented, one local Anchorage retailer estimates selling approximately 1,360 kg (3,000 lbs) of beluga whale muktuk per year.

Many social and cultural practices associated with beluga whale hunting would also be disrupted or limited for an extended period. Multiple generations might pass before hunting could be reinstated, with the effect that the teaching of this hunting skill would become a matter of memory, not a living cultural practice. Cooperation in hunting, and sharing of beluga whale foods, including the exchange of these foods in ceremonial contexts, would cease. The social standing, or prestige, accorded to successful beluga whale hunters would not be possible. Finally, loss of this important subsistence activity would affect cultural identity. For the Dena'ina of Tyonek, this means loss of the unique marine mammal hunting tradition that distinguishes them among all other Alaskan Athabascan groups.

As to indirect effects, the loss of beluga whale hunting would result in redirection of subsistence effort towards other species. For the Native Village of Tyonek, this is likely to increase reliance on salmon and moose. Whereas there is a historic comparison for this redirection of effort from the 1940s (Fall et al. 1984), in the current decade the moose population has declined, necessitating a more restrictive subsistence hunt management regime, referred to as Tier II. There is little room for an increase in moose harvests as an alternate resource to beluga whale hunting.

In sum, Alternative 1 would eliminate a highly culturally-valued subsistence resource for an extended period of time. This in turn would eliminate the associated social and cultural practices. These impacts would be major in magnitude and duration.

Alternative 2 - Options A and B

Alternative 2 (both options) provides for a limited traditional subsistence harvest for Cook Inlet beluga whale hunters, provided that by 2010 the population has grown to a five-year average of 350 beluga whales or more. However, the current population estimate is 336 (average abundance from 2003 to 2007 surveys). In addition, the harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales shows a 77.5 percent probability that the population would decline from its current abundance with no harvest and a 78 percent and 77.8 percent probability that the population would decline with a harvest as specified under this alternative. Given this probability of continued decline, it is highly unlikely that subsistence beluga whale harvests will be authorized under this alternative within the next ten years (2007 to 2017), defined as the reasonably foreseeable future for this analysis. Beluga whale foods would not be produced, and the social and cultural practices - cooperation, sharing, ceremony, and cultural identity - would be severely disrupted.

The harvest model indicates there is an 13.9 percent probability that the population would increase, but not recover to OSP, within 100 years with no harvest and a 14.5 percent probability that the population would increase but not recover with harvest as specified under this alternative. Although less likely, if the population growth scenario were to occur, then harvests of five to eight beluga whales would be authorized. This level of harvest would be slightly above the harvest levels by hunters from Tyonek since the moratorium in 1999, and it is likely this limited harvest opportunity would be shared between Tyonek hunters and hunters residing elsewhere in Cook

Inlet. This would mean less for each group in terms of food production but a small, recurring harvest would allow the associated social and cultural practices to continue.

As to indirect effects, hunters are likely to redirect subsistence effort to alternate species because both scenarios of declining or growing beluga whale population would result in a reduced beluga whale harvest, compared to most of the baseline period.

The effects of this alternative under the scenario of a stable or declining beluga whale population would be major in magnitude and duration. Under the scenario of a growing population and a limited harvest opportunity, the effects would still be adverse, but at a moderate level.

Alternative 3

Alternative 3 provides for a limited traditional harvest for Native beluga whale hunters, provided that the population has attained a five-year average abundance of 350 and the growth rate is high or intermediate. At a low rate of growth, no harvest would be permitted until the population exceeds 500 animals. The current population estimate is 336 (average abundance from 2003 to 2007 surveys) and the harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales shows a 77.5 percent probability that the population would decline from its current abundance with no harvest and a 77.7 percent probability that the population would decline with a harvest as specified under this alternative.

Given these probabilities of continued decline, it is highly unlikely that the population would attain the 350 minimum threshold and high or intermediate growth rates required to authorize a limited harvest under this alternative within the next 10 years (2008 to 2017), the reasonably foreseeable future for this analysis. Subsistence harvests would not occur and beluga whale food production would be lost with the important nutritional and economic value that beluga whale foods have contributed over the past two decades.

With regard to the social and cultural practices associated with beluga whale hunting, the likely cessation of harvest would eliminate the sharing, ceremonial, and cultural identity benefits associated with the local Cook Inlet hunt.

Whereas the probability is low, it is possible that the Cook Inlet beluga whale population would increase sufficiently to provide for a limited hunt under the harvest schedule of Alternative 3. There is an 13.9 percent probability that the population would increase, but not recover to OSP, within 100 years with harvest levels allowed under this alternative. If the population were to increase to 350 - 399 and the growth rate was intermediate or high then harvests of two to three beluga whales per five years would be authorized. This level of harvest would be slightly below the harvest levels by beluga whale hunters from Tyonek since the moratorium in 1999. This would allow for a low level of subsistence food production and continuation of the associate social and cultural practices, including cooperation, sharing, ceremonial exchanges, and cultural identify.

The indirect effects of Alternative 3, under either a declining or growing population, are likely to include redirection of subsistence hunting effort to other species, most likely salmon and moose, as discussed under Alternative 1.

In sum, with the more likely scenario of continued decline the direct and indirect effects would be like those of Alternative 1. The long-term loss of beluga whale foods and associated social and cultural practices would have major effects in both magnitude and duration. In the less likely scenario of beluga whale population growth and recovery, a limited harvest would be authorized producing subsistence food and providing for the associated social and cultural practices. Under this scenario, the effects would be adverse, but at a moderate level of magnitude.

Alternative 4

Alternative 4 provides for a traditional harvest for Alaska Native beluga whale hunters although no harvest would occur after 2009 if the population falls below a five-year average of 250 beluga whales or shows a low growth rate. However, the current population estimate is 336 (average abundance from 2003 to 2007 surveys) and the population is currently declining at 2.7 percent since 1999. The harvest model used to estimate effects on the growth and recovery of Cook Inlet beluga whales shows a 77.5 percent probability that the population would decline from its current abundance with no harvest and a 78.0 percent probability that the population would decline with a harvest as specified under this alternative.

Given these probabilities of continued decline, even though the current population abundance is above the minimum threshold of 250 animals, it is highly unlikely that the population would attain the high or intermediate growth rates required to authorize a limited harvest under this alternative within the next ten years (2007 to 2017). Beluga whales would not contribute to subsistence food production and the associated social and cultural practices would cease.

Whereas the probability is low, it is possible that the Cook Inlet beluga whale population would increase sufficiently to provide for a limited hunt under the harvest schedule of Alternative 4. There is a 14.5 percent probability that the population would increase, but not recover to OSP, within 100 years with harvests as provided for in this alternative. If the population were to show an intermediate or high rate of growth from the current level of 325 animals, harvests would be authorized. For a population of 300 - 349, with an intermediate or high growth rate, Alternative 4 provides for harvests of six to seven beluga whales per five years. For a population of 350 - 349 (the minimum increment at which harvest are authorized under Alternatives 2 and 3), this alternative provides for harvests of five to eight beluga whales depending on whether the growth rate is low, intermediate, or high. Under this scenario, beluga whales would be taken for subsistence foods and the associated social and cultural practices would continue.

As to indirect effects, whether the beluga whale harvest is eliminated under a declining beluga whale population scenario or continues at a very limited level if the beluga whale population is increasing, it is likely that beluga whale hunting households would redirect their effort to other species to meet their subsistence food requirements. However, the cultural aspects of this harvest would not be replaced by other food sources.

In sum, in the more likely scenario of continued decline, the direct and indirect effects would be like those of Alternative 1. The long-term loss of beluga whale foods and associated social and cultural practices would have major effects in magnitude and duration. In the less likely scenario of beluga whale population growth and recovery, a limited harvest would be authorized producing subsistence food and providing for the associated social and cultural practices. Under this scenario, the effects would be adverse, but at a moderate level of magnitude.

Environmental Justice Effects Analysis

Under E.O. 12898, the proposed action must be analyzed to examine whether a disproportionate burden of adverse effects falls upon minority or poor populations. The Cook Inlet beluga whale hunters and their families are Alaska Natives, considered a minority population under federal definitions. Moreover, some of the predominantly Alaska Native communities of Cook Inlet affected by the proposed action have higher rates of individuals living below the federally defined poverty level. For example, the non-road connected communities of Tyonek, Nanwalek, Port Graham, and Seldovia, when compared with the statewide average.

Because the effects of all alternatives under all Cook Inlet beluga whale population scenarios are adverse, this proposed action raises Environmental Justice concerns. However, the necessary conservation measures are not differentially directed at Alaska Native hunters as a result of agency discretion. Instead, when these conservation measures are required, as a result of the MMPA provisions limiting subsistence harvests by Alaska Natives when marine mammal populations are depleted, the effects are by statutory provision directed at Alaska Native hunters.

Cumulative Effects on Socio-Economic Resources

The cumulative effects of the alternatives on the socio-economic resources of the Cook Inlet beluga whale hunting families and communities follow closely from the cumulative effects on the beluga whale population itself. In addition to the beluga whale population modeling program referred to as the harvest model, a second population modeling program, the PVA model, provides for a more comprehensive analysis of potential factors affecting beluga whale population trends. Both population models attribute a higher probability to a scenario of population decline with a lesser probability of population growth. The adaptive management approaches incorporated into the harvest allocation procedures for Alternatives 2, 3, and 4, insure that subsistence harvests would not recommence until it can be conducted without harm to the recovery of the beluga whale population. In other words, under these managed hunts subsistence hunting of beluga whales would not be a likely factor in future population declines.

Another component of the cumulative effects analysis for socio-economic resources focuses on whether any of the reasonably foreseeable future actions, identified in Table 4-4, would affect the alternate subsistence harvest activities identified as an indirect effect of the proposed action such as increased reliance on moose and salmon. It is likely that beluga whale hunters from the Native Village of Tyonek have redirected some of their subsistence harvest efforts to salmon and moose since the reduction in beluga whale hunting opportunity following the 1999 moratorium. The RFFA that may have the most notable effect on moose in the vicinity of Tyonek is the Chuitna Coal Project. The SEIS for the Chuitna Coal Project is still under development (EPA 2007), though reviews of baseline studies of moose populations show an overlap between the proposed mine and high value breeding season or rut habitat (ABR, Inc. 2006).

In sum, the cumulative effects of the proposed action on the socio-economic resources of the Cook Inlet beluga whaling families and communities are estimated to be moderate to major in magnitude, depending on whether the beluga whale population remains in decline (the more probable scenario) or shows signs of recovery. When other reasonably foreseeable future actions are taken into account, it is likely that the Chuitna Coal Mine would have some effect on moose distribution and possibly on moose abundance in the vicinity of Tyonek. The moose population in this area declined in the 1990s, requiring limitations on the subsistence harvest through the state's Tier II hunt management procedure. Additive impacts from the Chuitna Coal Mine may further reduce the reliability of moose as an alternative subsistence resource during the period when beluga whale hunting is restricted.

Chapter 5 List of Preparers

5.1 SEIS Steering Committee

Barbara Mahoney	Biologist, Alaska Regional Office, NMFS, Anchorage, Alaska.
Steve Davis	Regional NEPA Coordinator, Alaska Regional Office, NMFS, Anchorage, Alaska
Dr. Rod Hobbs	Operational Research Analyst**,** National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, Seattle, Washington
Kaja Brix	Protected Resources Division Chief, Alaska Regional Office, NMFS, Juneau, Alaska.
Thomas Meyer	Attorney-Advisor, NOAA Office of General Counsel, Juneau, Alaska

5.2 Project Leaders

Steve Davis, Fishery Biologist, Alaska Regional Office, NMFS, Anchorage, Alaska. Analytical Team Leader and Regional NEPA Coordinator, he oversaw the compilation and organization of this document. His expertise on this document was the NEPA compliance and review, as well as contract officer. Twenty years experience with NEPA and marine issues. *M.S. University of Washington, Seattle, Washington.*

Dr. Rod Hobbs, Operation Research Analyst, National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, Seattle, Washington. His expertise is in experimental design and analysis, and population dynamics. Dr. Hobbs developed the current method for estimating the CI beluga abundance using aerial surveys and video analysis. Dr Hobbs investigated the CI beluga trends in abundance and the harvest impacts using a variety of modeling and statistical methods. Previous assignments with NEPA analyses include Subsistence Harvest Management of Cook Inlet Beluga Whales, Final EIS. Twenty years experience with the Federal Government working with marine conservation in Alaska. *Ph.D. University of California at Davis.*

Barbara Mahoney, Biologist, Alaska Regional Office, NMFS, Anchorage, Alaska. Oversaw compilation of this analysis, including assigned NMFS preparers, served as contract officer representative for portion of analysis done under contract, prepared the analysis outline, conducted conference calls with analysts, oversaw editing and document assembly. Previous assignments with NEPA analyses include Subsistence Harvest Management of Cook Inlet Beluga Whales, Final EIS. Twenty years experience as a biologist with marine conservation in Alaska. *B.S. University of Alaska, Fairbanks, Alaska.*

5.3 Contributors

Dr. Paul Becker, Biologist, National Institute of Standards and Technology, Hollings Marine Laboratory, Charleston, South Carolina. His expertise on this document was on contaminants, pollution, and marine mammals. More than thirty years of experience in environmental research, with 20 years devoted to investigations of contaminants in marine mammals and seabirds in Alaska. *Ph.D. Texas A&M University, College Station, Texas.*

Dr. Thomas Eagle, Fishery Biologist, Marine Mammal Division, Office of Protected Resources, NMFS, Silver Spring, Maryland. His expertise includes: population dynamics of large mammals, statistical analysis, wildlife management, and the implementation management and conservation strategies under federal conservation law. Fourteen years experience as a biologist involved with marine conservation for NMFS. *Ph.D. University of Minnesota, Saint Paul, Minnesota.*

James Hale, Technical Editor, Analytical Team, Alaska Regional Office, NMFS, Juneau, Alaska. Worked with other preparers on the SEIS to ensure clarity, oversaw editing, and document assembly. Mr. Hale's previous assignments with NEPA analyses include the Programmatic Alaska Groundfish SEIS (2004) for which he and other members of the team were awarded the Department of Commerce Silver Medal Award. Mr. Hale also conducts technical writing workshops for NMFS. He has more than a decade of experience working in Alaskan fisheries management with the Federal Government. M. Phil., Rutgers University.

