ENDANGERED SPECIES ACT: SECTION 7 CONSULTATION
BIOLOGICAL OPINION

Action Agency: National Marine Fisheries Service and US Corps of Engineers

Activity: 3-D Seismic Surveys of Cook Inlet, Alaska by Apache Alaska Corporation

Consulting Agency: National Marine Fisheries Service, Alaska Region

Date Issued: 5/21/12

Approved By: Robert DMecum

The National Marine Fisheries Service's (NMFS) Office of Protected Resources, Permits and Conservation Division (PR1), in conjunction with the U.S. Army Corps of Engineers (Corps), has requested formal consultation on the 3-D Seismic Surveys of Cook Inlet, Alaska by Apache Alaska Corporation (Apache or operator). This document constitutes NMFS Alaska Region's (NMFS AKR) opinion on the effects of that action on the endangered species in accordance with section 7 of the ESA. Specifically, this opinion analyzes the effects of the Cook Inlet 3-D Seismic Surveys on the endangered Cook Inlet beluga whale (*Delphinapterus leucas*) (73 FR 62919, October 22, 2008), Cook Inlet beluga whale critical habitat (76 FR 20180, April 11, 2011), and the endangered, western DPS of Steller sea lions (62 FR 24345, May 5, 1997).

In formulating this Biological Opinion, NMFS AKR used information presented in the following documents or sources:

- Biological Assessment for the Apache Alaska Corporation's Cook Inlet 3-D Seismic Program in Cook Inlet, Alaska (SAExploration, Inc 2011);
- Proposed Rule to Issue an IHA for take by Level B harassment to Apache Alaska Corporation (76 FR 58473, September 21, 2011);
- Environmental Assessment for Alaska Apache Corporation (October 2011);
- Conservation Plan for the Cook Inlet Beluga Whale (October 2008);
- 2008 Status Review and Extinction Risk Assessment of Cook Inlet Belugas (*Delphinapterus leucas*);
- 2008 Supplemental status review and extinction assessment of Cook Inlet belugas (*Delphinapterus leucas*);
- 2008 Final Supplemental Environmental Impact Statements for the Cook Inlet Beluga Whale Subsistence Harvest;
- Recovery Plan for Eastern and Western Distinct Population Segments of Steller Sea Lions (March 2008);
- Published scientific studies; and
- Unpublished data from the NMFS, NMML, the State of Alaska, and Alaska Native communities.

In addition to document reviews and conversations with involved individuals, NMFS AKR requested a meeting with the applicant (Apache), NMFS PR1, and the Corps to have a discussion to understand the specifics of this proposed project. This meeting was held October 3, 2011, and allowed NMFS AKR to ask directed questions about Apache's proposed process and timing of the seismic surveys, and for Apache to give a visual presentation of their equipment and methods. During this meeting, NMFS AKR staff observed an actual "node" to be the primary recording device set on the seafloor, thus providing a better understanding of the size and impact the nodes could have.

Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 *et. seq.*) requires that each federal agency ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species, or result in the destruction or adverse modification of any critical habitat of such species. When the action by a federal agency may affect a protected species, that agency is required to consult with either the NMFS or the US Fish and Wildlife Service (USFWS), depending upon the protected species that may be affected. Formal consultations on most listed marine species are conducted between the action agency and NMFS. Consultations are concluded after NMFS issues a biological opinion (opinion) that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its critical habitat. If jeopardy or destruction or adverse modification is found to be likely, the opinion must identify reasonable and prudent alternatives to the action, if any, that would avoid jeopardizing any listed species and avoid destruction or adverse modification of designated critical habitat. If jeopardy is not likely, the opinion will include an incidental take statement (ITS), which specifies the amount or extent of incidental take that is anticipated from the proposed action.

Consultation History

By letter dated September 2, 2011, the NMFS PR1 requested formal consultation with NMFS AKR on the proposed issuance of an Incidental Harassment Authorization (IHA) under the Marine Mammal Protection Act of 1972, as amended (MMPA) to take marine mammals by harassment during seismic surveys in Cook Inlet, Alaska. In a supplemental letter dated September 20, 2011, NMFS PR1 requested a programmatic consultation to examine the entire scope of the project (vs. only analyzing year one activities) and to request a joint consultation in conjunction with the Corps, who would have to authorize the placement and retrieval of an autonomous nodal system (nodes) below the mean high water mark for the purpose of conducting the 3-D seismic survey under Section 10 of the Rivers and Harbors Act of 1899. Given NMFS PR1's expertise with marine mammals, NMFS PR1 would be the lead agency for the consultation. Along with the consultation letters, NMFS AKR received a Biological Assessment (BA; SAExploration Inc 2011), the applicant's application for an IHA, the proposed rule to issue an IHA, and information regarding the proposed Corps permit. NMFS AKR agreed to initiate formal consultation by letter dated September 26, 2011. NMFS AKR issued a Biological Opinion on February 17, 2012. The present Biological Opinion revises the February 17, 2012 opinion to clarify several sections. The conclusions are unchanged.

Term of this Biological Opinion

This biological opinion will be valid upon issuance and remain in force until January 31, 2015, unless re-initiation becomes necessary. Consultation will be re-initiated if (1) the amount or extent of take specified in the incidental take statement is exceeded in any operational year; (2) the action is modified in a manner that causes an effect to the listed species or its critical habitat that was not considered in this biological opinion; (3) new information reveals effects of the action that may affect listed species or its critical habitat to an extent or in a manner not previously considered; or (4) a new species is listed or critical habitat designated under the ESA. See Section 9, p 101.

Presentation of the Analysis in this Opinion
Biological opinions are constructed around several basic sections that represent specific requirements placed on the analysis by the ESA and implementing regulations. These sections contain different portions of the overall analytical approach described here. This section is intended as a basic guide to the reader of the other sections of this opinion and the analyses that can be found in each section. Every step of the analytical approach described above will be presented in this opinion.

Description of the Proposed Action – This section contains a basic summary of the proposed Federal action and any interrelated and interdependent actions. This description forms the basis of the first step in the analysis where we consider the various elements of the action and determine the stressors expected to result from those elements. The nature, timing, duration, and location of those stressors define the action area and provide the basis for our exposure analyses.

Status of the Species – This section provides the reference condition for the species and critical habitat at the listing and designation scale. These reference conditions form the basis for the determinations of whether or not the proposed action is likely to jeopardize the species or result in the destruction or adverse modification of critical habitat. Other key analyses presented in this section include critical information on the biological and ecological requirements of the species and critical habitat and the impacts to species and critical habitat from existing stressors.

Environmental Baseline – This section provides the reference condition for the species and critical habitat within the action area. By regulation, the baseline includes the impacts of past, present, and future actions (except the effects of the proposed action) on the species and critical habitat. This section also contains summaries of the impacts from stressors that will be ongoing in the same areas and times as the effects of the proposed action (future baseline). This information forms part of the foundation of our exposure, response, and risk analyses.

Effects of the Proposed Action – This section details the results of the exposure, response, and risk analyses NMFS conducted for listed species and elements, functions, and areas of critical habitat.

Cumulative Effects – This section summarizes the impacts of future non-Federal actions reasonably certain to occur within the action area, as required by regulation. Similar to the rest of the analysis, if cumulative effects are expected, NMFS determines the exposure, response, and risk posed to individuals of the species and features of critical habitat.

Synthesis and Integration – In this section of the opinion, NMFS presents the summary of the effects identified in the preceding sections and then details the consequences of the risks posed to individuals and features of critical habitat to the species or Distinct Population Segment at issue.

Finally, this section concludes whether the proposed action may result in jeopardy to the continued existence of a species or the destruction or adverse modification of designated critical habitat.

Legal and Policy Framework
The purposes of the ESA "*are to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions set forth in subsection (a) of this section*." To help achieve these purposes, the ESA requires that "*[e]ach Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat . . . .*"

Jeopardy Standard
The "jeopardy" standard has been further interpreted in regulation (50 CFR 402.02). "*Jeopardize the continued existence of*" means "*to engage in an action that reasonable would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution*." It is important to note that the purpose of the analysis is to determine whether or not appreciable reductions are reasonably expected, but not necessarily to precisely quantify the amount of those reductions. As a result, our assessment often focuses on whether an appreciable reduction is expected or not, but not on quantifying the amount of reduction or the resulting population characteristics (abundance, for example) that could occur as a result of the proposed action.

NMFS equates a listed species' probability or risk of extinction with the likelihood of both the survival and recovery of the species in the wild for purposes of conducting jeopardy analyses under section 7(a)(2) of the ESA. A designation of a high risk of extinction indicates that the species faces significant risks from internal and external processes that can drive a species to extinction. The status assessment considers and diagnoses both the internal and external processes affecting a species' extinction risk.

The parameters of productivity, abundance, and population spatial structure are important to consider because they are predictors of extinction risk; the parameters reflect general biological and ecological processes that are critical to the survival and recovery of the listed species, and these parameters are consistent with the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR 402.02).

Destruction or Adverse Modification Standard
For critical habitat, NMFS does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the analysis with respect to critical habitat. NMFS will evaluate "destruction or adverse modification" of critical habitat by determining if the action reduces the value of critical habitat for the conservation of the species.

Additional requirements on the analysis of the effects of an action are described in regulation (50 CFR 402) and our conclusions related to “jeopardy” and “destruction or adverse modification” generally require an evaluation of the direct and indirect consequences of the proposed action, related actions, and the overall context of the impacts to the species and habitat from past, present, and future actions as well as the condition of the affected species and critical habitat [for example, see the definitions of “cumulative effects,” “effects of the action,” and the requirements of 50 CFR 402.14(g)]. Recent court cases have reinforced the requirements provided in section 7 regulations that NMFS must evaluate the effects of a proposed action within the context of the current condition of the species and critical habitat, including other factors affecting the survival and recovery of the species and the functions and value of critical habitat.

Consultations designed to allow Federal agencies to fulfill these purposes and requirements are concluded with the issuance of a biological opinion or a concurrence letter. Section 7 of the ESA and the implementing regulations (50 CFR 402), and associated guidance documents (*e.g.,* USFWS and NMFS 1998) require biological opinions to present: (1) a description of the proposed Federal action; (2) a summary of the status of the affected species and its critical habitat; (3) a summary of the environmental baseline within the action area; (4) a detailed analysis of the effects of the proposed action on the affected species and critical habitat; (5) a description of cumulative effects; and (6) a conclusion as to whether it is reasonable to expect the proposed action is not likely to appreciably reduce the species’ likelihood of both surviving and recovering in the wild by reducing its numbers, reproduction, or distribution or result in the destruction or adverse modification of the species’ designated critical habitat.

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1. PROPOSED ACTION

The National Marine Fisheries Service, Office of Protected Resources' Permits and Conservation Division (NMFS PR1) and the US Corps of Engineers (Corps) have jointly submitted a request for an ESA section 7 consultation to the National Marine Fisheries Service's Alaska Regional Office (NMFS AKR), Protected Resources Division to analyze the effect of issuing their respective permits on the Cook Inlet beluga whale and the Steller sea lion populations. They also requested the program be reviewed in its entirety, and not just year one activities as was initially requested. Thus, this biological opinion will review the proposed action of the applicant in its full scope (three-year project, not just the first year activities).

For year one activities, the applicant has submitted an application to the NMFS PR1 for an Incidental Harassment Authorization (IHA) under the Marine Mammal Protection Act to take by harassment 30 Cook Inlet beluga whales and 20 Steller sea lions during the first year of Apache's proposed seismic program. Apache has also submitted an application to the Corps for the first portion of their exploratory program to place and retrieve autonomous nodal recorders (nodes) below the mean high water mark (MHWM) of Cook Inlet (in accordance with the Section 10 of the Rivers and Harbors Act), and to temporarily discharge 2,807 cubic yards of material into no more than six acres of waters of the US, including wetlands (in accordance with Section 404 of the Clean Water Act). The temporary discharge of materials refers to the removal of substrate from the intertidal zone by Apache when drilling holes and then, after the charges are placed into the bottom of the holes, the holes will then backfilled with the previously removed materials. As such, no new fill material will be placed into Cook Inlet. The Corps determined this discharge of backfill materials into intertidal waters of Cook Inlet will have no effect on the Cook Inlet belugas and Steller sea lions, thus that aspect of the program will not be discussed in this biological opinion.

1.1 Purpose of Action

Apache Alaska Corporation (Apache) acquired over 800,000 acres of oil and gas leases in and around Cook Inlet in 2010 and 2011 with the primary objective to explore for and develop oil fields in Cook Inlet. Prior to any development of oil fields in Cook Inlet, Apache must first determine if and where any viable oil fields are located. The 3D seismic survey program described herein is the method proposed for obtaining this information.

In the spring of 2011, Apache conducted a seismic test program to evaluate the feasibility of using new nodal (no cables) seismic recording equipment for operations in the Cook Inlet environment and to test various seismic acquisition parameters in order to finalize the design for the 3D seismic program in the Cook Inlet. The test program occurred in late March 2011 and results showed that the nodal technology was feasible in the Cook Inlet environment. Therefore, Apache now proposes to conduct a phased 3D seismic survey program throughout Cook Inlet over three years.

1.2 Project and Action Areas

1.2.1 Project Area

Apache has acquired approximately 800,000 acres of onshore and tideland lease holdings within the Cook Inlet with the past two years state lease sales (Figure 1). The full proposed project area (onshore and offshore) encompasses approximately 12,339 square kilometers (km^2, ~4,764 square miles [mi^2]), of which 6,562 km^2 (~2,544 mi^2) is onshore and 5,777 km^2 (~2,230 mi^2) is offshore (Figure 1). Water depths for the program will range 0 to 128 meters (m; 0 to 420 feet [ft]).

The results from a sound source verification study conducted September 2011 in Cook Inlet indicated noise from the onshore activity does not transmit into the waters of Cook Inlet at levels exceeding the NMFS acoustic harassment threshold for intermittent sounds (160 dB re: 1μ Pa $_{RMS}$). As such, the project area for this biological opinion includes only intertidal and offshore areas, and does not include the onshore areas acquired and proposed for seismic survey by Apache.

The applicant has divided the intertidal and offshore areas of the proposed project area into three smaller areas and generally anticipates working in each area progressively over the three years of the project.

1.2.1.1 Project Area 1

Apache anticipates conducting seismic surveys over approximately 1,292.06 km^2 (498.87 mi^2) of intertidal and offshore areas the first year of operations in Cook Inlet. The proposed Area 1 program area is from East and West Foreland north to the Beluga River on the western side of upper Cook Inlet (Figure 2). The first portion of Area 1 to be surveyed is located along the western coast of middle Cook Inlet.

1.2.1.2 Project Area 2

Area 2 will take place in middle to lower Cook Inlet and includes Trading Bay on the western side and from the East Foreland south to Anchor Point (Figure 3). Area 2 encompasses 2,882.14 km^2 (1,112.79 mi^2) of intertidal and offshore areas and will be the second main area surveyed. Area 2 is scheduled to be surveyed the second year of the project.

1.2.1.3 Project Area 3

Area 3 includes upper Cook Inlet, southwest of Knik Arm and includes areas around the Susitna River (Figure 4). Area 3 will be the final main area surveyed (during year 3 of the project) and encompasses 1,602.71 km^2 (618.81 mi^2) of intertidal and offshore areas.

1.2.2 Action Area

The action area is defined by the ESA as all areas to be affected directly or indirectly by the federal action [50 CFR 402.02]. The action area is typically larger than the project area and extends out to a point where no measurable effects from the project occur.

NMFS has been using generic sound exposure thresholds to determine when an activity produces sound sufficient to affect marine mammals (70 FR 1871, January 11, 2005). These acoustic thresholds identify the levels at which different categories of noise (impulsive or continuous) may result in harm or harassment. For mid-frequency cetaceans (e.g., beluga whales), the harassment threshold for impulsive sounds, including those generated by airguns used during seismic surveys, is recognized at 160 decibels referenced to 1 microPascal (notated as 160 dB re: 1 μPa_{RMS}), and the harm/injury threshold is 180 dB re: 1 μPa_{RMS}. For pinnipeds (e.g., Steller sea lions) the harassment and harm thresholds are 160 and 190 dB re: 1 μPa_{RMS}, respectively.

FIGURE 1: The full project area is outlined in red and includes the onshore and offshore components. The yellow and orange cells represent lease areas obtained by Apache. ***Note: the onshore areas are not discussed further in this opinion.***

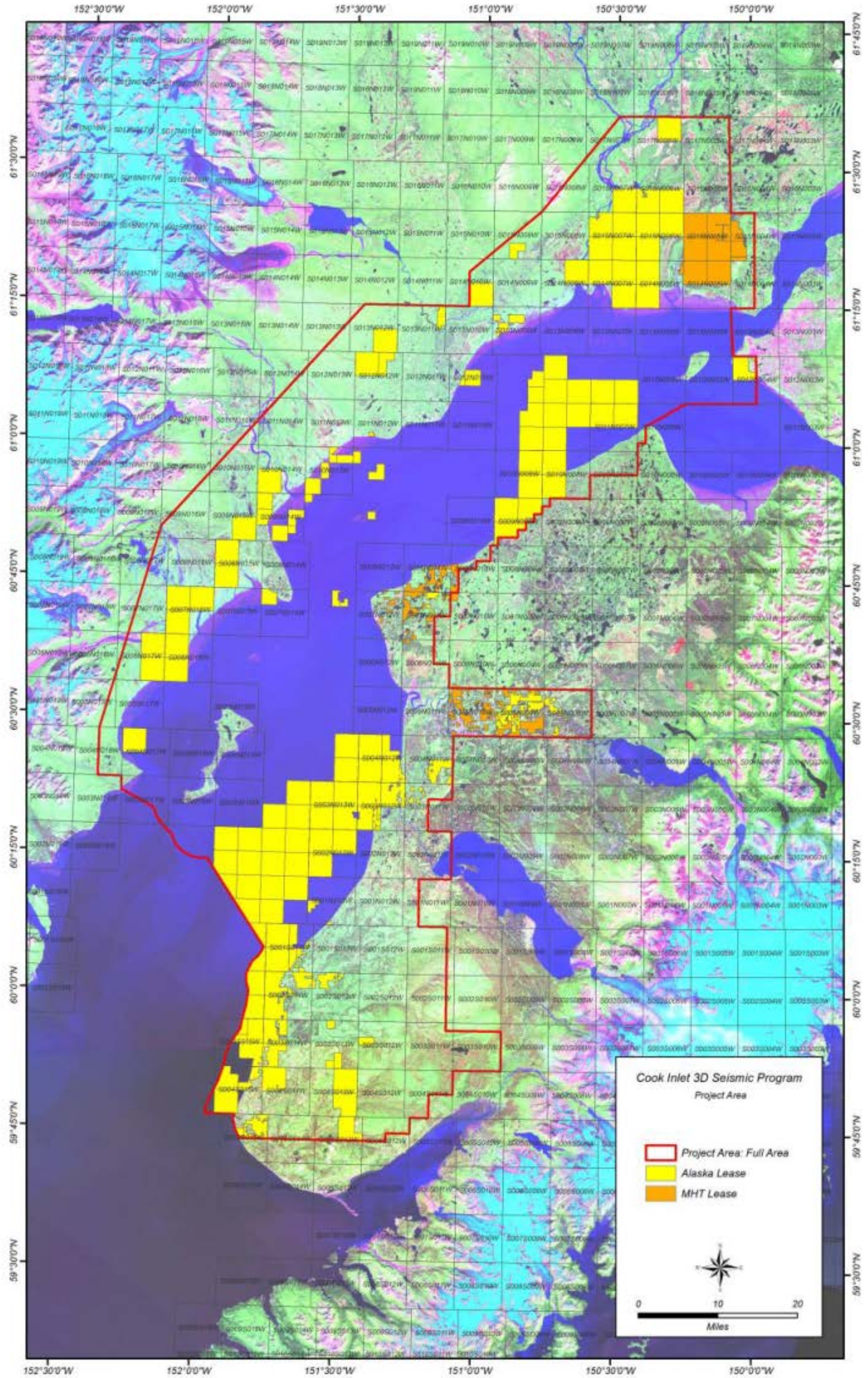


FIGURE 2: Project Area 1 (red line) encompasses approximately 1,292.06 km^2 (498.87 mi^2).

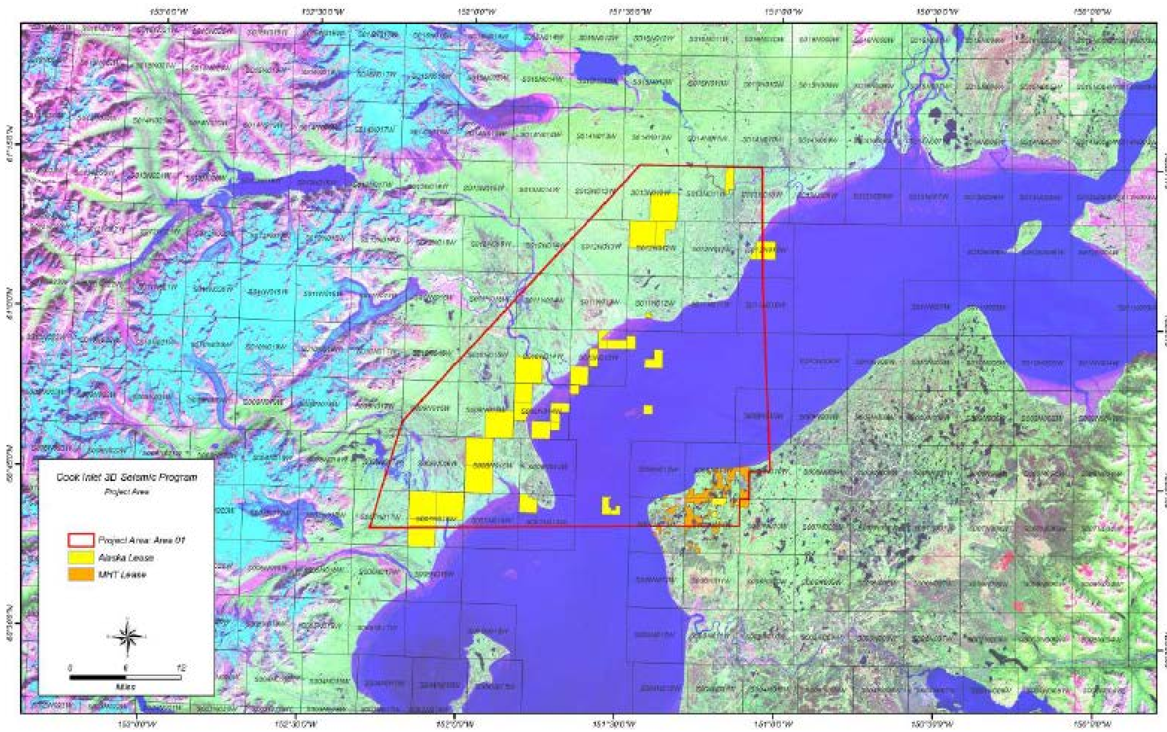


FIGURE 3: Project Area 2 (red line) encompasses approximately 2,882.14 km^2 (1,112.79 mi^2).

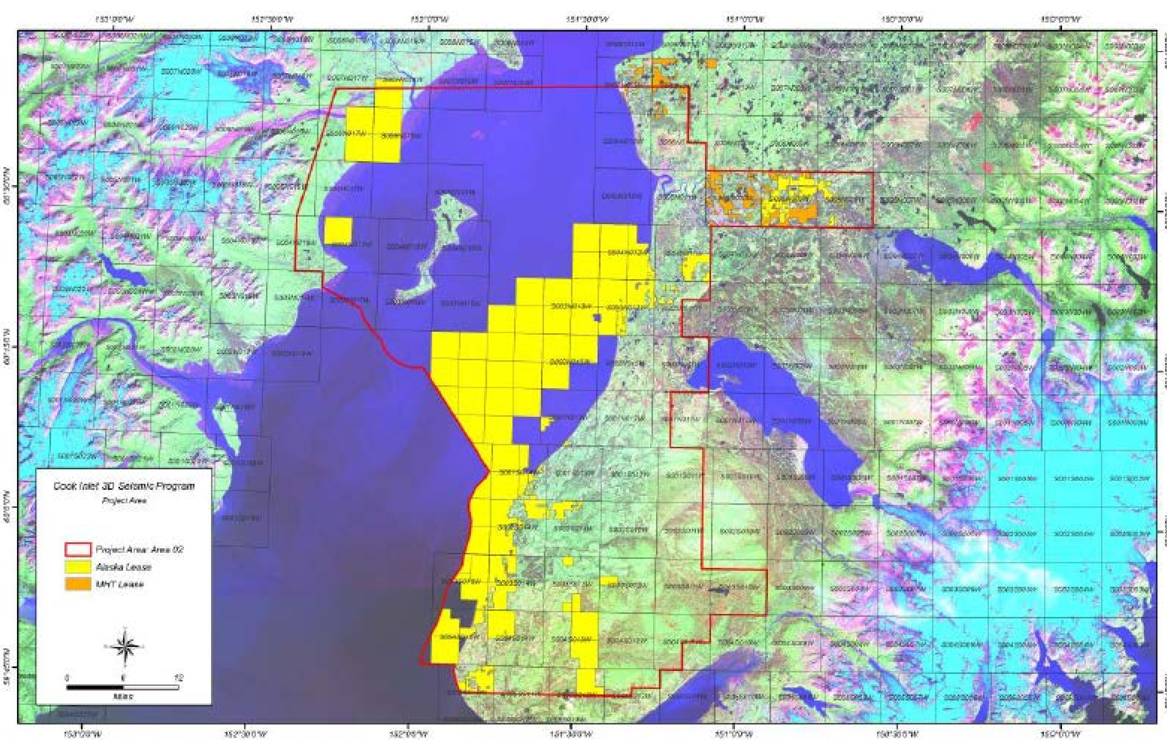
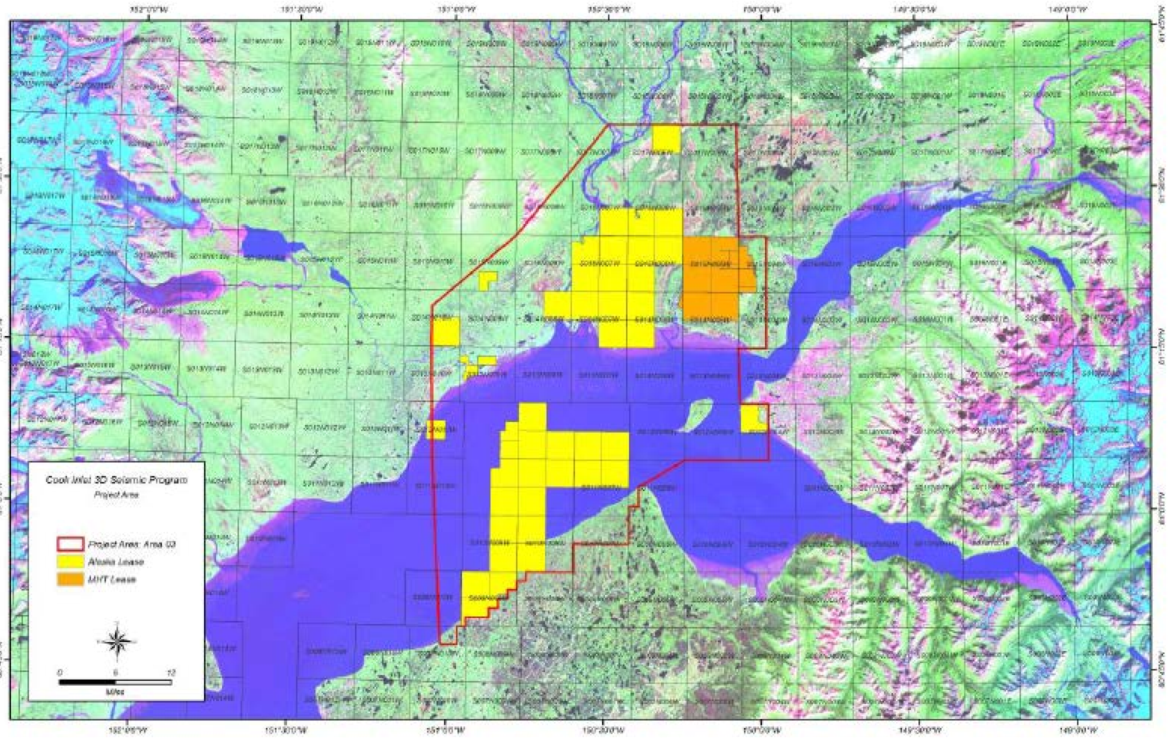


FIGURE 4: Project Area 3 (red line) encompasses approximately 1,602.71 km^2 (618.81 mi^2).

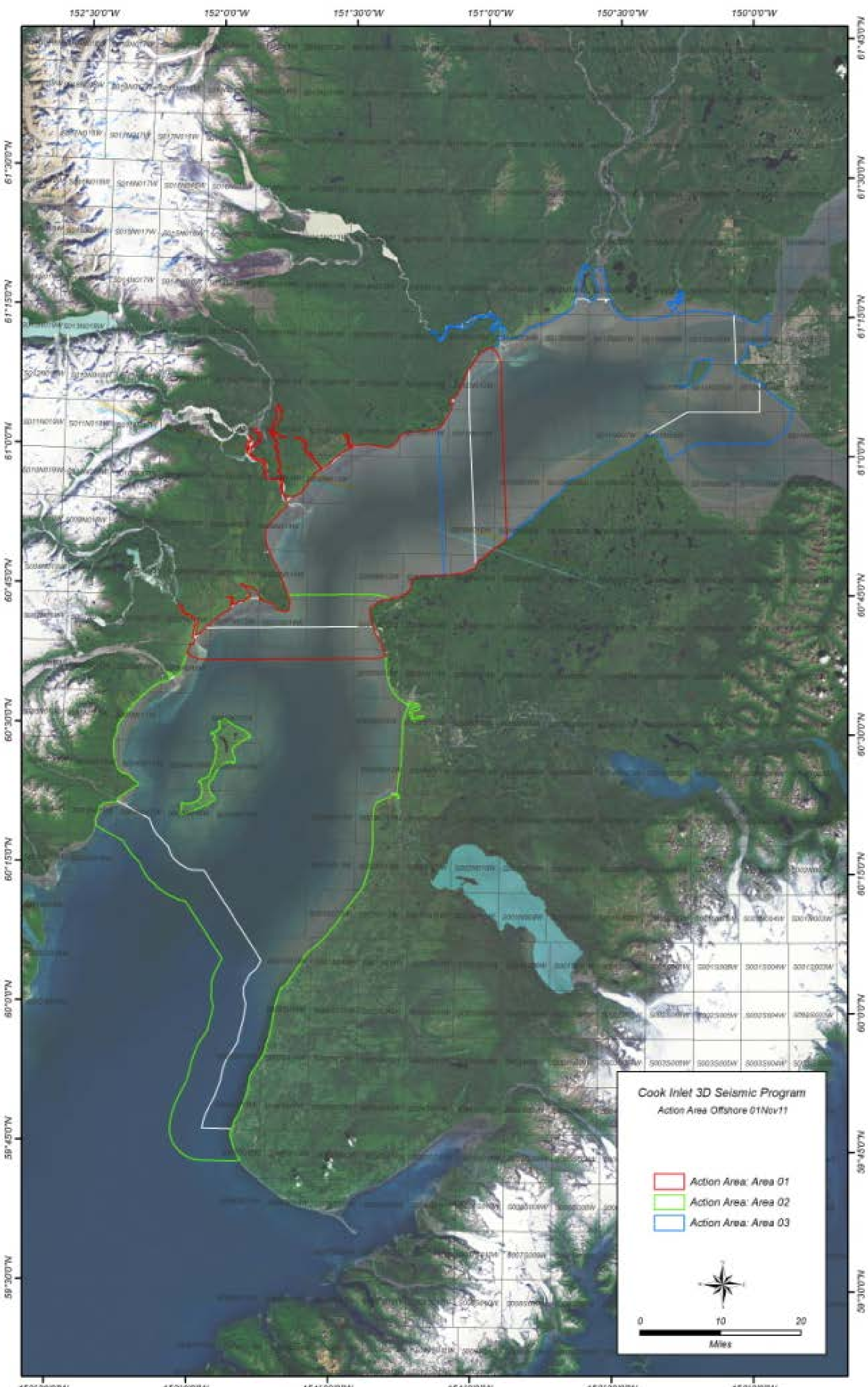


While other aspects of the project (e.g., increased vessel traffic; air traffic; etc.) may cause impacts to the environment, NMFS determined the periphery of the action area within Cook Inlet (Figure 5) by considering the activity whose impacts will extend farthest from the project: noise caused by the 2,400 cubic inch (cui) airgun arrays. For purposes of this biological opinion, the action area extends beyond the leased areas and is defined as all the areas within Cook Inlet, Alaska where threatened or endangered species under NMFS' jurisdiction may be subjected to underwater sound pressures of 160 dB re: 1 μPa_{RMS} or greater as a consequence of the seismic surveys.

The action area for the full proposed Cook Inlet 3D Seismic Survey Program (in-water component only) encompasses approximately 6,580 km^2 (2,540 mi^2) and includes a 6.41 km (~4 mi) buffer around the project area (Figure 5). The buffer reflects the calculated distance necessary for noises associated with the 2,400 cui arrays to attenuate below the 160 dB re:1 μPa_{RMS} threshold. The northern most border of the action area extends slightly past the entrances to Knik Arm and Turnagain Arm; the southern border runs from south of Trading Bay on the western side of Cook Inlet, across to Anchor Point on the eastern side (Figure 5).

Prior to the start of each year's activities, the applicant will conduct a sound source verification study using the 440 cui and 2,400 cui airgun arrays to determine the actual distance to the 160 dB re: 1 μPa_{RMS} threshold, and adjust the action area as necessary. Thus, the action area will encompass all areas that may be affected by underwater sounds equal to or greater than 160 dB re: 1 μPa_{RMS} as a result of the proposed action.

FIGURE 5: The project and action areas of the proposed seismic program. The entire area is subdivided into three smaller areas. The white lines depict the project area borders and the colored lines depict each of the action areas (action areas includes a 6.41 km (~4 mi) buffer around the intertidal and offshore regions in the project area).



1.3 Description of Proposed Action

This biological opinion is required under Section 7 of the ESA as a result of federal involvement in the proposed action. While there are two federal agencies[1] involved in this action, the proposed action described in this document is the activity these authorizations and permits would allow: Apache's proposed 3D seismic survey program in Cook Inlet, Alaska.

1.3.1 Dates and Duration of Activities

Apache proposes to conduct a phased 3D seismic survey program throughout Cook Inlet over the course of the next three years, starting in Area 1 in the spring of 2012, followed by Areas 2 and 3, with an anticipated ending date occurring in January 2015. Typically, activities will be restricted to one area during each operational period, but some overlap of areas in any given year may occur to accommodate avoidance of congregations of marine mammals, seasonal wildlife protection restrictions, or weather conditions, etc. General timing windows of activities are described below; however, these time periods are primarily tied to the retreat and encroachment of sea ice in Cook Inlet, although there are certain areas in which regulatory agencies, such as Alaska Department of Fish and Game (ADF&G), have limitations on use during specific time periods (see Figure 6). Sea ice typically retreats in the spring in early March through mid-April and encroaches in mid- to late December, although the timing varies considerably year to year. The timing windows below encompass the earliest starting and latest ending dates during which seismic activities may occur, and such activities may occur at any time during these windows.

Apache anticipates beginning seismic surveys in the offshore and transition zones of Area 1 in mid-April 2012 and operating in this area through the end of September 2012. In September through December 2012, Apache plans to survey the transition zones on the east side of Area 2, from Kasilof to Anchor Point. Starting March 2013 and running through the end of June 2013, and then again from the beginning of September through the end of November 2013, the offshore regions of Area 2 are currently scheduled to be surveyed. From September through December 2013, the transitional area northeast of Nikiski is planned to be surveyed. Beginning (April through the end of September 2013, Apache has plans to survey the offshore regions from Pt. Possession and Captain Cook State Park on the east side of Area 3 across to Lake Beluga on the west side. In 2014, Apache plans to survey the remaining portions of Area 3 from mid-February to the end of March, and then again mid-October through the end of January 2015. Apache has committed to not conduct seismic activities in areas which could impact beluga whales occurring in the Susitna Delta region during mid-April through mid-October. This time period represents the peak use of the Susitna Delta region by beluga whales for foraging and possible breeding activities, with an approximately two-week buffer on either side to allow for timing fluctuations of the whales' usage.

During each 24-hour period, activities related to the seismic operation will be active throughout the entire period; however, the in-water airguns will only be active for approximately 2.5 hours during each of the slack tide periods (unlike other seismic programs in the Arctic where airguns are operational 24 hours per day). Seismic operations are not conducted in ebb and flood tides because the signal-to-noise ratio of the seismic data are extremely poor due to the high ambient

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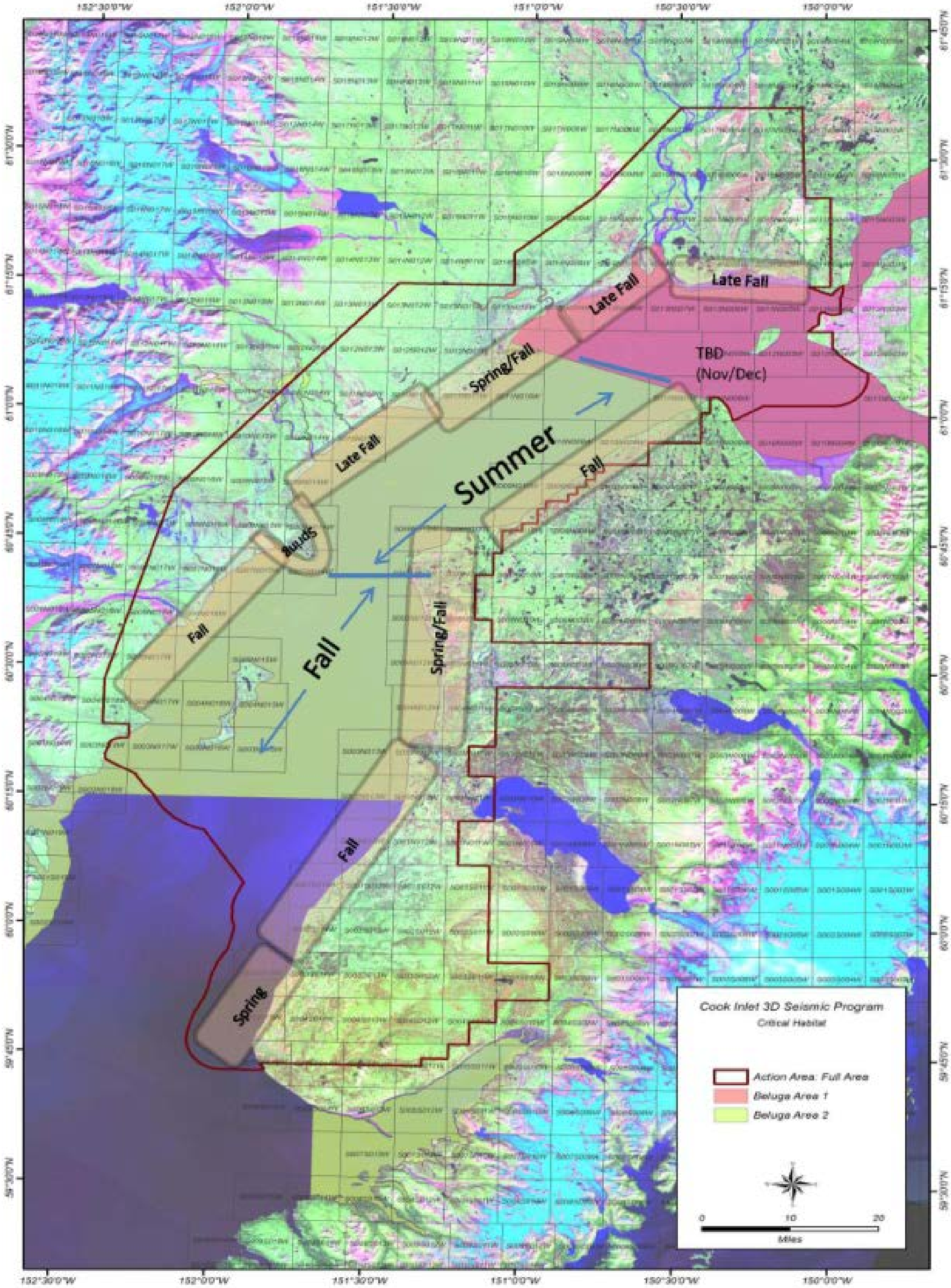
[1] NMFS PR1 is considering issuing an Incidental Harassment Authorization (IHA) under the Marine Mammal Protection Act for the harassment of marine mammals; the Corps is considering issuing a permit under both the Rivers and Harbors Act and the Clean Water Act.

FIGURE 6: Apache's seasonal windows of opportunity to conduct seismic surveys across the entire project area. The red outline documents the action area, including onshore areas.



noise from the tidal flow. Furthermore, actual towing of the array by the vessel in the high tidal flows (velocities up to 8 knots) is difficult and potentially unsafe for the vessel, people, and equipment. There are approximately 4 slack tide periods in a 24-hour period; therefore, Apache's airgun operations will be active approximately 10-12 hours per day, if weather conditions allow. Apache anticipates that a crew can acquire approximately 5.2 km^2 (2 mi^2) per day, assuming an efficient crew can work 10-12 hours per day (24 hour period).

1.3.2 3D Seismic Survey Method

1.3.2.1 Equipment

The proposed action is designed using standardized seismic surveying equipment. Such equipment includes vessels with varying roles; airguns to produce the sound waves necessary to penetrate the seafloor; hydrophones ("nodal recorders") to record the echoes back from the seafloor; positioning sensors to accurately locate the recorders on the seafloor; and support aircraft.

<u>Vessels:</u>
The proposed action plans to utilize vessels for four different functions: seismic source vessels; "nodal recorder" deployment and retrieval vessels; a mitigation/support vessel; and personnel transport vessels. The seismic source vessels currently planned for use are the *M/V Peregrine Falcon* and *M/V Arctic Wolf,* or similar vessels. Node deployment and retrieval operations will be supported by three shallow draft vessels *(M/V Miss Diane I, M/V Miss Diane II,* and *M/V Maxime*), or similar vessels. The mitigation/support vessel which will house the Protected Species Observers (PSO) will be the *M/V Dreamcatcher*. Two smaller jet boats will be used for personnel transport and node support in the extremely shallow water in the intertidal area.

<u>Airguns</u>:
The offshore and transition zone source effort will include the use of input/output sleeve airguns in two different configurations: a 440 and 2,400 cubic inch (cui) array. Apache plans to use two source vessels synchronized in time. The source vessels *M/V Peregrine Falcon* and the *M/V Arctic Wolf* (or similar vessels) will be equipped with compressors and 2,400 cui airgun arrays. In addition, the *M/V Peregrine Falcon* will be equipped with a 440 cui shallow water source which it can deploy at high tide in the intertidal area in less than 1.8 m (6 ft) of water.

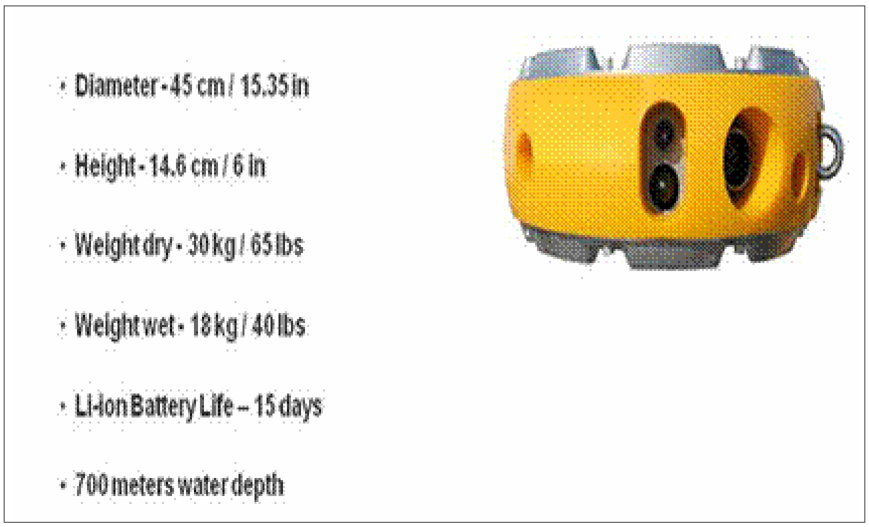
Both source vessels will be equipped with a 10 cui mitigation gun. A mitigation gun is used to sustain the sound of air guns in the water when the 440 or 2,400 cui arrays are not in operation to deter whales and sea lions from approaching the vessel. The mitigation gun is designed to alert marine mammals to the presence of seismic survey vessels in the area, which allows the animals the opportunity to move away from the vessel and the active sound source. If the mitigation gun remains in operation, a full ramp up of the air gun will not be required. This gun is a separate system on a davit system to deploy separate from the arrays. Table 1 provides the maximum broadband source levels for each of the guns.

<u>Nodal Recorders (Nodes):</u>
The recording system that will be employed is an autonomous system "nodal" (i.e., no cables). For the inter-tidal and offshore zone, this is a submersible multi-component system made up of

TABLE 1: Projected broadband source levels (dB re: 1 μPa$_{RMS}$ @1 m) for each of the different sizes of airgun arrays and the pinger. When multiple values given (e.g., broadside vs endfire), the largest (and thus most conservative) value is used. A sound source verification study will be conducted prior to any in-water airgun use to verify these values.

Source Type	Max Source Level
Pinger	188 dB
10 cui airgun	206.4 dB
440 cui airgun	224.8 dB
2,400 cui airgun	237.8 dB

FIGURE 7: The schematics of the autonomous recording system (node) to be used in the intertidal and marine zones.



three velocity sensors and a hydrophone (Figure 7). This system has the ability to record continuous data.

Node Positioning Sensors:
In shallow water, the location of each node can be obtained by a land surveyor or based upon the position at which the navigator has laid the unit. In deep water, the location can be identified either with a hull/pole mounted pinger and transducer attached to each node, or by using a 10 cui airgun. The pinger system that may be used is a Sonardyne Shallow Water Cable Positioning system, comprised of a transceiver and a transducer. The transceiver (pinger) operates at a frequency of 33-55 kHz at a max source level of 188 dB re: 1 μPa at 1 m, and the transponder operates at a frequency of 35-50 kHz at a source level of 185 dB re: 1 μPa at 1 m.

Aircraft:
Bell 204 and Jet Ranger 407 helicopters (or similar aircraft) will be used for support and transport during the proposed project.

Fuel Storage:
Any fuel storage required within the program site will be positioned away from waterways and lakes and located in modern containment enclosures. The capacity of the containment will be 125% of the total volume of the fuel stored in the bermed enclosures. All storage fuel sites will be equipped with additional absorbent material and spill clean-up tools. Any transfer or bunkering of fuel for offshore activities will either occur dock side or comply with U.S. Coast Guard bunkering at sea regulations.

1.3.2.2 "Patch Shooting" Process

The method that Apache will employ to gather the seismic data is called patch shooting. This type of seismic surveying requires the use of multiple vessels for node layout/pickup, recording, and sourcing. Patch shooting can be broken down into four steps per patch, which are then repeated multiple times in different locations until the entire area has been surveyed.

Node Deployment
Operations begin by deploying lines of nodes (the receivers) off the back of the layout vessels onto the seafloor. Inline spacing between nodes on a single line will be 50 m (165 ft); a rope connects one node to another. Node lines will be laid parallel to each other and perpendicular to the shoreline. The node lines will be separated by either 402 or 503 m (1,320 or 1,650 ft). The node vessels will lay the entire patch on the seafloor prior to the air gun activity.

A single patch will consist of 6–8 node lines. Individual vessels are capable of carrying up to 400 nodes. With three node vessels operating simultaneously, a patch can be laid down in a single 24 hour period, weather permitting. Vessels will lay the nodes on the seafloor in periods of low current, or in the case of the intertidal area, during high tide. A sample patch is depicted in Figure 9.

Node Positioning
Once the nodes are in place on the seafloor, the exact position of each node must be documented. There are several techniques used to locate the nodes on the seafloor, depending on the depth of the water. In very shallow water, a node's position is either surveyed by a land surveyor when the tide is low, or the position is accepted based on the position at which the navigator has laid the unit.

In deeper water, there are two recognized techniques. The first is to use a hull or pole mounted pinger to send a signal to transponder which is attached to each node. The transponders are coded and the crew knows which transponder goes with which node prior to the layout. The transponder's response (once pinged) is added together with several other responses to create a suite of ranges and bearings between the pinger boat and the node. Those data are then calculated to precisely position/locate the node. In good conditions, the nodes can be interrogated as they are laid out. It is also common for the nodes to be pinged after they have been laid out. The second technique for deeper water is called Ocean Bottom Receiver Location (OBRL). This technique uses a small volume (10 cui) airgun firing parallel to the node line. The airgun is fired along each side of the line, the data are then gathered from the node and combined with the known position of the airgun to give a precise location of each node. Figure 8 shows a typical pinger or OBRL geometry that is used to position the nodes. Once the patch of nodes is on the seafloor and positioning information has been gathered, the source activity begins.

<u>Seismic Source Shots</u>

The source vessels *M/V Peregrine Falcon* and the *M/V Arctic Wolf* (or similar vessels) will be equipped with compressors and 2,400 cui airgun arrays (16 guns per array). In addition, the *MV Peregrine Falcon* will be equipped with a 440 cui shallow water source (4 guns per array) which it can deploy at high tide in intertidal areas in less than 1.8 m (6 ft) of water.

The two source vessels will traverse the same patch at speeds from 2-4 knots in lines perpendicular to the node lines and parallel to the coast (see Figure 9, red lines are the source lines). Each source line is approximately 13 km (~8 mi) long.

Apache will use two source vessels synchronized in time, using a shooting technique called ping/pong. The ping/pong method will have the first source boat commence the source effort. As the first airgun pop is initiated, the second source boat is sent a command and begins a countdown to pop its guns 12 seconds after the first vessel. The first source boat would then take its second pop 12 seconds after the second vessel has popped, and so forth. The vessels will attempt to manage their speed so that they cover approximately 50 m (165 ft) between pops. The objective is to generate source positions for each of the two arrays close to a 50 m (165 ft) interval along each of the source lines in a patch.

FIGURE 8: Schematic of a Pinger or OBRL vessel interrogating a patch of six node lines.

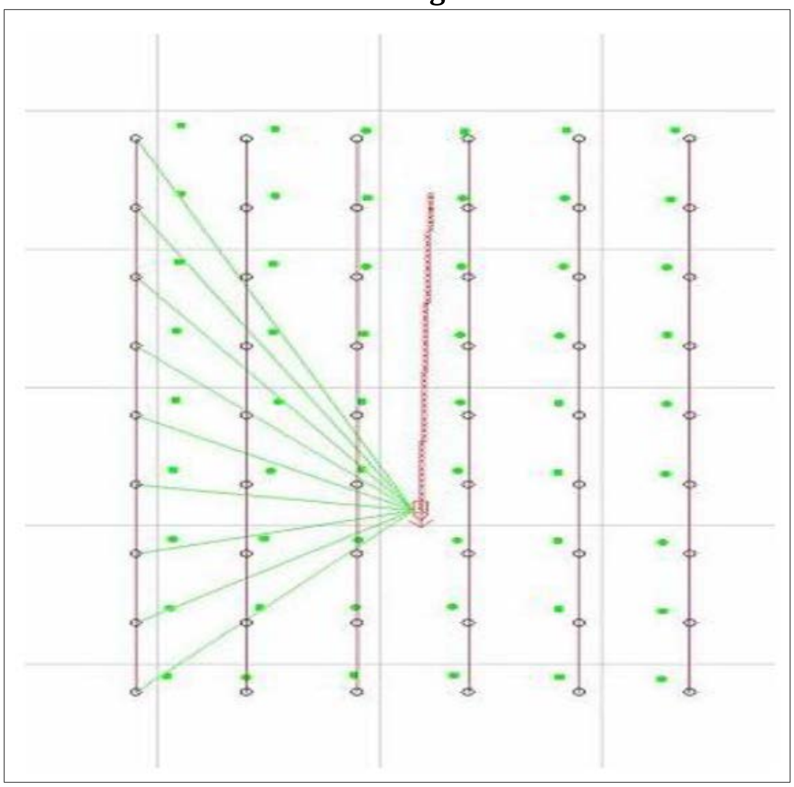


FIGURE 9. Patch shooting. A single patch, six lines of nodes (blue) and 16 source lines (red) depicted by the red and blue lines running perpendicular to each other.

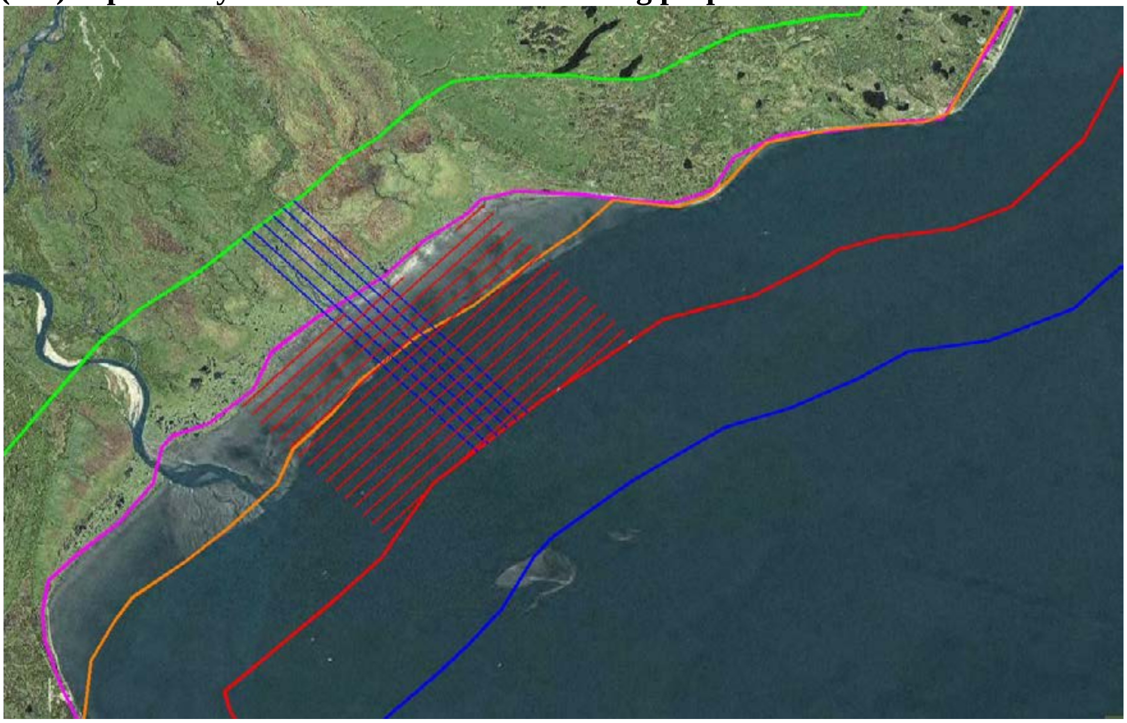
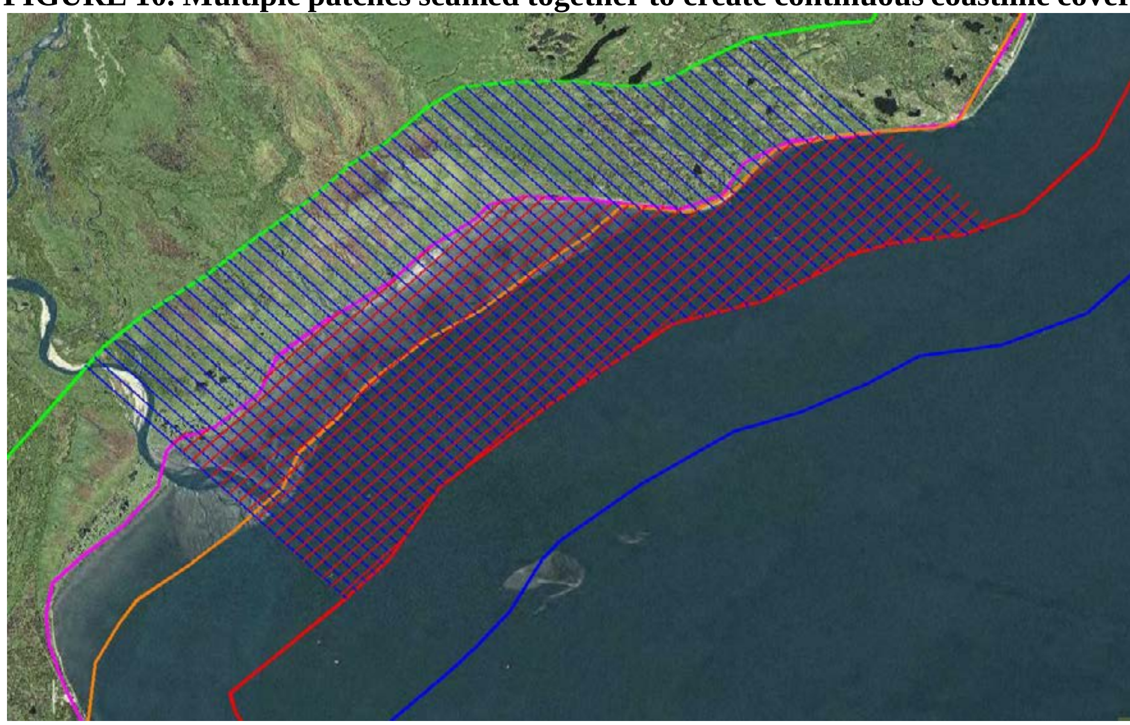


FIGURE 10. Multiple patches seamed together to create continuous coastline coverage.



The source effort will average 10-12 hours per day. A single vessel is capable of acquiring a source line in approximately 1 hour. The number of source lines will vary depending on location and whether it is a transition zone acquisition or an offshore acquisition. Most often, number of lines will vary between 20-28 lines per patch. With two source vessels operating simultaneously, a patch of approximately 3,900 source points can be acquired in a single day assuming a 10-12 hour source effort, but a more typical scenario is that it will take 2-2.5 days.

A typical scenario for acquiring a patch is that the vessels will be staggered and on different lines travelling the same speed and the same direction with only one line separation between the vessels. Each line is 400-500 m (1,320-1,650 ft) apart, therefore, the plan is to configure the vessel effort to remain a distance no further than 2km away to ensure that the safety zone can be monitored for the combined source effort.

Node Retrieval

After the source effort is finished and when the data from the patch of nodes have been acquired, the node vessels pick up the patch and roll it to the next location. The pickup effort will take 3/4 of a day. Vessels will retrieve the nodes during periods of low current, or in the case of the intertidal area, during high tide.

As the patches are acquired, the node lines will be moved either side to side or inline to the next patch's location. Figure 10 depicts multiple side to side patches that are acquired individually but when seamed together at the processing phase, create continues coverage along the coastline.

1.3.3 Mitigation Measures

The applicant has incorporated a number of mitigation measures into its project design in an effort to reduce impacts to marine mammals. Beluga whales, Steller sea lions, and critical habitat elements could be exposed to seismic sound during the proposed Cook Inlet 3D Seismic Program. The following section describes the mitigation measures to reduce the impact of noise from the seismic activity. These mitigation measures include safety radii, visual and passive acoustics monitoring, ramp-up procedures, power- and shut-down procedures, speed or course alterations, and habitat protections. As the applicant obtains other permits and authorizations, such as a MMPA permit, additional mitigation measures may be imposed. The analysis in this biological opinion, however, does not assume the imposition of any such measures. As a result, any additional mitigation measures would likely reduce the potential effects of the action described in this opinion.

1.3.3.1 Acoustic Safety Radii

Given the effects of noise from this project have the furthest reaching impacts, and are used to identify the borders of the action area, the applicant developed a sound propagation model in an effort to determine the 160, 180 and 190 dB re:1 μPa_{RMS} radii. A computer modeling study was performed to predict 24-hour acoustic footprints of airgun arrays for Apache's planned Cook Inlet seismic surveys (see Appendix A of the BA [SAExploration Inc 2011]). As discussed in detail in Appendix A of the BA, received sound levels for determining safety zones were obtained from the results of a field validation test conducted by JASCO for a seismic program in Cook Inlet for ConocoPhillips in 2007 for larger airgun configurations. JASCO carried out acoustic measurements of an 810 cui airgun array as a function of distance from the source for

ConocoPhillips' 2007 Beluga 3D Seismic Shoot survey program, as well as for the 2010 Apache test program.

The study considered seismic survey activities at nearshore locations at the sides of Cook Inlet having sloping bottoms, and in the Inlet's main channel where depth is relatively constant. The nearshore locations were subdivided into three depth intervals of 5-21 m (16-69 ft), 21-38 m (69-125 ft), and 38-54 m (125-177 ft). The channel scenario had a constant water depth of 80 m (262 ft) to correspond approximately with the mean channel depth over the region of Cook Inlet that Apache plans to survey. The nearshore survey depth interval subdivisions are based on the zones that can be surveyed in 24 hour periods based on anticipated nominal survey line length of 16.1 km (10 mi) and survey line spacing of 503 m (1,650 ft).

The largest possible airgun array configuration Apache would use (2,400 cui) was considered by the modeling study to provide conservative estimates of noise footprints; smaller arrays may be used and are anticipated to produce smaller footprints. The predicted distances to the 160, 180, and 190 dB re: 1 μPa_{RMS} sound level thresholds for different depths (nearshore/offshore) using the 2,400 and 10 cui airguns, and the pinger, are presented in Table 2. This information was not modeled for the 440 cui airgun.

Apache's method for positioning the receivers/nodes also involves introduction of sound into the water. JASCO has also calculated the distances to the 190, 180, and 160 dB received sound levels for these sources. The distances for the single 10 cui mitigation gun were estimated using the results of a field validation test performed for a shallow hazard program for Shell's 2007 Beechy Point program in the Alaskan Beaufort Sea (Funk et al. 2008). That site is unusually conducive to sound propagation and consequently the measurements presented in Table 2 are likely conservative for use in the Cook Inlet.

Prior to each year's in-water program, Apache will conduct a sound source verification to determine the 190, 180 and 160 dB monitoring zones for each airgun array size, and will use the results from the actual data instead of the computer model for determining the appropriate safety radii.

More details about the acoustic model are available in Appendix A of the biological assessment.

TABLE 2: Summary of computer modeled distances to NMFS' sound level thresholds for injury (190 dB re: 1 μPa_{RMS} for Steller sea lions; 180 dB re: 1 μPa_{RMS} for belugas) and harassment (160 dB re: 1 μPa_{RMS}). The threshold for the 440 cui airgun array was not modeled. Apache will conduct a sound source verification study prior to any in-water airgun use to determine the actual values of these threshold zones.

Source Type	190 dB	180 dB	160 dB
Pinger	1 m	3 m	25 m
10 cui airgun	10 m	33 m	330 m
440 cui airgun	NA	NA	NA
2,400 cui airgun (nearshore)	0.51k m	1.42 km	6.41 km
2,400 cui airgun (offshore)	1.18 km	0.98 km	4.89 km

1.3.3.2 Visual Monitoring

Vessel-based Surveys

Apache proposes to monitor the safety zones for beluga whales and Steller sea lions before, during, and after the operation of the offshore airguns and pingers. Monitoring will be conducted using qualified protected species observers (PSOs) on three vessels. Two PSOs will be on each of the two source vessels and two PSOs will be on the mitigation/support vessel. The two PSO's will switch every two hours to avoid fatigue and eye strain; therefore, one PSO is monitoring while one is resting. The mitigation/support vessel will be offshore of the program at a distance about 3-5 km from the source vessels.

Vessel-based observers will monitor marine mammals at the seismic program during all daytime airgun operations. During daytime operations, PSOs will watch for marine mammals at the project location during all periods of seismic operations and for a minimum of 30 minutes prior to the planned start of airgun operations, including after an extended shutdown[2]. If no activity has occurred for 15 minutes, the operation will go through the "clearing the zone" and "ramping up" sequence as defined in 1.3.3.4. Use of the mitigation gun though would not be considered a full shutdown. PSOs will also observe opportunistically during daylight hours when no seismic activity is taking place.

When marine mammals are observed within or about to enter designated safety zones, airgun or pinger operations will be immediately powered down or shut down as necessary (see 1.3.3.5). Mitigation measures will be communicated by the PSO on the source vessel to the airgun operators and vessel captain/crew.

Apache proposes to conduct both daytime and nighttime operations. PSOs will not monitor during seismic operations at night. Vessel captains and crew will watch for marine mammals (insofar as practical at night) and will call for the airgun(s) to be shut down if marine mammals are observed in or about to enter the safety radii. After a shut down during night operations, seismic activity will be suspended until the following day when the full safety zone is visible. Nighttime operations can be initiated only if a mitigation gun has been continuously operational (firing every 8-12 seconds much like the normal array configuration) from the time that the PSO monitoring ended. Seismic activity will not ramp up (see below) from an extended shutdown during nighttime operations.