Jeanne Hanson, Biologist, Alaska Regional Office, NMFS, Anchorage, Alaska. Her expertise on this document was with Essential Fish Habitat. Twenty years experience with the Federal Government working with marine conservation in Alaska. *B.S. Texas A&M University, College Station, Texas.*

Kevin Heck, Assistant Special Agent-in-Charge, NOAA Office for Law Enforcement, Alaska Enforcement Division, NMFS, Anchorage, Alaska. His expertise on this document was with Enforcement issues. Seventeen years experience with the Federal Government working with Enforcement on marine conservation in Alaska.

Dr. Peggy Krahn, Manager, Environmental Assessment Program, Northwest Fisheries Science Center, NMFS, Seattle, Washington. Her expertise on this document was with contaminants, pollution, and marine mammals. Twenty-eight years experience with NMFS working on contaminants in natural resources, including marine mammals. *Ph.D. University of Washington, Seattle, Washington.*

Dave Rugh, Wildlife Biologist, National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, Seattle, Washington. His expertise on this document was with habitat and applied marine mammal research. Thirty years experience with NMFS working on marine mammal conservation in Alaska. *M.S. Ohio State University, Ohio.*

Kim Shelden, Marine Biologist, National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, Seattle, Washington. Her expertise on this document was with marine mammals. Seventeen years experience with the Federal Government working with marine mammal conservation in Alaska. *M.M.A. University of Washington, Seattle, Washington.*

Brad Smith, Biologist, Alaska Regional Office, NMFS, Anchorage, Alaska. His expertise includes: noise effects to marine mammals, wildlife management, and the implementation management and conservation strategies under federal conservation law. Thirty years experience as a biologist involved with marine conservation in Alaska. *B.S. Colorado State University, Fort Collins, Colorado.*

Daniel Vos, Biologist, Alaska Regional Office, NMFS, Anchorage, Alaska. His expertise on this document was with marine mammals, habitat and Cook Inlet. Fifteen years experience with the Federal Government working with conservation issues in Alaska. *M.S. Alaska Pacific University, Anchorage, Alaska.*

5.4 Consultant Contributors

Dr. Kathy Burek, DVM, M.S., Diplomate A.C.V.P. Alaska Veterinary Pathology Services, Eagle River, Alaska. Prepared the Parasitism and Disease section, and updated stranding information. Fifteen years as a veterinary pathologist working with marine mammals in Alaska. *D.V.M. and M.S. at University of Wisconsin, Madison. Diplomate A.C.V.P. through residency at University of California – Davis.*

Taylor Brelsford, Senior Anthropologist, URS Corporation, Anchorage, Alaska. Contributed to Chapter 3 *Affected Environment* and Chapter 4 *Environmental Consequences* including analysis of cumulative effects of the sociocultural resources. Over 25 years of experience in subsistence management and social impact assessment in Alaska. *M.A., Anthropology, McGill University, Ontario, Canada*

Ian Dickson, Biologist, URS Corporation, Anchorage, Alaska. Contributed to Chapter 3 *Affected Environment*. Three years of experience conducting research on marine mammals. *Postgraduate Diploma, Wildlife Management, University of Otago, Dunedin, New Zealand.*

David Erikson, Senior Biologist, URS Corporation, Anchorage, Alaska. Contributed to Chapter 3 *Affected Environment* and Chapter 4 *Environmental Consequences* including analysis of cumulative effects. over 32 years experience in wildlife biology and fisheries in Alaska and 27 years experience with preparation of NEPA documents, *M.S. in Biology from the University of Nevada, Reno, Nevada.*

Kim Goetz, contract biologist with National Marine Mammal Laboratory, Alaska Fisheries Science Center, NMFS, Seattle, Washington. Her expertise on this document was with anadromous fish and beluga habitat. *M.S. University of Washington, Seattle, Washington.*

Richard Kleinleder, Senior Biologist, URS Corporation, Anchorage, Alaska. Contributed to Chapter 3 *Affected Environment* and Chapter 4 *Environmental Consequences* including design of the direct, indirect and cumulative effects analysis of Cook Inlet beluga whales. Over 25 years of experience with Alaska wildlife issues. *M.S. from University of Alaska, Fairbanks, Alaska.*

Tonya Messier, Project Assistant, URS Corporation, Anchorage, Alaska. Provided editorial, word processing and graphics support for the Draft Supplemental EIS. Seven years of experience in Alaska.

Anne Southam, Project Manager, Environmental Scientist, URS Corporation, Anchorage, Alaska. Provided overall project management for development of the Supplemental EIS. Contributed to Chapters 1, 2, 3 and 4 and development of the cumulative effects analysis. *M.S. in Environmental Science, University of North Texas, Denton, Texas.*

Sheyna Wisdom, Senior Biologist, URS Corporation, Anchorage, Alaska. Senior Biologist, URS Corporation, Anchorage, Alaska. Contributed to Chapter 3 *Affected Environment* and Chapter 4 *Environmental Consequences* including analysis of cumulative effects. Over 9 years of experience conducting noise and biological assessments for NEPA compliance documents. *M.S. in Marine Science, University of San Diego, San Diego, CA.*

Laura Young, Technical Services Group Manager, URS Corporation, Anchorage, Alaska. Contributed to the overall document organization and presentation. Twenty years of Alaska experience, primarily in NEPA compliance. *Degree in Process, Fire Chemistry and Emergency Management University of Alaska, Anchorage, Alaska.*

Chapter 6 List of Agencies, Organizations, and Persons who Received Copies of Draft Supplemental Environmental Impact Statement

Organizations

Alaska Beluga Whale Committee
Mr. Willie Goodwin
P.O. Box 334
Kotzebue, AK 99752

Alaska Beluga Whale Committee
Mr. Harry Brower
PO Box 69
Barrow, AK 99723

Alaska Beluga Whale Committee
Ms. Molly Chythlook
P.O. Box 692
Dillingham, AK 99576

Alaska Beluga Whale Committee
Ms. Kathy Frost
1300 College Rd
Fairbanks, AK 99701

Alaska Beluga Whale Committee
Mr. Charles Saccheus
PO Box 39090
Elim, AK 99739

Alaska Center for the Environment
807 G St., Suite 100
Anchorage, AK 99501

Alaska Community Action on Toxics
505 W. Northern Lights Blvd
Suite 205
Anchorage, AK 99503-2553

Alaska Department of Fish & Game
P.O. Box 25526
Juneau, AK 99802-5526

Alaska Dept. of Natural Resources
Division of Lands
550 West 7th Ave Suite 800
Anchorage, AK 99501

Alaska Dept. of Natural Resources
Division of Oil and Gas
550 West 7th Ave Suite 800
Anchorage, AK 99501

Alaska Division of Governmental Coordination
P.O. Box 110030
Juneau, AK 99811

Alaska Miners Association
3305 Arctic #105
Anchorage, AK 99503

Alaska Marine Conservation Council
Box 101145
Anchorage, AK 99510

Alaska Native Marine Mammal Hunters' Committee
Mr. and Mrs. Joel Blatchford
PO Box 1126
Kasilof, AK 99610

Alaska Native Harbor Seal Committee
800 East Dimond Blvd, Suite 3-590
Anchorage, AK 99515

Alaska Oceans Program
308 G St., Suite 219
Anchorage, AK 99501

Alaska Oil and Gas Association
121 West Fireweed Lane Suite 207
Anchorage, AK 99503-2035

Alaska Railroad
Barbara Hotchkin
327 West Ship Creek Ave
Anchorage, AK 99501

Alaska Scientific Review Group
PO Box 3232
Vancouver, BC, Canada
V6B3X8

Alaska Scientific Review Group
Ms. Sue Hills
U of A - Institute of Marine Science
Fairbanks, AK 99775-7220

Alaska Scientific Review Group
Mr. Charlie Johnson
P.O. Box 948
Nome, AK 99762

Alaska Scientific Review Group
Mr. Brendan Kelly
11120 Glacier Highway
Juneau, AK 99801

Alaska Scientific Review Group
Mr. Lloyd Lowry
1300 College Rd.
Fairbanks, AK 99701

Alaska Scientific Review Group
Ms. Jan Straley
P.O. Box 273
Sitka, AK 99835

Alaska Scientific Review Group
Ms. Kate Wynn
118 Trident Way
Kodiak, AK 99615

Alaska Sea Otter and Steller Sea Lion Commission
6239 B St #204
Anchorage, AK 99518

Alaska Wildlife Alliance
P.O. Box 202022
Anchorage, AK 99520

American Consulting Engineers Council
P.O. Box 200345
Anchorage, AK 99520-0345

Anchorage Daily News
PO Box 149001
Anchorage, AK 99514

Anchorage Water and Wastewater Utilities
3000 Arctic Boulevard
Anchorage, AK 99503-3898

Animal Welfare Institute
P.O. Box 3650
Washington, D.C. 20007-0150

Associated Press
750 West 2nd Ave Suite 102
Anchorage, AK 99501

Attorney General
1031 W 4th Ave Suite 200
Anchorage, AK 99517

Center for Biological Diversity
PO Box 549
Joshua Tree, CA 92252

Cetacean Society International
P.O. Box 953
Georgetown, CT 6829

CH2M Hill
301 W. Northern Lights Blvd.
Suite 601
Anchorage, AK 99503

Chevron
PO Box 196247
Anchorage, AK 99519-6247

Conoco Phillips
700 G St.
Anchorage, AK 99519

Cook Inlet Citizens' Advisory Council
910 Highland Ave
Kenai, AK 99611

Cook Inlet Keeper
P.O. Box 3269
Homer, AK 99603

Cook Inlet Marine Mammal Council
Mr. Peter Merryman
PO Box 82009
Tyonek, AK 99682

Cook Inlet Treaty Tribes
P.O. Box 1105
Chickaloon, AK 99674

Cook Inlet Tribal Council
3600 San Jeronimo Drive
Anchorage, AK 99508

Cook Inlet Tug and Barge
Mr. Carl Anderson, President
824 Delaney
Anchorage, AK 99501

Defenders of Wildlife
PO Box 959
Moss Landing, CA 95039

Earthjustice Legal Defense Fund
325 4th Street
Juneau, AK 99801

Environmental Protection Agency
Region 10, Letourneau
1200 6th Avenue ECO
Seattle, WA 98101

Environmental Protection Agency
Region 10
222 West 7th Avenue #19
Anchorage, AK 99513-7588

Friends of Anchorage Coastal Wildlife Refuge
PO Box 220196
Anchorage, AK 99522-0196

HDR, Inc.
2525 C St Suite 305
Anchorage, AK 99503

Horizon Lines
1717 Tidewater Rd
Anchorage, AK 99501

The Humane Society of the U.S.
Sharon Young
22 Washburn St
Sagamore Beach, MA 2562

Inuit Circumpolar Conference
401 E. N. Lights Blvd Suite 203
Anchorage, AK 99503

Jade North
1336 West 12th Ave
Anchorage, AK 99501

Kachemak Bay Conservation Society
3734 Ben Walters Lane,
Suite 202
Homer, AK 99603

Kachemak Bay Wilderness Lodge
China Poot Bay - P.O. Box 956
Homer, AK 99603

Kenai Peninsula Borough
144 N. Binkley
Soldotna, AK 99669-7599

Kenai Peninsula Fishermen's Association
43961 K-Beach Rd Suite F
Soldotna, AK 99669-8240

Kenaitz Indian Tribe
P.O. Box 988
Kenai, AK 99611

Knik Arm Bridge and Toll Authority
550 W 7th Ave Room 1850
Anchorage, AK 99501

Knik Tribe
P.O. Box 871565
Wasilla, AK 99687

KTUU - TV
701 E. Tudor Rd
Anchorage, AK 99503

LDR Specialties
2440 East Tudor Rd. #1119
Anchorage, AK 99507

LGL Alaska
1101 East 76th Ave
Anchorage, AK 99518

Living Resources, Inc
Mr. John J. Burns
P.O. Box 83570
Fairbanks, AK 99708

Marine Mammal Commission
4340 East-West Hwy., Room 905
Bethesda, MD 20814

Matanuska-Susitna Borough
350 Dahlia Ave
Palmer, AK 99654

Minerals Management Service
Ms. Lisa Rotterman
3801 Centerpoint Dr., Suite 500
Anchorage, AK 99503

Municipality of Anchorage
Mr. David Wigglesworth
PO Box 196650
Anchorage, AK 99519

National Audubon Society
715 L St., Suite 200
Anchorage, AK 99501

National Fish and Wildlife Foundation
806 SW Broadway Suite 750
Portland, OR 97205

National Marine Fisheries Service
Mr. Tom Eagle
Native American Rights Fund
420 L St Suite 505
Anchorage, AK 99501

Native Village of Chickaloon
P.O. Box 1105
Chickaloon, AK 99674

Native Village of Eklutna
Mr. Marc Lamoreaux
26339 Eklutna Village Rd.
Chugiak, AK 99567

Native Village of Nanwalek
PO Box 8028
English Bay, AK 99603-6628

Native Village of Tyonek
Ms. Angela Standstol
P.O. Box 82009
Tyonek, AK 99682

Natural Resources Defense Council
544 White Oak Place
Worthington, OH 43085

Ninilchik Traditional Council
P.O. Box 39070
Ninilchik, AK 99639

North Gulf Oceanic Society
3430 Main St. B1
Homer, AK 99603

North Pacific Fishery Mngt. Council
605 W. 4th Ave. Room 306
Anchorage, AK 99510

Northern District Setnetters Association of Cook Inlet
P.O. Box 1480
Anchorage, AK 99510

Ocean's Campaign
1725 DeSales St. NW, Suite 600
Washington, DC 20036

Port Graham Village
PO Box 5510
Port Graham, AK 99603

Port of Anchorage
2000 Anchorage Port Rd.
Anchorage, AK 99501

Qutekcok Native Tribe
P.O. Box 1467
Seward, AK 99664

Resource Development Council
121 West Fireweed Suite 250
Anchorage, AK 99503

RurAL CAP
731 East 8th Ave
Anchorage, AK 99501

Seldovia Village Tribe
P.O. Drawer L
Seldovia, AK 99663

Sierra Club - Alaska Chapter
333 West 4th Ave., Suite 307
Anchorage, AK 99501

Trustees for Alaska
1026 W. 4th Ave Suite 201
Anchorage, AK 99501

Trustees for Alaska
1026 W. 4th Ave Suite 201
Anchorage, AK 99501

U.S. Airforce
3CES/CEVP
6326 Arctic Warrior Dr.
Elmendorf, AK 99506-3240

U.S. Army
Attn: APVR - RPW - EV
600 Richardson Dr. #6503
Fort Richardson, AK 99505

U.S. Coastguard Waterways
510 L St., Suite 100
Anchorage, AK 99501

U.S. Fish and Wildlife Service
605 W. 4th Ave, G-61
Anchorage, AK 99501

U.S. Forest Service
PO Box 327
Yakutat, AK 99689

U.S. Forest Service
PO Box 129
Girdwood, AK 99587

U.S. Park Service
PO Box 137
Yakutat, AK 99689

Village of Salamatof
PO Box 2682
Kenai, AK 99611

Western Geophysical
351 East International Airport Rd.
Anchorage, AK 99518

Individuals

Mr. Joseph Amarok
221 Pettis Rd.
Anchorage, AK 99515

Mr. Eugene and Mr. Roy Avessuk
P.O. Box 877267
Wasilla, AK 99687

Mr. Gilbert Bane
117 Benny Benson Drive
Kodiak, AK 99615

Mr. Matt Berman and Ms. Gabrielle Barnett
P.O. Box 662
Girdwood, AK 99587

Mr. Samuel Black
2949 Kimberlie Ct.
Anchorage, AK 99508

Ms. Valerie Brown
PO Box 91659
Anchorage, AK 99509

Ms. Sylvia Brunner
PO Box 84983
Fairbanks, AK 99708

Ms. Delice M. Calcote
P.O. Box 4491
Palmer, AK 99645

Ms. Barbara Carlson
PO Box 220196
Anchorage, AK 99522-0196

Mr. John Chase
1150 Golden Dawn Cir. #3
Anchorage, AK 99515

Mr. Matt Cronin
8415 Jupiter Dr.
Anchorage, AK 99507

Ms. Carol H. Daniel
8141 Alatna Ave.
Anchorage, AK 99516

Mr. John Davis
9920 Tolsona Circle
Anchorage, AK 99515

Mr. James A. Diehl
Box 868
Girdwood, AK 99587

Dimmick Family
8C-1 Box 2270
Glennallen, AK 99588

Mr. Perry Dimmick
1505 Richardson Dr
Anchorage, AK 99504

Mr. Clyde Eben
229 Petterson St
Anchorage, AK 99504

Mr. Charles Edwardson
PO Box 70454
Fairbanks, AK 99707

Mr. Smiley Fields
2140 Shore Drive
Anchorage, AK 99515

Mr. Irvin Franks
3005 Rudder Cir
North Pole, AK 99705

Ms. Karen Furnweger
924 West Winona
Chicago, AK 60640

Mr. Leslie Green
2649 Northrop
Anchorage, AK 99508

Mr. James Grotha
1360 West 70th Ave
Anchorage, AK 99518

Ms. Eileen Henniger
PO Box 418
Yakutat, AK 99689

Ms. Arlene Hobson
PO Box 233212
Anchorage, AK 99523

Mr. Larry Holmes
P.O. Box 454
Girdwood, AK 99587

Ms. Alta Horst
PO Box 221236
Anchorage, AK 99522

Mr. Brian Johansen
PO Box 3310
Kenai, AK 99611-3310

Mr. and Mrs. Floyd Kakaruk
10124 Chain of Rock
Eagle River, AK 99577

Mr. Doug Koester
48730 Elmers Way
Homer, AK 99603

Mr. Komakhuk
17907 Sanctuary Dr
Eagle River, AK 99577

Mr. and Mrs. Ronald Komakhuk
P.O. Box 93028
Anchorage, AK 99509

Mr. Jess Lanman
PO Box 1105
Chickaloon, AK 99674

Mr. Jack W. Lentfer
P.O. Box 2617
Homer, AK 99603

Ms. Brit Lively
259 South Alaska St.
Palmer, AK 99645

Ms. Nancy Lord
P.O. Box 558
Homer, AK 99603

Mr. William Lucy
PO Box 160
Yakutat, AK 99689

Mr. Jason Martin
P.O. Box 240931
Anchorage, AK 99524

Ms. Beth Mathews
P.O. Box 140
Gustavus, AK 99826

Mr. Emil McCord
P.O. Box 82009
Tyonek, AK 99682

Ms. Mary Ann Mills
PO Box 143
Sterling, AK 99672

Mr. Albert Nuglene
3206 East 18th Ct
Anchorage, AK 99508

Mr. Arthur Nuglene
8632 Boundary Ave, Unit P4
Anchorage, AK 99504

Ms. Linda Paez
214 Denver Way
Henderson, NV 89015

Mr. Earl Paniptchuk
7800 Lucy St
Anchorage, AK 99502

Mr. Gilbert Paniptchuk, Sr.
3100 Merganser Ave
Anchorage, AK 99516

Mr. Nikos Pastos
8101 Peck Ave. # M-88
Anchorage, AK 99504

Ms. Katy Penland
3021 Lincoln Blvd. #A
Santa Monica, CA 90405

Mr. Caleb Pungowiyi
PO Box 256
Kotzebue, AK 99752

Mr. Lenwood Saccheus
P.O. Box 143183
Anchorage, AK 99514

Mr. Roswell Schaeffer, Sr.
PO Box 293
Kotzebue, AK 99752

Mr. Shawn Seetomoma
4630 East 8th Ave
Anchorage, AK 99508

Mr. Ben Snowball
4401 6th Ave
Anchorage, AK 99508

Mr. Dan Standifer, Sr.
P.O. Box 82046
Tyonek, AK 99582

Mr. Joseph Standifer
P.O. Box 82062
Tyonek, AK 99582

Mr. Randy Standifer
P.O. Box 82071
Tyonek, AK 99582

Mr. Sky Starkey
1540 200 St
St Croix Falls, WI 54024

Mr. Daniel Steffensen
2949 Kimberlie Ct.
Anchorage, AK 99508

Ms. Stephanie Thompson
8128 Cranberry St.
Anchorage, AK 99502

Tocktoo Family
434 Irwin St. #1
Anchorage, AK 99508

VanFleet Family
5223 East 24th #20
Anchorage, AK 99508

Mr. Carl Wassillie
3724 Campbell Airstrip Rd.
Anchorage, AK 99504

Mr. Marty Waters
1330 W 7th Ave
Anchorage, AK 99501

Mr. Savok Wien
7929 East Ave., Apt C
Anchorage, AK 99504

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Chapter 7 Literature Cited

ABR, Inc. 2006. Chuitna Coal Project: Summary and Review of Previous Baseline Studies for Terrestrial Wildlife and Marine Birds. Prepared for Mine Engineers, Inc., and DRven Corporation on behalf of Pac Rim Coal LP. March 31, 2006. Anchorage and Fairbanks: ABR, Inc.

ADT. 1965. Advertisement for guided beluga hunts in *Alaska Outdoors, A Thursday Feature*. July 1, 1965 edition, p. 21.

Agler, B.A., S.J. Kendall, and D.B. Irons. 1998. Abundance and distribution of marbled and Kittlitz's murrelets in southcentral and southeast Alaska. Condor 100: 254-265.

Agler, B. A., S. J. Kendall, P. E. Seiser, and D. B. Irons. 1995. Estimates of marine bird and Sea Otter abundance in Lower Cook Inlet, Alaska, during summer 1993 and winter 1994. Report No. MMS 94–0063, Minerals Management Service, Anchorage, AK. 124 pp.

Ainsworth, R.W. 1960. Petroleum vapor poisoning. British Medical Journal. 1:1547-1548.

Alaska Department of Fish and Game (ADFG). Undated. The use of fish and wildlife resources in Tyonek, Alaska. Technical Paper No. 105. Division of Subsistence. 8 p.

Alaska Department of Fish and Game, Division of Subsistence. 2001. Community Profile Database. Version 3.12. July 10, 2001.

Alaska Department of Natural Resources (ADNR). 1999.

Allen, K., and T. Smith. 1978. A note on the relation between pregnancy rate, age at maturity and adult and juvenile mortality rates. Report. International Whaling Commission. 28: 477-478.

Allen, M.J. and G. B. Smith. 1988. Atlas and zoogeograghy of common fishes in the Bearing Sea and northeastern Pacific. U.S. Department of Commerce, NOAA Technical Report. NMFS 66, 151 p.

Alton, M.S., and B.A. Megrey. 1986. Condition of the walleye pollock resource of the Gulf of Alaska as estimated in 1985. NOAA Technical Memorandum, NMFS F/NWC-106, U.S. Department of Commerce, NOAA. National Marine Fisheries Service 2001(a).

Anchorage Daily News (ADN). 1994. Beluga hunting history remains fuzzy. Article appearing in ADN of August 14, 1994.

ADN. 2001. More Natives moving to Anchorage. Article appearing in ADN of March 21, 2001.

Anchorage Daily Times (ADT). 1965. Beluga offer top big game. Article appearing in ADT of July 1, 1965.

Anchorage Water and Wastewater Utility (AWWU). 1999. Letter from Mark Premo to Hilda Diaz-Soltero, National Marine Fisheries Service, dated April 27, 1999.

Angliss, R.P., D.P. DeMaster, and A.L. Lopez. 2001. Alaska marine mammal stock assessments, 2001. U. S. Department of Commerce, NOAA Technical Memorandum. NMFS-AFSC-124, 203 p.