NMFS requires marine mammal monitoring for seismic operations for all daylight hours and prior to ramp up procedures, and NMFS recognizes that not all conditions are conducive for visually observing marine mammals. There will be times during the winter with limited amounts of daylight, overnight operations with no daylight, and times when weather (e.g., fog) limits the visibility during the daylight. If there is a full shut down (i.e., no mitigation gun firing) during poor observing conditions, seismic activity is not allowed to start back up until the entire safety zone area is visible. During extremely rough seas, seismic survey operations are not feasible; therefore, observations would not be required during this time. In recognition of the limitations of visual monitoring, Apache has incorporated other mitigation measures into the project, as described below.

[2] An extended shutdown is defined as when the airgun has been down with no activity for at least 15 minutes.

Aerial Surveys

When operating near river mouths, Apache will conduct aerial overflights prior to the first shot to ensure no beluga whale congregations (five or more whales[3]) are present. Aerial surveys will fly at an altitude of 305 m (1000 ft) when practical and weather conditions permit. In the event of a marine mammal sighting, aircraft will attempt to maintain a radial distance of 457 m (1,500 ft) from the marine mammal(s). Aircraft will avoid approaching marine mammals from head-on, flying over or passing the shadow of the aircraft over the marine mammals. These restrictions will keep underwater sound levels from the aircraft below NMFS harassment thresholds. If observers from either of the vessels or the helicopters see a large congregation of belugas (five or more whales) near the area or approaching the area Apache plans to acquire (or within the 6.41 km action area), Apache will not begin shooting or shoot at all until the animals have left the area. Depending on program timing and location, operational decisions to move from the area or stay put and wait will be varied.

Shore-based Surveys

When possible, Apache will also employ shore-based monitors located on a scaffolding of sufficient height to observe marine mammals. Using big-eye binoculars, the PSO would scan the area prior to, during, and after the airgun operations, and would be in contact with PSOs on the vessels. Shore based monitoring stations would be set up in areas where there are appropriate conditions for monitoring. Conditions that could preclude the use of shore-based stations include: the level of difficulty in accessibility to a site; safety for the observers; the extensiveness of tidal flats which could make it difficult for observers to see far enough into the water to recognize marine mammals; or lack of height on the shore to see far enough into the water. As Apache operates in particular areas, it will consult with NMFS to determine if a shore-based station would be appropriate.

More details about the visual monitoring are available in Appendix B of the biological assessment.

1.3.3.3 Passive Acoustics Monitoring

Apache has committed to using passive acoustic monitoring (PAM) to enhance detection of cetaceans, during both day and nighttime operations. While the specific PAM system has not yet been determined, monitoring will be conducted with boat-based and fixed real-time PAM. The fixed system may include two JASCO Advanced Multichannel Acoustic Recorders (AMAR) systems deployed in surface buoys on anchored moorings. The AMARs will send real-time acoustic data via digital UHF radio-broadcast systems to the PAM operators aboard the *M/V Dreamcatcher*. The PAM operators will use specialized real-time detection software and audio playback to detect marine mammal sounds. If the PAM operators detect marine mammals, Apache will initiate a power- or shut-down of airgun systems to avoid takes.

In ice-free conditions, the PAM systems will be located in both the up-inlet and down-inlet directions, outside of the 180 dB zone but within the 160 dB zone. The boundaries are predicted to occur at between 4.89 km and 6.1 km from the sources, depending upon airgun array

[3] The number five was recommended in the Port of Anchorage IHA and LOA by NMFS PR1 as being a "congregation" for shut down purposes, and was recommended by PR1 for this proposed project as well. This number has been implemented for the Port of Anchorage since 2008 as a "large congregation" of whales.

configuration. Apache proposes to locate the PAM mooring in the middle of the inlet at 1 km inside the exclusion zone boundaries east and west of the survey sites. This approach should be able to detect whistles from animals just entering the exclusion zone and well into the zone. It has the added benefit of providing coverage closer to the airgun sources to identify animals that may have eluded visual observers near the boundary. PAM is still relatively new, particularly within the Cook Inlet; therefore, the design and best location would need to be tested at the beginning of the season with the acoustics contractor.

Based on results of a test program, these buoys are not deployable when ice is present. However, the buoys were operational and detected beluga signals when anchored on the *M/V Dreamcatcher*. Thus, when there is ice, Apache will deploy a hydrophone on a surface buoy tethered directly to the *M/V Dreamcatcher*. This hydrophone can be monitored in real time via direct cables or via WiFi. It is anticipated to have a maximum detection range for belugas of 2-3 km. The predicted distance to the 180 dB levels range is 1.42 km or less. Therefore, this technique should be sufficient to pick up belugas signals in the 160 dB zone and, based on detection distance, to prevent injury by exposure to the 180 dB zone.

More details about the PAM program are available in Appendix B of the biological assessment.

1.3.3.4 Ramp-up Procedure

A “ramp-up” procedure gradually increases airgun volume at a specified rate. NMFS normally requires that the rate of ramp-up be no more than 6 dB per five minute period. This is to allow marine mammals in the area time to leave prior to the full airgun array firing. Ramp-up is used at the start of airgun operations, after a power- or shut-down, and after any period greater than 10 minutes in duration without airgun operations. The ramp-up will begin with the smallest gun in the array, but the safety zone for the full airgun array will be monitored.

If the complete safety radius (180 dB) has not been visible for at least 30 minutes prior to the start of operations, ramp-up will not commence unless the 10 cui mitigation gun has been operating (every 8-12 seconds) during the interruption of seismic survey operations. This means that it will not be permissible to ramp-up either the 2,400 cui or the 440 cui gun source from a complete shut-down in thick fog or at other times when the outer part of the safety zone is not visible if the mitigation gun has not been firing. Ramp-up of the airguns will not be initiated if a marine mammal is sighted within or near the applicable safety radii at any time.

1.3.3.5 Power- and Shut-down Procedures

A power-down procedure involves reducing the number of airguns in use such that the radius of the 180 dB (or 190 dB for pinnipeds) zone is decreased to the extent that marine mammals are not in the safety zone. A power-down procedure can reduce the array down to either 440 or 10 cui (or any other size feasible for the configuration) to reduce the area of potential disturbance to marine mammals that may be approaching an area. This allows the operator to reduce power but keep operating such that a full ramp-up procedure from a shutdown is not required. The minimum power-down would be to the 10 cui airgun (aka, the mitigation gun), which would allow for the smallest monitoring zone. Operation of the mitigation gun allows the safety radii to decrease to 10 m, 33 m, and 330 m for the 190 dB, 180 dB, and 160 dB zones, respectively.

A shut-down occurs when all airgun activity is suspended. The operating airgun(s) and/or pinger will be shut down completely if a marine mammal approaches the applicable injury safety zone (180 or 190 dB). The shut-down procedure will be accomplished within several seconds (of a “one shot” period) of the determination that a marine mammal is either in or about to enter the 180/196 dB safety zone.

In order to avoid any marine mammal takes by injury, Apache proposes to shut down airguns or positioning pingers if a marine mammal approaches the 180 (belugas) or 190 (sea lions) dB injury sound level zone, if a group of more than five belugas is sighted within the 160 dB harassment sound level zone, or if a beluga whale calf is sighted approaching or within the 160 dB harassment zone.

If a marine mammal is detected outside the safety radius (either injury or harassment) but is likely to enter that zone, the airguns may be powered down before the animal is within the safety radius, as an alternative to a complete shutdown. Likewise, if a marine mammal is already within the harassment safety zone (160 dB) when first detected, the airguns will be powered down immediately if this is a reasonable alternative to a complete shutdown. If a marine mammal is already within the 180 dB safety zone when first detected, the airguns will be shut down immediately.

Following a power- or shut-down, airgun activity will not resume until the marine mammal has cleared the 160 dB safety zone. The animal will be considered to have cleared the 160 dB safety zone if it:

- Is visually observed to have left the safety zone, or
- Has not been seen within the zone for 15 minutes[4] in the case of Steller sea lions, or
- Has not been seen within the zone for 30 minutes[4] in the case of beluga whales.

1.3.3.6 Vessel Speed or Course Alterations

If a marine mammal is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, the vessel's speed and/or direct course may, when practical and safe, be altered. These types alterations may also minimize the effect on the seismic program. Speed or course alterations can be used in coordination with a power-down procedure. The marine mammal activities and movements relative to the seismic and support vessels will be closely monitored to ensure that the marine mammal does not approach within the safety radius. If the animal appears likely to enter the safety radius, further mitigative actions will be taken, i.e., either further course alterations, power-down, or shut- down of the airgun(s).

1.3.3.7 Other Protections

The following section describes mitigation measures to reduce the impacts of noise on belugas and their prey species. Permanent modifications to the Cook Inlet beluga whale habitat are not anticipated with the proposed project.

- There shall be no marine seismic activity within 10 miles of the mean higher high water (MHHW) line of the Susitna Delta (the area from Beluga River to Little Susitna River)

[4] For the last 10 years of monitoring around seismic survey operations in the Arctic and previous Cook Inlet projects, NMFS PR1 has implemented these periods of 15 minutes for pinnipeds and 30 minutes for cetaceans. These periods are based on shorter dive times for pinnipeds and longer dive times for cetaceans.

from mid-April to mid-October so as to avoid any effects to belugas and their prey in this critical feeding and potential breeding area. If the results of the SSV study indicate that noise over 160 dB travels further than 6.41 km (~4 mi), Apache will work with NMFS AKR to establish a new minimum setback distance for this area during this time.

- There shall be no airguns used as an energy source within 1.6 km (1 mi) of the mouth of any stream listed by the ADF&G on the Catalogue of Waters Important for the Spawning, Rearing, or Migration of Anadromous Fishes, unless approved by ADF&G on a case-by-case basis.
    - *Although the applicant identifies this as a mitigation measure, NMFS does not consider the 1.6 km (1 mi) setback from river mouths in the analysis of impacts to belugas whales, beluga critical habitat, and sea lions because there is the possibility of exemptions to this setback by ADF&G. NMFS has no authority to determine exemptions allowed or denied by ADF&G, and thus must assume in this opinion that airguns will occur within 1 mile of the mouths of all anadromous streams.*
- Airgun arrays shall be discharged at depths greater than 2 m (~ 6.6 ft) to avoid interference or injury to out-migrating juvenile salmonids.
- The seismic program will be conducted in a relatively small area at one time, bordered on one side by the shoreline.
- The airguns will only be active for approximately 2.5 hours during each of the slack tide periods (~4 slack tides per 24 hour period), thereby confining noise levels to one location for short and intermittent time periods spaced throughout a 24-hour day resulting in effects to a very small proportion of the available habitat in Cook Inlet.
    - *The time period of Apache's proposed seismic sources (intermittently for approximately 10-12 hours per 24 hour period during the source shooting phase) is "shorter" than traditional seismic programs in the Arctic (or in open water conditions) which operate airguns continuously on a 24-hour basis. Thus, unlike typical seismic programs, Apache's program will involve periods when airgun sounds are not being introduced into the environment. Any future reference to "short" time periods in this document means the intermittent use of the airguns by Apache vs. the continuous use of airguns typical of seismic operations in the Arctic.*
- There shall be no seismic operations conducted in marine waters of Cook Inlet during regularly scheduled or emergency commercial fishery openings in the areas that are open. Season openings and fishing days can vary from year to year, usually beginning in late June, and are open for a couple of days a week, ending by late August. It is the permittee's responsibility to contact the ADF&G to obtain the correct opening and closing information for the area, year, and time of the seismic operations.
    - *Although the applicant has included this as a mitigation measure, NMFS does not consider regularly scheduled or emergency commercial fishery openings in our analysis of impact to the species and critical habitat. Instead, NMFS assessed the timings as described in section 1.3.1.*

2. STATUS OF THE SPECIES/CRITICAL HABITAT

NMFS has determined the Cook Inlet beluga whale and the Steller sea lion to be the only threatened or endangered species under NMFS's jurisdiction likely to occur in the action area. The Cook Inlet Distinct Population Segment (DPS) of beluga whale was listed as endangered under the ESA in October 2008 (73 FR 62919), and critical habitat was designated April 2011 (76 FR 20180). The Steller sea lion was listed as threatened under the ESA in 1990, but in May 1997 the species was split into two DPSs and the status of the western stock of Steller sea lions was changed to endangered, and the status of the eastern DPS was left unchanged (62 FR 24345). While critical habitat has been designated for the Steller sea lions, none exists within the action area. Thus, this opinion considers the potential effects of the above described actions only on the Cook Inlet beluga whales and their critical habitat, and on the western DPS of Steller Seal lions. Cook Inlet beluga whales and Steller sea lions are also designated as depleted and strategic stocks under the Marine Mammal Protection Act (MMPA).

2.1 Cook Inlet Beluga Whales

A detailed description of the Cook Inlet beluga whales' biology, habitat and extinction risk factors may be found in the Proposed Listing Rule (72 FR 19854, April 20, 2007), the 2008 Status Review and Status Review Supplement (Hobbs et al. 2008; Hobbs and Shelden 2008), and the Conservation Plan (NMFS 2008a).

2.1.1 Description and Taxonomy

The beluga whale is a small, toothed whale in the family Monodontidae, a family it shares with only the narwhal. Beluga whales are also known as "white whales" because of the adults' white coloration. Beluga calves are born dark to brownish gray and lighten to white or yellow-white with age. Adult Cook Inlet beluga whales average between 12 and 14 ft in length, although Native hunters have reported some may reach as much as 20 ft (Huntington 2000). Adult beluga males may weigh up to 3,300 pounds while females are typically smaller, weighing up to 3,000 pounds (Nowak 2003). The cervical vertebrae in beluga whales are not fused, allowing them to turn and nod their heads. Instead of a dorsal fin, beluga whales have a tough dorsal ridge. They also have a relatively small head, fluke, and flippers.

2.1.2 Range

To identify Cook Inlet beluga habitat use, particularly in winter, NMFS researchers placed satellite positioning tags on 18 beluga whales between 1999 and 2002. Those tagged whales remained in Cook Inlet, indicating that belugas occupy Cook Inlet year round and do not display the seasonal migrations that northern beluga populations display (Hobbs et al. 2005). Given the best scientific information available, NMFS determined the Cook Inlet beluga whales comprised a DPS which is confined to waters of Cook Inlet, and does not include beluga whales found in Yakutat or other Gulf of Alaska waters beyond Cook Inlet. Thus, the range of Cook Inlet beluga whale DPS has been defined as the waters of Cook Inlet north of a line from Cape Douglas to Cape Elizabeth (72 FR 19854, April 20, 2007).

During the 1970s, the summer distribution of Cook Inlet beluga whales included the upper, mid, and parts of lower Cook Inlet, in both coastal and offshore waters (Harrison and Hall 1978; Murray and Fay 1979). An August 1979 survey observed beluga whales throughout Cook Inlet (Calkins 1989). Calkins (1983) indicated that belugas were "seen throughout the year in the central and lower Inlet, with heaviest use occurring in the central area". Others reported seeing hundreds of belugas continuously throughout Cook Inlet in the 1970s and 1980s, including areas where few are now found (Pers. Comm. S. Foster 1995, via B. Mahoney, NMFS). Local knowledge and other historical evidence show that prior to the 1990s belugas were regularly seen in lower Cook Inlet waters, both nearshore and offshore (Huntington 2000; Rugh et al. 2000). Summer opportunistic sightings of belugas as recently as 1996 in Kamishak Bay in the lower Inlet were made during intermittent herring surveys flown between late April and early June from 1979-2002 (Pers. Comm. T. Otis, ADFG 2008 via J. Wilder, NMFS). This information indicates that these areas were important habitats when the beluga population was larger. These observations provide evidence that belugas (lone animals up to 60 whales) formerly frequented Iniskin Bay, Iliamna Bay, and Kamishak Bay in the lower Inlet in spring and summer.

Dedicated marine mammal surveys of the lower Inlet by Speckman and Piatt (2000) in late July through August 1995-1999, documented no beluga sightings south of Kalgin Island in any of the five years. Annual aerial abundance surveys by NMFS have shown that beluga whales are no longer regularly observed in the lower Inlet in summer (last NMFS observation was in 2001; Rugh et al. 2005, 2010). TEK of Alaska Natives and systematic aerial survey data document a contraction of the summer range of Cook Inlet beluga whales (Huntington 2000; Rugh et al. 2010). While beluga whales were once abundant and frequently sighted in the mid and lower Inlet during summer, they are now primarily concentrated in the upper Inlet during that time period.

It is unknown if the current contracted distribution is a result of changing habitat (Moore et al. 2000), predator avoidance (Shelden et al. 2003), or a shift of a reduced population into preferred habitat areas that offer the most abundant prey, the most favorable feeding topography, and the best calving areas (Rugh et al. 2010; Goetz et al. 2007). Regardless, the result is a greater proximity to Anchorage and a smaller range. While the overall range of the population has contracted within Cook Inlet as the population has declined, whales continue to inhabit predictable locations and in patterns clearly related to time of year and the appearance of seasonally important prey resources. The contraction of the range of this population northward into the upper Inlet makes it far more vulnerable to catastrophic events with the potential to kill a significant fraction of the population. If and when the Cook Inlet beluga population begins to increase, a reoccupation of mid and lower Inlet habitats during the summer months may be the first indication of recovery.

2.1.3 Distribution and Movements

Beluga whales generally occur in shallow, coastal waters, often in water barely deep enough to cover their bodies (Ridgway and Harrison 1981). Little information is available on the beluga whale distribution in Cook Inlet prior to 1970; however, in the 1970s and 1980s, beluga sightings occurred across much of lower and upper Cook Inlet (Calkins 1984).

Belugas remain in Cook Inlet year-round, as evidenced by satellite tagging studies (Hobbs et al. 2005), monthly aerial surveys conducted between June 2001 and June 2002 (Rugh et al. 2004), systematic aerial surveys (Rugh et al. 2000, 2005a, 2005b, 2006, 2007; Shelden et al. 2008, 2009, 2010, 2011), boat and land based observations (Speckman and Piatt 2000; McGuire et al. 2008, 2009, 2011), TEK of Alaskan Natives (Huntington 2000), and opportunistic reports (Rugh et al. 2000; Vate-Brattstrom et al. 2010; NMFS unpubl. data).

Although beluga whales remain year-round in Cook Inlet, they demonstrate seasonal movement within the Inlet; they concentrate in upper Cook Inlet at rivers and bays in summer and fall, but tend to disperse offshore and move to mid Inlet in winter (Hobbs et al. 2005). There is also obvious and repeated use of certain habitats by Cook Inlet beluga whales. Belugas have consistently been documented in Knik Arm, Turnagain Arm, Chickaloon Bay and the Susitna Delta (Beluga River to Little Susitna River) areas of the upper Inlet (Rugh et al. 2005a; NMFS 2008a; McGuire et al. 2008, 2009, 2011; NMFS unpubl. data).

The timing and location of eulachon and salmon runs have a strong influence on belugas' spring and summer movements. Beluga whales are regularly sighted in the upper Inlet beginning in late April or early May, coinciding with eulachon runs in the Susitna River and Twenty Mile River in Turnagain Arm. In the summer, whales tend to concentrate near the Susitna Delta feeding on the various salmon runs, and are generally first observed in Knik Arm in May.

In addition to frequenting the Susitna Delta and corresponding rivers and flats throughout the summer, belugas may remain in the upper Inlet into the fall and appear to use the smaller streams along the west side of the Inlet, following first the eulachon and king salmon runs and later in the summer the Coho salmon runs. Intensive use of Knik Arm by belugas in the fall also coincides with the Coho run. During the fall the belugas also use Chickaloon Bay and areas of the west side near Tyonek. Data from 14 satellite tagged beluga whales and TEK support beluga use of streams on the west side of Cook Inlet from the Susitna Delta south to Chinitna Bay during late summer and fall (Huntington 2000; Hobbs et al. 2005). As recently as September 2007, 25-30 belugas were sighted in Chinitna Bay by Kachemak Bay Research Reserve staff (Pers. Comm. S. Baird, KBRR, 2008 via M. Migura, NMFS) suggesting that some belugas still visit the lower inlet in the fall.

Prior to satellite tagging data in 2000-2002, the winter distribution of this stock was poorly understood, in part because winter aerial surveys were limited in detecting beluga whales in the ice flows of upper Cook Inlet (Rugh et al. 2004). Eight dedicated aerial surveys in Cook Inlet between February 12 and March 14, 1997 (Hansen and Hubbard 1999) resulted in only a few beluga whale sightings. Conversely, satellite data showed tagged whales used Knik and Turnagain Arms for much of the tracked time (August-March), venturing as far south as Redoubt Bay (October), Kalgin Island (January), and East Foreland (December-January) (Hobbs et al. 2005).

The available information indicates that Cook Inlet belugas move throughout much of the Inlet in the winter months. They concentrate in deeper waters in mid Inlet past Kalgin Island, with occasional forays into the upper Inlet, including the upper ends of Knik and Turnagain Arms. Although the beluga whales move into the mid to lower Inlet during the winter, ice cover does not appear to limit their movements. Their winter distribution does not appear to be associated with river mouths, as it is during the warmer months. The spatial dispersal and diversity of winter prey likely influences the wider beluga winter range throughout the mid Inlet.

2.1.4 Biology and Behavior

Beluga whales are extremely social animals that typically interact together in close, dense groups. Groups of 10 to more than 100 whales have been observed in Cook Inlet. It is unknown if these represent distinct social divisions but Reeves et al. (2002) mentioned that beluga groups are often of the same sex and age class. Traditional knowledge also suggests that beluga whales maintain family groups (Huntington 2000).

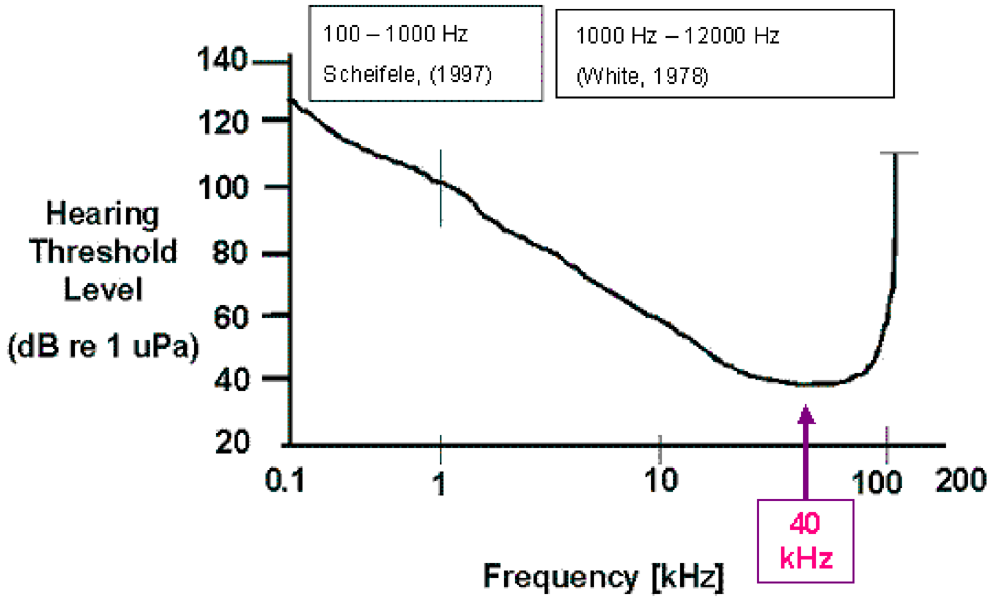
Sexual maturity can vary from 4 to 10 years for females and 8 to 15 years for males. While mating is assumed to occur sometime between late winter and early spring, there is little information available on the beluga whale mating behavior. Beluga whales typically give birth to a single calf every two to three years, after a gestation period of approximately 14 months. Young beluga whales are nursed for two years and may continue to associate with their mothers for a considerable time thereafter (Reeves et al. 2002). Most 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 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 (Katona et al. 1983; Calkins 1989). Surveys conducted from 2005 to 2007 in the upper Inlet by LGL, Inc., documented neither localized calving areas nor a definitive calving season, since calves were encountered in all surveyed locations and months (April-October) (McGuire et al. 2008). The warmer, fresher coastal waters may also be important areas for beluga whales' seasonal summer molt.

It is believed that beluga whales may live more than 30 years, although recent discoveries pertaining to ageing techniques may lead scientists to effectively double these estimates. Beluga whales normally swim about 2 to 6 miles per hour, but when pursued, can attain a speed of 14 miles per hour. While they usually surface to breathe every 30 to 40 seconds, radio-tracking studies show that they also routinely dive for periods of 9.3 to 13.7 minutes and to depths of 66 to 1,140 ft, presumably for feeding (Nowak 2003). However, data from belugas tagged in Cook Inlet indicated that over 50% of the dives were two meters or less in depth and lasted two minutes or less, however, there were deeper (5-50 m) and longer (>21 minutes) dives recorded (Goetz et al., *in prep*). Their vision is reported to be well developed; they appear to have acute vision both in and out of water and, as their retinas contain both rod and cone cells, are believed to see in color (Herman 1980).

Beluga whales are known to be among the most adept users of sound of all marine mammals and use sound rather than sight for many important functions. 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, then to the brain. A study conducted with a captive beluga showed that the most efficient hearing pathway is from the rostrum tip, and may indicate that there are acoustic fat channels which begin at the beluga rostrum tip that effectively guide sound to the inner ear (Mooney et al. 2008). To date, belugas are the only odontocetes known to hear from the rostrum tip. This feature probably gives belugas higher directional hearing characteristics than other odontocetes. It is possible that the unfused vertebrae, and thus the highly movable head, of belugas have allowed for adaptations of highly directional hearing.

These whales hear over a large range of frequencies, from about 40 Hertz (Hz) to approximately 150 kiloHertz (kHz) (Au 1993), although their hearing is most acute at middle frequencies between about 10 kHz and 75 kHz (Fay 1988). Figure 11, adapted from Anderson et al. 2007, shows the estimated hearing threshold (the level when the beluga starts to hear sound) curve for a

FIGURE 11. Hearing Range and Threshold for the Beluga Whale (from Anderson et al. 2007)



beluga whale. At lower frequencies around 40 Hz, the whale's hearing threshold is about 140 dB re: 1 µPa. In the range of best hearing, at about 40 kHz, the threshold is 40 dB re: 1 µPa. Beluga whales conduct communication and echolocation at relatively high frequencies where they have a lower hearing threshold and greater hearing sensitivity. Studies have shown beluga whales to emit communication calls with an average frequency range from about 2.0 to 5.9 kHz. Echolocation is generally conducted at frequencies greater than 40 kHz. Studies have shown that beluga whales generally produce signals with peak frequencies of 40 to 120 kHz during echolocation, and the intensity of the signal can change with location and background noise levels (Au et al. 1985). Complementing their excellent hearing, beluga whales have one of the most diverse vocal repertoires of all marine mammals. They are capable of making a variety of vocalizations (e.g., whistles, buzzes, groans, roars, trills, peeps, etc.) which lead to their nickname as sea canaries.

2.1.5 Feeding Behavior and Habitat

Both scientific research and Alaska Native TEK say beluga whales may move hundreds of miles to exploit changes in prey distribution (i.e., beluga whales follow their prey). Cook Inlet beluga whales are opportunistic feeders and feed on a wide variety of prey species, focusing on specific species when they are seasonally abundant.

Spring prey of Cook Inlet beluga whales includes eulachon and gadids (e.g., saffron cod, Pacific cod, and walleye pollock). Eulachon first enter the upper Inlet in April, with two major spawning migrations occurring 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). Gadids prefer shallow coastal waters and are found near and in rivers within the zone of tidal influence (Morrow 1980; Cohen et al. 1990).

In the summer, as eulachon runs begin to diminish, beluga whales rely heavily on salmon as a primary prey resource. Beluga whale hunters in Cook Inlet reported one whale having 19 adult Chinook salmon in its stomach (Huntington 2000). In July 2005, NMFS (unpubl. data) observed a 4.3 m (14 ft 3 in) male with 12 Coho salmon, totaling 27.9 kg (61.5 lbs), in its stomach.

In the fall, as anadromous fish runs begin to decline, beluga whales again return to consume the gadid fish species found in nearshore bays and estuaries. This includes cod species observed in the spring diet as well as other bottom-dwellers, such as Pacific staghorn sculpin, and flatfishes, such as starry flounder and yellowfin sole. This change of diet in the fall is consistent with other beluga populations known to feed on a wide variety of food.

In the winter, Cook Inlet beluga whales concentrate in deeper waters in mid Inlet past Kalgin Island and make deep feeding dives, likely to feed on such prey species as flatfish, cod, sculpin, and pollock. The narrowing of the Inlet in this area and the presence of Kalgin Island just south of the Forelands may result in upwelling and eddies which concentrate nutrients and may provide a still-water refuge area for several migrating anadromous fishes (Calkins 1983, 1989). The Kalgin Island area may also be rich in biological productivity; for instance, crustaceans are known to occur south of the island (Calkins 1983). The Kalgin Island area may serve as a late-winter staging area for eulachon prior to migration to their natal streams in upper Cook Inlet. If these fish and crustaceans are generally present in this area during late winter, they may be an important food source for beluga whales in the winter, and the Kalgin Island area may be an important winter feeding habitat for belugas.

Based on the movements and feeding distribution of beluga whales, it is apparent that beluga movements are not simply explained by when and where the most fish are. Beluga whales do not always feed at the streams with the largest runs of fish; for example, beluga whales today are seen less frequently at the mouth of the Kenai River despite large salmon returns to the river. Dense concentrations of prey appear essential to beluga whale feeding success, but the relationship between beluga whale concentrations and salmon concentrations is not fully known. In upper Cook Inlet, beluga whales concentrate offshore from several important salmon streams and appear to use a feeding strategy which takes advantage of the bathymetry in the area. The channels formed by the river mouths and the shallow waters may act as a funnel for salmon as they move past waiting beluga whales. Therefore, bathymetry and fish density may be more important than sheer numbers of fish in their feeding success. If true, this would imply Cook Inlet beluga whales do not simply go where the fish are, but are partially dependent on particular feeding habitats with appropriate topography.

Beluga whales exhibit high site fidelity and may persist in an area with fluctuating fish runs or may tolerate certain levels of disturbance from boats or other anthropogenic activities in order to feed. There is repeated use of several areas of the upper Inlet for summer and fall feeding by beluga whales. The primary “hotspots” for beluga feeding areas include the Big and Little Susitna Rivers, Eagle Bay to Eklutna River, Ivan Slough, Theodore River, Lewis River, and Chickaloon River and Bay. Access to these areas and to corridors between these areas is important.

2.1.6 Breeding and Calving Habitat

Very little is known about beluga whale breeding behavior, and it is difficult to identify beluga breeding habitat with any certainty. The known presence of pregnant females in late March, April, June, and July (Mahoney and Shelden 2000; Vos and Shelden 2005, NMFS unpubl. data) suggests breeding may occur in late spring into early summer. Gestation is 14-14.5 months with a single calf born in the late spring or early summer.

The shallow waters of the upper Inlet may play an important role in reproduction. Since newborn beluga whales do not have the thick blubber layer of adults, they benefit from the warmer water temperatures in the shallow tidal flat areas where fresh water empties into the Inlet, and hence it is likely these regions are used as nursery areas (Katona et al. 1983; Calkins 1989). 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 summer (Huntington 2000).

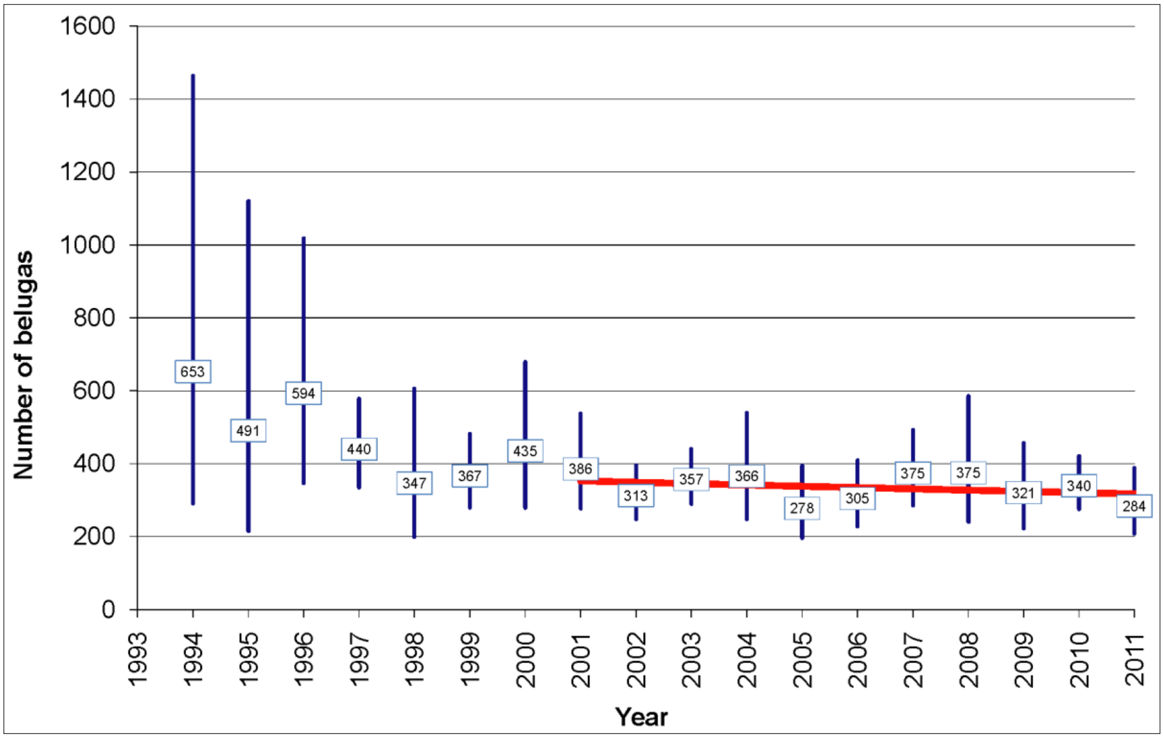
Knik Arm is used extensively in the summer and fall by cow/calf pairs. Surveys by LGL (Funk et al. 2005; McGuire et al. 2011) noted a relatively high representation of calves in the uppermost part of Knik Arm. The mouth of Knik Arm has been reported to be transited in the summer and fall by cow/calf pairs (Cornick and Kendall 2008), presumably moving into the upper reaches of Knik Arm. McGuire et al. (2008) photographically identified 37 distinct beluga whales with calves in the upper Inlet during 2005-2007. Since calves were seen in all areas of their study (Susitna Delta, Knik Arm, Chickaloon Bay/Southeast Fire Island, and Turnagain Arm), they were unable to determine distinct calving areas (McGuire et al. 2008, 2011). However, when corrected for effort, Knik Arm had the largest number of calf sightings within the areas observed.

2.1.7 Population Abundance and Trends

The Cook Inlet beluga whale population has probably always numbered fewer than several thousand animals, but in recent years has declined significantly from its historical abundance (NMFS 2008a). It is difficult, however, to accurately determine the magnitude of decline due to the paucity of information on the beluga whale population that existed in Cook Inlet prior to development of the region, or prior to modern subsistence whaling by Alaska Natives. With no reliable abundance surveys conducted prior to the 1990s, scientists must estimate historical abundance based on what little data exist. Relying on a survey conducted in portions of Cook Inlet during 1979, Calkins (1989) estimated a population of 1,293 beluga whales. This overall abundance estimate provided by Calkins represents the best available information on historical abundance. For management purposes, NMFS currently considers 1,300 beluga whales as a reasonable estimate of historical abundance.

Comprehensive, systematic aerial surveys of beluga whales in Cook Inlet began in 1994 with the goal of determining the overall abundance and population trend for the species (Figure 12). A decline in abundance of around 47 percent, from an estimate of 653 whales to 347 whales, was documented between 1994 and 1998 (Hobbs et al. 2000). After measures were established in 1999 to regulate subsistence harvests, NMFS expected that the population would grow at an annual rate between 2 and 6 percent. Abundance estimates from aerial surveys (1999 – 2008) indicate this level of growth did not occur. This lack of growth led to the ESA listing in 2008. Looking at the population estimates for the past 10 years (2001 – 2011), NMFS has documented

FIGURE 12. Abundance estimates for Cook Inlet beluga whales with 95 percent confidence intervals (vertical bars). Over the past 10 years, (2001-2011), the rate of decline (red trend line) has been 1.1 percent per year.



a population decline of 1.1 percent per year. The 2011 population abundance estimate was 284 whales.

While a precise comprehensive statistical assessment of population trend since 1979 is not possible given differences in survey methods and analytical techniques prior to 1994, a straight comparison of the 1979 estimate (1,293 belugas) with the 2011 estimate (284 belugas) would indicate a roughly 78 percent decline over 33 years, but with unspecified confidence. NMFS has committed to conducting systematic abundance surveys which monitor population status and growth over time, such that a significant change in abundance and trend would be detected over a 10 year time period.

2.1.8 Population Viability Analysis and Extinction Risk Assessment

In October 2008, the NMML published the 2008 Supplemental Status Review and Extinction Risk Assessment of Cook Inlet Beluga Whales (*Delphinapterus leucas*) (Supplemental Review; Hobbs and Shelden 2008). The Supplemental Review included an update of a November 2006 (Hobbs et al. 2006) and April 2008 (Hobbs et al. 2008) Status Reviews and responded to issues raised by a panel of independent experts regarding the earlier Status Reviews. The conclusions of the Supplemental Review were:

- The contraction of the range of this population northward and westward into the upper inlet makes it far more vulnerable to catastrophic events which have the potential to kill a significant fraction of the population.
- The population is not growing at 2% to 6% per year as had been anticipated since the cessation of unregulated hunting.
- The population is discrete and unique with respect to the species, and if it should fail to survive, it is highly unlikely that Cook Inlet would be repopulated with belugas. This would result in a permanent loss of a significant portion of their range.
- The importance of seasonal anadromous fish runs in Cook Inlet to belugas is evident. The bulk of their annual nutrition is acquired during the summer months.
- Belugas in Cook Inlet are unique in Alaska given their summer habitat is in close proximity to the largest urban area in the state.
- While the impact of disease and parasitism on this population has not been quantified, this population is at greater risk because of its small size and limited range such that a novel disease would spread easily through this population.
- The PVA shows a 26% probability of extinction in 100 years and 70% probability of extinction in 300 years (for the model assuming one predation mortality per year and a 5% annual probability of an unusual mortality event killing 20% of the population). It is likely that the Cook Inlet beluga population will continue to decline or go extinct over the next 300 years unless factors determining its growth and survival are altered in its favor.

The Supplemental Review also reaffirmed NMFS's earlier position that the Cook Inlet beluga whale stock is discrete and significant in terms of the ESA, and constitutes a species under the definitions of the ESA. The Review included a PVA model that was the most-detailed of any such models for Cook Inlet beluga whales, being age and gender based, and focused on the behavior of a declining population at sizes less than 500 whales. Small population effects, demographic stochasticity, Allee effects, predation mortality, and unusual mortality events were modeled explicitly. The PVA employed 20 sub-models with 11 various assumptions: different predation levels, unusual mortality events, Allee effects, habitat loss, counting/survey errors, and other factors. For each sub-model, 100,000 trials were run to provide a statistical distribution of the stochastic and deterministic variables of the model in order to allow for analysis. The PVA results were then used in the Extinction Risk Analysis (ERA) to estimate the probabilities for the stock to become extirpated within certain time frames. The ERA found that, for the sub-model judged to be the best approximation for the current population, the extinction probability was 26% within 100 years.

An important outcome of the ERA was that the extinction probabilities increased dramatically when predation was set for more than one beluga whale mortality per year. We do not have adequate data to accurately evaluate the removal levels from this stock due to killer whale predation or other factors, but we believe annual mortalities could very easily exceed this threshold. This finding has particular significance in assessing the cumulative risks to the Cook Inlet beluga whales. The Environmental Baseline section has discussions on factors (stressors) known to be, or thought to be, impacting this population within the action area. The individual and cumulative contribution of these stressors must be carefully considered in assessing the consequences of this proposed action.

2.2 Cook Inlet Beluga Whale Critical Habitat Designation

While it is difficult to quantify the importance of various habitats in Cook Inlet for the health, survival, and recovery of the beluga whale, certain areas are particularly important. Subsequent to the ESA listing and pursuant to ESA section 4(b)(2) NMFS AKR designated critical habitat for the Cook Inlet beluga whales in April 2011 (76 FR 20180; Figure 13).

2.2.1 Critical Habitat Boundaries

The Cook Inlet beluga whale critical habitat includes two geographic areas of marine habitat in Cook Inlet comprising 7,809 km^2 (3,013 mi^2). These areas are bounded on the upland by Mean High Water (MHW) datum. Critical habitat does not extend into the tidally-influenced channels of tributary waters of Cook Inlet, with the exceptions noted in the descriptions of each critical habitat area.

Area 1 comprises 1,918 km^2 of marine habitat in Cook Inlet and encompasses all marine waters of Cook Inlet north of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) connecting to Point Possession (61°02.1′ N., 150°24.3′ W.), including waters of the Susitna River south of 61°20.0′ N., the Little Susitna River south of 61°18.0′ N., and the Chickaloon River north of 60°53.0′ N.

Area 2 comprises 5,891 km^2 of Cook Inlet and encompasses all marine waters of Cook Inlet south of a line from the mouth of Threemile Creek (61°08.5′ N., 151°04.4′ W.) to Point Possession (61°02.1′ N., 150°24.3′ W.) and north of 60°15.0′N., including waters within two nautical miles seaward of MHW along the western shoreline of Cook Inlet between 60°15.0′ N. and the mouth of the Douglas River (59°04.0′ N., 153°46.0′ W.). Area 2 also includes all waters of Kachemak Bay east of 151°40.0′ W. and waters of the Kenai River below the Warren Ames bridge at Kenai, Alaska.

Consistent with the proposed rule (74 FR 63080, December 2, 2009), portions of military lands were determined to be ineligible for designation as critical habitat. Section 4(a)(3)(B)(i) of the ESA allows for an exemption from critical habitat of military lands if the Integrated Natural Resources Management Plan (INRMP) provides benefit for the listed species. NMFS concluded that the Army's INRMP provides benefit for the Cook Inlet beluga whale and exempted the Eagle River Flats area from the critical habitat designation. This also included the lower reaches of Eagle River. NMFS also exempted the Port of Anchorage from the final rule in consideration of national security interests.

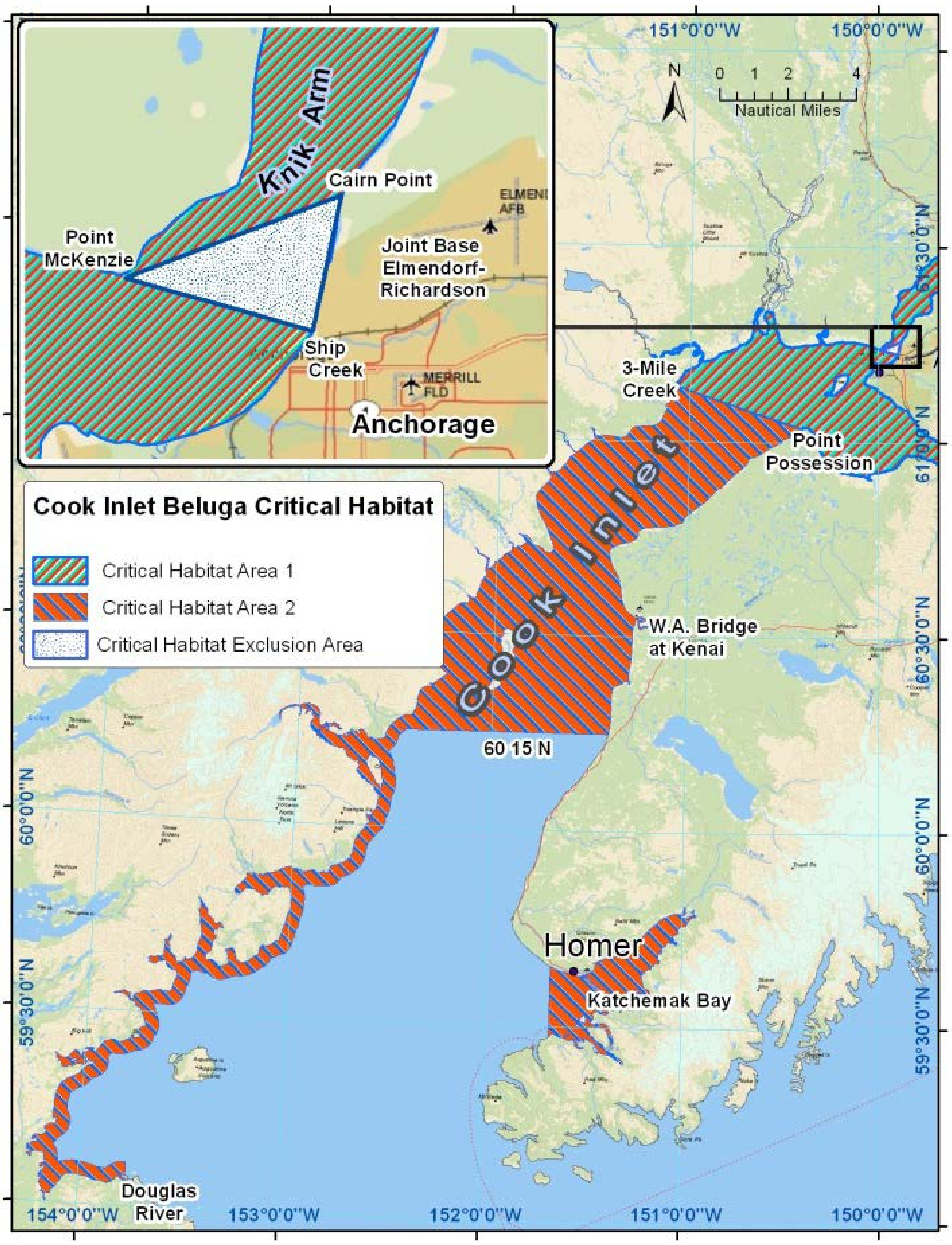
2.2.2 Primary Constituent Elements

The final rule also included designation of five environmental attributes that are deemed essential to the conservation of the CI beluga whale. These attributes, or primary constituent elements (PCEs), are:

- Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within five miles of high and medium flow anadromous fish streams.
- Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.

- Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.
- Unrestricted passage within or between the critical habitat areas.
- Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

FIGURE 13. Critical habitat for the Cook Inlet beluga whale.



2.2.2.1 PCE 1: Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within 5 miles of high and medium flow anadromous fish streams.

Intertidal and subtidal waters of Cook Inlet with depths less than 30 feet (mean lower low water, MLLW) (9.1 m) and within 5 miles (8 km) of high and medium flow anadromous fish streams support important beluga feeding habitat because of their shallow depths and bottom structure which act to concentrate prey and aid in feeding efficiency by belugas. The physical attributes of this PCE could be modified or lost through filling, dredging, channel re-alignment, dikes, and other structures. Approximately 1,940 km^2 (750 mi^2) of intertidal and sub tidal waters and habitat within 8 km (5 mi) of anadromous fish streams exist in the action area (Figure 14). Currently, the majority of coastal development in Cook Inlet exists near Anchorage, as a result, the intertidal, subtidal and areas within 8 km (5 mi) of anadromous fish streams within the action area are generally intact and undisturbed.

The intertidal or transitional zone described for the proposed Cook Inlet 3D Seismic Program differs from that described by NMFS for PCE 1. Onshore areas are considered the areas above high water line, offshore areas are considered the areas beyond the low water line, and the intertidal areas are between the onshore and offshore zones. The intertidal area extends 3 mi off the mudflats in the action area. The zones were delineated in this manner in order to minimize the amount of seismic activity within the intertidal area by extending the receivers 3 mi in either direction. This also allow for merging of the seismic images between the onshore and offshore areas.

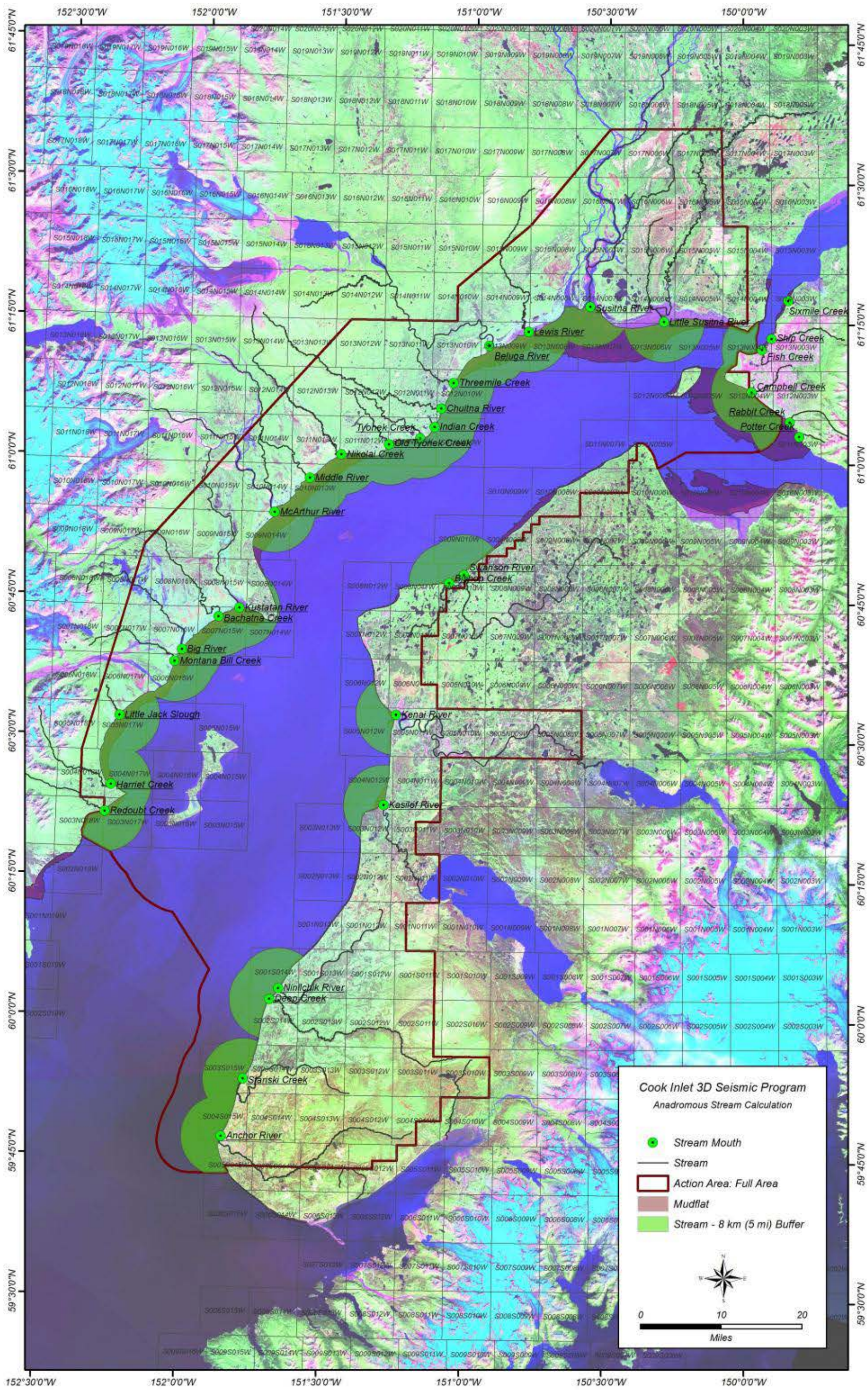
2.2.2.2 PCE 2: Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.

Four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole constitute the most important food sources for Cook Inlet beluga whales as identified through research and as held by the traditional wisdom and knowledge of Alaska Natives who have participated in the subsistence hunting of these whales. Stomach analysis of Cook Inlet beluga whales has found these species constitute the majority of consumed prey by weight during summer/ice free periods. All of these species are targeted by commercial fisheries, and some are prized by sport fishermen. All the prey species listed under PCE 2 exist in the proposed action area.

The ADF&G has management responsibility for most of the commercial fisheries in Cook Inlet, with the exception of a few federally managed fisheries in the lower Inlet, and sets escapement and harvest limits. The North Pacific Fisheries Management Council (NPFMC) provides North Pacific Ground Fish Stock Assessment and Fishery Evaluation (SAFE) Reports on Pacific cod, walleye pollock, saffron cod and yellowfin sole by region (i.e., Bering Sea, Aleutian Islands and Gulf of Alaska [GOA]). Although the SAFE Reports discuss a much larger area than the action area (GOA), the stock assessments on these species from the SAFE Reports are discussed below. The SAFE Reports compare the previous year’s assessment to the current year’s assessment and these reports project the future status of these species on a one to two year basis (NPFMC 2010). Additionally, the ADF&G opportunistically samples and documents their findings on these species while they are conducting surveys on other fish species in Cook Inlet[5].

[5] Richard Gustafson (Fisheries Biologist, ADF&G) personal communication with Lindsey Kendall, May 25, 2011.

FIGURE 14: Occurrence of PCE 1 (intertidal and sub tidal waters of Cook Inlet with depths less than 9.1 m [30 ft; MLLW] and within 8 km [5 mi] of high and medium flow of anadromous fish streams) in the action area. The area of PCE 1 at each anadromous stream is in green.



Pacific Salmon: The four Pacific salmon species (Chinook, sockeye, coho, chum) listed under PCE 2 all exist in the action area. The ADF&G reviews annual escapement goals and makes management recommendations to the Alaska Board of Fisheries (BOF) on a 3-year cycle that corresponds to the BOF schedule for evaluating regulatory proposals (Fair et al. 2010). Escapement goals are only based on anadromous streams surveyed by ADF&G (e.g., foot and aerial surveys, mark-recapture, weir counts, hydroacoustics or sonar) and do not reflect other streams in Cook Inlet where salmon may return (Fair et al. 2010). If there are stocks of concern, ADF&G would identify these stocks and list the criteria in their report to the BOF. According to the ADF&G there are no Pacific salmon stocks listed as a concern (Fair et al. 2010) and the stocks are generally in good condition in the action area[6].

NMFS recognizes and acknowledges that the current management structure of the salmon fisheries has generally provided for the sustained harvest and productivity of salmon in Cook Inlet. However, it should also be noted that there is uncertainty inherent in any management system. The size of several king (Chinook) salmon returns in 2009 and 2010 was substantially below average, resulting in closures of sport and commercial fisheries in the Inlet. The Deshka River king salmon runs were extremely low in 2008 and 2009, resulting in closures. The Susitna River sockeye salmon runs failed to meet minimum escapement goals for 5 of 7 years between 2001 and 2007. Sockeye commercial harvests for the Northern District of Cook Inlet fell from an average of 180,000 fish in the 1980s to an average of 26,000 since 2002. The ADF&G has cited management decisions leading to overescapement as a contributing factor. However, at this time NMFS has no information to suggest prey availability is or has been a factor in the decline or is in need of improvement to promote the recovery of the Cook Inlet beluga whale.

Eulachon: Eulachon return to spawning areas in Cook Inlet from mid-May to mid-June. Particularly large runs of eulachon are found in the Susitna, Kenai and Twentymile Rivers (Shields 2010), which are outside of the action area. Commercial fisheries are open from 1 May-30 June from the Chuitna to the Little Susitna River. A total of 100 tons may be harvested annually with the use of hand-operated dipnets (Shields 2010). The stocks in Cook Inlet appear to be in good condition. If there were indications that the eulachon stocks were in poor condition, there would be an emergency closure for commercial fishing by the ADF&G[7].

Pacific Cod: Pacific cod is not overfished and is not approaching an overfished condition in the Gulf of Alaska (NPFMC 2010). According to ADF&G Pacific cod are very abundant in Cook Inlet and the overall health of the stock is in good condition[8].

Walleye Pollock: Pollack is not subject to overfishing and is not being overfished in the GOA. The projected mean spawning biomass in 2013 is 272,877 tons, and therefore, is not approaching an overfished condition in the GOA (NPFMC 2010). ADF&G's 2010 biomass estimate for Pollock was down 15 percent from 2009, but increased 60 percent from the previous three years (NPFMC 2010). Currently, there are no ongoing pollock fisheries in Cook Inlet[9].

[6] Dan Bosch (Area Biologist, ADF&G) personal communication with Lindsey Kendall, May 25, 2011.
[7] Shane Hertzog (Fisheries Biologist, ADF&G) personal communication with Lindsey Kendall, June 2, 2011.
[8] Charlie Trowbridge (Fisheries Biologist, ADF&G) personal communication with Lindsey Kendall, June 2, 2011.
[9] Chris Russ (Fisheries Biologist, ADF&G) personal communication with Lindsey Kendall, May 25, 2011.

Saffron Cod: Saffron cod are not discussed in the SAFE reports. They are generally found in shallow coastal waters in depths less than 60 m and are found in brackish and fresh water, up rivers and streams (FAO 2011). According to ADF&G, saffron cod are in good health in Cook Inlet[10].

Yellowfin Sole: In the GOA, yellowfin sole is managed as part of the shallow-water flatfish complex, which also include northern rock sole, southern rock sole, butter sole and starry flounder, English sole, sand sole and Alaska plaice (NPFMC 2010). Shallow-water flatfish surveys occur on a biennial basis. As a result there was no new survey data for shallow-water flatfish in 2010; therefore, the most recent evaluation on these species occurred in 2009 (NPFMC 2010). In 2009, the biomass estimates for yellowfin sole were 21,627 tons, which is consistent with the previous two surveys conducted in 2005 and 2007 (NPFMC 2009).

In the action area of the proposed Cook Inlet 3D Seismic Program, the best scientific and commercial data available indicates that, overall, the major beluga whale prey species are in good condition.

2.2.2.3 PCE 3: Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.

The Cook Inlet region is the most populated and industrialized region of the state. Its waters receive various pollutant loads through activities that include urban runoff, oil and gas activities (e.g., discharges of drilling muds and cuttings, production waters, treated sewage effluent discharge, deck drainage), municipal sewage treatment effluents, oil and other chemical spills, fish processing, and other regulated discharges. Many of these pollutants are regulated by either the EPA or the Alaska Department of Environmental Conservation (ADEC), who may authorize certain discharges under the National (or Alaska) Pollution Discharge Elimination System (section 402 of the CWA). Management of pollutants and toxins is necessary to protect and maintain the biological, ecological, and aesthetic integrity of Cook Inlet's waters.

Levels of polychlorinated biphenyl (PCB) compounds, pesticides, petroleum hydrocarbons and heavy metals found in the water column and in the sediment of Cook Inlet were below detection limits, and levels of heavy metals were below management levels (KABATA 2004, NMFS 2008a, USACE 2008). Upper Cook Inlet was designated as Category 3 on the Clean Water Act Section 303(d) list of impaired waterbodies by ADEC. A Category 3 designation is the result of insufficient information in determining if the waterbody meets water quality standards. The lower Cook Inlet is not on the listed of impaired water bodies (ADEC 2010). In the action area, waters are generally free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.

2.2.2.4 PCE 4: Unrestricted passage within or between the critical habitat areas.

Certain actions may have the effect of reducing or preventing beluga whales from freely accessing the habitat area necessary for their survival. Dams and causeways may create physical barriers, while noise and other disturbance or harassment might cause a behavior barrier, whereby the whales reach these areas with difficulty or, in a worst case, abandon the affected habitat areas altogether due to such stressors. Within the action area, potential barriers that could

[10] Charlie Trowbridge (Fisheries Biologist, ADF&G) personal communication with Lindsey Kendall, June 2, 2011.

restrict beluga whale movement include port facilities, vessel traffic and noise. Port facilities are located along the coastal areas throughout Cook Inlet and large cargo ships, and commercial and recreational fishing boats pass through the action area. Noise from construction, oil and gas platforms, and other coastal activities also have the potential to restrict movement of beluga whales. The majority of disturbing anthropogenic noise is found in upper Cook Inlet near Anchorage. Currently, passage within or between the critical habitat areas is unrestricted in the action area.

2.2.2.5 PCE 5: Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

Based on research and empirical data from beluga whales in the wild, NMFS has established in-water noise levels that define when these animals are harassed or injured. NMFS considers the threshold for acoustic harassment to be 160 dB re: 1 μPa for impulsive sounds (e.g., seismic pulses) and 120 dB re: 1 μPa for continuous noise. Major contributors to noise in the action area include vessel traffic and gas and oil development.

Beluga whales have been observed in the action area throughout different times of the year (Hobbs et al. 2005) when these activities are likely taking place. Vessel traffic includes ships traveling to and from the POA and smaller docks in Cook Inlet. Vessels are also used as support for oil and gas development for providing supplies and by transporting gas and oil products from the western side to the eastside of Cook Inlet as well as to other parts of Alaska. Additionally, recreational and fishing vessels exist in the action area. Noise associated with oil and gas development includes drilling operations and noise associated with the platform itself. Although there are currently numerous sources of in-water noise in Cook Inlet, there is no evidence that the levels of noise have resulted in the abandonment of any critical habitat areas.

2.3 Steller Sea Lions

A detailed description of the Steller sea lions' biology, habitat, threats and recovery factors may be found in the Steller Sea Lion Recovery Plan (NMFS 2008c).

2.3.1 ESA Status

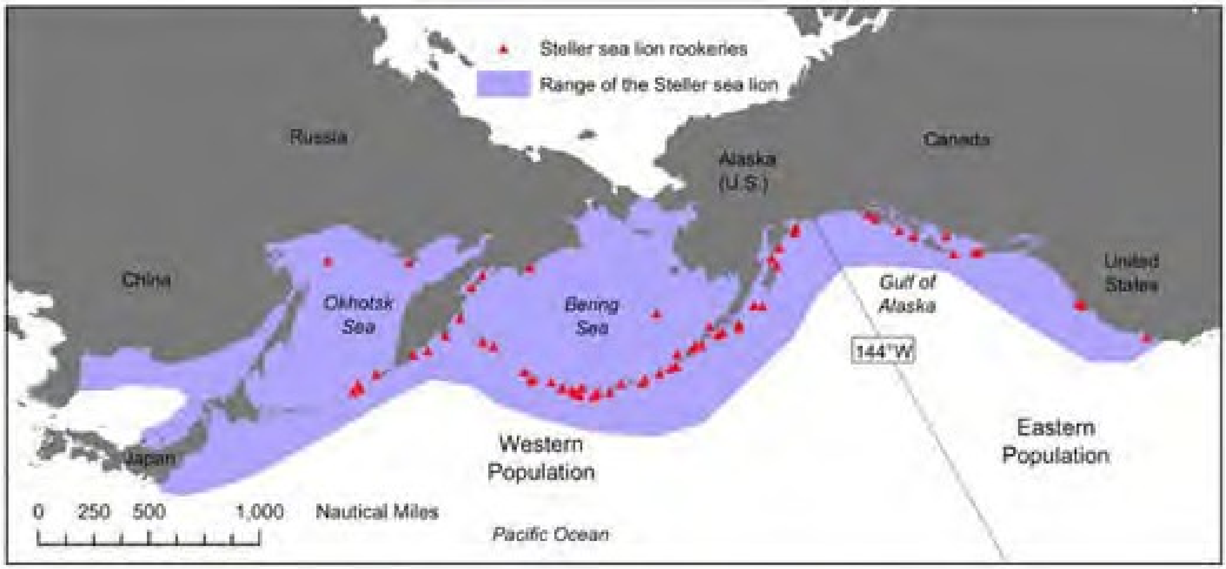
The Steller sea lion was listed as a threatened species in 1990 (55 FR 49204; November 26, 1990). In 1997, NMFS reclassified Steller sea lions as two distinct population segments (DPS) under the ESA based on genetic studies and phylogeographical analyses from across the sea lions' range (62 FR 24345; May 5, 1997). The eastern DPS was listed as threatened; the western DPS was listed as endangered.

2.3.2 Range

The range of the Steller sea lion extends across the North Pacific Ocean rim from northern Japan, the Kuril Islands and Okhotsk Sea, through the Aleutian Islands and Bering Sea, along Alaska's southern coast, and as far south as the California Channel Islands (NMFS 2008c; Figure 15). The eastern DPS includes sea lions born on rookeries from California north through Southeast Alaska; the western DPS includes those animals born on rookeries from Prince William Sound westward with a boundary set at 144^{o}W (NMFS 2008c).

The western DPS Steller sea lion occurs in Cook Inlet, primarily south of Anchor Point around the offshore islands and along the west coast of the inlet in the bays (Chinitna Bay, Iniskin Bay,

FIGURE 15: Range of the Steller sea lion.



etc.; Rugh et al. 2005a). The occasional individual animal may wander into Cook Inlet river mouths during summer periods to seek seasonal runs of prey such as salmon or euchalon. No haulouts occur in upper Cook Inlet and Steller sea lions are rarely sighted north of Nikiski (Rugh et al. 2005a; LGL 2006). Eighteen years of systematic aerial surveys of Cook Inlet for estimating Cook Inlet beluga whale abundance have documented no Steller sea lions within the action area (NMFS unpubl. data). Opportunistic sightings reported to NMFS have only sporadically documented single Steller sea lions in Knik or Turnagain Arms, north of the action area (less than five individual Steller sea lions reported since 2003; NMFS unpubl. data).