Angliss, R.P., and K.L. Lodge 2002. Alaska marine mammal stock assessments, 2002. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-AFSC-133, 224 p.

Angliss, R.P. and A. L. Lodge. 2004. Alaska Marine Mammal Stock Assessments. Seattle, WA: USDOC, National Marine Fisheries Service, 193 p.

Angliss, R.P. and R.B. Outlaw. 2005. Alaska marine mammal stock assessments, 2005. U. S. Department of Commerce, NOAA Technical Memorandum. NMFS-AFSC-161, 250 p.

Angliss, R.P., and R.B. Outlaw. 2007. Alaska marine mammal stock assessments, 2006. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-AFSC-168, 224 p.

Arneson, P. D. 1981. Identification, documentation and delineation of coastal migratory bird habitat in Alaska. U.S. Department of Commerce, NOAA, OCSEAP Final Reports of Principal Investigators 15: 1–363.

Au, W. 1993. The Sonar of Dolphins. Springer Verlag, New York, NY.

Becker, P.R., M.M. Krahn, E.A. Mackey, R. Demiralp, M.M. Schantz, M.S. Epstein, M.K. Donais, B.J. Porter, D.C.G. Muir, and S.A. Wise. 2000. Concentrations of Polychlorinated Biphenyls (PCB's), chlorinated pesticides, and heavy metals and other elements in tissues of belugas, *Delphinapterus leucas*, from Cook Inlet, Alaska. Marine Fisheries Review, Vol. 62, No. 3.

Béland, P., S. De Guise, and R. Plante. 1992. Toxicologie et pathologie des mammiferes marins du Saint-Laurent. INELS, Montreal, Qc for the Fond Mondial pour la Nature (Canada), Toronto. NTIS (cited in Lesage and Kingsley 1998).

Bickham, J. W., J. C. Patton, and T. R. Loughlin. 1996. High variability for control-region sequences in a marine mammal: Implications for conservation and biogeography of Steller sea lions (Eumetopias jubatus). Journal of Mammalogy 77(1):95-108.

Blackwell, S.B. and C.R. Greene, Jr. 2002. Acoustic measurements in Cook Inlet, Alaska, during 2001. Report from Greeneridge Sciences, Inc., Aptos, CA, for NMFS, Anchorage, AK.

Blatchford, J. 2007. Personal communication, via B. Mahoney, NMFS, Alaska Region, Anchorage, Alaska.

Bower, W.T. 1919. Alaska fisheries and fur industries in 1918. U.S. Department of Commerce, Bureau of Fisheries, Doc. 872:64-65

Bower, W.T. 1920. Alaska fisheries and fur industries in 1919. U.S. Dep. Commer., Bureau of Fisheries, Doc. 891:58

Bower, W.T. 1921. Alaska fisheries and fur industries in 1920. U.S. Dep. Commer., Bureau of Fisheries, Doc. 909:66-67

Braham, HW. 1984. Review of reproduction in the white whale, *Delphinapterus leucas*, narwhal, *Monodon monoceros*, and irrawaddy dolphin, *Orcaella brevirostris*, with comments on stock assessment. Report of the International Whaling Commission Special Issue 6:81-89.

Braham, H.W., and M.E. Dalheim. 1982. Killer whales in Alaska documented in the platforms of opportunity program. Pp 643-645 in Report of the International Whaling Commission 32. Cambridge, England.

Brannian, L. and J. Fox. 1996. Upper Cook Inlet subsistence and personal use fisheries report to the Alaska Board of Fisheries, 1996. ADFG, Division of Commercial Fisheries Management and Development, Regional Information Report 2S96-03, Anchorage, Alaska.

Bratton, G.R., C.B. Spainhour, W. Flory, M. Reed, and K. Jayko. 1993. Presence and potential effects of contaminants, in the Bowhead Whale. J.J. Burns, and C.J. Montague, Eds.

Breton-Provencher, M. 1981. Survey of the beluga whale population in the Poste-de-la-Baleine region. Unpublished Document SC/32/SM16, International Whaling Commission Scientific Committee.

Brodeur, R. D., and M.T. Wilson. 1996. A review of the distribution, ecology, and population dynamics of age-0 walleye pollock in the Gulf of Alaska. Fisheries Oceanography. 5 (Supplement 1):148- 166. National Marine Fisheries Service 2001(a).

Brodie PF. 1969. Mandibular layering in *Delphinapterus leucas* and age determination. Nature 221:956-8.

Brodie PF. 1971. A reconsideration of aspects of growth, reproduction, and behavior of the white whale (*Delphinapterus leucas*), with reference to the Cumberland Sound, Baffin Island, population. J Fish Res Bd Can 28:1309-18.

Brodie PF. 1982. The beluga (*Delphinapterus leucas*): Growth at age based on a captive specimen and a discussion of factors affecting natural mortality estimates. Report from the International Whaling Commission 32:445-7.

Brodie PF, Geraci JR, St. Aubin DJ. 1990. Dynamics of tooth growth in beluga whales, *Delphinapterus leucas*, and effectiveness of tetracycline as a marker for age determination. Smith TG. St. Aubin DJ, Geraci JR, editors. Advances in research on the beluga whale, *Delphinapterus leucas*. Can. Bull. Fish. Aquat. Sci. 224:141-8.

Brodie, P.F., J.L. Parsons, and D.E. Sargeant. 1981. Present status of the white whale (*Delphinapterus leucas*) in Cumerland Sound, Baffin Island. Report from the International Whaling Commission 31:579-582.

Burek, Kathy, D.V.M. 1999a. Biopsy report of beluga whale: Case No. 98V0581. NMFS, Anchorage, Alaska. 3p.

Burek, Kathy, D.V.M. 1999b. Biopsy report of beluga whale: Case No. 98V0579. NMFS, Anchorage, Alaska. 2p.

Burek, Kathy, D.V.M. 1999c. Biopsy report of beluga whale: Case No. 99V0269. NMFS, Anchorage, Alaska. 2p.

Burek, K. 2007. Personal communication, AVPS, Eagle River, Alaska.

Burns, J.J., and G.A. Seaman. 1986. Investigations of belukha whales in coastal waters of western and northern Alaska. II. Biology and ecology. U.S. Department of Commerce, NOAA, OCSEAP Final Report 56 (1988): 221-357.

Calkins, D.G. 1983. Susitna hydroelectric project phase II annual report: big game studies. Vol. IX, belukha whale. ADFG, Anchorage, Alaska. 15p.

Calkins, D.G. 1984 (p3-6)

Calkins, D.G. 1986. Marine mammals. In: The Gulf of Alaska physical environment and biological resources. D.W. Hood and S.T. Zimmerman, eds. OCS study, MMS 86-0095. p. 527-558.

Calkins, D.G. 1989. Status of belukha whales in Cook Inlet. In: Gulf of Alaska, Cook Inlet, and North Aleutian Basin information update meeting. L.E. Jarvela and L.K. Thorsteinson (Eds). Anchorage, AK., Feb. 7-8, 1989. Anchorage, AK.: USDOC, NOAA, OCSEAP, p. 109-112.

Caron, L.M.J., and T.G. Smith. 1990. Philopatry and site tenacity of belugas, *Delphinapterus leucas*, hunted by Inuit at the Nastapoka estuary, eastern Hudson Bay. Pages 69-79 In: T.G. Smith, D.J. St. Aubin, and J.R. Gerace, eds. Advances in research on the beluga whale, Delphinapterus leucas. Can. Bull. Fish. Aquat. Sci. 224.

Center for Biological Diversity. 2001. Petition to list the Kittlitz's murrelet under the Endangered Species Act. Online: http://www.biologicaldiversity.org/swcbd/species/murrelet/index.ht

Chen, A-L and Y. Sakurai. 1993. Age and growth of saffron cod (*Eleginus gracilis*). Sci. Rep. Hokkaido Fish. Exp. Station 42: 251-264.

Clausen, D.M. 1983. Food of walleye pollock, Theragra chalcogramma, in an embayment of southeastern Alaska. Fishery Bulletin. 81(3):637-642. In National Marine Fisheries Service 2001(a).

Cohen, D.M., T. Inada, T. Iwamoto and N. Scialabba, 1990. FAO species catalogue. Vol. 10. Gadiform fishes of the world (Order Gadiformes). An annotated and illustrated catalogue of cods, hakes, grenadiers and other gadiform fishes known to date. FAO Fish. Synop. 10 (125). 442 p.

Consiglieri, L.D., and H.W. Braham. 1982. Seasonal distribution and relative abundance of marine mammals in the Gulf of Alaska. Research Unit 68. NOAA, OCSEAP, Juneau. 212p.

Cook Inlet Marine Mammal Council (CIMMC). 1996. Native harvest and use of beluga in the upper Cook Inlet from July 1 through November 15, 1995. NMFS, Anchorage, Alaska. 3p.

CIMMC. 1997. Native harvest and use of beluga in Cook Inlet from April throughout November 1996. NMFS, Anchorage, Alaska. 5p.

Credle, V.R., D.P. DeMaster, M.M. Merklein, M.B. Hanson, W.A. Karp, and S.M. Fitzgerald (Eds.). 1994. NMFS observer programs: minutes and recommendations from a workshop held in Galveston, Texas, November 10-11, 1993. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-OPR-94-1. 96 p.

Dahlheim, M.E. 1997. A photographic catalogue of killer whales (*Orcinus orca*) from the Central Gulf of Alaska to the southeastern Bering Sea. U,S, Department of Commerce, NOAA, Tech. Rep. NMFS-131. 54 p.

Dahlheim, M.E., and C.O. Matkin. 1994. Assessment of injuries to Prince William Sound killer whales. In: Marine mammals and the Exxon Valdez. T.R. Loughlin (Ed). Academic Press. 395p.

Davis, R. A., and C. R. Evans. 1982. Offshore distribution and numbers of white whales in the eastern Beaufort Sea and Amundsen Gulf, summer 1981. Report for SOHIO Alaska Petroleum Co., Anchorage, and Dome Petroleum Ltd., Calgary, Alberta, by LGL Ltd. 76p.

Davis, R.A., and K.J. Finley. 1979. Distribution, migrations, abundance and stock identity of eastern Arctic white whales. Unpublished Document SC/3/SM10, International Whaling Commission Scientific Committee.

Day, R. H., D. J. Kuletz, and D. A. Nigro. 1999. Kittlitz's Murrelet (Brachyramphus brevirostris). In The Birds of North America, No. 435 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

DeGuise, S. A. Lagace, and P. Beland. 1993. Intramuscular Sarcocystis in two beluga whales and an Atlantic white-sided dolphin from the St. Lawrence Estuary, Quebec, Canada. Journal of Veterinary Diagnostic Investigation. 5:296-300.

DeGuise, S., D. Martineau, P. Beland, M. Fournier. 1995a. Possible mechanisms of action of environmental contaminants on St. Lawrence beluga whales (*Delphinapterus leucas*). Environ. Health Perspect. 103 (suppl 4): 73-77.

DeGuise, S., A Lagace, P. Beland, C. Girard, and R. Higgins. 1995b. Non-neoplastic lesiomis in beluga whales (*Delphinapterus leucas*) and other marine mammals from the St. Lawrence Estuary. Journal of Comparative Pathology 257-271.

DeMaster, D. P. 1995. Minutes from the third meeting of the Alaska Scientific Review Group, 16-17 February 1995, Anchorage, Alaska. 21 pp. + appendices. (available upon request - D. P. DeMaster, National Marine Mammal Laboratory, 7600 Sand Point Way, NE, Seattle, WA 98115).

DeMaster, D.P., K.Frost, and D.J. Rugh. 1999. Summary of beluga whale harvest information for Alaska; harvest levels and hunting techniques. Unpubl. manuscript for International Whaling Commission, Workshop on Humane Killing.

Department of Commerce, Community, and Economic Development (DCCED). 2007. Alaska Community Database Community Information Summaries. Available: http://www.commerce.state.ak.us/dca/commdb/CIS.cfm. (August 2007).

Department of Fisheries and Oceans (DFO), Canada and World Wildlife Fund, Canada. 1995. Saint Lawrence beluga whale recovery plan. Saint Lawrence beluga whale recovery team. 73p.

DiCosimo, J., and N. Kimball. 2001. Groundfish of the Gulf of Alaska: A Species Profile. North Pacific Fishery Management Council, 605 W. 4th Avenue, Site 306, Anchorage Alaska 99501.