2.3.3 Hearing

Steller sea lions have similar hearing thresholds in-air and underwater to other otariids. In-air hearing ranges from 0.250 - 30 kHz, with a region of best hearing sensitivity from 5 - 14.1 kHz (Muslow and Reichmuth 2010). An underwater audiogram shows the typical mammalian U-shape. The range of best hearing underwater was from 1 to 16 kHz. Higher hearing thresholds indicating poorer sensitivity were observed for signals below 16 kHz and above 25 kHz (Kastelein et al. 2005).

2.3.4 Threats

It is likely that a cumulative effect of multiple factors are influencing population trends in the western DPS Steller sea lion population (NMFS 2008c). Factors include food web interactions, predation (killer whale and shark), nutritional stress due to competition for prey related to commercial fisheries and regime change, incidental take by commercial fisheries, subsistence harvest, illegal shooting, entanglement in marine debris and fishing gear, disease, parasitism, toxic substances, and anthropogenic disturbance (aircraft, vessels).

2.3.5 Population Abundance and Trends

The 2008 count of non-pups (31,246) plus the number of pups in 2005-2009 (11,120) is 42,366, which is used as a minimum population estimate for the U.S. portion of the western stock of Steller sea lion (Allen and Angliss 2010). Currently, NMFS believes the western DPS of Steller sea lions is increasing overall at about 1.8% annually, based on pup counts conducted at trend sites between 2001-2011 (DeMaster 2011); however, two sub-populations in the Aleutian Islands have been declining.

2.3.6 Steller Sea Lion Critical Habitat

NMFS designated critical habitat for the western DPS of Steller sea lions on August 27, 1993 (58 FR 45269, Figure 16). Critical habitat for the Steller sea lion includes a 20 nautical mile buffer around all major haul-outs and rookeries, as well as associated terrestrial, air and aquatic zones, and three large offshore foraging areas. Portions of the southern reaches of the lower Cook Inlet are designated as critical habitat (Figure 17) including those near the mouth of the Inlet, which are far south of the action area. Steller sea lion critical habitat does not occur in the action area of the proposed Cook Inlet 3D Seismic Program. It is unlikely that any Steller sea lions would occur in the action area during operations. Since no critical habitat for the Steller sea lions exists within the action area, critical habitat for Steller sea lions will not be discussed further in this opinion.

FIGURE 16. Critical habitat designated within the range of the Steller sea lion, western distinct population stock (NMFS 2010).

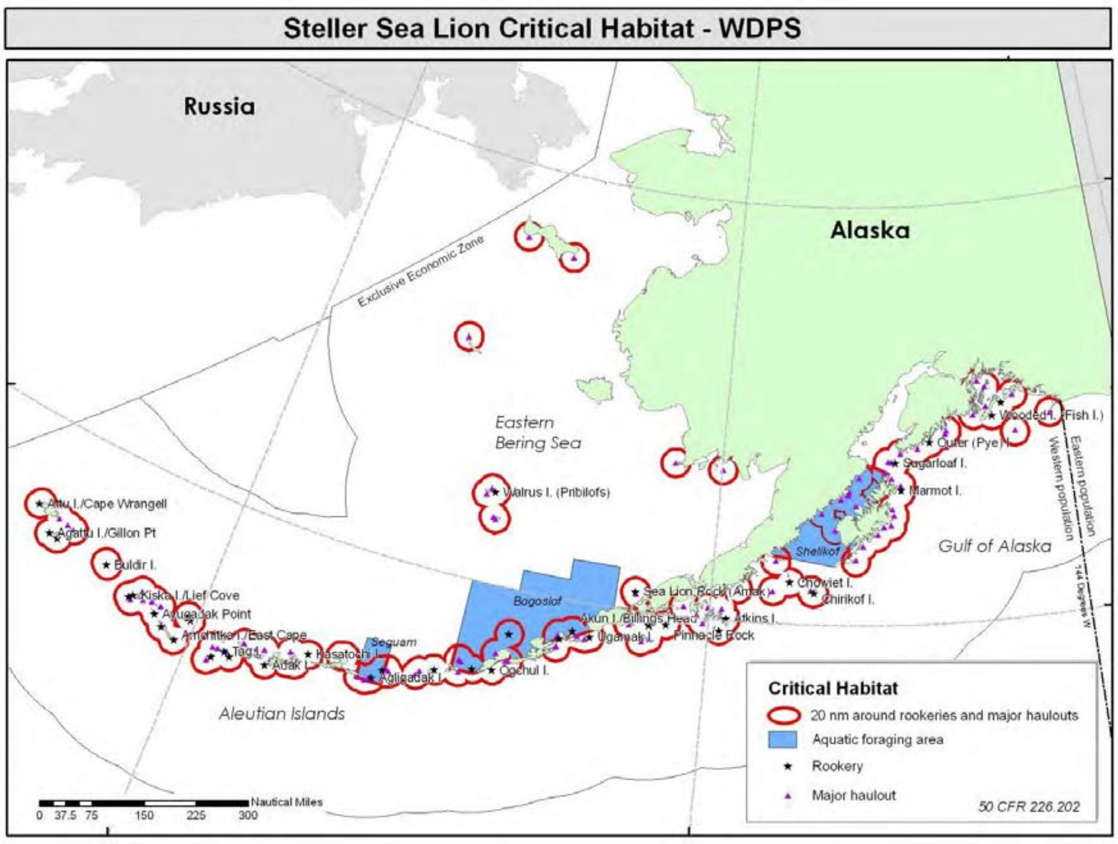
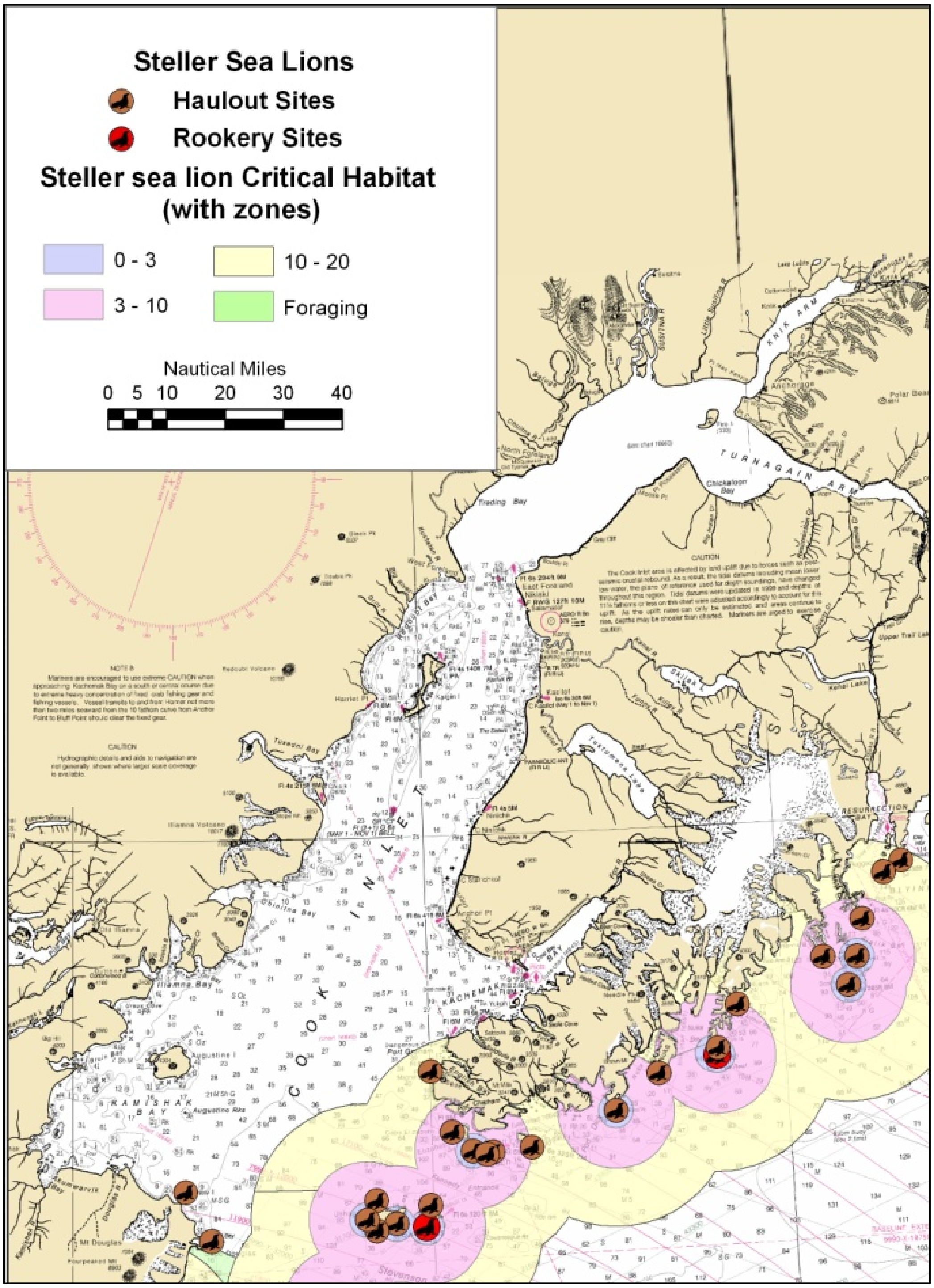


FIGURE 17. Steller sea lion haulouts, rookeries, and designated critical habitat within or adjacent to Cook Inlet, Alaska.



3. ENVIRONMENTAL BASELINE

By regulation, the environmental baseline for biological opinions includes the past and present impacts of all state, Federal, or private actions and other human activities in the action area, the anticipated impacts from all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). The environmental baseline for this biological opinion includes the effects of several activities that affect the survival and recovery of threatened and endangered species and designated critical habitat in the action area.

3.1. Status of the Species/Critical Habitat within the Action Area

3.1.1 Cook Inlet Beluga Whales

The action area encompasses a vast majority of the Cook Inlet belugas' range and designated critical habitat. There may be times when the entire beluga population is located within the action area. As previously discussed, the beluga population is decreasing in numbers and constricting in summer range.

3.1.2 Cook Inlet Beluga Whale Critical Habitat

The best scientific and commercial data available indicate that the current status of the Cook Inlet beluga whale critical habitat PCE's in the action area can be summarized as follows (see section 2.2.2 for more details):

- The intertidal, sub tidal and areas within 8 km of anadromous fish streams are generally intact and undisturbed.
- Primary prey species that exist in the action area includes all four salmon species, Pacific eulachon, Pacific cod, walleye, Pollock, saffron cod, yellowfin sole and all stocks are generally in good condition.
- Waters do not contain toxic levels likely to harm the beluga whales.
- Passage within or between critical habitat areas is unrestricted.
- There is no evidence that in-water noise levels have caused Cook Inlet beluga whales to abandon their critical habitat.

3.1.3 Steller Sea Lions

Overall, the abundance of the western DPS of Steller sea lions is increasing despite some localized areas of decline (see section 2.3.5). The proposed project is located well outside Steller sea lion critical habitat, there are no recognized haul-outs or rookeries in the action area, and Steller sea lions are rarely observed in the action area.

3.2 Factors affecting Species Environment within the Action Area

The upper Cook Inlet region is the major population center of Alaska, with the 2009 Municipality of Anchorage population at 286,174, Matanuska-Susitna Borough at 88,379, and Kenai Peninsula Borough at 54,665 (U.S. Census Bureau). Such large numbers of people in a relatively small area present added concerns to the natural environment and to Cook Inlet beluga whales.

The Cook Inlet beluga whale and Steller sea lion populations may be affected by various natural and anthropogenic factors, including: coastal development; ship strikes; noise pollution; water pollution; prey reduction; direct mortalities; research; and environmental change. While a number of known and potential threats have been identified, there is not enough known about the effect of each specific threat to definitively know the level of impact that each threat has on the Cook Inlet beluga whale or Steller sea lion. In addition, Cook Inlet beluga whales and Steller sea lions may be affected by multiple threats at any given time, compounding the impacts of the individual threats (NMFS 2008a, 2008c). These threats may also impact the Cook Inlet belugas' critical habitat.

Beluga whales are not uniformly distributed throughout Cook Inlet; they are predominantly found in nearshore waters, and concentrate in the upper Inlet in summer. Where beluga whales must compete with people for nearshore habitats, coastline development leads to the direct loss of this preferred habitat. Indirect alteration of habitat may occur due to bridges, boat traffic, in-water noise, and discharges that affect water quality. Most beluga habitat in Cook Inlet remains essentially intact, however, extensive sections of Turnagain Arm and Anchorage shorelines have been developed (e.g., rip rap, road, and railroad construction); Knik Arm supports the largest port and military base in the state; and there are numerous offshore oil and gas platforms ranging between the Forelands to just north of Tyonek.

3.2.1 Coastal Development

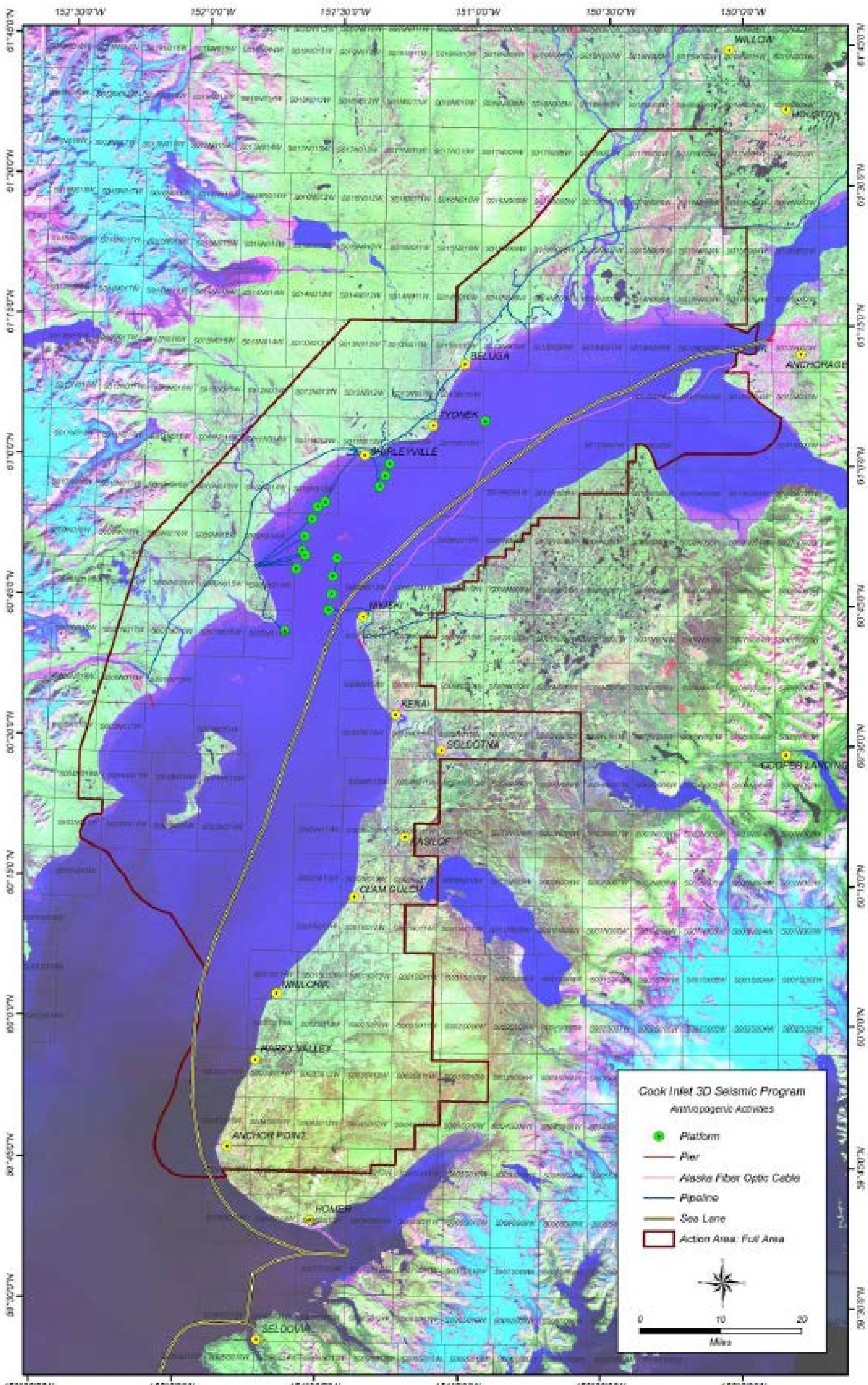
Southcentral Alaska is the State's most populated and industrialized area. Many cities, villages, ports, airports, treatment plants, oil and gas platforms and refineries, highways, and railroads are situated on or very near to Cook Inlet (Figure 18). This development has resulted in both the loss and alteration of near shore beluga habitat and changes in habitat quality due to vessel traffic, noise, and pollution. There is concern that increased development may prevent beluga whales from reaching important feeding and breeding areas. Frequent use of shallow, near shore and estuarine habitats makes beluga whales particularly prone to regular interaction with human activities (Perrin 1999), and thus belugas area likely to be affected by those activities.

<u>Port Facilities</u>

Port facilities in Cook Inlet are found at Anchorage, Mackenzie, Tyonek, Drift River, Nikiski, Kenai, Anchor Point, and Homer.

The Port of Anchorage (POA) is Alaska's largest seaport and the main port of entry for southcentral and interior regions. It is a deep draft facility which exists along eastern lower Knik Arm in an area that is heavily used by beluga whales. Operations began at the POA in 1961 with a single berth. Since then, the POA has expanded to a five-berth terminal that moves more than four million tons of material across its docks each year (POA 2009). Construction associated with the current Marine Terminal Development Project has been ongoing on a seasonal basis since 2006, and has included both in-water and out-of-water activities. The POA Intermodal Expansion Project will add 135 acres of useable land to the current 129 acre POA (total area of 264 acres). The POA Intermodal Expansion Project will rebuild and enlarge docking facilities, improve loading/unloading facilities, provide additional working space to handle shipped fuel, freight and other materials, and improve access by road and rail transportation serving the POA. The new expanded POA will provide efficient transport of goods into and out of Anchorage for the next 50 years and more. In-water activities during the POA Expansion Project have an annual take by harassment of 34 beluga whales. During the 2009 construction work at the POA, a total of 23 beluga whales were reported to have been taken; in 2010, 13 were taken; in 2011, 4

FIGURE 18: Anthropogenic activities within the action area of the proposed Cook Inlet 3D Seismic Program.



were taken. These takes were determined by the presence of belugas within the designated harassment zones, and not behavioral criteria. Although one Steller sea lion was sighted at the POA in June 2009, the POA shut down in-water operations to avoid a take until the animal left the area. Since Steller sea lions are rarely sighted in upper Cook Inlet, the POA did not request, nor did NMFS recommend, an authorization to take Steller sea lions.

POA maintenance dredging has occurred annually since 1965. The current operations and maintenance plan at the POA authorizes the Army Corps of Engineers to dredge to -35 ft MLLW. The footprint dredged at the POA fluctuates annually, varying from 95 acres in 1999 to 117 acres in 2004. Over the past several years the average size of the dredged footprint has been about 100 acres. The amount of dredging required to maintain the POA varies from year to year, with a maximum of about 2.1 million cubic yards (cy) of material dredged in 2004. Maintenance dredging is conducted by one or more dredges and lasts from mid-May through November, depending on the weather. Two to five barge trips per day transport about 1,500 cy of material from each dredge to the disposal site (USACE 2008). Dredging along coastal waterways has been identified as a concern with respect to the Saint Lawrence beluga whales (DFO 1995). There, dredging of up to 600,000 cubic meters of sediments re-suspended contaminants into the water column and seriously impacted the beluga whales. The Saint Lawrence beluga whale recovery plan contains recommendations to reduce the dredge amount and to develop more environmentally sound dredging techniques (DFO 1995). While the volume of dredging in Cook Inlet is comparable to St. Lawrence, the material in Cook Inlet does not appear to contain harmful levels of contaminants (USACE 2005, 2008).

Port MacKenzie is along western lower Knik Arm and development began in 2000 with the construction of a barge dock. The first shipments arrived in July 2001. Additional construction has occurred since then and Port MacKenzie currently consists of a 500-foot bulkhead barge dock, a 1,200 ft deep-draft dock with a conveyor system, a landing ramp, and more than 8,000 acres of adjacent uplands; however, plans call for a bulk loading facility with deep-draft capability.

The Drift River facility in Redoubt Bay is used primarily as a loading platform for shipments of crude oil. The docking facility there is connected to a shoreside tank farm and designed to accommodate tankers in the 150,000 deadweight-ton class. Nikiski is home to several privately owned docks (including those belonging to oil and gas companies). Activity at Nikiski includes the shipping and receiving of anhydrous ammonia, dry bulk urea, liquefied natural gas, petroleum products, sulfuric acid, caustic soda, and crude oil.

Oil & Gas Exploration

Oil and gas development in Cook Inlet takes place within the action area of the proposed Cook Inlet 3D Seismic Program. Much of the Cook Inlet region overlies reserves of oil and natural gas. Upper Cook Inlet and the Kenai Peninsula have an association with the petroleum industry that dates back to the 1950s. Most of the platforms were in place by 1967, hence the infrastructure is over 40 years old. As such, many of the pipes are aging and will need repair if their use is going to be continued. At the peak of its infrastructure development, there were 16 offshore production and three onshore treatment facilities in upper Cook Inlet and approximately 230 mi of undersea pipelines (80 mi of oil pipeline, 150 mi of gas pipeline). Some of these facilities were "shut in" (not actively producing, but not yet plugged or abandoned) in 1992 as

Cook Inlet production continuously declined. The offshore production facilities operating in Cook Inlet currently support over 200 wells. There are 16 platforms in upper Cook Inlet, 12 of which are active today (Figure 18). Currently there are no platforms in the lower Inlet, and no permits have been issued for the construction of new permanent platforms anywhere within the Inlet (Pers. Comm. B. Havelock, ADNR 2008).

State lease sales for oil and gas development in Cook Inlet began in 1959 (ADNR 2009). Prior to the lease sales, there were attempts at oil exploration along the west side of Cook Inlet. Today, there are a total of 391 active oil and gas leases, totaling approximately 986,153 acres of State leased land of which 449,884 acres are offshore and 536,270 acres are onshore (ADNR 2011a).

In 2010, the State of Alaska offered up to $25 million in tax credits for the first well drilled from a jack-up rig in Cook Inlet, up to $22.5 million in tax credits for the second well drilled by another producer, and up to $20 million for the third well drilled by a different producer. In 2011, two new companies (Escopeta and Buccaneer) worked to take advantage of the State of Alaska's production and tax credits for exploration expenses. Escopeta began drilling its first well using a jack-up rig in September 2011 in the Kitchen Lights Unit of Cook Inlet, about 10 miles north of Nikiski. The well is half finished; the company plans to finish this well and drill another well in summer 2012. Buccaneer conducted a well-site geohazard survey at four well locations in October 2011 and anticipates that its jack-up rig will arrive in Cook Inlet in April 2012. Buccaneer plans to begin drilling its first well at the Southern Cross prospect in May 2012.

Underwater Transmission Lines

In 2009, Alaska Communications Systems Group, Inc. (ACS) installed a fiber optic cable from Florence, Oregon to Anchorage, Alaska to improve communication between Alaska and the rest of the United States. The portion the fiber optics cable that is located in the action area is the submarine cable that extends from Nikiski on the Kenai Peninsula to Point Woronzof in Anchorage (Figure 18). Potential impacts from the fiber optic cable included a temporary increase in vessel traffic and noise during the installation of the cable. During installation, vessels generally operated at speeds of 1-2 kn as the cable was buried 1.2 m (3.9 ft) below the seafloor (ACS 2008). After installation, the fiber optic cable rests along the seafloor with a minimal footprint. As a result the direct loss of habitat was minimal and did not likely have an adverse effect on beluga whales.

3.2.2 Ambient Noise and Noise Pollution

Beluga whales rely heavily on sound to meet basic biological needs such as communicating, foraging and navigating (Richardson 1995), especially in the turbid waters of Cook Inlet. In general, Cook Inlet is a noisy environment and noise has the potential to disrupt beluga whales' ability to meet these basic biological needs. Noise sources in Cook Inlet that could be found in the action area include ambient sound (e.g. flow noise, wind), large and small vessels, aircraft, oil and gas drilling, construction activities (e.g. dredging and pile driving; NMFS 2008a). Noise studies in Cook Inlet have focused on areas in upper Cook Inlet, many outside the action area (Blackwell and Greene 2002; Blackwell 2005; URS 2007; SFS 2009; Širović and Kendall 2009); however, these studies can give a good indication of anticipated noise in other areas of the Inlet.

TABLE 3: Summary of received sound levels, the distance to the noise and the frequency of various noise sources in Cook Inlet.

Source	Received Level (dB re 1 µPa)	Distance	Frequency (kHz)
Ambient Noise[1]			
Mouth of Little Susitna River	100	-	-
Between Fire Island and the mouth of Susitna River	113	-	-
Birchwood (Knik Arm outside action area)	95	-	-
Mouth of Eagle River (Knik Arm outside action area)	118	-	-
North of Point Possession	120	-	-
Anchorage Airport (ANC)	105	-	-
Joint Base Elmendorf-Richardson (JBER)	119	-	-
Port of Anchorage (POA)	113	-	-
Vessel Noise[1]			
Cargo-freight – Northern Lights (docked)	126	100-400 m	Generally < 1 kHz
Cargo-bulk carrier – Emerald Bulker (with 2 tugs)	134	>200 m	
Tug – Leo (pushing gravel barge Katie II)	149	100 m	
Small boat – Boston Whaler (drive by)	138	13 m	
Small rubber boat - Avon (drive by)	142	8.5 m	
Aircraft Noise[1]			
ANC	118.4 ± 5.7[2]	-	Generally < 2 kHz
JBER	128.0 ± 9.0	-	
DC-10	124[3]	-	
Landing Military Jet	134	-	
Oil and Gas Drilling Noise[1]			
Phillip A Oil Platform	119 [3]	1.2 km	< 10 kHz

[1]Blackewell and Greene 2002
[2]Mean and standard deviation
[3]Maximum values

Ambient noise is environmental background noise that includes sources such as wind, waves, ice, current, and tidal flow (Richardson 1995). Sound levels from ambient noise vary at different locations in Cook Inlet. Blackwell and Greene (2002) recorded ambient noise levels at five locations in Cook Inlet in areas known to have high concentrations of beluga whales and at three locations near anthropogenic activities. The mouth of the Little Susitna River and Birchwood are known to have some of the highest concentration of beluga whales and were found to have the lowest levels of ambient noise.

Table 3 provides a summary of anthropogenic noise sources occurring in Cook Inlet, including some activities outside the action area.

<u>Oil and Gas Exploration and Production Noise</u>
Increased noise from seismic activity, vessel and air traffic and well drilling could result from gas and oil development. Seismic surveys use high energy, low frequency sound in short pulse durations to determine substrates below the seafloor, such as gas and oil deposits (Richardson 1995). These short pulses of sound increase noise levels near the seismic activity. Airguns

have been previously used in Cook Inlet for seismic exploration (JASCO 2007). Oil produced on the western side of Cook Inlet is transported by tankers to the refineries on the east side. Refined petroleum products are then shipped to other parts of Alaska. Liquid gas is also transported via tankers once it is processed (ADNR 2009). Offshore drilling is generally conducted from man-made islands, drilling vessels or platforms (Richardson 1995). Blackwell and Greene (2002) recorded underwater noise produced at Phillip A oil platform at six locations at distances ranging from 0.3-19 km. The highest recorded sound level was 119 dB re: 1 µPa at a distance of 1.2 km (Table 3). The noise from the oil platform was operating not drilling noise, and was generally below 10 kHz. In general, noise from the platform itself is thought to be very weak because of the small surface area (the four legs) in contact with the water (Richardson 1995) and that the majority of the machinery is on the deck of the platform which is above the water surface. However, noise carried down the legs of the platform likely contributed to the high levels documented by Blackwell and Greene (2002).

While much of the sound energy in this noise fell below the hearing thresholds of beluga whales, some noises between two and 10 kHz were measured as high as 85 dB re: 1 µPa as far out as 19 kilometers from the source. This noise is audible to beluga whales.

The acoustics study did not address marine geophysical seismic activity in Cook Inlet, although it does occur. Geophysical seismic operations were conducted in 2007 in Cook Inlet near Tyonek, the Forelands area, areas off Anchor Point, and areas west of Clam Gulch. A previous seismic program occurred near Anchor Point in the fall of 2005. Seismic exploration is associated with both State and Federal offshore tracts. Geophysical seismic activity has been described as one of the loudest man-made underwater noise sources, with the potential to harass or harm marine mammals, including beluga whales.

<u>Vessel Traffic Noise</u>

Vessel traffic includes large shipping, commercial and support vessels, commercial fishing vessels, and personal water craft. Vessel traffic can produce noise disturbance to beluga whales. Blackwell and Greene (2002) recorded underwater noise produced by both large and small vessels near the POA (Table 3). The Leo tugboat produced the highest broadband levels of 149 dB re: 1 µPa at a distance of approximately 100 m, while the docked Northern Lights (cargo freight ship) produced the lowest broadband levels of 126 dB re: 1 µPa at 100-400 m. Ship noise was generally below 1 kHz.

<u>Aircraft Noise</u>

Cook Inlet also experiences significant levels of aircraft traffic. The Anchorage International Airport (ANC) is directly adjacent to lower Knik Arm and has high volumes of commercial and cargo air traffic. Joint Base Elmendorf Richardson (JBER) also has a runway near and airspace directly over Knik Arm. Lake Hood and Spenard Lake in Anchorage are heavily used by recreational seaplanes. Other small public runways are found at Birchwood and Goose Bay in Knik Arm; Merril Field; Girdwood; the Kenai Municipal Airport; Ninilchik; Homer; and Seldovia.

Even though sound is attenuated by the water surface, Blackwell and Greene (2002) found aircraft noise can be loud underwater when jet aircraft are directly overhead. Blackwell and Greene (2002) recorded aircrafts noise underwater near ANC and JBER, outside of the action area. Recordings included 15 commercial aircraft and 11 F-15 military jets. Eleven of the 15 commercial aircrafts and two of the 11 military jets were detectable underwater due to sound transmission across air and water. Results indicated that aircraft and ambient noise levels at JBER were higher than at ANC. The sound energy recorded from the aircrafts were generally broadband and below 2 kHz.

Richardson (1995) discovered that beluga whales in the Beaufort Sea will dive or swim away when low-flying (less than 500 m) aircraft passed directly above them. However, beluga survey aircraft flying at approximately 244 m (800 ft) in Cook Inlet observed little or no change in beluga swim directions (Rugh et al. 2000). This is likely because beluga whales in Cook Inlet have habituated to routine small aircraft over flights. Beluga whales may be less sensitive to aircraft noise than vessel noise, but individual responses may be highly variable and depend on previous experiences, beluga activity at the time of the noise, and characteristics of the noise.

Coastal Development Noise

Construction noise in Cook Inlet is associated with activities such as dredging and pile driving. The majority of construction activities have taken place near Anchorage; therefore, most of the studies documenting construction noise in Cook Inlet have occurred outside of the action area. Additionally, these studies have focused on pile driving activities because of the major concerns of potential harassment to beluga whales from in-water noise produced by this activity. As a result there is very little to no documentation of noise levels from other construction activity in Cook Inlet. Only one study recorded dredging noise near the Port of Anchorage (POA) (SFS 2009). Noise levels from construction activities are presented in Table 4.

The Port of Anchorage is currently under construction while they are expanding. Construction is expected to last several more years. During this phase, dredging requirements have increased. The Knik Arm Crossing may begin construction as early as 2013 and complete construction as early as 2016.

TABLE 4: Summary of construction activity noise levels found in Cook Inlet

Study	Pile	Vibratory	Impact	Dredging
Blackwell 2005	91 cm (36 in) diameter	162 and 164 dB re 1 µPa at 56 m[1]	190 and 189 164 dB re 1 µPa at 62 m[1]	-
URS 2007	35 cm (14 in) diameter	120 - 168 dB re 1 µPa at 600 and 10 m respectively	160 -177 164 dB re 1 µPa at 300-19 m respectively	-
SFS 2009	76 cm (30 in) diameter	144 dB_{RMS} at 35 m	-	156.9 dB re 1 µPa at 30m
SFS 2009	sheet	141 dB_{RMS} at 757 m	167 dB_{RMS} at 301 m	-
Širović and Kendall 2009	unknown	183.2 ± 4.8[2] dB re 1 µPa at 1 m	196.9 ± 6.1 dB re 1 µPa at 1 m	-

[1]Depths of the hydrophone ranged from 1.5-10m respectively
[2]Standard deviation

3.2.3 Water Quality and Water Pollution

The waters of Knik Arm are brackish, with salinities ranging from 4 to 6 practical salinity units (equivalent to grams of dissolved solids per kg of seawater) north of Cairn Point. Water temperatures range from freezing to 63°F or more (in surface pockets observed during the summer months). Measurements of suspended sediment also vary. Several locations near the river mouths exhibit concentrations of up to 1,000 milligrams of sediment per liter (mg/L) between water surface and depths of 15 ft, while sediment concentrations at greater water depths have measured more than 4,000 mg/L (Smith et al. 2005). The average natural turbidity in upper Cook Inlet and Knik Arm typically ranges from 400 to 600 nephelometric turbidity units. The turbulent nature of the system mixes the water and maintains relatively high dissolved oxygen concentrations throughout the entire water column.

The Conservation Plan for the Cook Inlet Beluga Whale (NMFS 2008a) states contaminants are a concern for the sustained health of Cook Inlet beluga whales. The principal sources of pollution in the marine environment are: 1) discharges from industrial activities not entering municipal treatment systems; 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).

<u>Contaminants found in Belugas</u>

Contaminants released into the beluga whales' habitat can affect their overall health (Becker et al. 2000). Since 1992, tissues from Cook Inlet beluga whales have been collected from subsistence harvested and dead stranded beluga whales, when possible, and analyzed for contaminants as part of the Alaska Marine Mammal Tissue Archival Program. These samples were compared to samples taken from beluga whales in two Arctic Alaska locations (Point Hope and Point Lay), Greenland, Arctic Canada, and the Saint Lawrence estuary in eastern Canada (Becker et al. 2000). Cook Inlet beluga whales appear to have lower levels of contaminants stored in their bodies than do other beluga whale populations; however, the impacts of contaminants on beluga whales in Cook Inlet are unknown (NMFS 2008a). Becker et al. (2000) concluded that little is known about the role of multiple stressors in animal health and that future research should examine their interaction and effects on recruitment in declining populations, such as the Cook Inlet beluga whale.

<u>Stormwater Runoff</u>

Stormwater runoff has the potential to carry numerous pollutants from the Municipality of Anchorage, the Mat-Su Borough, and the Kenai Peninsula Borough into Cook Inlet. Runoff can include pollution coming from streets, construction and industrial areas, and airports. Runoff can also carry hazardous materials from spills and contaminated sites into Cook Inlet. The effect of these pollutants on beluga whales is unknown.

Numerous releases of petroleum hydrocarbons have been documented from the Port of Anchorage (POA), Joint Base Elmendorf Richard (JBER), and the Alaska Railroad Corporation (ARRC). The POA transfers and stores petroleum oils, as well as other hazardous materials; and since 1992, all significant spills and leaks have been reported. Past spills have been documented at each of the bulk fuel facilities within the POA and also on JBER's property (POA 2003a,b). JBER is listed on the National Priorities List because of its known or threatened releases of hazardous substances, pollutants, or contaminants. Spills have also been reported at the ARRC rail yard. In 1986, petroleum seeped into Ship Creek from the nearby rail yard and several oil spills occurred in 2001 (U.S. Army 2010). Freight handling activities have historically caused numerous surface stains and spills at the rail yard.

Deicing and anti-icing of aircraft and airfield surfaces are required by the Federal Aviation Administration to ensure the safety of passengers. Deicing and anti-icing chemicals are used from October through May and may be used on aircraft, tarmacs, and runways. Depending on the application, deicing activities use different chemicals. For instance, ethylene glycol and propylene glycol are used on aircraft for anti-icing and deicing purposes, whereas potassium acetate and urea are used to deice tarmacs and runways. Much of the deicing materials or their break down products eventually enters Cook Inlet. No studies exist analyzing the potential impacts on beluga whales from deicing agents that enter Cook Inlet.

Wastewater Discharge

Ten communities currently discharge treated municipal wastes into Cook Inlet. Wastewaters entering these plants may contain a variety of organic and inorganic pollutants, metals, nutrients, sediments, bacteria and viruses, and other emerging pollutants of concern (EPOCs). Wastewater from the Municipality of Anchorage, Nanwalek, Port Graham, Seldovia, and Tyonek receive primary treatment, wastewaters from Homer, Kenai, and Palmer receive secondary treatment, and wastewaters from Eagle River and Girdwood receive tertiary treatment. Primary treatment means that only materials easily collected from the raw wastewater (such as fats, oils, greases, sand, gravel, rocks, floating objects, and human wastes) are removed, usually through mechanical means. The primary effluent is discharged directly into Cook Inlet, where it becomes diluted. Wastewater undergoing secondary treatment is further treated to substantially degrade the biological content of the sewage (such as in human and food wastes). Tertiary treatment plants use technology in addition to primary and secondary treatment to increase the quality of the effluent discharge.

Ballast Water Discharges

Discharges of wastes from vessels are regulated by the United States Coast Guard. Potential discharges include oily waste, sewer water, gray water (e.g., shower water), and garbage. Gray water and sewer water, provided that they are free from oil waste, may be discharged in the open sea. However, by law, no discharges of any kind are allowed within three miles of land.

Ships can potentially release pollutants and non-indigenous organisms into Cook Inlet through the discharge of ballast water. It is a recognized worldwide problem that aquatic organisms picked up in ship ballast water, transported to foreign lands, and dumped into non-native habitats, are responsible for significant ecological and economic perturbations costing billions of dollars. The National Ballast Information Clearinghouse reported that more than five million metric tons of ballast water was released in Cook Inlet, from Homer to Anchorage, between 1999 and 2003. Invasive species were found just off the POA in a 2004 survey by the Smithsonian Environmental Center. The effect of discharged ballast water and possible invasive species from such discharges on beluga whales and their habitat is unknown.

Oil Spills

While construction of an oil/gas facility may temporarily result in habitat loss, a natural gas blowout or oil spill could severely impact the beluga whales and put the population at risk.

Between 1984-1994, approximately 10,500 gallons of oil spilled from oil platforms and four gas blowouts have occurred since 1962 (ADNR as discussed in Moore et al. 2000). Offshore oil spill records in Cook Inlet during 1994-2011 (ADNR 2011b) show only three spills during oil exploration: two oil spills at the UNOCAL Dillion Platform in June 2011 (two gallons) and December 2001 (three gallons); and one oil spill at the UNOCAL Monopod Platform in January 2002 (one gallon). During the same time, 71 spills occurred offshore during oil production. Most spills ranged: 0.0011-1 gallon (42 spills); with three spills larger than 200 gallons: 210 gallons in July 2001 (Cook Inlet Energy Stewart facility); 250 gallons in February 1998 (King Salmon Platform); and 504 gallons in October 1999 (UNICOL Dillion Platform). All 71 crude oil spills from the offshore platforms, both exploration and production, totaled less than 2,140 gallons. Related effects from one of these events could include death or injury from swimming through oil (skin contact, ingestion of oil, respiratory distress from hydrocarbon vapors), contaminated food sources, or displacement from foraging areas (NMFS 2008a).

In addition to oil spills (which are low-probability events), water pollution from oil and gas activities may include the marine discharge of drilling fluids (muds and cuttings), produced waters (the water phase of liquids pumped from oil wells), gray waters, and sanitary wastes. Drilling fluids discharged into Cook Inlet average 89,000 barrels annually and contain several pollutants. Currently, the EPA regulates the discharges from these offshore platforms under the National Pollutant Discharge Elimination System (NPDES) program. Beginning October 31, 2012, the State of Alaska will administer and enforce the Alaska Pollutant Discharge Elimination System (APDES) program in lieu of the EPA.

3.2.4 Prey Reduction

Fisheries may compete with beluga whales in Cook Inlet for salmon and other prey species. There is strong indication that these whales are dependent on access to relatively dense concentrations of high value prey throughout the summer months. Any reduction in the amount of available prey may impact the energetics of Cook Inlet belugas and delay recovery.

Several fisheries occur in Cook Inlet waters and have varying likelihoods of competing with beluga whales for fish due to differences in gear type, species fished, timing, and location of the fisheries. Given that beluga whales concentrate in upper Cook Inlet during summer (Rugh et al. 2010), fisheries that occur in those waters during spring and summer could have a higher likelihood of interacting with beluga whales.

<u>Commercial Fisheries</u>

The Alaska Department of Fish and Game (ADFG) has management responsibility for most of the commercial fisheries in Cook Inlet, with the exception of halibut and a few federally managed fisheries in the lower Inlet. The state-managed fisheries in the upper and mid Inlet include salmon (both set and drift gillnet), herring (gillnet), a recently reopened dip net fishery for eulachon (a.k.a. hooligan or smelt), and a razor clam fishery. The largest fisheries in Cook Inlet, in terms of participant numbers and landed biomass, are the State-managed salmon drift and set gillnet fisheries concentrated in the Central and Northern Districts in the upper and mid Inlet. Even though all five types of Pacific salmon are caught in the upper Inlet, sockeye salmon is the primary target of the salmon commercial fisheries. Times of operation 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. Salmon fishery effort varies between years, and within-year effort can be temporally and spatially directed through salmon management regulations. While the number of permits fished in Cook Inlet salmon gillnet fisheries has been relatively constant, the actual number of fish caught has fluctuated greatly during the past 20 years (ranging from a high of 10.6 million in 1992 to a low of 1.8 million in 2000). The 2007 commercial harvest of salmon in upper Cook Inlet was 3.6 million, slightly higher than the 10 year average of 3.5 million harvested salmon. The sac roe herring fisheries are located in four subdistricts of the upper and mid Inlet (Upper, West, Kalgin Island, and Chinitna Bay subdistricts), however, the Upper subdistrict fishery is the most productive one. In 2007, the herring catch was 26,000 pounds. The commercial razor clam fishery off the west side of the Inlet is the only remaining commercial fishery for razor clams in Alaska and takes about 400,000 pounds per year (Pers. Comm. J. Fox, ADFG 2008).

There has been a sporadic fishery for eulachon since 1978 (taking between 300-100,000 pounds in 1978, 1980, 1998 and 1999). NMFS made recommendations to the Board of Fisheries (BOF) to discontinue this fishery effective in 2000, in part due to the lack of data on the eulachon runs into the Susitna River, and due to the absence of any evaluation of the effect of this fishery on beluga whales in terms of disturbance/harassment or competition for these fish. Additionally, it was noted beluga whales may be heavily dependent on the oil-rich eulachon early in the spring (preceding salmon migrations) and that large eulachon runs may occur in only a few upper Inlet streams. The commercial fishery for eulachon was reopened in 2005, but is restricted to hand-operated dip nets in saltwaters between the Chuit River and the Little Susitna River, with a total harvest of 100 tons or less. There was no fishing effort in 2005; 45.4 tons of eulachon were caught in 2006 and 62.5 tons of eulachon were caught in 2007 (Pers. Comm. P. Shields, ADFG 2007).

In the lower Inlet, in addition to the salmon and herring fisheries, ADFG also manages commercial fisheries for groundfish (lingcod and rockfish; Pacific cod; and sablefish), and shellfish (weathervane scallops; hardshell clams; and tanner crabs). 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 Cook Inlet (divided at 152°20' W longitude), with most of the catch coming from the Southern District. 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 until 1999, when this fishery was closed. The lower Inlet herring fishery will remain closed in 2008 in an attempt to allow herring biomass to rebuild. Also, a mechanical/hand jig fishery for lingcod and rockfish occurs in the lower Inlet.

Commercial fishing for halibut in Cook Inlet is managed by the International Pacific Halibut Commission (IPHC). The IPHC manages stocks of Pacific halibut within agreement waters of the United States and Canada. Cook Inlet falls in regulatory area 3A, which also includes a portion of the Gulf of Alaska. In Cook Inlet, this fishery primarily operates in mid and lower Inlet waters. In 2007, a total of approximately seven million pounds of halibut were landed in Kenai, Ninilchik and Homer.

<u>Recreational, Personal Use, and Subsistence Fisheries</u>
Recreational fishing is a very popular sport in Alaska, as evidenced by the intensive fishing during salmon runs and the high number of charter fishing operations. There are numerous

recreational fishing areas targeting primarily salmon, including the hundreds of drainages of the Susitna River, the Little Susitna River, the west Cook Inlet streams, the Kenai River, and areas around Anchorage such as Ship Creek. Recreational fishing for salmon in Ship Creek is the most popular stream fishery in the Anchorage area. In 2005, anglers fishing in the Anchorage area represented four percent of the total statewide sport fishing effort. In lower Cook Inlet, recreational fishing for groundfish such as halibut, rockfish and lingcod are also popular. There are even recreational fishers digging for littleneck clams, butter clams, and razor clams.

Personal use gill net fisheries occur in Cook Inlet and have been subjected to many changes since 1978 (Ruesch and Fox 1999), which are summarized in Brannian and Fox (1996). Fishing for eulachon is popular in Turnagain Arm, with no bag or possession limits. The two most significant areas where eulachon are harvested in personal use fisheries are the Twentymile River (and shore areas of Turnagain Arm near Twentymile River) and Kenai River. Other areas where eulachon are harvested include the Big and Little Susitna River and their tributaries, the Placer River, and shoreline areas of Turnagain Arm and Cook Inlet north of the Ninilchik River. Annual harvests have ranged from 2.2 to 5 tons over the past decade. The personal use harvest of eulachon is possibly under-reported as some participants may confuse their harvests as being subsistence and not personal use. Currently, no subsistence records are kept for eulachon or herring harvests (ADFG 2004).

3.2.5 Direct Mortality

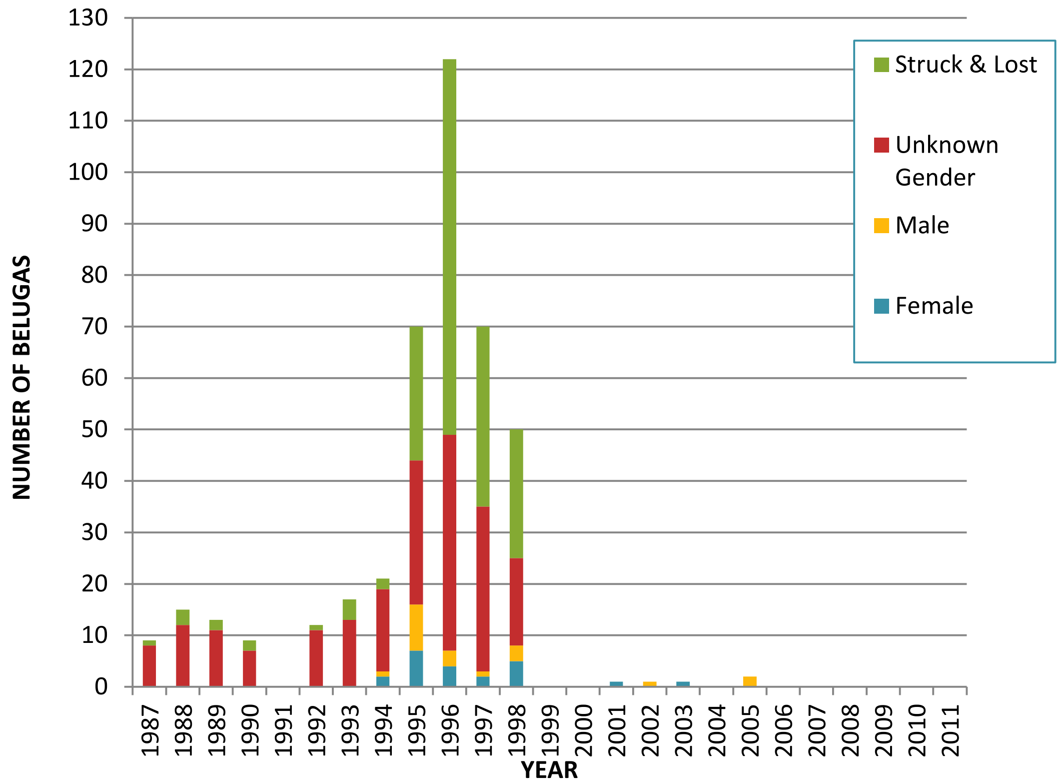
There are several means by which Cook Inlet beluga whales may die or be killed. This section summarizes the known and potential human and natural causes of direct mortality.

Subsistence Harvest

The MMPA provides an exemption from its prohibitions that allows for the harvest of marine mammals by Alaska Natives for subsistence purposes and for traditional handicrafts. The effect of past subsistence harvest practices on the Cook Inlet beluga whale population is significant. While a harvest occurred at unknown levels for decades, NMFS believes the subsistence harvest levels increased substantially in the 1980s and 1990s. Reported subsistence harvests between 1994 and 1998 can account for the estimated stock’s decline during that interval. The observed decline during that period and the reported and estimated harvest rates (including estimates of whales that were struck and lost, and assumed to have perished) indicate these harvest levels were unsustainable.

Figure 19 summarizes subsistence harvest data from 1987 to 2011 (CIMMC 1996, 1997; Angliss and Outlaw 2008; NMFS 2008b; NMFS unpubl. data). The known subsistence harvest by Alaska Natives during 1995-1998 averaged 77 beluga whales annually. The harvest, which was as high as 20 percent of the population in 1996, was sufficiently high to account for the 14 percent annual rate of decline in the population during the period from 1994 through 1998 (Hobbs et al. 2000). In 1999 there was no harvest as a result of a voluntary moratorium by the hunters that spring, with a permanent moratorium in effect in 2000 that required a cooperative agreement between NMFS and affected Alaska Native organizations for an allowable harvest. Since 2000, only five Cook Inlet belugas have been harvested for subsistence purposes, the last one in 2005.

FIGURE 19: Summary of known Cook Inlet beluga whale subsistence harvest from 1987-2011.



Poaching and Illegal Harassment

Due to their distribution within the most-densely populated region in Alaska and their approachable nature, the potential for poaching beluga whales in Cook Inlet still exists. Although NMFS maintains an enforcement presence in upper Cook Inlet, the area to cover is extensive. While poaching is a possible threat, no poaching incidents have been confirmed to date. NMFS Enforcement has investigated several reported incidences of harassment of Cook Inlet beluga whales, but to date there have been no convictions. The potential, however, for both poaching and illegal harassment exists.

Incidental Take by Fisheries

The term incidental take in regards to commercial fishing typically refers to the catch or entanglement of animals that were not the intended target of the fishing activity. Marine mammal injury or mortality reports incidental to commercial fishing operations in Cook Inlet have been obtained from fisheries reporting programs (self-reporting or logbooks), observer programs, and reports in the literature. The only reports where beluga whales were fatally taken incidental to the commercial salmon gillnet fishing in Cook Inlet are from the literature. Murray and Fay (1979) stated that salmon gillnet fisheries in Cook Inlet caught five beluga whales in 1979. Incidental take rates by commercial salmon gillnet fisheries in the Inlet were estimated at three to six beluga whales per year during 1981 – 1983 (Burns and Seaman 1986). Neither report, however, differentiated between the set gillnet and drift gillnet fisheries. There have been sporadic reports over the years of a single beluga whale becoming entangled in fishing nets (drift net and set gillnet); however, mortalities could not be confirmed.

NMFS placed observers in the commercial Cook Inlet salmon drift net and upper and lower Inlet set gillnet fisheries in 1999 and 2000. During the two years of observations, only three beluga whale sightings occurred and no beluga whale injuries or mortalities were reported. Furthermore, during the period 1990 through 2000, fishermen's voluntary self-reports indicated no beluga whale mortalities from interactions with commercial fishing. NMFS has found the current rate of direct mortality from commercial fisheries in Cook Inlet appears to be insignificant and should not delay recovery of these whales. Additionally, NMFS is unaware of any beluga whales injured or killed in Cook Inlet due to personal use, subsistence, or recreational fisheries.

Stranding

Beluga whale strandings in upper Cook Inlet are not uncommon, with most reported in Turnagain Arm. More than 700 whales stranded in upper Cook Inlet since 1988 (NMFS unpubl. data). Mass strandings (involving two or more whales) primarily occur in Turnagain Arm and Knik Arm, and often coincided with extreme tidal fluctuations ("spring tides") and twice coincided with a killer whale sighting (NMFS unpubl. data). NMFS 2006 status review (Hobbs et al. 2006) recognized that stranding was a constant threat to the Cook Inlet beluga whale recovery and determined this declining population could not easily recover from multiple mortalities that resulted from a mass stranding event.

Prolonged stranding events that lasts more than a few hours may result in significant mortalities. Over the past 10 years the average number of dead-stranded beluga whales was approximately 10 whales per year; a total of 267 - 285 live beluga whales were confirmed to have mass-stranded since 1999. Another concern is the loss of reproductive females; in 2009, four beluga whales stranded, all female and two pregnant. This has a greater impact to recovery than had all four been male. The annual abundance estimates continue to confirm a declining whale population trend and stranding events may represent a significant threat to the conservation and recovery of these whales.

Predation

Although infrequent, it has been documented that killer whales prey upon beluga whales in Cook Inlet (witnessed and necropsies). The number of killer whales reported in the upper Inlet appears to be small. There may be a single pod with five or six individuals that has extended its feeding territory into upper Cook Inlet. However, given the small population size of the Cook Inlet beluga whales, predation may have a significant effect on the beluga whales' recovery and abundance. On average one Cook Inlet beluga whale is estimated to be killed per year by killer whales (Shelden et al. 2003). Killer whale predation effects were also addressed in status reviews conducted by NMFS in 2006 and 2008 where the models demonstrated that killer whale predation on an annual basis could significantly impact recovery. In addition to directly reducing the beluga population, killer whale presence in upper Cook Inlet may also increase live stranding events. In fact, witnesses reported killer whales in Turnagain Arm during the live stranding events in August 1999 (58 – 70 whales) and September 2000 (15 – 20 whales), and one witness observed and reported the death of a beluga by a killer whale in September 2008. As such, NMFS considers killer whale predation to be a potentially significant threat to the conservation and recovery of these whales.

3.2.6 Ship Strikes

Most of Cook Inlet is navigable and used by various classes of water craft. There are eight port facilities and numerous improved and unimproved small boat launches located in Cook Inlet. Commercial shipping occurs year round, with containerships transiting between the Seattle/Puget Sound areas and Anchorage. Other commercial shipping includes bulk cargo freighters and tankers. Currently, with the exception of the Fire Island Shoals, Port MacKenzie, and POA, no other large-vessel routes or port facilities in Cook Inlet occur in high value beluga whale habitat. Beluga whales are regularly sighted in and around the POA (Rugh et al. 2005a; Cornick and Kendall 2008; POA 2009) passing near or under vessels (Blackwell and Greene 2002), indicating that these animals may have a high tolerance of large vessel traffic.

Various commercial fishing vessels operate throughout Cook Inlet, with some very intensive use areas associated with salmon and herring fisheries. Sport fishing and recreational vessels travel between Anchorage and several popular fishing streams that enter the upper Inlet.

The potential for ship strikes exists whenever ships and beluga whales are in the area at the same time. Due to their slower speed and straight-line movement, ship strikes from large vessels are not believed to pose a significant threat to Cook Inlet beluga whales. However, smaller boats that travel at high speed and change direction often present a greater threat. In Cook Inlet, beluga whales concentrate near river mouths, which predispose them to strikes by high speed watercraft associated with sport fishing and general recreation.

While ship strikes have not been definitively confirmed in a Cook Inlet beluga whale death, in October 2007 a dead whale washed ashore with “wide, blunt trauma along the right side of the thorax” (NMFS unpubl. data), which suggested a ship strike was the cause of the injury. High-speed vessels operating in beluga whale concentration areas have an increased probability of striking a whale, as evidenced by observations of Cook Inlet beluga whales with propeller scars (Burek 1999; McGuire et al. 2009, 2011). Small boats and jet skis, which are becoming more abundant in Cook Inlet, are also more likely to approach and disturb any whales that are observed.

3.2.7 Research

Research on Cook Inlet beluga whales and their habitat within Cook Inlet can also cause disturbance. Research often requires the use of boats and/or planes to conduct surveys, adding to the vessel traffic, noise, and pollution near the action area. Research conducted in the action area includes aerial surveys, satellite tagging, land- and boat based visual surveys, and passive acoustic monitoring. The information below summarizes research that has and is occurring within Cook Inlet.

Since 1993, aerial surveys conducted by NMFS occur every June, July and/or August. The primary goal of these surveys is to document abundance and distribution of beluga whales in Cook Inlet (Rugh et al. 2000, 2005a, 2005b, 2006, 2007; Shelden et al. 2008, 2009, 2010, 2011). Aerial surveys were also conducted every one to two months between June 2001 and June 2002 (Rugh et al. 2004). A small fix-winged aircraft is used to conduct the surveys and maintains an altitude of 244 m (800 ft; Rugh et al. 2005a; Hobbs et al. 2009). Aerial surveys fly at altitudes of 800 ft to reduce in-water noise from the aerial survey plane.

Between 1999 and 2002, NMFS placed satellite tags on 18 beluga whales in upper Cook Inlet (Hobbs et al. 2005). Shortly after a tagging event in 2002, a beluga whale was reported dead. NMFS was unable to recover the carcass and therefore could not visually identify and confirm that it was one of the tagged belugas; however, eight days after tagging, the flipper band identifying the whale as a tagged animal was recovered from the carcass. Data from the tag only transmitted for 32 hours. A review of data from other tags during the same field season were analyzed and indicated two other whales' tags transmitted data for less than 48 hours with similar dive patterns; these were also assumed dead.

Since 2005, researchers from LGL Alaska Research, Inc. have photographed beluga whale in upper Cook Inlet as part of a photographic-identification project on Cook Inlet beluga whales, conducted for the National Fish and Wildlife Foundation, Chevron, and Conoco Phillips Alaska, Inc. Photographs are taken from small boats and on land, and later analyzed and cataloged into an extensive database (McGuire et al. 2008, 2009, 2011). In 2011, this project was expanded to include waters of the Kenai Peninsula Borough. Boat-based surveys, such as the photo-identification study, often require the boat to come within close proximity of a whale or group of whales being studied, likely increasing noise in the immediate area.

Various researchers have deployed hydrophones and collected acoustic data at and near Eagle Bay, Cairn Point (POA), Fire Island, Beluga River, Trading Bay, Kenai River, Tuxedni Bay, and Kachemak Bay (e.g., Širović and Kendall 2009; ADFG 2011; HDR 2011; GSI 2012). Passive acoustic monitoring often requires a boat to deploy and recover hydrophones. The boat temporarily increases noise in the immediate area during deployment and recovery, which may cause disturbance to nearby beluga whales. However, once the instruments are deployed, this type of monitoring remains noninvasive because the recording devices are generally anchored on the seafloor or suspended in the water column passively recording sound from the environment.

Several development projects (ongoing and planned) have conducted research or monitored the presence of Cook Inlet belugas and marine mammals in their respective action areaa. For instance, the Knik Arm Bridge and Toll Authority (KABATA) collected baseline environmental data on beluga whale activity to be used to evaluate the potential impact of a proposed bridge crossing in Knik Arm, north of Cairn Point. Boat and land-based observations were conducted in Knik Arm from July 2004 through July 2005 (Funk et al. 2005), and in the fall of 2011, KABATA conducted a "Proof of Concept" study to test visual and acoustic methods' abilities to detect beluga whales near the project site prior to implementing the full scale monitoring once construction begins (HDR 2011). In addition to KABATA's studies, land-based marine mammal observers have been utilized for other development projects. For example, the POA utilized both construction marine mammal observers during the in-water work, and sponsored research on presence and habitat use of Cook Inlet belugas near the POA's expansion site (Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; Cornick et al. 2010). Ocean Renewable Power Company (ORPC) in 2009-2010 sponsored land-based observations from Fire Island documenting belugas near a potential hydrotidal project site (McGuire et al. 2011b).

Although research could have an effect on beluga whales, it is anticipated that research will continue to increase because there are many remaining data gaps on the biology and ecology of the Cook Inlet beluga (NMFS 2008a).

3.2.8 Environmental Change

There is now widespread consensus within the scientific community that atmospheric temperatures on earth are increasing (warming) and that this will continue for at least the next several decades. There is also consensus within the scientific community that this warming trend will alter current weather patterns. Cook Inlet is a very dynamic environment which experiences continual change in its physical composition; there are extreme tidal changes, strong currents, and tremendous amounts of silt being added from glacial scouring. For example, an experienced and knowledgeable Alaska Native beluga hunter observed that the Susitna River (an area frequented by beluga whales, especially during anadromous fish runs) has filled in considerably during the past 40 – 50 years (pers. comm. P. Blatchford 1999 via B. Smith, NMFS). This hunter told of one persistent channel in the river that was more than 40 ft deep but was filled in with sediment. Since beluga whales are still seen in the area today, they must be able to adapt to physical changes in their habitats.

The climate in Cook Inlet is driven by the Alaska Coastal Current (a low salinity river-like body of water that flows through the Pacific Ocean and along the coast of Alaska with a branch that flows into Cook Inlet) and the Pacific Decadal Oscillation (PDO). PDO is similar to El Nino except it lasts much longer (20 – 30 years in the 20th century) and switches between a warm phase and a cool phase. Phase changes of the PDO have been correlated with changes in marine ecosystems in the northeast Pacific; warm phases have been accompanied by increased biological productivity in coastal waters off Alaska and decreased productivity off the west coast of Canada and the US, whereas cold phases have been associated with the opposite pattern.

Prior to 2004 temperatures in the Gulf of Alaska were relatively stable, but in mid 2004 temperatures warmed and stayed warm until late 2006. Sampling of oceanographic conditions (via GAK-1) just south of Seward, Alaska has revealed anomalously cold conditions in the Gulf of Alaska beginning winter of 2006 – 2007; “deep (more than 150m) temperatures are the coldest observed since the early 1970s” (Weingartner 2007). Deep water temperatures are anticipated to be even colder in winter 2007 – 2008 due to deep shelf waters remaining cold throughout the 2007 summer, and Gulf of Alaska temperatures in spring 2008 are predicted to be even colder than in spring 2007 (Weingartner 2007).

The change in water temperature may in turn affect zooplankton biomass and composition. Plankton is mostly influenced by changes in temperature, which may affect their metabolic and developmental rates, and possibly survival rates (Batten and Mackas 2007). Data collected by Batten and Mackas (2007) demonstrated that mesozooplankton (planktonic animals in the size range 0.2 – 20 mm) biomass was greater in warm conditions, and that zooplankton community composition varied between warm and cool conditions, thus potentially altering their quality as a prey resource. In Cook Inlet, mesozooplankton biomass has increased each year from 2004 to 2006; however, sampling from late 2006 to early 2007 suggests biomass values are decreasing; a change most certainly driven by changes in climate (Batten and Mackas 2007). Therefore, changes in temperature effect changes in zooplankton, which in turn may influence changes in fish composition, and hence, alter the quality and types of fish available for beluga whales. While El Nino events have the potential to affect sea surface temperatures, the effects from the

1998 El Nino warming event in lower Cook Inlet were lessened by upwelling and tidal mixing at the entrance to Cook Inlet (Piatt et al. 1999). It is likely that the physical structure of Cook Inlet and its dominance by freshwater input act to buffer these waters from periodic and short-term El Nino events.

Beluga whale use of Cook Inlet, and particularly, feeding habitat, has been correlated to the presence of tidal flats and related bathymetry. Their preference for shallow waters found in Knik Arm, Turnagain Arm, and the Susitna Delta undoubtedly relates to feeding strategy, as has been reported for beluga whales in Bristol Bay (Fried et al. 1979). Frost et al. (1983) theorized beluga whales' feeding efficiencies improve in relatively shallow channels where fish are confined or concentrated. There is evidence these areas are being lost through the deposition of glacial materials. The senescence of these habitats will likely reduce the capacity of the upper Inlet to provide the needs for this population.

At this time however, the data are insufficient to assess effects (if any exist) from environmental change on Cook Inlet beluga whale distribution, abundance, or recovery.

4. EFFECTS OF THE ACTION

Here we consider the specific aspects of the 3D Seismic Program that may adversely affect Steller sea lions, Cook Inlet beluga whales, and Cook Inlet beluga whale critical habitat. These effects include both direct and indirect effects (effects occurring later in time).