EBASCO Environmental. 1990a. Summary report: Cook Inlet discharge monitoring study: produced water (discharge number 016) Sept. 1988-Aug. 1989. Prepared for the Anchorage, Alaska office of Amoco Production Company, ARCO Alaska Inc., Marathon Oil Company, Phillips Petroleum Company, Shell Western E&P Inc., Texaco Inc., Unocal Corporation, and U.S. Environmental Protection Agency, Region 10, Seattle, WA.

EBASCO Environmental. 1990b. Comprehensive report: Cook Inlet discharge monitoring study: Apr. 1987-Jan. 1990. Prepared for the Anchorage, Alaska office of Amoco Production Company, ARCO Alaska Inc., Marathon Oil Company, Phillips Petroleum Company, Shell Western E&P Inc., Texaco Inc., Unocal Corporation, and U.S. Environmental Protection Agency, Region 10, Seattle, WA.

Environmental Protection Agency (EPA). 2007. Chuitna Coal Project - Supplemental Environmental Impact Statement Project Website. Accessed September 27, 2007 at www.chuitnaseis.com/default.htm.

Erikson, D. 1977. Distribution, abundance, migration and breeding locations of marine birds, Lower Cook Inlet, Alaska. 1976. L. L. Trasky, L. B. Flagg, and D. C. Burbank ed(s). vol. VIII. Alaska Department of Fish and Game. Anchorage, AK. pp. 182.

Eschmeyer, W.N., E.S. Herald and H. Hammann. 1983. A field guide to Pacific coast fishes of North America. Houghton Mifflin Company, Boston, U.S.A. 336 p.

Fadely, B.S., K.W. Pitcher, and J.M. Castellini. 1997. Comparison of harbor seal body condition within lower Cook Inlet between 1978 and 1996. Univ. Alaska, School Fish. And Ocean Sci., and AK. Dept. Fish and Game. In: The Cook Inlet symposium: abstracts of papers and posters, watersheds 97 conference, October 29-31, 1997.

Fair, P.A., and P.R. Becker, 2000. Review of stress in marine mammals. Journal of Aquatic Ecosystem Stress and Recovery 7, 335-354.

Fay, J.A., D.J. Foster, and R.T. Stanek. 1984. The use of fish and wildlife resources in Tyonek, Alaska. ADFG, Div. Subsistence, Anchorage, Tech. Rep. Ser. 105. 219p.

Fay, R.R. 1988. Hearing in vertebrates: a psychophysics databook. Winnetka, Illinois: Hill-Fay Associates.

Federal Highways Administration (FHWA) and Knik Arm Bridge and Toll Authority (KABATA). 2006. Knik Arm Crossing Project, Draft Environmental Impact Statement and Draft Section 4(f) Evaluation. Prepared by HDR, Inc. for KABATA, Anchorage, Alaska.

Feldman, K.D. 1986. Subsistence Beluga Whale Hunting in Alaska: A View from Eschscholtz Bay. In S.J. Langdon, ed., Contemporary Alaska Native Economies. Lanham, Md.: University Press of America Pp. 153 - 171.

Ferrero, R. C., S.E. Moore, and R.C. Hobbs. 2000. Development of beluga, *Delphinapterus leucas*, capture and satellite tagging protocol in Cook Inlet, Alaska.. Mar. Fish. Rev. 62(3):112-123.

Finley, K.J., G.W. Miller, R.A. Davis, and C.R. Greene. 1990. Reactions of belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros,* to ice-breaking ships in the Canadian high Arctic. Canadian Bulletin of Fisheries and Aquatic Sciences 224: 97-117.

Fiscus, C.H., H.W. Brahan, and R.W. Mercer. 1976. Seasonal distribution and relative abundance of marine mammals in the Gulf of Alaska. Process report, marine mammal division, NMFS, Seattle. 238p.

Fitch, J.E. and R. J. Lavenberg. 1975. Tidepool and nearshore fishes of California. University of California Press. Berkley.

Fowler, M.E., 1986. Zoo and Wild Animal Medicine. Editor in Chief, W.B. Saunders Company, Philadelphia, PA.

Fried, S. M., J. J. Laner, and S. C. Weston. 1979. Investigation of white whale (*Delphinapterus leucas*) predation upon sockeye salmon (*Oncorhynchus nerka*) smolts in Nushagak Bay and associated rivers: 1979 aerial reconnaissance surveys. Project 11-41-6-340. Alaska Department of Fish and Game, Dillingham, Alaska. 15p.

Frost, K.J., L.F. Lowry, and J.J. Burns. 1982. Distribution of marine mammals in the coastal zone of the Bering Sea during summer and autumn. U.S. Department of Commerce, NOAA, OCSEAP Final Rep. 20(1983):365-561.

Frost, K.J., Lowry, L.F., and Nelson, R.R. 1985. Radiotagging studies of belukha whales (*Delphinapterus leucas*) in Bristol Bay, Alaska. Marine Mammal Science 1:191-202.

Funk, D.W., R.J. Rodrigues, and M.T. Williams (eds.) 2005. Baseline studies of beluga whale habitat use in Knik Arm, Upper Cook Inlet, Alaska. Rep. from LGL Alaska Research Associates, Inc., Anchorage, AK, for HDR Alaska, Inc., Anchorage, AK, and Knik Arm Bridge and Toll Authority, Anchorage, AK. 65 p. + appendices.

Gales, R.S. 1982. Effects of noise of offshore oil and gas operations on marine mammals-An introductory assessment. NOSC TR 844, 2 vol. U.S. Naval Ocean Systems Cent., Sand Diego, CA.

Geraci, J.R. 1990. Physiologic and toxic effects on cetaceans. p. 167-192. In: Sea mammals and oil: confronting the risks J.R. Geraci and D.J. St. Aubin, Editors. First ed., Academic Press, Inc. San Diego, California: 239 p.

Geraci, J.R., and D.J. St. Aubin. 1985. Expanded study of the effects of oil on cetaceans, final report, part I. Contract 14-12-0001-29169. Prepared for U.S. Department of the Interior, Bureau of Land Management, Washington, D.C. by the University of Guelph, Ontario.

Geraci, J.R. and D.J. St. Aubin. 1987. Effects of parasites on marine mammals. International Journal for Parasitology 17(2):407-414.

Gill, R. E., Jr., and T. L. Tibbitts. 1999. Seasonal shorebird use of intertidal habitats in Cook Inlet, Alaska. Final Report. U.S. Department of Interior, U.S. Geological Survey, Biological Resources Division and OCS Study, MMS 99–0012.

Goetz, K.T., D.J. Rugh, A.J. Read, and R.C. Hobbs. 2007. Habitat use in a marine ecosystem: beluga whales in Cook Inlet, Alaska. Mar. Ecol. Ptog. Ser. 330:247-256.

Goren AD, Brodie PF, Spotte S, Ray GC, Kaufman WH, Gwinnett AJ, Sciubba JJ, Buck JD. 1987. Growth layer groups (GLGs) in the teeth of an adult belukha whale (*Delphinapterus leucas*) of known age: evidence for two annual layers. Marine Mammal Science 3:14-21.

Grant, S.W., and F.M. Utter. 1094. Biochemical population genetics of Pacific herring (*Clupea pallasi*). Can. J. Fish. Aquat. Sci. 4 1:856-864

Haley, D. 1986. Marine Mammals. Second edition. Seattle: Pacific Search Press.

Hampton, M.A. 1982. Lower Cook Inlet environmental geology and Shelikof Strait environmental geology. U.S. Department of Interior. U.S. Geologic Survey Open-File Report. 82-928. Reston, VA.

Hart, J.L. 1973. Pacific fishes of Canada. Fisheries Research Board of Canada Bulletin, 180, Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, K1A 0S9. p. 740. In National Marine Fisheries Service 2001(a).

Harvey, J.T. and M.E. Dahlheim. 1994. Cetaceans in oil. Marine mammals and the Exxon Valdez. 1st ed. Ed. Thomas R. Loughlin. San Diego: API, 257-264.

Hazard, K. 1988. Beluga whale, *Delphinapterus leucas*. In: Selected marine mammals of Alaska: species accounts with research and management recommendations. J.W. Lentfer, ed. Mar. Mammal Comm., Washington, D.C.

Heide-Jorgensen MP, Jensen J, Larsen AH, Teilmann J, Neurohr B. 1994. Age estimation of white whales (*Delphinapterus leucas*) from Greenland. Meddr Gronland, Biosci 39:187-193. Copenhagen 1994-04-02.

Herman, L. 1980. Cetacean behavior. New York: John Wiley and Sons.

Hirschberger, W.A., and G.B. Smith. 1983. Spawning of twelve groundfish species in the Alaska and Pacific coast regions, 1975-1981. NOAA Technical Memorandum, NMFS F/NWC-44, U.S. Department of Commerce, NOAA. p. 50. In National Marine Fisheries Service 2001(a).

Hobbs, R.C., D. J. Rugh, and D. P. DeMaster. 2000. Abundance of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska, 1994-2000. Mar. Fish. Rev. 62(3):37-45.

Hobbs, R.C., K.L. Laidre, D.J. Vos, B.A. Mahoney, and M. Eagleton. 2005. Movements and area use of belugas, *Delphinapterus leucas,* in a subarctic Alaskan estuary. Arctic 58(4): 331-340.

Hobbs, R. C., K. E. W. Shelden, D. J. Vos, K. T. Goetz, and D. J. Rugh. 2006. Status review and extinction assessment of Cook Inlet belugas (Delphinapterus leucas). AFSC Processed Rep. 2006-16, 74 p. Alaska Fish. Sci. Cent., NOAA, Natl. Mar, Fish. Serv., 7600 Sand Point Way NE, Seattle WA 98115.

Hobbs, R.C. and Waite. In review. (p3-31)

Hohn AA, Lockyer C. 1999. Growth layer patterns in teeth from two known-history beluga whales: reconsideration of deposition rates. International Whaling Commission, Scientific Committee. Document SC/51/SM4. 12 p + figures.

Hollowed, A.B., E. Brown, J. Ianelli, P. Livingston, B. Megrey, and C. Wilson. 1997. Walleye pollock, North Pacific Fishery Management Council, 605 W. 4th Avenue, Suite 306, Anchorage, Alaska 99501-2252. pp. 362-396. In National Marine Fisheries Service 2001(a).

Hoover, A.A. 1988. Harbor seal, *Phoca vitulina*. In: Selected marine mammals of Alaska: species accounts with research and management recommendations. J.W. Lentfer, ed. Marine Mammal Commission, Washington, D.C.

Hoover-Miller, A. 1994. Harbor seal, *Phoca vitulina*, biology and management in Alaska. Marine Mammal Commission, Washington, D.C.

Houghton, J., J. Starkes, M. Chambers, and D. Ormerod. 2005. Marine fish and benthos studies in Knik Arm, Anchorage, Alaska. Report prepared for the Knik Arm Bridge and Toll Authority, and HDR Alaska, Inc., Anchorage, AK, by Pentec Environmental, Edmonds, WA.

Howard, E.B., J.O. Britt, G.K. Marsumoto, R. Itahara, and C.N. Nagano. 1983. Bacterial Diseases. p. 70-118 in: E.B. Howard (ed.) Pathology of marine mammal diseases, Vol. 1. CRC Press, Boca Raton, FL. 238p.

Huntington, H.P. 2000. Traditional knowledge of the ecology of belugas, Delphinapterus leucas, in Cook Inlet, Alaska. Marine Fisheries Review 62: 134- 140.

Katona, S.K., V. Rough, and D.T. Richardson. 1983. A field guide to the whales, porpoises and seals of the Gulf of Maine and eastern Canada. New York: Charles Scribner's Sons.

Kendall, S.J., and B.A. Agler. 1998. Distribution and abundance of Kittlitz's murrelets in southcentral and southeastern Alaska. Colonial Waterbirds 21(1):53-60.

Khuzin, R. S. 1961. The procedure used in age determination and materials relating to reproduction of the beluga. Nauchno-Tekh. Byull. TINRO 1(15): 58-60.

Klinkhart, E.G. 1966. The beluga whale in Alaska. Alaska Dept. Fish and Game. Fed. Aid in Wildlife Restoration Proj. Rep. Vol. VII. 11p.

Krahn, M.M., D.G. Burrows, J.E. Stein, P.R. Becker, M.M. Schantz, D.C.G. Muir, T.M. O'Hara, and T. Rowles. 1999. White whales (*Delphinapterus leucas*) from three Alaskan stocks: concentrations and patterns or persistent organochlorine contaminants in blubber. J. Cetacean Res. Manage. 1(3):239-249.

Kuletz, K.J. 2004. Kittlitz's Murrelet - A Glacier Bird in Retreat. Kittlitz's Murrelet – Background information. by Kathy Kuletz, updated May 3, 2004.

Kuletz, K.J., B. Manly, C. Nations, and D.B. Irons. 2005. Declines in Kittlitz's and marbled murrelets in Prince William Sound, Alaska: Dealing with uncertainty. In: Foraging Behavior and Productivity of a Non-Colonial Seabird, the Marbled Murrelet (Brachyramphus marmoratus), Relative to Prey and Habitat, K. Kuletz. Ph.D. Dissertation, University of Victoria, Victoria, British Columbia. p 173-195.

Lacy, R.C. 1997. Importance of genetic variation to the viability of mammalian populations. Journal of Mammalogy 78:320-335.

Laidre, K.L., K.E.W. Shelden, B.A. Mahoney, and D.J. Rugh. 2000. Beluga, *Delphinapterus leucas*, distribution and survey effort in the Gulf of Alaska. Marine Fisheries Review, Vol. 62, No. 3.

Larned, W. W. 2005. Trip Report: Aerial survey of lower Cook Inlet to locate molting flocks of Steller's eiders and mergansers. 14 September 2005. U.S. Fish and Wildlife Service, Soldotna, AK

Larned, W. W. 2006. Winter distribution and abundance of Steller's eider (Polysticta stelleri), in Cook Inlet, Alaska - 2004-2005. Prepared for Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region, Environmental Studies Section, Anchorage, Alaska.

Leatherwood, J.S., and M.E. Dahlheim. 1978. Worldwide distribution of pilot whales and killer whales. Naval Oceans Systems Center, Tech, Rep. 443:1-39.

Leatherwood, J.S., W.E. Evans, and D.W. Rice. 1972. The whales, dolphins, and porpoises of the eastern north Pacific. A guide to their identification in the water. Naval Undersea Center, NUC TP 282. 175p.

Lerczak, J.A., K.E.W. Shelden, L.K. Litzky, B.A. Mahoney, and D.J. Rugh. 2000. Application of suction-cup-attached VHF transmitters to the study of beluga, *Delphinapterus leucas*, surfacing behavior in Cook Inlet, Alaska. Marine Fisheries Review, Vol. 62, No. 3.

Lesage, V., and M. C. S. Kingsley. 1998. Updated status of the St Lawrence River population of the beluga, *Delphinapterus leucas*. Can. Field-Nat. 112(1): 98-114.

LGL Ltd. and Greeneridge Sciences. 1986. Reactions of beluga whales and narwhals to ship traffic and ice-breaking along ice edge in the eastern Canadian high arctic: 1982-1984. Environ. Stud. 37. Indian and northern Affairs Canada, Ottawa, Ont.

Lipscomb, T.P., R.K. Harris, A.H. Rebar, B.E. Ballachey, and R.J. Haebler. 1994. Pathology of sea otters. Marine Mammals and the Exxon Valdez. 1st ed. Ed. Thomas R. Loughlin San Diego: API, 265-280.

Litzky, Laura K., Roderick C. Hobbs and Barbara A. Mahoney. 2001. Field report for tagging study of beluga whales in Cook Inlet, Alaska, September 2000, pp. 13-19 In: Anita L. Lopez and Robyn P. Angliss, editors, Marine Mammal Protection Act and Endangered Species Act implementation program 2000. U.S. Department of Commerce, Seattle, WA.

Loughlin, T.R. 1994. Tissue hydrocarbon levels and the number of cetaceans found dead after the spill." Marine mammals and the Exxon Valdez. 1st ed. Ed. Thomas R. Loughlin San Diego: API, 1994. 359-70.

Loughlin, T. R. 1997. Using the phylogeographic method to identify Steller sea lion stocks. p. 159-171, in A. Dizon, S. J. Chivers, and W. F. Perrin, editors, Molecular genetics of marine mammals. Special Publication #3 of the Society for Marine Mammalogy.

Lowry, L.F. 1985. The belukha whale (*Delphinapterus leucas*). In J.J. Burns, K.J. Frost, and L.F. Lowry (Editors), Marine mammal species accounts, p. 3-13. Alaska Department of Fish and Game, Wildlife Technical Bulletin 7.

Lowry, L., O'Corry-Crowe, G., and Goodman, D. 2006. *Delphinapterus leucas* (Cook Inlet population). In: IUCN 2006. 2006 IUCN Red List of Threatened Species.

Macy, P., J.M. Wall, N.D. Lampsakis, and J.E. Mason. 1978. Resources of non-salmonid pelagic fishes of the Gulf of Alaska and eastern Bering Sea. NOAA-NMFS-NWAFC Final Report, OCSEAP.

Manly, B.F.J. 2006. Incidental catch and interactions of marine mammals and birds in the Cook Inlet salmon driftnet and setnet fisheries, 1999-2000. Cook Inlet Observer Program, National Marine Fisheries Service, Juneau, Alaska. 98pp.

Masuda, H., K. Amaoka, C. Araga, T. Uyeno and T. Yoshino, 1984. The fishes of the Japanese Archipelago. Vol. 1 (text). Tokai University Press, Tokyo, Japan. 437 p. (text), 370 pls.

Mahoney, B.A. and K.E.W. Shelden. 2000. Harvest history of belugas, *Delphinapterus leucas*, in Cook Inlet, Alaska. Marine Fisheries Review, Vol. 62, No. 3.

Margolis, H.S., J.P. Middaugh, and R.D. Burgess. 1979. Arctic trichinosis: two Alaskan outbreaks from walrus meat. Journal of Infectious Diseases 139:102-105.

Markowitz, Dr. Tim. 2007. Annual Report of activities conducted under General Authorization, Letter of Confirmation No. 481-1795. Submitted to NMFS General Authorization No. 481-1795-01. June 1, 2007. 6 pg.

Martineau, D. S. DeGuise, M. Fournier, L. Shugart, C. Girard, A. Lagace, P. Beland. 1994. Pathology and toxicology of beluga whales from the St. Lawrence Estuary, Quebec, Canada. Past, present and future. The Science of the Total Environment. 154:201-215.

Martineau, D. A. Lagace, P. Beland, R. Higgins, D. Armstrong, and L. R. Shugart. 1988. Journal of Comparative Pathology 98(3): 287-311.

Martineau, D., A. Lagace, P. Beland and C. Desjardins. 1986. Rupture of a dissecting aneurysm of the pulmonary trunk in a beluga whale (*Delphinapterus leucas*). Journal of Wildlife Disease 22(2):289-294.

McCarty, S. 1981. Survey of effects of outer continental shelf platforms on cetacean behavior. App. C. Vol. II In: Gales, R.S. Effects of noise of offshore oil and gas operations on marine mammals. An introductory assessment. NOSC Tech. Rept. 844.

McPhail, J.D., and C. C. Lindsey. 1970. Freshwater fishes of northwestern Canada and Alaska. Bulletin of the Fisheries Research Board of Canada 173:381.

Measures, L. 2001 Lung worms of Marine Mammals. (in) Infectious and Parasitic Disease of Wild Mammals.

Meilke, J.E. 1990. Oil in the ocean: the short- and long-term impacts of a spill. Congressional research service report for Congress, July 24, 1990. Washington, D.C.: Library of Congress.

Menzie, C.A. 1982. The environmental implications of offshore oil and gas activities. Environmental science and technology 16 (8):454A-472A.

Merryman, P. 2007. Personal communication, via B. Mahoney, NMFS, Alaska Region, Anchorage, Alaska.

Minerals Management Service (MMS). 1984. Proposed Gulf of Alaska/Cook Inlet Lease Sale 88. Final Environmental Impact Statement. U.S Department of the Interior Minerals Management Service. Alaska Outer Continental Shelf Region, Anchorage, Alaska.

MMS. 1995. Cook Inlet Planning Area, Oil and Gas Lease Sale 149, Final EIS. U.S Department of the Interior, Minerals Management Service. Alaska Outer Continental Shelf Region, Anchorage, Alaska.

MMS. 1996. Cook Inlet planning area oil and gas lease sale 149. Final Environmental Impact Statement. U.S. Dept. Int. Alaska OCS Region.

MMS. 1999. Distribution of Cook Inlet beluga whales (*Delphinapterus leucas*) in winter. U.S. Dept. Int. Alaska OCS Region. OCS Study MMS 99-0024. 30p.

MMS. 2003. Cook Inlet Planning Area, Oil and Gas Lease Sale 191 and 199, Final EIS. U.S Department of the Interior, Minerals Management Service. Alaska Outer Continental Shelf Region, Anchorage, Alaska.

Montgomery, R.A. 2005. Modeling the terrestrial habitat use of harbor seals. MS, Univ. of Washington. 56 pp.

Moore, S., K. Shelden, L. Kitzky, B. Mahoney, and D. Rugh. 2000. Beluga (Delphinapterus leucas) habitat associations in Cook Inlet, Alaska. Marine Fishery Review, 62 (3). pp 80.

Moore, Sue. 2003. Annual Report for Marine Mammal Protection Act Permit #782-1438. Submitted to NMFS Scientific Research Permit #782-1438. May 29, 2003. 34 pg.

Morrow, J.E. 1980. The freshwater fishes of Alaska. Alaska Northwest Publishing Company, Anchorage, AK.

Morseth, C.M. 1997. Twentieth Century Changes in Beluga Whale Hunting and Butchering by the Kanigmiut of Buckland, Alaska. Arctic 50 (3) 241 - 255 (September 1997).

Moulton, L.L. 1994. 1993 northern Cook Inlet smolt studies. Draft report for ARCO Sunfish project. MJM Research. 100p.

Moulton, L.L. 1997. Early marine residence, growth, and feeding by juvenile salmon in northern Cook Inlet. Alaska Fisheries Research Bulletin 4(2):154-177.

Municipality of Anchorage (MOA) Watershed Management Program. 2006. 2005 Annual report, NPDES Permit No. AKS05255-8. Document No. WMP PMr05001. Anchorage, Alaska.

Murray, N.K., and F.H. Fay. 1979. The white whales or belukhas, *Delphinapterus leucas*, of Cook Inlet, Alaska. Draft prepared for June 1979 meeting of the Sub-committee on Small Cetaceans of the Scientific Committee on Small Cetaceans of the Scientific Committee of the International Whaling Commission. College of Environmental Sciences, Univ. Alaska, Fairbanks. 7p.

National Marine Fisheries Service (NMFS). 2001a. Steller Sea Lion Protection Measures Draft Supplemental Environmental Impact Statement. National Marine Fisheries Service. Juneau, Alaska.

NMFS. 2005. Environmental Impact Statement for Essential Fish Habitat Identification and Conservation in Alaska. National Marine Fisheries Service. Juneau, Alaska.

National Marine Fisheries Service (NMFS) and the Cook Inlet Marine Mammal Commission (CIMMC). 2005. Agreement between the National Marine Fisheries Service and the Cook Inlet Marine Mammal Commission for the Co-management of the Cook Inlet Stock of Beluga Whales for the year 2005. Signed by Peter Merryman, Chairman, CIMMC, and by Ronald J. Berg, Acting Administrator, Alaska Region, NMFS, on July 22, 2005.

National Oceanic and Atmospheric Administration (NOAA). 2003. Subsistence harvest management of Cook Inlet beluga whales, Final Environmental Impact Statement, Alaska Region, NOAA Fisheries, July 2003, 178pp.

NOAA. 2005. Environmental Assessment, Co-management Agreement between the National Marine Fisheries Service and the Cook Inlet Marine Mammal Council for the year 2005, September 2005. 73pp.

NMFS. 2005. Draft Conservation Plan for the Cook Inlet Beluga Whale. National Oceanic and Atmospheric Administration, National Marine fisheries Service, Protected Resources Division, Alaska Region, Juneau, AK. 149 p.

National Research Council (NRC). 1983. Drilling discharges in the marine environment. Panel on assessment of fates and effects of drilling fluids and cuttings in the marine environment, Sept. 26, 1983. Washington, DC: National Academy Press, 601 p.

Neff, J.M.. 1991. Technical review of document: process waters in Cook Inlet, Alaska. Prepared by the public awareness committee for the environment, 100 Trading Bay, Suite #4, Kenai, Alaska. Ref. 67519. Cambridge, MA: Arthur. D. Little, Inc., 55p.

Neff, J.M. and G.S. Douglas. 1994. Petroleum and hydrocarbons in the water and sediments of upper Cook Inlet, Alaska, near a produced water outfall. Submitted to Marathon Oil Company, Anchorage, AK. Duxbury, MA: Battelle Ocean Science Laboratory, 30 p.

Nichol, D.G., and E.I. Acuna. 2001. Annual and batch fecuddity of yellowfin sole, *Limanada aspera*, in the eastern Bering Sea. Fishery Bulletin. 99(1):108-122.