Components of the seismic program would result in impacts that would co-occur in space and time with Steller sea lions and beluga whales. In this section, we describe the probable risks of the seismic program on individual sea lions and beluga whales and then integrate those individual risks to identify consequences to the populations. We examined the best scientific and commercial data available to determine whether and how these individuals and this population are likely to respond given the adverse impacts associated with the seismic program. We measure risks to individuals using their "fitness," the ability to survive and reproduce. In particular, we examine the scientific data available to determine if an individual's probable responses to the action's effects are likely to have consequences for the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When individual animals exposed to an action's effects are expected to experience reductions in fitness, we would expect reductions in the abundance, reproduction rates, or growth rates (or increase the variance in these measures) of the population those individuals represent. On the other hand, when animals are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations.

In determining whether individual Cook Inlet beluga whales or Steller sea lions would be affected, it is necessary to analyze when, where, and how an animal would be exposed to the various activities associated with the seismic program. Many biological aspects of Cook Inlet beluga whales are not well known or understood. During the analysis, several assumptions were made about their habitats, hearing abilities, and behaviors to reach the conclusions. For most situations, there is some information to apply to Cook Inlet beluga whales, but for those with little to no data, we erred on the side of species. To avoid Type II errors, i.e., concluding that the animal was not affected when in fact it was in situations with many unknowns or uncertainties, we assumed an effect would occur, thereby giving the "benefit of the doubt" to the species.

4.1 Direct Effects of the Action

Direct effects defined under the ESA are immediate effects caused by the proposed action and occurring concurrently with the proposed action. The proposed seismic program may directly affect Cook Inlet belugas and Steller sea lions by introducing noise into the environment, increasing the potential for direct injury from ship strikes and falling/ascending nodes, by increasing the number of vessels in Cook Inlet and thus potential for oil spills from vessels, and temporary habitat disturbance.

4.1.1 Noise

Since 1997, NMFS has been using generic sound exposure thresholds to determine when an activity in the ocean produces sound potentially resulting in impacts to a marine mammal and causing take by harassment (70 FR 1871). NMFS has used 160 db re: 1 μPa_{RMS} and 180 dB re: 1 μPa_{RMS} as proxies for prohibited "take" under the MMPA. New science-based thresholds to improve and replace the current generic exposure level thresholds may be considered in the future but new criteria have not been finalized (Southall et al. 2007). The current Level A (injury) threshold for impulse noise (e.g., seismic airgun shots) is 180 dB for cetaceans (whales, dolphins, and porpoises) and 190 dB for pinnipeds (seals, sea lions). These criteria were established before information was available about minimum received levels of sound that would cause auditory injury in cetaceans. They are not frequency specific and therefore are often lower than necessary, and are intended to be precautionary estimates below which no physical injury will occur (Southall et al. 2007). The current Level B (disturbance) threshold for impulse noise is 160 dB for cetaceans and pinnipeds.

Southall et al. (2007) recently drafted acoustic guidelines for 126 species of marine mammals, divided into five functional hearing groups, for three categories of anthropogenic noise: single pulse, multiple pulse, and non-pulse. According to this study, referred to earlier as well, the relevance of the 160 dB disturbance criterion is not well established. Animals exposed to either natural or anthropogenic sound may experience physical and psychological effects, ranging in magnitude from none to severe, depending upon spatial relationships between the sound source and the animal receiver, sensitivity of the receiver, received exposure level, duration, and many other factors (Southall et al. 2007; Richardson 1995). The same acoustic source may have radically different effects depending on operational and environmental variables, and on the physiological, sensory, and psychological characteristics of exposed animals. In many cases, specific acoustic features of the sound and contextual variables (e.g., proximity, subject experience and motivation, duration, or recurrence of exposure) may be of considerably greater relevance to the behavioral response than simple acoustic variables such as the received sound level. These factors make it difficult to base broad, objective determinations of impact thresholds on received levels alone (Southall et al. 2007).

There is new research to suggest that the 160 dB behavioral harassment and 180 dB injury levels currently accepted by NMFS might be significantly below the noise levels that actually harass or injure beluga whales. Southall et al. (2007) estimated that beluga whales subjected to single pulse or multiple pulse events would theoretically not be injured until sound pressure levels reach 230 dB re: 1 μPa or greater. Southall et al. (2007) recommends peak sound pressure values of 224 dB re: 1 μPa as “behavioral” disturbance criteria for beluga whales (a mid frequency cetacean), and 212 dB re: 1 μPa for Steller sea lions (pinnipeds in-water value).

In Cook Inlet, marine mammals must compete acoustically with natural and anthropogenic sounds. Human-induced noises include large and small vessels, aircraft, oil and gas drilling, marine seismic surveys, pile driving, shore based activities, dredging, filling, and other events. The effects of human-caused noise and associated increased background noises on beluga whales and Steller sea lions depend on several factors including the intensity, frequency, and duration of the noise, the location and behavior of the animal, and the nature of the acoustic environment. High frequency noise diminishes more rapidly than low frequency noises. Sound also dissipates more rapidly in shallow waters and over soft bottoms (sand and mud). Much of Cook Inlet is characterized by its shallow depth, sand/mud bottoms, and high background noise from currents and glacial silt (Blackwell and Greene 2002), thereby making it a poor environment for propagating acoustics.

4.1.1.1 General Effects of Noise

Janssen (1980) describes three levels of noise impacts on wildlife. Primary effects result in damage to hearing organs and a temporary or permanent hearing loss. Secondary effects result in behavior alteration (including startle response or movement away from the noise) or inducement of the physiological stress response. Tertiary effects result in population-level changes including increased mortality, reduced reproductive rate, or habitat abandonment. The potential for these effects is extremely hard to quantify since there are many variables affecting the actual exposure of whales at any given time, and whale sensitivity to specific sounds at specific frequencies is not well understood. While some observers have noted that beluga whales are very sensitive to noise, in more heavily trafficked areas there is evidence of habituation to anthropogenic noise.

Primary Effects
According to Southall et al. (2007), no data exist on exposures that would cause permanent auditory injury of odontocetes (primary effects). Limited data on captive marine mammals exposed to various kinds of noise suggest that auditory fatigue (an increased hearing threshold, i.e., poorer sensitivity temporarily for some period of time following exposure) onset occurs at levels which may be below those required for direct non-auditory physiological trauma.

Secondary Effects
Secondary effects (those resulting in behavior alteration or inducement of the physiological stress response) are generally more variable, context-dependent, less predictable than effects from noise exposure on hearing or physiology, and dependent on a suite of internal and external factors which may result in varying degrees of significance (NRC 2005; Southall et al. 2007). Internal factors include: (1) individual hearing sensitivity, activity pattern, and motivational and behavioral state (e.g., feeding, traveling) at the time it receives the stimulus; (2) past exposure of the animal to the noise, which may lead to habituation or sensitization; (3) individual noise tolerance; and (4) demographic factors such as age, gender, and presence of dependent offspring. External factors include: (1) non-acoustic characteristics from the sound source (e.g., if it is moving or stationary); (2) environmental variables (e.g., substrate) which influence sound transmission; and (3) habitat characteristics and location (e.g., open ocean vs. confined area). Thus, behavioral responses to sound are highly variable and context-specific. It has proven to be exceedingly challenging to establish a generally accepted definition of biologically meaningful behavioral disturbance (NRC 2005). Peak sound pressure values of 224 dB re: 1 μPa are recommended as "behavioral" disturbance criteria for beluga whales by Southall et al. (2007).

Tertiary Effects
Tertiary effects, *i.e.*, those resulting in population-level changes including increased mortality, reduced reproductive rate, or habitat abandonment, are also not well understood. A metric for the impacts from noise exposure on critical biological parameters such as growth, survival and reproduction is needed. Unfortunately, as Wartzok et al. (2004) points out, no such metric is currently available, and it is likely to take decades of research to provide the analytical framework and empirical results needed to create such a metric, if one in fact is ultimately even viable (Southall et al. 2007).

The distances to which sounds are audible depend on source level and frequency, ambient noise levels, physical habitat characteristics (e.g., water temperature, depth, substrate type), and sensitivity of the receptor (Richardson 1995). Impacts to beluga whales and sea lions exposed to loud sounds include possible mortality (either directly from the noise or indirectly based on the reaction to the noise), injury and/or disturbance ranging from severe (e.g., permanent abandonment of vital habitat) to mild (e.g., startle).

There are increasing indications that gas-bubble disease (analogous to "the bends") could be a pathologic mechanism for the strandings and mortality of some deep-diving cetaceans, such as beaked whales, exposed to sonar. The evidence for this remains circumstantial and is associated with exposure to naval mid-frequency sonar, not seismic surveys (Cox et al. 2006; Southall et al. 2007). One of the hypothesized mechanisms by which naval sonars lead to strandings might, in theory, also apply to seismic surveys: If the strong sounds sometimes cause deep-diving species, such as beaked whales, to alter their surfacing-dive cycles in a way that causes bubble formation in tissue, that hypothesized mechanism might apply to seismic surveys as well as mid-frequency naval sonars. However, there is no specific evidence of this as a result of exposure to airgun pulses. Seismic pulses and mid-frequency sonar signals are quite different, and some mechanisms by which sonar sounds have been hypothesized to affect beaked whales are unlikely to apply to airgun pulses. Typical military mid-frequency sonars emit non-impulse sounds at frequencies of 2-10 kHz, generally with a relatively narrow bandwidth at any one time (though the frequency may change over time), whereas sounds produced by airgun arrays are broadband impulses with most of the energy below 1 kHz. Thus, it is not appropriate to assume that the effects of seismic surveys on beaked whales, or other species such as belugas, would be the same as the apparent effects of military sonar. For example, resonance effects (Gentry 2002) and acoustically-mediated bubble-growth (Crum et al. 2005) are implausible in the case of exposure to broadband airgun pulses. Additionally, it is unlikely that effects such as gas-bubble disease seen in beaked whales, which are deep-diving cetaceans, would be the same for the relatively shallow diving Cook Inlet beluga whales.

Seismic survey activities could cause behavioral harassment; however, neither physical injury nor mortalities (often described as Level A takes) are anticipated due to the nature of the operations, the marine mammals potentially exposed, and mitigation measures.

In general, noise associated with seismic surveys has the potential to harass beluga whales and sea lions that may be present around the specific action area. Marine mammals use sound for vital life functions, and introducing sound into their environment could be disrupting to those behaviors. Sound (hearing and vocalization/echolocation) serves four main functions for odontocetes (toothed whales and dolphins). These include: (1) providing information about their environment; (2) communication; (3) enabling remote detection of prey; and (4) enabling detection of predators. Introducing noise into the environment may cause hearing impairment, non-auditory physiological effects, or behavioral effects.

<u>Hearing Impairment</u>

Temporary or permanent hearing impairment is a possibility when marine mammals are exposed to very loud sounds. Hearing impairment is measured in two forms: temporary threshold shift (TTS) and permanent threshold shift (PTS).

Temporary threshold shift is the mildest form of hearing impairment that can occur during exposure to loud sound (Kryter 1985). It is not considered to represent physical injury, as hearing sensitivity recovers relatively quickly after the sound ends. It is, however, an indicator that physical injury is possible if the animal is exposed to higher levels of sound. The onset of TTS is defined as a temporary elevation of the hearing threshold by at least 6 dB (Schlundt et al. 2000).

Because noise from the seismic survey would not be a one-time exposure, as with most human development and exploration activities, a time component must be incorporated into any effects analysis. Experiments with marine mammals show a nearly linear relationship between sound exposure level and duration of exposure: the longer an animal is exposed, the lower the level required to produce TTS (Kastak & Schusterman 1999; Schlundt et al. 2000; Nachtigall et al. 2003). Using auditory evoked potentials (AEP) methods, Natchigall et al. (2004) found TTS of approximately 4 to 8 dB following nearly 50 minutes of exposure to the same frequency noise (center frequency 7.5 kHz) at 160 dB re: 1 μPa-m (193-195 dB re: 1 μPa2-s [SEL]). TTS recovery occurred within minutes or tens of minutes.

Permanent threshold shift is defined as "irreversible elevation of the hearing threshold at a specific frequency" (Yost 2000). It involves physical damage to the sound receptors in the ear and can be either total or partial deafness or impaired ability to hear sounds in specific frequency ranges (Kryter 1985). Some causes of PTS are severe extensions of effects underlying TTS (e.g., irreparable damage to sensory hair cells). The onset of PTS is determined by pulse duration, peak amplitude, rise time, number of pulses, inter-pulse interval, location, species, and health of the receivers ear (Ketten 1994). PTS is presumed to be likely if the hearing threshold is reduced by 40 dB (i.e., 40 dB of TTS) (Southall et al. 2007). PTS has never been induced in marine mammals despite some hearing threshold studies exposing beluga whales to pulses up to 208 dB (Finneran et al. 2002), 28 dB louder than NMFS's current Level A (injury) harassment threshold.

Non-Auditory Physiological Effects

Non-auditory physiological effects or injuries that theoretically might occur in beluga whales exposed to strong underwater sound include stress, neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage.

Romano et al. (2004) demonstrated that belugas exposed to seismic water gun and (or) single pure tones (SPLs up to 201 dB) resembling sonar pings showed increased stress hormone levels of norepinephrine, epinephrine, and dopamine. However, in two studies, exposure of captive beluga whales to playbacks of drilling noise did not result in increased levels of (stress-related hormones) (API 1986; Thomas et al. 1990). Wright et. al (2007) concluded that anthropogenic noise, either by itself or in combination with other stressors, can reduce the fitness of individual marine mammals and decrease the viability of some marine mammal populations. The available literature suggests stress hormone levels may be affected by noise exposure, but that the results are highly variable and dependent (in part) upon factors such as the duration, frequency, and intensity of sound, the species of marine mammal, the individual's response, and the amount of control the individual has over the stressor. The physiological effects of any elevation in hormone levels are equally variable.

Studies have also demonstrated that reactions of animals to sounds could result in physical injury. It has recently been reported that stranded deep diving marine mammals displayed physical attributes similar to the bends (e.g., in vivo gas bubble formation) (Fernandez et al. 2004, 2005). Marine mammals may experience these symptoms if surfacing rapidly from deep dives in response to loud sounds. However, because Cook Inlet is generally a shallow water estuary, marine mammals found there are not considered deep divers, and due to proposed mitigation measures, non-auditory physiological impacts, other than stress, are not expected.

Behavioral Effects

Behavioral responses of marine mammals to noise are highly variable and depend on a suite of internal and external factors which in turn results in varying degrees of significance (Southall et al. 2007). Internal factors include: (1) individual hearing sensitivity, activity pattern, and motivational and behavioral state (e.g., feeding, traveling) at the time it receives the stimulus; (2) past exposure of the animal to the noise, which may lead to habituation or sensitization; (3) individual noise tolerance; and (4) demographic factors such as age, sex, and presence of dependent offspring. External factors include: (1) non-acoustic characteristics of the sound source (e.g., if it is moving or stationary); (2) environmental variables (e.g., substrate) which influence sound transmission; and (3) habitat characteristics and location (e.g., open ocean vs. confined area). There are no consistent observed threshold levels at which beluga whales respond to an introduced sound. Beluga whale responses to sound stimuli have been noted to be highly dependent upon behavioral state and motivation to remain or leave an area. Few field studies involving stationary industrial sounds have been conducted on beluga whales. Reactions of belugas in those studies varied. For example, in Awbrey and Stewart (1983) (as summarized in Southall et al. [2007]), recordings of noise from SEDCO 708 drilling platform (non-pulse) were projected underwater at a source level of 163 dB. Beluga whales less than 1.5 km from the source usually reacted to onset of the noise by swimming away (Received Levels (RL) approximately 115.4 dB). In two instances groups of whales that were at least 3.5 km from the noise source when playback started continued to approach (RLs approximately 109.8 dB). One group approached within 300 m (RLs approximately 125.8 dB) before all or part turned back. The other group submerged and passed within 15m of the projector (RL approximately 145.3 dB). TTS experiments have also documented behavioral responses by trained belugas. These responses included reluctance to return to experimental stations when exposed to watergun pulse sounds projected 4.5m from the subject at approximately 185.3 dB (171 dB re 1 μPa2-s [SEL]) (Finneran et al. 2002) and behavioral changes when exposed to sounds from the explosion simulator at approximately 200 dB (177 dB re 1 μPa2-s [SEL]) (Finneran et al. 2000). In a non-pulse exposure experiment (i.e., 1 s tones), belugas displayed altered behavior when exposed to 180-196 dB (180-196 dB re 1 μPa2-s [SEL]) (Schlundt et al. 2000).

Many marine mammals, including beluga whales, perform vital functions (e.g., feeding, resting, traveling, socializing) on a diel (i.e., 24 hr) cycle. Repeated or sustained disruption of these functions is more likely to have a demonstrable impact than a single exposure (Southall et al. 2007). However, it is possible that marine mammals exposed to repetitious sounds from the proposed seismic program may become habituated or tolerant after initial exposure to these sounds, as demonstrated by belugas' tolerance to vessels (Richardson 1995; Blackwell and Green 2002). Habituation is found to be common in marine mammals faced with introduced sounds in their environment. For example, bowhead whales (*Balaena mysticetus*) have continued to use pathways where drilling ships are working (RLs: 131 dB re: 1 μPa) so that they can continue their eastward migration (Richardson 1995). Harbor porpoise, dolphins, and seals have become habituated to acoustic harassment deterrent devices such as pingers and seal bombs after repeated exposure (Mate and Harvey 1987; Cox et al. 2001). Beluga whales appear to be relatively tolerant of intensive fishing vessel traffic in Bristol Bay, Alaska, and beluga whales are commonly seen during the summer at the POA, even during periods of intensive construction (Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; Cornick et al. 2010).

Masking of whale calls or other sounds potentially relevant to whale vital functions may occur. Southall et al. (2007) defines auditory masking as the partial or complete reduction in the audibility of signals due to the presence of interfering noise with the degree of masking depending on the spectral, temporal, and spatial relationships between signals and masking noise as well as the respective received levels. Masking occurs when the background noise is elevated to a level which reduces an animal's ability to detect relevant sounds. Belugas are known to increase their levels of vocalization as a function of background noise by increasing call repetition and amplitude, shifting to higher frequencies, and changing structure of call content (Lesage et al. 1999; Scheifele et al. 2005). Another adaptive method to combat masking was demonstrated in a beluga whale which reflected its sonar signal off the water surface to ensonify an object on which it was trained to echolocate (Au et al. 1985). Due to the low frequencies of the seismic noise, intermittent use of the seismic airguns (2.5 hours around slack tides), and the ability of belugas to adapt vocally to increased background noise, it is anticipated that masking, and therefore interruption of behaviors such as feeding and communication, are unlikely to occur (see discussion on page 66).

4.1.1.2 Effects from Airgun Noise

Marine mammals close to underwater detonations of high explosives can be killed or severely injured, and the auditory organs are especially susceptible to injury (Ketten et al 1993; Ketten 1995). However, explosives are no longer used in marine waters for commercial seismic surveys or (with rare exceptions) for seismic research; they have been replaced by airguns and other non-explosive sources. Airgun pulses are less energetic and have slower rise times, and NMFS is not aware of any direct evidence that they have caused serious physical injury, death, or stranding of any marine mammal, including beluga whales, even in the case of large airgun arrays.

Studies have shown that pulsed sounds from airguns are often readily detectable in the water at distances of many kilometers (Richardson and Würsig 1997; Goold and Fish 1998), but they do not necessarily cause behavioral disturbances. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, environmental conditions, and many other factors (Richardson 1995; Southall et al. 2007). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a short distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or the species as a whole. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on the animals could be significant (e.g., Weilgart 2007). Displacement from important feeding/breeding areas are not anticipated from the proposed seismic activity since the majority of the primary feeding and suspected breeding areas are located outside of the action area, except for the Susitna Delta area, which is scheduled to be surveyed after peak feeding and breeding periods (May-September).

Numerous studies have shown that marine mammals at distances over a few kilometers from operating seismic vessels often show no apparent response. That is often true even when pulsed sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to temporarily react behaviorally to airgun pulses under some conditions, at other times they have shown no overt reactions. In general, pinnipeds and small odontocetes are more tolerant of exposure to airgun pulses than baleen whales. The sound criteria used to estimate how many marine mammals might be disturbed to some biologically important but unknown degree by a seismic program are based on behavioral observations during studies of several species, including gray whales, bowhead whales, and ringed seals. The criteria established for these marine mammals, which are applied to other marine mammals, are conservative and have not been demonstrated to significantly affect individuals or populations of marine mammals in Alaska waters. For example, monitoring of seismic work within the Beaufort and Chukchi Seas has indicated that exposures to these levels of noise have not resulted in serious injury or mortality, changes in localized abundance, or changes in the growth or recovery of these stocks.

Behavioral Responses of Cook Inlet beluga whales

Little systematic information is available about reactions of beluga whales to noise pulses. In auditory studies that exposed captive beluga whales to strong, pulsed sounds similar in duration to those typically used in seismic surveys, the belugas exhibited changes in behavior (Finneran et al. 2000, 2002, 2005). Sometimes the belugas vocalized after such exposure and were reluctant to return to the test site for subsequent exposures (Finneran et al. 2002). However, some animals have tolerated high received levels of sound (peak–peak level >200 dB re: 1 μPa) before exhibiting aversive behaviors (Richardson 1995). Some belugas summering in the Eastern Beaufort Sea may have avoided a specific area of seismic operations (2 arrays with 24 airguns per array) by 10 to 20 km, although belugas occurred as close as 1,540 m to the line of seismic operations (Miller et al. 2005).

The response of beluga whales to the seismic program is difficult to accurately predict. The most likely beluga whale response to seismic noise is expected to be short-term, localized avoidance. For example, beluga whales in the MacKenzie River estuary in the Beaufort Sea moved away during construction on an artificial island, but did not leave the area of construction (Richardson 1995). Examples from scientific studies and opportunistic sightings suggest that belugas are tolerant of in-water noise; Cook Inlet beluga whales have continued to use habitat in Knik Arm despite heavy disturbance and underwater noise from maritime operations, maintenance dredging, aircraft operations, and pile driving for the Port of Anchorage expansion. This beluga whale behavior may, however, be taken as evidence of a possible high motivation to reach important habitat in Knik Arm, rather than as an indication that the noise is not bothersome to the whales. Some beluga whales repeatedly exposed to noise may habituate to the sounds and, upon subsequent exposures, may not change their behavior or distribution when exposed to those sounds; the proposed seismic activities may not have substantial effects on these habituated individuals.

It is possible that some individual Cook Inlet beluga whales will avoid areas actively or recently surveyed by Apache. However, beluga whales' fidelity to feeding, molting, and calving areas, coupled with the exhibited tolerance of individual belugas to in-water noise, indicates that they will likely continue to access these sites once the surveys in the area are completed.

Masking of marine mammal calls and other natural sounds are expected to be limited, although there are very few specific data of relevance. Some whales are known to continue calling in the presence of seismic pulses. Their calls can be heard between seismic pulses (e.g., Richardson et al. 1986; McDonald et al. 1995; Greene et al. 1999; Nieukirk et al. 2004). Masking effects of seismic pulses are expected to be negligible in the case of the beluga, given the intermittent nature of seismic pulses and that the sounds important to belugas are predominantly at much higher frequencies than are airgun sounds. Therefore, the potential problem of auditory masking for beluga whales is diminished by the small amount of overlap between frequencies produced by seismic and other industrial noise (<1 kHz) and frequencies which beluga whales call (0.26-20 kHz) and echolocate (40-60 kHz and 100-120 kHz) (Blackwell and Greene 2002).

Hearing Impairment in Cook Inlet beluga whales

The RMS level of an airgun pulse is typically 10-15 dB higher than the SEL for the same pulse when received within a few km of the airguns. A single airgun pulse might therefore need to have a received level of approximately 196-201 dB re: 1 μPa_{RMS} to produce brief, mild TTS. Exposure to several strong seismic pulses, each with a flat-weighted received level near 190 dB RMS (175-180 dB SEL) could result in cumulative exposure of approximately 186 dB SEL and thus slight TTS in a beluga. When estimating the amount of sound energy required for the onset of TTS, it is generally assumed that the effect of a given cumulative SEL from a series of pulses is the same as if that amount of sound energy were received as a single strong sound (Southall et al. 2007). However, some recovery may occur between pulses and it is not currently known how this may affect TTS threshold. More data are needed in order to determine the received levels at which belugas would start to incur TTS upon exposure to repeated, low-frequency pulses of airgun sound with variable received levels. For example, the total energy received by an animal will be a function of received levels of airgun pulses as an airgun array approaches, passes at various distances and moves away (e.g., Erbe and King 2009).

The relationships between TTS and PTS thresholds have not been studied in marine mammals and there is currently no evidence that exposure to airgun pulses can cause PTS in any marine mammal. However there has been speculation about that possibility (e.g. Richardson 1995; Gedamke et al. 2008). It is unlikely that a marine mammal would remain close enough to a large airgun array long enough to incur PTS. Southall et al. (2007) estimate that beluga whales subjected to single pulse or multiple pulse events would theoretically not be injured until sound pressure levels reach 230 dB re: 1 μPa or greater, well above the current NMFS threshold for injury (180 dB).

Behavior Response of Steller sea lions

While there are no published data on seismic effects on sea lions, anecdotal data and data on arctic seals indicate that sea lions and other pinnipeds generally tolerate strong noise pulses (Richardson 1995). Monitoring studies in the Alaskan and Canadian Beaufort Sea during 1996–2002 provided considerable information regarding behavior of arctic seals exposed to seismic pulses (Miller et al. 2005; Moulton and Lawson 2002). These seismic projects usually involved arrays of 6 to 16 with as many as 24 airguns with total volumes 560 to 1500 cui. The combined results suggest that some seals avoid the immediate area around seismic vessels. In most survey years, ringed seal sightings tended to be farther away from the seismic vessel when the airguns were operating than when they were not (Moulton and Lawson 2002). However, these avoidance movements were relatively small, on the order of 100 m (328 ft) to (at most) a few hundred meters, and many seals remained within 100 to 200 m (328 to 656 ft) of the trackline as the operating airgun array passed by them. Seal sighting rates at the water surface were lower during airgun array operations than during no-airgun periods in each survey year except 1997. Miller et al. (2005) also reported higher sighting rates during non-seismic than during line seismic operations, but there was no difference for mean sighting distances during the two conditions nor was there evidence ringed or bearded seals were displaced from the area by the operations. The operation of the airgun array had minor and variable effects on the behavior of seals visible at the surface within a few hundred meters of the array. The behavioral data from these studies indicated that some seals were more likely to swim away from the source vessel during periods of airgun operations and more likely to swim towards or parallel to the vessel during non-seismic periods. No consistent relationship was observed between exposure to airgun noise and proportions of seals engaged in other recognizable behaviors, e.g., "looked" and "dove". Such a relationship might have occurred if seals seek to reduce exposure to strong seismic pulses, given the reduced airgun noise levels close to the surface where "looking" occurs (Miller et al. 2005; Moulton and Lawson 2002).

Consequently, by using the responses of bearded, ringed, and spotted seals (least amount of data on reaction to seismic operations) to seismic operations as surrogates for sea lions, it is reasonable to conclude that the extremely small numbers of sea lions possibly occurring in the action area during seismic operations are not likely to show a strong avoidance reaction to the proposed airgun sources. Pinnipeds rarely avoid the area within a few hundred meters of operating airgun arrays, even for airgun arrays much larger than those planned for the proposed project (e.g., Harris et al. 2001). Reactions are expected to be very localized and confined to relatively small distances and durations, with no long-term effects on individuals or populations.

While there are no published data on seismic effect on sea lions, anecdotal data and data on arctic seals indicate that sea lions and other pinnipeds generally tolerate strong noise pulses (Richardson 1995).

<u>Hearing Impairment in Steller sea lions</u>

The auditory response of pinnipeds to underwater pulsed sounds has been examined in only one study. Finneran et al. (2003) measured TTS onset in two captive California sea lions exposed to single underwater pulses produced by an arc-gap transducer. No measurable TTS was observed following exposures up to a maximum level of 183 dB re: 1 μPa peak-to-peak (SEL 163 dB re: 1μPa2s).

<u>Summary of Airgun Noise Effects</u>

Most of the nearshore areas of Cook Inlet are poor acoustic environments because of their shallow depth, soft bottoms, and high background natural noise from currents and glacial silt. These factors greatly reduce the distance sound travels (Blackwell and Greene 2002).

Although seismic-related activities will occur 24 hours per day, in-water airguns will be active for approximately 2.5 hours during each of the slack tide periods (~ four per 24 hour period); therefore, source acquisition may be active intermittently for 10-12 hours per day (not continuously for 24 hours per day as is seismic in the Arctic). In addition, monitoring and mitigation measures implemented during seismic surveys are designed to detect cetaceans and other marine mammals near the airgun array and avoid exposing them to sound pulses that may cause hearing impairment. For example, the seismic operator will gradually ramp- up airgun arrays after an extended shut-down, which should allow animals near the airguns at startup time to move away from the source. These factors combined with the fact that many marine mammal species avoid ships and/or seismic operations should be sufficient to avoid causing hearing impairment in Cook Inlet beluga whales and Steller sea lions. If animals do incur TTS, it is a temporary and reversible phenomenon, unless exposure exceeds the TTS-onset threshold by an amount sufficient to cause PTS. To date, no documentation exists of PTS or TTS in free ranging marine mammals exposed to airgun pulses.

The noise from the seismic program and effects this activity would have on ambient underwater noise will be temporary. Based on sound modeling presented in the Biological Assessment, sound associated with the seismic program, using the largest 2,400 cui airgun array, will attenuate to below the acoustic harassment threshold (160 dB re: 1 μPa_{RMS}) at a distance of 6.41 km from the seismic source and 1.42 km for the injury threshold (180 dB re: 1 μPa_{RMS}). Based on data from the aforementioned studies, the fact that seismic pulses would occur only for short intervals of time over a 24 hour period, and animals would not be exposed to sound levels at or above 180 dB due to proposed mitigation, NMFS AKR anticipates that TTS, if it does occur, would not last more than a few minutes and would not likely result in impacts to vital life functions such as communication and foraging.

The seismic program is not scheduled to occur in areas of the upper Cook Inlet (critical habitat area 1) in the summer, when over 95% of the beluga population is concentrated. The lower reaches of critical habitat area 1 along the western coast may be surveyed in the spring, but the majority of the activity in critical habitat area 1 is planned for late fall and early winter (see Figure 6). Although areas in the Susitna Delta are scheduled to be surveyed, the timing of these surveys (late fall, after mid-October) is after the end of the anadromous fish runs and the high use by belugas; the high value areas of Knik Arm and Turnagain Arm are not part of the seismic program. Additionally, in recognition of the importance of river mouths for feeding, Apache has committed to conducting aerial surveys of river mouths prior to commencing operations in those areas to reduce the potential for disturbing feeding whales at river mouths.

The temporary loss of habitat for use by marine mammals as a result of noise from the seismic surveys is a possibility. However, avoidance behaviors are expected to be very short term since the use of the large airgun arrays will be sporadic (2.5 hours around slack tides) and localized in small areas. Mitigation measures are incorporated into the project description that reduce impacts to the whales, including not operating in important feeding areas or when there are large congregations of whales present. Given the apparent site fidelity belugas have to certain areas, it is anticipated that once the noise in the area has ceased, any displaced whales that were actively using the area should return if it was an area important to them. Thus, at most there would be a temporary, short-term (matter of days) displacement from habitat to a small number of belugas, and to a lesser extent, Steller sea lions if any are in the area.

Noise from the airguns associated with the proposed Cook Inlet 3D Seismic Program is likely to have the greatest impact to these species over any other aspect of the proposed action. Although NMFS is not aware of any direct evidence that noise from airguns has caused serious physical injury, death, or stranding of any marine mammal, even in the case of large airgun arrays, noise from the airguns associated with this project **may affect, and is likely to adversely affect** beluga whales (and Steller sea lions if present) in the action area; however, the seismic activity will be short-term and localized, and Apache will implement the mitigation measures previously described to reduce effects from noise associated with the seismic activity.