Nichol, D.G. 1997. Effects of geography and bathymetry on growth and maturity of yellowfin sole, *Pleuronectes asper*, in the eastern Bering Sea. Fishery Bulletin, 95(3):494-503. In National Marine Fisheries Service 2001(a).

Nichol, D.G. 1994. Maturation and Spawning of female yellowfin sole in the Eastern Bering Sea. Proceedings of the International Pacific Flatfish Symposium, October 26-28, 1994, Anchorage, Alaska. In National Marine Fisheries Service 2001(a).

Nowak, R.M. 1991. Walker's marine mammals of the world. Volume 2. Fifth Ed. Baltimore: The Johns Hopkins University Press.

O'Corry-Crowe, G.M., R.S. Suydam, A. Rosenberg, K.J. Frost, and A.E. Dizon. 1997. Phylogeography, population structure and dispersal patterns of the beluga whale *Delphinapterus leucas* in the western Nearctic revealed by mitochondrial DNA. In: Molecular Ecology, Vol. 6: 955-970.

O'Corry-Crowe, G.M., A.E. Dizon, R.S. Suydam, and L.F. Lowry. 2002. Molecular genetic studies of population structure and movement patterns in a migratory species: the beluga whale, *Delphinapterus leucas*, in the western Nearctic. Pages 53-64 In C.J. Pfeiffer (ed.), Molecular and cell biology or marine mammals. Krieger Publishing Company, Malabar, FL.

O'Corry-Crowe, G., Lucey, W., Bonin, C., Henniger, E., and Hobbs, R. 2006. The ecology, status and stock identity of beluga whales, *Delphinapterus leucas*, in Yakutat Bay, Alaska. Report to the U.S. Marine Mammal Commission, February 2006. 22p.

O'hara, T. and V. Woshner. 2006. Personal communication via K. Burek, AVPS, Eagle River, Alaska.

Ognetov, G. N. 1981. Studies on the ecology and the taxonomy of the white whale (*Delphinapterus leucas*) Pall., 1776) inhabiting the Soviet Arctic. Report of the International Whaling Commission. 31: 515-520.

Ohsumi, S. 1979. Interspecies relationships among some biological parameters in cetaceans and estimation of the natural mortality coefficient of the southern hemisphere minke whale. Report of the International Whaling Commission. 29: 397-406.

Page, L.M. and B.M. Burr. 1991. A field guide to freshwater fishes of North America north of Mexico. Houghton Mifflin Company, Boston. 432 p.

Payne, S.A., B.A. Johnson, and R.S. Otto. 1999. Proximate composition of some north-eastern Pacific forage fish species. Fish Oceanography. 8:3, 159-177.

Perez, M.A. 1990. NOAA technical memorandum NMFS F/NWC-186. Review of marine mammal population and prey information for Bering Sea ecosystem studies.

Perrin, W.F. (ed.). 1982. Annex H: report of the sub-committee on small cetaceans. Report of the International Whaling Commission. 32: 113-125.

Piatt, J. 2002. Response of seabirds to fluctuations in forage fish density. Final Report to Exxon Valdez Oil Spill Trustee Council and Minerals Management Service. Alaska Science Center, U.S. Geological Survey, Anchorage, Alaska, 406 p.

Pitcher, K.W. 1977. Population productivity and food habitat of harbor seals in the Prince William Sound-Cooper River delta area, Alaska. Marine Mammal Commission, Washington, D.C. 36p.

Pitcher, K.W. and D.C. Calkins. 1979. Biology of the harbor seal, *Phoca vitulina richardii*, in the Gulf of Alaska. RU 229. Environmental assessment of the Alaskan continental shelf, final report of principal investigators, Vol. 19, Dec. 1983. Juneau, AK: USDOC, NOAA, and USDOI, MMS.

Rausch, R.L. 1970. Trichinosis in the Arctic. p. 348-373 in: S.E. Gould (ed.) Trichinosis in man and animals. Charles C. Thomas, Springfield, IL.

Ray, G. C., D. Wartzok, and G. Taylor. 1984. Productivity and behavior of bowheads, *Balaena mysticetus*, and white whale, *Delphinapterus leucas*, as determined from remote sensing. Report of the International Whaling Commission (Special Issue 6):199-209.

Richardson, W.J., and C.I. Malme. 1993. Man-made noise and behavioral responses. p. 631-700 In: J.J. Montague and C.J. Cowles (eds.), The bowhead whale. Spec. Publ. 2. Soc. Mar. Mammal., Lawrence, Kansas. 787p.

Richardson, W.J., C.R. Greene, Jr., W.R. Koski, C.I. Malme, G.W. Miller, M.A. Smultea and B. Wursig. 1990. Acoustic effects of oil production activities on bowhead and white whales visible during spring migration near Pt. Barrow, Alaska-1989 phase. OCS study MMS 90-0017. Rep. From LGL Ltd., King City, Ont., for U.S. Minerals Management Service, Herndon, Va. 284p.

Richardson, W.J., C.R. Greene, Jr., W.R. Koski, and M.A. Smultea, with G.Cameron, C. Holdsworth, G. Miller, T. Woodley, and B. Wursig. 1991. Acoustic effects of oil production activities on bowhead and white whales visible during spring migration near Pt. Barrow, Alaska-1990 phase. OCS study MMS 91-0037. Rep. From LGL Ltd., King City, Ont., for U.S. Minerals Management Service, Herndon, Va. 311 p.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D. Thomson. 1995. Marine mammals and noise. Academic Press. 576 p.

Ridgway, S. and Sir R. Harrison. 1981. Eds., Handbook of marine mammals. Volume 4. London: Academic Press.

Ridgway, S. H., D.A. Carder, T. Kamolnick, R.R. Smith, C.E. Schlundt and W.R. Elsberry. 2001. Hearing and whistling in the deep sea depth influences whistle spectra but does not attenuate hearing by white whales (*Delphinapterus leucas*) (*Odontoceti*, *Cetacea*). Journal Exp. Biol.

Rodrigeus, R. M. Nemeth, T. Markowitz. D. Funk. 2007. Review of Literature on Fish Species and Beluga Whales in Cook Inlet, Alaska. Prepared by LGL, Research Associates, Inc. for DRVen Corporation. Anchorage, AK.

Ruesch, P.H. and J. Fox. 1999. Upper Cook Inlet commercial fisheries annual management report, 1998. Alaska Department of Fish and Game, Division of Commercial Fisheries Management and Development, Regional Information Report 2A99-21, Anchorage. 55 p.

Rugh, D.J., K.E.W. Shelden, and B.A. Mahoney. 2000. Distribution of beluga whale, *Delphinapterus leucas*, in Cook Inlet, Alaska, during June/July 1993-2000. Mar. Fish. Rev. 63(3):6-21.

Rugh, D.J., B.A. Mahoney, and B. K. Smith. 2004. Aerial surveys of beluga whale in Cook Inlet, Alaska between June 2001 and June 2002. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-AFSC-145, 26p.

Rugh, D.J., K.E.W. Shelden, C.L. Sims, B.A. Mahoney, B.K. Smith, L.K. (Litzky) Hoberecht, and R.C. Hobbs. 2005. Aerial surveys of belugas in Cook Inlet, Alaska, June 2001, 2002, 2003, and 2004. NOAA Technical Memorandum NMFS-AFSC-149. 71pp.

Safronov, S.N. 1986. Peculiarities of reproduction and principles of change in the fecundity of Pacific navaga, *Eleginus gracilis* (Gadidae). Journal of Ichthyology 26(5): 59-68.

Scheifele, P.M., S. Andrew, R.A. Cooper, M. Darre, F.E. Musiek, and L. Max. 2005. Indication of a Lombard vocal response in the St. Lawrence River beluga. J. Acoust. Soc. Am. 117(3): 1486-1492.

Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Bulletin of the Fisheries Research Board of Canada. 184:1-996.

Seaman, G. A., and J. J. Burns. 1981. Preliminary results of recent studies of belukhas in Alaskan waters. Report of the International Whaling Commission 31: 567-574.

Sergeant DE. 1959. Age determination in odontocete whales from dentinal growth layers. Norsk Hvalfangsttid. 48(6):273-88.

Sergeant, D.E. and P.F. Brodie. 1969. Body size in white whales, *Delphinapterus leucas*. Journal Fisheries Research Board of Canada 26(10), p. 2561-2580.

Sergeant, D.E. and P.F. Brodie. 1975. Identity, abundance, and present status of white whales, *Delphinapterus leucas*, in North America. Journal Fisheries Research Board of Canada 32(7), 1975, p. 1047-1054.

Sergeant DE. 1973. Biology of white whales (*Delphinapterus leucas*) in western Hudson Bay. Journal Fisheries Research Board of Canada 30:1065-90.

Shelden, K.E.W. 1994. Beluga whales (Delphinapterus leucas) in Cook Inlet – a review. Unpublished document. 10 p. [referenced as Appendix A in Withrow et al. (1994). Beluga whale distribution and abundance in Cook Inlet, 1993. Pp 128-153 in MMAP Status of Stocks and Impacts of Incidental Take 1993. Office of Protected Resources, NMFS, Silver Springs, MD. June 1994.]

Shelden, K.E.W. 1995. Impacts of vessel surveys and tagging operations on the behavior of beluga whales (*Delphinapterus leucas*) in Cook Inlet, Alaska, 1-22 June 1994. NMFS, National Marine Mammal Laboratory, Seattle, Washington. 14p.

Shelden, K.E.W., D.J Rugh,B.A. Mahoney, and M.E. Dahlheim. 2003. Killer whale predation on belugas in Cook Inlet, Alaska: Implications for a depleted population. Marine Mammal Science 19(3): 529-544.

Shields, P. 2005. Upper Cook Inlet commercial herring and smelt fisheries, 2004. Alaska Department of Fish and Game, Report to the Board of Fisheries, 2005, Anchorage.

Shields, P. 2006. Personal communication, via B. Mahoney, NMFS, Alaska Region, Anchorage, Alaska.

Slemmons, J. 2006. Personal communication, via B. Mahoney, NMFS, Alaska Region, Anchorage, Alaska.

Sowls, A.L., S.A. Hatch, and C.J. Lensink. 1978. Catalog of Alaskan Seabird Colonies. Report FWS/OBS-78/78. Washington, DC: USDOI, Fish and Wildlife Service, Office of Biological Services.

Speckman, S.G., J.F. Piatt, and K.J. Kuletz. 2005. Population status and trends of Brachyramphus murrelets in lower Cook Inlet, Alaska. Science Support Program/ Species at Risk Annual Report for U.S. Fish and Wildlife Service, USGS Alaska Science Center, Anchorage.

Spies, R.B., S.D. Rice, D.A. Wolfe, and B.A. Wright. 1996. The effects of the Exxon Valdez oil spill on the Alaskan coastal environment. Proceedings of the Exxon Valdez oil spill symposium. 2-5 February, 1993, Anchorage. American Fisheries Society Symposium 18. American Fisheries Society, Bethesda, Maryland.

Stanek, R.T. 1985. Patterns of Wild Resource Use in English Bay and Port Graham, Alaska. Anchorage: Alaska Department of Fish and Game, Division of Subsistence, Technical Paper No. 104.

Stanek, R.T. 1994. The subsistence use of beluga whale in Cook Inlet by Alaskan natives, 1993. Draft Final report for year two, subsistence study and monitoring system No. 50ABNF200055. ADFG, Juneau, Alaska. 23 pp.

Stanek, R.T., J.A. Fall, and D.L. Holen. 2006. West Cook Inlet Ethnographic Overview and Assessment for Lake Clark National Park and Preserve. National Park Service Research/Resource Management Report NPS/AR/CCR 2007-59.Anchorage: National Park Service.

State of Alaska, Division of Oil and Gas (DOG). 2004. Supplement to the Cook Inlet Areawide Oil and Gas Lease Sale Best Interest Finding. http://www.dog.dnr.state.ak.us/oil/products/publications/cookinlet/ciaw2004/ci_2004_supplement.pdf

Stewart, B.S., F.T. Awbrey, and W.E. Evans. 1982. Effects of man-made waterborne noise on behavior of belukha whale (*Delphinapterus leucas*) in Bristol Bay, Alaska. HSWRI Tech. Rept. No. 82-145.

Stewart, B.S., W.E. Evans, and F.T. Awbrey. 1983. Belukha whale (*Delphinapterus leucas*) responses to industrial noise in Nushagak, Bay, Alaska. HSWRI Tech. Rep. 83-161.

Stewart, R.E.A., S.E. Campana, C.M. Jones, B.E. Stewart. 2006. Bomb radiocarbon dating calibrates beluga (*Delphinapterus leucas*) age estimates. Can. J. Zool. 84:1840-1852.

Tokranov, A.M. 1988. Reproduction of sculpins of the genus Gymnocanthus (Cottidae) in the coastal waters of Kamchatka. Journal of Ichthyology 28(3): 124-128.

Tokranov, A.M. 1981. Rate of sexual maturation and fecundity of the staghorn sculpin, Gymnocanthus detrisus (Cottidae), off the east coast of Kamchatka. Journal of Ichthyology vol. 21, no. 1, pp. 76-82.

Trupp, R. 2007. Personal communication, via B. Mahoney, NMFS, Alaska Region, Anchorage, Alaska.

Tyack, P. L. 1999. Communication and cognition. In Biology of Marine Mammals. J.E. Reynolds III and S.A. Rommel eds. Smithsonian, Washington. Pp. 287-323.

US Army Corps of Engineers, Alaska District (USACE). 1993. Deep Draft Navigation Reconnaissance Report. Cook Inlet, Alaska. 119 p.

USACE. 2003. Anchorage harbor, Alaska. 2003 project maps and index sheets. U.S. Army Corps of Engineers, Alaska District.

U. S. Census Bureau. 2007. Census 2000. Available: http://factfinder.census.gov/home/saff/main.html?_lang=en. (August 2007)

United States Coast Guard (USCG). 1988. Federal on-scene coordinator's report - major oil spill: M/V Glacier Bay. Cook Inlet, Alaska. 2July to 3 August 1987.

U. S. Fish and Wildlife Service. 2005. Species Assessment and listing priority assignment form: Brachyramphus brevirostris. On line: http://ecos.fws.gov/docs/candforms_pdf/r7/B0AP_V01.pdf

Van Pelt, T.I., J.F. Piatt, B.K. Lance, and D.D. Roby. 1997. Proximate composition and energy density of some north Pacific forage fishes. Comparative Biochemical Physiology 118A(4):1393-1398.

Van Pelt, T.I. and J.F. Piatt. 2003. Population status of Kittlitz's and Marbled Murrelets, and surveys for other marine bird and mammal species in the Kenai Fjords area, Alaska. Science Support Program / Species at Risk Ann. Rep. For U.S. Fish and Wildl. Serv., USGS Alaska Science Center, Anchorage, Alaska, 65 pp.

van Vleit, G.B. 1993. Status concerns for the 'global' population of Kittlitz's Murrelet: is the 'glacier murrelet' receding? Pacific Seabird Group Bull. 20: 15-16.

Vlasman, K. L. and G. D. Campbell. 2003. Field Guide: Diseases of parasites of marine mammals of the Eastern Canadian Arctic. Canadian Cooperative Wildlife Health Centre and the Inuit Tapiriit Kanatami. Univ of Guelph.

Vos, D.J. 2003. Cook Inlet beluga age and growth. M.S., Alaska Pacific University. 69 p.

Vos, D.J. and K.E.W. Shelden. 2005. Unusual mortality in the depleted Cook Inlet beluga population. In Press, Northwest. Nat. 86(2):59-65.

Vos, D. 2007. Personal communication, via B. Mahoney, NMFS, Alaska Region, Anchorage, Alaska.

Wang, C.C., and G.V. Irons. 1961. Acute gasoline intoxication. Arch. Environ. Health. 2:714-716.

West. G. 2002. A birder's guide to Alaska. America Birding Association, Bird Finders Guide. Birchside Studios. 592 pp.

Whitehead, H., R.R. Reeves, and P.L. Tyack. 2000. Science and the conservation, protection, and management of wild cetaceans. In Cetacean Societies: Field Studies of Dolphins and Whales. J. Mann, R.C. Connor, P.L. Tack, and H. Whitehead eds. University of Chicago Press, Chicago.

Wilderbuer, T.K. and D. Nichol. 2002. Yellowfin sole. In Appendix A: Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions. pp. 207-253. North Pacific Fishery Management Council, 605 West 4th Avenue, Suite 306, Anchorage, AK 99501.

Witherell, D. 2000. Groundfish in the Bering Sea and Aleutian Islands area: species profiles 2001. North Pacific Fishery Management Council, Anchorage, AK. 15 pp.

Wolotira Jr., R. J., T.M. Sample, S.F. Noel, and C.R. Iten. 1993. Geographic and bathymetric distributions for many commercially important fishes and shellfishes off the west coast of North America, based on research survey and commercial catch data, 1912-1984. NOAA Technical Memorandum, NMFS-AFSC-6, U.S. Department of Commerce, NOAA. p.184. In National Marine Fisheries Service 2001(a).

Woshner, V. 2000. Concentrations and interactions of selected elements in tissues of four marine mammal species harvested by Inuit hunters in arctic Alaska, with an intensive histologic assessment, emphasizing the beluga whale. Doctoral dissertation. University of Illinois at Urbana-Champaign, Urbana, IL. pp. 302.

Young, N.M., S. Iudicello, K. Evans and D. Baur. 1993. The incidental capture of marine mammals in U.S. fisheries. Center for Marine Conservation, Wash. D.C. 413 p.

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Chapter 8.0 Index

APPENDIX A

HARVEST MODEL

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Appendix A: Harvest Model

Within the SEIS there are several statements that are based on population modeling and analysis. The intent here is to describe these analyses in sufficient detail that a person knowledgeable in population modeling and computer programming could repeat the results or determine if the methods were indeed valid. Note that several of the definitions below are not original to this document, but were developed by the Technical Committee advising the Administrative Law proceedings or in earlier reports to the ALJ hearings. They are included here for completeness.

<u>Population Projection Model</u>

All population modeling was done using a population projection model written algebraically as:

$N_{y+1} = (N_y\text{-}H_y)+(N_y\text{-}H_y)[R_{max}(1\text{-}[(N_y\text{-}H_y)/K]^z)]$ if R_{max} is positive or zero,

$N_{y+1} = (N_y\text{-}H_y)+(N_y\text{-}H_y)[R_{max}(1+[(N_y\text{-}H_y)/K]^z)]$ if R_{max} is negative.

With:

Abundance (N_y) is the number of beluga in the population at the beginning of year y, and the first year is y = 1994 (i.e. N_{1994} is the population size in 1994).

Harvest (H_y) is the number of whales harvested in year y. For years prior to 1999 the actual harvest numbers with struck and lost are used, For the years 1999 and later the no harvest model has harvest of zero, for the harvest alternatives the years 1999 to 2006 use the reported harvest for those years with no struck and lost and after 2006 the harvest is determined from the harvest rule for that alternative.

Maximum Annual Growth (R_{max}) is the per capita annual increase or decrease when N is small;

Carrying Capacity (K) is set at 1,300; and

The Shape Parameter (Z) is set to 2.39 so that MNPL will occur at 60% of K.

In this model the number of beluga in the population in the following year, N_{y+1}, is the sum of the post harvest population size and any growth or decline that occurs. The harvest is subtracted from the population in the current year, $(N_y\text{-}H_y)$, to get the post harvest population size. Then it is multiplied by the per capita replacement $[R_{max}(1\text{-}[(N_y\text{-}H_y)/K]^z)]$ to determine the growth or decline. Note that when $(N_y\text{-}H_y)$ is large and close to K then the quantity $(1\text{-}[(N_y\text{-}H_y)/K]^z)$ is close to zero and when $(N_y\text{-}H_y)$ is small and close to zero then the quantity $(1\text{-}[(N_y\text{-}H_y)/K]^z)$ is close to one. This is a density dependent effect which allows larged per capity growth when the population is small and no growth as the population approaches K. The density dependent effect is multiplied by the maximum possible per capita growth, R_{max}, to determine the per capita growth in year y, $[R_{max}(1\text{-}[(N_y\text{-}H_y)/K]^z)]$, which is multiplied by the post harvest population size, $(N_y\text{-}H_y)$, to determine the population growth.

Definitions

Year of Recovery: For a depleted population the year of recovery for harvest policy P, Y_{RP}, is the first year that the size of the population N is greater than or equal to 780.

Time to Recovery: The time to recovery in years for a population under harvest policy P assumes that the population growth is prorated over the year prior to recovery so that the actual recovery occurs at a fraction of the previous year:

$T_{RP} = (Y_{RP} -1)+ (780- N_{YRP -1})/(N_{YRP} -N_{YRP -1})-1999$

Delay in Recovery: The percent delay in recovery attributed to harvest policy P, D_P for a population is calculated as the percent delay over the no harvest model where the harvest is zero for 1999 and after:

$D_P = [(T_{RP} – T_{R0})/ T_{R0}] X 100$,

where P = 0 is defined as the no harvest policy for the same population.

Bayesian analysis: A harvest rule is tested for a range of initial population sizes (400 to 1300), and annual per capita growth or decline (-0.10 to 0.06). An initial population size (N_{1994}) is drawn from a uniform random distribution, U(400, 1300), and annual per capita growth (Rmax) drawn from a uniform random distribution, U(-0.10, 0.06). For the Bayesian analysis 100,000 pairs of these parameters are drawn and the population is projected from 1994 to 2006 using each pair. The population size for each year is compared to the abundance estimates for that year and the likelihood is calculated. The product of likelihoods for all years between 1994 and 2006 is the likelihood of that parameter pair. A sampling-inference-resampling (SIR) algorithm is used in which the 10,000 draws with replacement are taken from the 100,000 parameter pairs weighted by their likelihoods. The resample set of parameter pairs is the Bayesian posterior distribution of those parameters. The simulations for the 10,000 parameter pairs are then projected out to 2099 to determine the posterior distribution of the 100 year outcomes.

Each of the parameter pair projections proceeded through the following steps:

1) A value for N_{1994} was chosen at random from U(400, 1300). An R_{max} was drawn at random from a uniform distribution U(-0.10, 0.06).
2) The population was then projected forward from 1994 to 1999 using the harvest and struck and lost reported for those years.
3) Starting from N_{1999} two separate projections are maintained, one the no harvest projection has no harvest in 1999 and after, the second projection uses the reported harvest through 2006 and then the harvest determined by the harvest rule alternative being tested.
4) The values for N_{1994} to N_{2006} from the harvest alternative projection are compared to the abundance estimates for the years 1994 to 2006 to determine the likelihood of the parameter pair, N_{1994} and R_{max}. A normal distribution is used so that the likelihood of an abundance estimate, $Est(N_y)$, resulting from the model abundance, N_y ,is:

$Like_y = Norm(N_y ,Est(N_y), CV(Est(N_y)) Est(N_y))$, and

$Like = Product(Like_y ,Y = 1994 \text{ to } 2006)$

With:

$Like_y$ is the likelihood of the estimated abundance Est (N_y) given the abundance calculated by the model.
Norm(x, mu, sigma) is probability density at x of a normal distribution with mean mu and standard deviation sigma.
Est (N_y) is the estimated number of beluga in the population from the aerial survey in year y.
CV(Est (N_y)) coefficient of variation of Est (N_y).
Like is the likelihood of the entire series of Est (N_y) for y = 1994 to 2006 given the series N_y for y = 1994 to 2006. This is also the likelihood the parameter pair (N_{1994}, R_{max}).

5) The parameter pair is then included in the draw for the SIR algorithm. If it is not selected, then it is not projected further. These details are necessary to determine population effects. If it is not selected, then it is not projected further. These details are necessary to determine population effects.
6) The no harvest policy using $H_y = 0$ for all years after 1999 is calculated through 2099 and the time to recovery with no harvest is determined.
7) The projection of the population with harvest is projected forward from 2006 to 2099. An abundance estimate was drawn for each year from a normal distribution with mean N_y and a CV drawn at random from the CV's of the CIB abundance estimates from 1996 to 2003 (0.28, 0.14, 0.29, 0.14, 0.23, 0.087, 0.12, 0.107). Every 5th year starting with year = 2008 or 2010 the arithmetic average of the abundance estimates was computed from the previous 5 years (year-5 to year-1), and the probability distribution of Rmax is determined. The growth rate probability distribution was compared to criteria for setting the harvest to determine the harvest for the following 5 years.
8) The year of recovery was determined and the delay in recovery computed as above.

The potential harvest tables were tested using a FORTRAN 90 program, the comparison among the potential harvest tables was done in an EXCEL spreadsheet.

<u>Comparison with Harvest Model in Cook Inlet Beluga Status Review and Extinction Assessment</u>

The population model used in the extinction risk assessment includes age structure and sex structure and accounts for demographic stochasticity and small population effects to estimate the probability of extinction, because they have significant effects at population sizes of 200 or less.

During the Administrative Law Judge hearings the simple two parameter model described at the beginning of Appendix A was developed as the population model to be used in development and testing of alternative harvest policies. None of the harvest alternatives allow a harvest below a population size of 250 and harvest from increasing populations only. The simple two parameter model is adequate for testing these models consequently it is not necessary revise the model that was included in the ALJ ruling.

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