4.1.1.3 Effects from Vessel Noise

Vessels will be used for support and transport during the Cook Inlet 3D Seismic Program. Vessel noise associated with the seismic program will be transmitted through water and constitutes a continuous noise source (versus an impulse noise). Marine mammal responses to vessels are generally associated with noise and depend on changes in the engine and propeller speed (Richardson 1995). As with aircrafts, visual cues may contribute to marine mammals' reactions to nearby vessels (Richardson 1995). Broadband source levels for tugs have been measured at 145 to 170 dB re: 1 µPa, and 170 to 180 dB re: 1µPa for small ships and supply vessels (Richardson 1995). Based on data for vessels proposed for use during construction of the Knik Arm bridge, the loudest vessel noise associated with that project would be produced by ships ranging in length from 55 to 85 m (180 to 279 feet), with source levels ranging from 170 to 180 dB re: 1 µPa. Sound from a vessel of that size would attenuate below 125 dB re: 1 µPa between 86 m and 233 m (282 and 764 feet) from the source. All of the vessels used in the proposed seismic program will be smaller than that size; the largest vessel proposed for the seismic program is 135 x 30 ft and will likely be quieter than the vessels proposed for the bridge construction given their smaller size. The amount of noise from the small number of seismic-related vessels (six acquisition vessels and two personnel transport vessels) is expected to be insignificant.

<u>Beluga responses to vessel noise</u>
Odontocetes often show tolerance to vessel activity; however, they may react at long distances if they are confined by ice, shallow water, or were previously harassed by vessels (Richardson 1995). Beluga whale responses to vessels noise varies greatly from tolerance to extreme sensitivity depending on whale activities and experience, habitat, boat type, and boat behavior (Richardson 1995). Reactions may include behavioral responses, such as altered headings or avoidance (Blane and Jaakson 1994; Erbe and Farmer 2000); fast swimming; changes in vocalizations (Lesage et al. 1999, Scheifele et al. 2005); and changes in dive, surfacing, and respiration patterns.

Lesage et al. (1999) observed changes in the vocal behavior of beluga whales in the presence of a 7 m (23 ft) vessel powered by two 70 horsepower (HP) engines and a 2,173 gross-ton ferry 80 m (260 ft) long with two 2,000 HP engines each fitted with a propeller 235 cm in diameter. Vocal responses included a reduction in call rate, an increase in emissions of certain call types, repetition of specific calls and a shift in frequency bands. Responses occurred more frequently when exposed to the ferry versus the small vessel. Scheifele et al. (2005) documented the Lombard vocal response in beluga whales exposed to different vessel traffic in the St. Lawrence Estuary. The Lombard vocal response occurs when an animal increases the intensity of their vocalizations in response to a change in the environmental noise. Blane and Jaakson (1994) observed avoidance behavior by belugas in the presence of a 5 m (16 ft) inflatable boat with an outboard motor. Avoidance behavior of the belugas included decreased surfacing, increased speed and bunching into groups. Once the disturbance ceased, belugas resumed their previous behavior. Additionally, Blackwell and Greene (2002) observed beluga whales in close proximity of the Northern Lights cargo-freight ship docked with motors running (126 dB re: 1 µPa) at the POA, indicating that the belugas were not particularly bothered by the ship noise.

Belugas in the MacKenzie Estuary appeared to react less to a stationary dredge as opposed to a moving one, despite similar noise levels created by the vessels (Fraker 1977). Because of the frequency of marine traffic in their habitats, Cook Inlet beluga whales are familiar with the presence of large and small vessels. Belugas are frequently sighted in and around the Port of

Anchorage, the Port MacKenzie dock, and the small boat launch adjacent to the outlet of Ship Creek (Blackwell and Greene 2002; NMFS 2008a; Markowitz et al. 2005; Funk et al. 2005). For example, Blackwell and Greene (2002) reported that Cook Inlet beluga whales did not appear to be bothered by the sounds from a passing cargo freight ship. Despite increased shipping traffic and maintenance operations (e.g., dredging) beluga whales continue to utilize waters within and surrounding the POA, interacting with tugs and cargo freight ships (Markowitz and McGuire 2007; NMFS 2008a).

Steller sea lion responses to vessel noise
There are few data published on pinniped responses to vessel activity, most of the information is anecdotal (Richardson 1995). Generally, sea lions in water show tolerance to close and frequently approaching vessels and sometimes show interest in fishing vessels. They are less tolerant when hauled out on land; however, they rarely react unless the vessel approaches within 100-200 m (330-660 ft; reviewed in Richardson 1995). The risk of vessel activity threatening the recovery of Steller sea lions has been ranked low in the Steller Sea Lion Recovery Plan (NMFS 2008c) with a high feasibility of mitigation.

Summary of responses to vessel noise
Noise associated with vessel activity will temporarily increase in the action area during the Cook Inlet 3D Seismic Program as a result of the operation of eight vessels. To minimize the effects of noise associated with vessel activity on beluga whales and Steller sea lions in the area, Apache will follow NMFS's Marine Mammal Viewing Guidelines and Regulations (NMFS 2008d) and will alter heading or speed if a marine mammal gets too close to a vessel. The addition of noise due to vessels associated with the seismic program would not be outside the present experience of belugas or sea lions in Cook Inlet, although levels may increase locally. Given the large number of vessels in Cook Inlet and the apparent habituation to vessels by Cook Inlet belugas, vessel noise associated with the proposed action **may affect, but is not likely to adversely affect** the Cook Inlet beluga whales and Steller sea lions.

4.1.1.4 Effects from Aircraft Noise

Helicopters will be used for support and transport during the Cook Inlet 3D Seismic Program. Noise associated with aircraft may affect marine mammals in the action area; however, a large amount of acoustic energy is reflected when sound is transmitted from air to water (Richardson 1995; Blackwell and Greene 2002). Underwater received sound levels from noise associated with aircraft depends on the aircraft altitude, aspect and strength of the source; the marine mammal's depth; and propagation characteristics of the waterbody (e.g., water depth and bottom characteristics; Richardson 1995). Sound is generally reflected at angles greater than 13 degrees and does not penetrate the water; this is particularly true with calm sea conditions, deep water, or shallow water with a non-reflective bottom (Richardson 1995).

Marine mammal responses to aircraft noise depend on the type of aircraft, flight pattern, altitude and the activity of the animal (Richardson 1995); however, visual cues may also play a role in marine mammal's reactions to nearby aircrafts (Richardson 1995).

Beluga responses to aircraft noise
Responses to aircrafts by odontocetes may include changes in surfacing intervals, diving patterns, direction, behavioral states and temporary displacement (Richardson 1995; Patenaude et

al. 2002; Smultea et al. 2007). Beluga whale responses to aircrafts are variable (Richardson 1995). Some belugas reacted to aircrafts flying at altitudes of 500 m (1,640 ft) by diving, while others did not respond. More often belugas responded when aircrafts flew at altitudes of 150-200 m (490-690 ft). Responses to aircrafts at this altitude included longer dives, shorter surfacing intervals and displacement (Bel'koich 1960; Kleinenburg et al. 1964). Belugas engaged in foraging appeared less disturbed than individual whales. Individual whales often dove in the presences of the aircraft. Patenaude et al. (2002) observed beluga whale responses to both a helicopter (Bell 212) and a fixed-winged aircraft (Twin Otter). Belugas responded more often to the helicopter than the fixed-winged aircraft. Responses to the helicopter included sudden dives, change in direction, change in behavioral state and displacement. Responses to the helicopter occurred more frequently when the helicopter flew at altitudes less than 150 m (490 ft) and a lateral distance of less than 250 m (820 ft). When the fixed-winged aircraft flew directly overhead at altitudes of less than 182 m (600 ft), beluga responses included abrupt dives, change in swimming speed and behavioral states.

Steller sea lion responses to aircraft noise

The majority of observations of pinnipeds reacting to aircraft noise are associated with haul-out sites on land or ice. There are very little data describing the reactions of pinnipeds in water to aircraft (Richardson 1995). In the presence of aircrafts, pinnipeds hauled out for pupping or molting generally became alert and then rushed or slipped (when on ice) into the water. The greatest reactions from hauled out pinnipeds were observed when low flying aircrafts passed directly above the animal(s) (Richardson 1995).

Steller sea lions have been observed rushing into the water at haul-out sites in the presence of an aircraft (Calkins 1979; NMFS 2008c); however, immature or pregnant females entered the water more often than territorial males and females with pups (Calkins 1979). Withrow et al. (1985, as reported in Richardson 1995) observed a large group of Steller sea lions rush from the beach into the water in response to a Bell 205 helicopter approximately 1.6 km (1 mi) away.

Summary of responses to aircraft noise

Noise associated with aircraft activity will temporarily increase in the action area during the Cook Inlet 3D Seismic Program since Apache has committed to conducting aerial overflights looking for beluga groups prior to commencing seismic activities near certain river mouths. Although noise associated with aircraft activity could cause hauled out Steller sea lions to rush into the water, it is not likely large numbers of Steller sea lions will be affected by the aircraft noise because there are no known haul-out sites or rookeries in the action area. Additionally, Apache will follow NMFS's Marine Mammal Viewing Guidelines and Regulations, and has committed to altitude restrictions (staying above 1000 ft) and avoiding flying directly over marine mammals. Thus, aircraft noise associated with the proposed project **may affect, but is not likely to adversely affect** Cook Inlet beluga whales and Steller sea lions in the action area.

4.1.1.5 Summary of Direct Effects from Noise

NMFS has been in the practice of using the 180 and 190 dB re: 1 μPa isopleths (belugas and sea lions, respectively) as the injury zones, and the 160 dB re: 1 μPa isopleth for the behavioral harassment zone for impulsive noises as proxies for defining "take" under the MMPA (70 FR 1871).

Several aspects of the planned monitoring and mitigation measures for the seismic program are designed to detect marine mammals in and near these zones, and to avoid exposing them to sound that could potentially cause hearing impairment (e.g., power down and shut down zones) and minimize disturbance (e.g., shut down if allocated takes used, for large groups and groups with calves). In addition, to avoid exposure to full energy seismic surveys, marine mammals will be given a chance to leave or avoid the area by ramping-up the array after an extended shutdown and by using a mitigation gun during times when the full array is not in use. In those cases, the avoidance responses of the animals themselves will likely reduce or eliminate any possibility of hearing impairment.

The applicant has reduced any serious risk of exposing beluga whales and Steller sea lions to noise exceeding 180/190 dB, however, there does remain a possibility that undetected beluga whales, and to a lesser degree Steller sea lions, could be exposed to noise greater than or equal to 180/190 dB. There is recent research to suggest that the 160 dB and 180/190 dB harassment levels currently accepted by NMFS might be significantly below the noise levels that actually harass or injure beluga whales. Although no takes by serious injury or death (Level A takes) are anticipated resulting from the proposed seismic program, the applicant has requested 30 Cook Inlet beluga and 20 Steller sea lion behavioral harassment (Level B) takes for the first year of the operation. Temporary disturbance or localized displacement are the most likely reactions to occur.

Due to the potential for exposure of beluga whales and sea lions to noises at or above 160 dB re: 1 μPa, NMFS agrees with the determination that noise from the use of airguns associated with the proposed seismic program **may affect, and is likely to adversely affect** the Cook Inlet beluga whales (and Steller sea lions if present).

4.1.2 Direct Injury

4.1.2.1 Ship Strikes

Vessel traffic in Cook Inlet will temporarily increase to support the seismic program. However, there will only be eight additional vessels necessary for this project. The increase in vessel activity will occur throughout the project area. Vessel collision could result in possible serious injuries or death. Beluga whales may display avoidance reactions when approached by watercraft, particularly small, fast-moving craft that can maneuver quickly and unpredictably.

Larger vessels that do not alter course or speed around these whales seem to cause little, if any, reaction (NMFS 2008a). Beluga whales are regularly sighted in and around the Port of Anchorage (Rugh et al. 2005a; Cornick and Kendall 2008; Cornick and Saxon-Kendall 2009; POA 2009; Cornick et al. 2010) passing near or under vessels (Blackwell and Greene 2002), indicating that these animals may have a high tolerance of large vessel traffic. However, smaller boats that travel at high speed and change direction often present a greater threat.

Despite the regularity of vessel movement in and out of Cook Inlet, ship strikes have not been definitively confirmed as causing a Cook Inlet beluga whale death (NMFS 2008a). Because of their slower speed and linear movement, large vessels, such as those to be used in the seismic program, are not expected to pose a substantial threat to Cook Inlet beluga whales (NMFS 2008a) or Steller sea lions.

Vessels will be operating at a slow speed (2-4 kts) and in a purposeful manner transiting to and from work sites in as direct a route as possible. Marine mammal monitoring observers and passive acoustic devices will alert vessel captains as animals are detected to ensure safe and effective measures are applied to minimize beluga whale impacts. If necessary to avoid a collision (and to reduce the potential for a marine mammal entering the 180 dB zone), the captains may alter course and speed to avoid a collision with a marine mammal. As such, ship strikes associated with the seismic program are extremely unlikely to occur and therefore are discountable.

4.1.2.2 Falling/Ascending Nodes

There is the possibility that a node, when being placed on the seafloor, may fall onto an unseen beluga or sea lion. However, given the conservation measures Apache has incorporated into their project design to ensure belugas and sea lions are not in the immediate vicinity of the vessels, it is an unlikely occurrence. In the event a marine mammal is struck by a node, given the rounded shape and the slow speed of descent (falling through the water), the impact will result in minimal, if any, physical injury. However, it is likely that the belugas will be able to detect the nodes in the water and avoid any such contact. As such, injury from the nodes associated with the seismic program is extremely unlikely to occur and is therefore discountable.

4.1.2.3 Summary of Effects from Direct Injury

The proposed seismic program has the potential to cause direct injury to marine mammals if they are struck by a vessel or a falling/ascending node. However, given the generally straight line paths and constant speeds of the vessels associated with the seismic program, the small area actively being surveyed at any given time, and low probability that a node will strike a marine mammal, direct injury to belugas or sea lions associated with the seismic program is extremely unlikely to occur and is therefore discountable.

4.1.3 Water Pollution

Oil spills are a significant concern with regard to offshore oil and gas production, petroleum product shipment, and general vessel traffic. The operation of marine vessels during the seismic program will increase the risk of marine fuel spills from leaks or breaks in vessel fueling equipment, vessel collisions or sinking, mechanical or structural failures, or human errors such as leaving valves open. Onshore storage of fuel will also present a risk for a spill of fuel or other hazardous materials, however, storage sites will be positioned away from waterways and lakes, and located in modern containment enclosures with a capacity 125% the total volume of stored fuel. Standard best management practices will be in place to reduce the potential for these accidents to occur.

<u>Effects of water pollution on Cook Inlet belugas</u>

Research has shown that while cetaceans are capable of detecting oil they do not seem to be able to avoid it (Geraci 1990). It is difficult to accurately predict the effects from oil on Cook Inlet beluga whales (or any cetacean) because data is lacking on the metabolism of this species. Nevertheless, some generalizations can be made regarding impacts from oil on individual whales based on present knowledge. Oil spills that occur while Cook Inlet beluga whales are present could result in skin contact with the oil, respiratory distress from hydrocarbon vapors, contaminated food sources, and displacement from feeding areas. Actual impacts would depend on the extent and duration of contact, and the characteristics (type and age) of the oil. Cook Inlet beluga whales could be affected through residual oil from a spill even if they were not present during the oil spill due to the highly mobile nature of the spill and the drastic tidal fluctuations in Cook Inlet (NMFS 2008a). Also, response actions may impact whales due to intensive vessel traffic or specific technologies, such as *in situ* burning of oil. If an oil spill were concentrated in an area that is used by large numbers of beluga whales, it is possible that a whale could inhale enough vapors from a fresh spill to affect its health. Contaminated food sources and displacement from feeding areas also may occur immediately as a result of an oil spill.

Polycyclic aromatic hydrocarbons (PAHs), a group of contaminants found in petroleum products, combined with other contaminants, may cause cancer in beluga whales (Kingsley 2002) and are otherwise a concern with respect to the conservation and recovery of the Cook Inlet beluga whale. Cook Inlet belugas appear to be bioaccumulating PAHs from the environment and prey (Reynolds 2010). A spill of petroleum products during project construction might increase the release of PAHs into the environment. PAHs, however, generally do not easily dissolve in water and the fast currents and assimilative capacity of Cook Inlet could reduce any impacts on water quality that might result in the event of a spill. Because of the physical and chemical properties of PAHs, it is unlikely the project will result in high concentrations of these toxins in Cook Inlet or result in impacts on Cook Inlet beluga whales.

Effects of water pollution on Steller sea lions

Oil has been implicated in the deaths of pinnipeds (St. Aubin 1990). Pinnipeds exposed to oil at sea through incidental ingestion, inhalation, or limited surface contact do not appear greatly harmed by the oil; however, pinnipeds found close to the source or who must emerge directly in oil appear substantially more affected. Fur seals' pelts exposed to oil appear to lose thermal characteristics causing energetic stress.

Toxic substances, such as oil, may be a contributing factor in the decline of Steller sea lion population (NMFS 2008c). Sea lions exposed to oil through inhalation, dermal contact and absorption, direct ingestion or through the ingestion of prey may become heavily contaminated with PAHs. The Exxon Valdez oil spill occurred after the decline began in the Steller sea lion population; however, there were substantial mortalities from toxic contamination following the event. Twelve carcasses were discovered in Prince William Sound and 16 were found near Prince William Sound, the Kenai coast and the Barren Islands. The highest levels of PAHs were in the animals found dead after the spill (NMFS 2008c). While the Exxon Valdez oil spill likely resulted in mortality of Steller sea lions, this project is unlikely to result in an oil spill, and there are significantly fewer sea lions in Cook Inlet than in Prince William Sound.

Summary of water pollution effects

Increased vessel activity in the action area from the proposed Cook Inlet 3D Seismic Program will temporarily increase the risk of accidental oil spills. Accidental oil spills may occur from a vessel leak, if a vessel runs aground, or from a leak in the onshore storage facility. Impacts from an oil spill on beluga whales or Steller sea lions in the action area will remain relatively small and will be minimized by maintaining safe operational and navigational conditions and best standard operating procedures. Oil spills associated with the seismic program **may affect, but are not likely to adversely affect** beluga whales and sea lions.

4.1.4 Habitat Disturbance

While it is difficult to quantify the importance of various habitats in terms of Cook Inlet beluga whale health, conservation, and recovery, NMFS believes certain areas are particularly important. The topography and water depth in river mouths is believed to be very important to beluga feeding. Beluga whales use the shallow water and river channels to aid in chasing and trapping fish. Although much of the nearshore area to be surveyed is shallow, it is available to beluga whales and assumed to provide some habitat values. Whales are generally described to move up to the upper inlet in the summer, and disperse more across the mid inlet and along the western shore in fall and winter. These are very generalized but we believe there will always be some beluga whales distributed throughout the action area. As previously discussed, Steller sea lions' use of the habitats in the action area is rare.

The seismic program will likely result in the temporary disturbance of beluga whale habitat as a result of the placement and removal of nodes on the seafloor. However, since Cook Inlet is a dynamic and ever changing system, permanent habitat disturbance from the nodes being placed on the seafloor is extremely unlikely as the foot print of a single node is a small and natural processes would quickly restore the seafloor once the node is picked up. Furthermore, the disturbance will be localized as seismic activity will only operate in a small area (a patch) at a time, and will be scheduled around windows of opportunity (see Figure 6) to reduce the potential for significant impacts to individuals or groups of marine mammals.

The proposed action has the potential to affect beluga whales through the disturbance of their habitat within the action area. Any habitat disturbance resulting from the placement and removal of the nodes will be temporary as the local natural processes are effective in restoring any alterations in the bottom topography the nodes may cause. Therefore, the potential and temporary habitat disturbance associated with the proposed seismic program **may affect, but is not likely to adversely affect** the Cook Inlet beluga whales or Steller sea lions.

The effects of the seismic program on beluga critical habitat are discussed later in this opinion.

4.1.5 Predation

Killer whales are the only natural predators of beluga whales and Steller sea lions in Cook Inlet (Allen and Angliss 2010). Beluga whale stranding events have been correlated with the presence of killer whales, and Native hunters believe that beluga whales intentionally strand themselves in order to escape killer whale predation (Huntington 2000). Killer whale predation has the potential to create significant impacts on the Cook Inlet beluga whale and western DPS of Steller sea lion populations (Heise et al. 2003; Shelden et al 2003), especially for the former because of its current low population level.

Prior to 2000, NMFS estimated that, on average, one beluga was killed annually by killer whales, with 18 reported killer whale sightings in upper Cook Inlet from 1985-2002 (Shelden and Mahoney 2000). However, between 2001-2011 only two Cook Inlet beluga whales were reported as preyed upon by killer whales (NMFS unpublished data). This reduced killer whale presence in upper Cook Inlet is supported by the fact that no killer whales were observed during almost 15,000 hours of land-based observational efforts from LGL's beluga monitoring projects in Cook Inlet, Alaska (covering areas from Knik and Turnagain Arms south to Ladd Landing) (T. McGuire, LGL, pers. comm. August 2, 2011). Even if the proposed action were to result in temporary displacement of some areas by Cook Inlet beluga whales, the areas where belugas typically go to escape killer whale predation (the shallow areas of Knik Arm and Turnagain Arm) are not areas in which Apache has proposed to conduct their seismic surveys. Thus, Knik Arm and Turnagain Arm will still be available habitats for the purpose of escaping predation. Given the low predation rates and killer whale sightings in recent years as well as the availability of predator avoidance habitat, it is not anticipated that the proposed action will have any impact on the predation rate of Cook Inlet beluga whales or Steller sea lions.

4.1.6 Stranding

NMFS is not aware of any conclusive evidence of cetacean strandings or deaths at sea as a result of exposure to seismic surveys, but a few cases of stranding in the general areas where a seismic survey was ongoing have led to the suggestion of a possible link between seismic surveys and strandings. In one case, the suggestion of a link between seismic surveys and strandings of humpback whales in Brazil (Engel et al. 2004) were not well founded (IAGC 2004; IWC 2007). In September 2002, there was a stranding of two Cuvier's beaked whales in the Gulf of California, Mexico, when the L-DEO seismic vessel R/V *Maurice Ewing* was operating a 20-airgun, 8,490-in^3 airgun array in the general area. The evidence linking the stranding to the seismic survey was inconclusive and not based on any physical evidence (Yoder 2002). The ship was also operating its multi-beam echo sounder at the same time, but this had much less potential than the aforementioned naval sonars to affect beaked whales, given its downward-directed beams, much shorter pulse durations, and lower duty cycle. Nonetheless, the Gulf of California incident and the beaked whale strandings near naval exercises involving use of mid-frequency military tactical sonar suggest a need for caution in conducting seismic surveys in areas occupied by beaked whales until more is known about effects of seismic surveys on those species (Hildebrand 2005). However, it is unlikely that effects such as gas-bubble disease seen in beaked whales, which are deep-diving cetaceans, would be the same for the relatively shallow diving Cook Inlet beluga whales.

Given there is no definitive and only limited circumstantial evidence that airguns have caused strandings or mortalities for any cetacean, combined with the fact that Cook Inlet beluga strandings typically have occurred on exposed mudflats in Knik and Turnagain Arms and are generally a result of tidal fluctuations or killer whale predation avoidance, it is not expected that the proposed action will appreciably increase stranding rates. This is especially true here because Apache will not be conducting seismic operations within Knik or Turnagain Arms.

4.2 Indirect Effects of the Action

Indirect effects defined under the ESA are effects from the proposed action that occur later in time (after the cessation of the activity), but are still reasonably certain to occur. Only a small fraction of the potentially available habitat in Cook Inlet would be impacted by the Cook Inlet 3D Seismic Program at any given time during seismic surveys. The constant movement of the seismic vessels and the short duration of actual seismic activity would result only in short-term, temporary, and very localized impacts to belugas, beluga prey species, and habitat.

Indirect effects from the proposed Cook Inlet 3D Seismic Program may include the possibility of a reduction in beluga prey, however, as discussed in other parts of this opinion (see section 4.4.2), any impacts would be very localized and short term, and are not expected to last beyond the timing of the action. As such, the Cook Inlet 3D Seismic Program is not expected to have any indirect effects that could cause permanent or long-term consequences for beluga whales or sea lions.

4.3 Interrelated and Interdependent Effects

Interrelated actions are actions that are part of a larger action and depend on the larger action for their justification. Interdependent actions are actions that have no independent utility apart from the proposed action (50 CFR 402.02).

4.3.1 Future Oil and Gas Development of Cook Inlet

If oil and gas are discovered by the proposed Cook Inlet 3D Seismic Program in the action area, oil and gas development will likely take place. Apache will likely use existing structures found in the action area and will continue to undergo consultation with NMFS to reduce any impacts from oil and gas development on the Cook Inlet beluga whale. However, future oil and gas development could result in the input of additional noise into the environment of Cook Inlet beluga whales.

4.3.2 Future Oil Spills

If, in the future, Apache pursues an active oil and gas development program there will be an increased potential for oil spills in Cook Inlet. However, the probability of an oil spill from future Apache operations cannot be determined since it is unknown if Apache will discover viable quantities of oil or gas and pursue further operations in the future. At this point, the effects to Cook Inlet beluga whales and Steller sea lions will be similar as to those described previously.

4.4 Effects on Critical Habitat

NMFS is required under Section 4(b)(2) of the ESA to designate critical habitat for the Cook Inlet beluga whale. A final rule to designate this critical habitat was published in the Federal Register on April 11, 2011 (76 FR 20180). The action area for the proposed project is both within and outside the critical habitat borders (see Figure 13). The proposed action has the potential to affect beluga whales through the disturbance or modification of their habitat. This section describes the essential physical and biological features of the beluga whale critical habitat occurring in the action area, the mechanisms of potential direct and indirect effects from the seismic program, and the anticipated impact of these mechanisms to the critical habitat. For each essential feature (also known as a Primary Constituent Element [PCE]), we consider the baseline condition. We then assess the potential effect of the proposal on the quality, quantity, and availability of each PCE. If there is a reduction of a PCE, then the timing, duration, and magnitude of the reduction is estimated. Any mitigation measures are also considered in this evaluation. We then sum the individual effects to the PCEs to consider the project impact to critical habitat. The destruction of critical habitat and its adverse modification are evaluated by the consequences of any changes in the function, amount, or capacity of the PCEs relative to their ability to provide for the ecological needs of a recovered population.

4.4.1 PCE 1: Intertidal and subtidal waters of Cook Inlet with depths <30 feet (MLLW) and within 5 miles of high and medium flow anadromous fish streams.

This PCE reflects the importance of shallow intertidal and subtidal areas proximate to tributary waters of Cook Inlet that contain anadromous fish populations that comprise the principle prey for Cook Inlet beluga whales during the spring, summer, and fall. NMFS tagging data and visual observations by various monitoring and research efforts confirm these areas are preferentially used during ice-free seasons. In addition to feeding habitat, these areas may also be important for calving and predator avoidance. This PCE is present in the nearshore waters of the action area (see Figure 14).

Quality
The possibility exists that the quality of this essential feature may be slightly altered by the temporary disturbance caused by the placement and removal of the nodes on the seafloor. However, as described previously, the nodes will only be resting on the seafloor for a short duration, therefore, the functional effect of such slight alterations of this PCE from the nodes to beluga whales is not considered significant because these areas would still provide the water depths and channels that support foraging behavior.

Quantity
No habitat of the intertidal or subtidal waters will be removed. However, there may be an insignificant amount of disturbance resulting from the temporary placement of the nodes on the seafloor in these areas.

Availability
Cook Inlet has habitat as defined in PCE #1 in abundance. No intertidal and subtidal habitat will be removed or substantially altered by the placement of the nodes on the seafloor. The nodes would not obstruct access to this PCE anywhere in the critical habitat nor obstruct the availability of PCE # 1. The seismic program is not likely to affect the availability and conservation function of PCE # 1, and therefore, would not have a measurable consequence to individual whales or this DPS.

4.4.2 PCE 2: Primary prey species consisting of four (4) species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.

Cook Inlet beluga whales are highly mobile, opportunistic feeders known to prey on a wide variety of species, particularly seasonally abundant fish such as eulachon and salmon. All the species listed in this PCE occur in the action area. The salmon and eulachon are prevalent in the spring to fall in the upper inlet, especially in the Susitna Delta, Knik Arm and Turnagain Arm. The cod, pollock, and sole are found primarily in the mid inlet and are primary prey in the fall to spring when salmon and eulachon runs decline. In determining the effects of this action on PCE #2, we considered the disturbance to fish habitat and the effects of seismic noise on these prey species. Temporary disturbance of intertidal and subtidal shoreline habitat will result from the placement of nodes. Seismic noise will radiate throughout the water from the airguns until it dissipates to background levels. However, since no standard distances from a noise source have been established for prey fish protection, we are unable to estimate the magnitude of this effect.

Although in general little is known about how noise affects fish (Hastings and Popper 2005; DFO 2004), salmon have been found to respond to low frequency sounds such as those created by the proposed action, but only at very short ranges, within distances of a few feet from the sound source.

Quality

The seismic program is not expected to have any impact on the quality of prey species. Quality of prey may be considered to include their lipid content, body burdens of toxins or pollutants, and nutritional value to beluga whales. This action will not introduce pollutants and is not anticipated to alter the quality of these prey species.

Quantity

In general, fish perceive underwater sounds in the frequency range of 50 to 2,000 Hz, with peak sensitivities below 800 Hz (Popper and Carlson 1998; Department of the Navy 2001). However, fish are sensitive to underwater impulsive sounds due to swimbladder resonance as the pressure wave passes through the fish. The swimbladder may repeatedly expand and contract, creating pressure on the internal organs surrounding the swimbladder. Permanent injury to fish from acoustic emissions has been shown for high-intensity sounds of several hours long. In a review on the effects of low-frequency noise to fish, a threshold of 180 dB peak sound level was used to define the potential injury to fish. Sound pressure levels greater than an average of 150 dB rms are expected to cause temporary behavioral changes such as a startle response or behaviors associated with stress. Although these SPLs are not expected to cause direct injury to a fish, the functional effect of impaired sensory ability could potentially reduce survival, growth, and reproduction, increase predation, and alter foraging and reproductive behaviors. This may decrease the quantity of fish available as prey to Cook Inlet belugas.

Some research indicates that some noises may evoke flight and avoidance response in juvenile salmon. Other studies have shown that the avoidance response is temporary. Salmon have been found to respond to low frequency sounds, but only at very short ranges (Chamberlin 1991). Carlson (1994), in a review of 40 years of studies concerning the use of underwater sound to deter salmonids from hazardous areas at hydroelectric dams and other facilities, concluded that salmonids were able to respond to low-frequency sound and to react to sound sources within a few feet of the source. He speculated that the reason that underwater sound had no effect on salmonids at distances greater than a few feet is because they react to water particle motion/acceleration, not sound pressures. Detectable particle motion is produced within very short distances of a sound source, although sound pressure waves travel farther (USDOT 2005). It is also likely that fish will avoid sound sources within ranges that may be harmful (McCauley et al. 2003).

For the proposed seismic program, airgun arrays will only be discharged at depths greater than 2 m (~ 6.6 ft) to avoid interference or injury to out-migrating juvenile salmonids. This, along with the short duration of seismic activity in any given area, and the seasonal abundance of anadromous prey and the broadly distributed abundance of over-winter prey, make it unlikely that significant numbers of fish would be impaired to the point that it would impact the feeding success of Cook Inlet beluga whales.

Availability

Cook Inlet beluga whales utilize the Susitna Delta area, Chikaloon Bay, upper Knik Arm, and Twenty Mile River in Turnagain Arm as major foraging sites in the late spring through fall. Only the Susitna Delta is within the action area. The belugas distribution and feeding locations are more dispersed over winter and include deeper dives for feeding, suggesting a movement away from river mouths and a broader use of the entire inlet.

Only a small fraction of the potentially available habitat in Cook Inlet would be impacted by noise from the Cook Inlet 3D Seismic Program at any given time during seismic surveys. The constant movement of the seismic vessel and the short duration of actual seismic activity would result in short-term, temporary, and very localized acoustic impacts on prey species. Thus, the Cook Inlet 3D Seismic Program is not expected to meaningfully affect the availability and conservation function of these fish as prey species nor impair the feeding opportunities of beluga whales.

4.4.3 PCE 3: Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.

This essential feature recognizes the importance of water quality to Cook Inlet belugas. As high-level predators, beluga whales may bio-accumulate pollutants, as evidenced by populations elsewhere, such as in the Saint Lawrence, which have been found to carry heavy body burdens of certain chemicals. Cook Inlet beluga whales appear to have lower levels of many contaminants than other populations. However, the Conservation Plan (NMFS 2008a) and the Final Rule for critical habitat designation stated that toxins are a concern for the sustained health of Cook Inlet beluga whales. Toxicity and dose-response data are minimal for the majority of emerging chemicals, and the impact from most other contaminants to beluga whales is unknown (NMFS 2008a). NMFS is presently unable to identify those pollutant agents and concentrations that are harmful to beluga whales. In a report prepared for NMFS, URS (2010) identified certain chemicals or substances as being a potential concern to Cook Inlet beluga whales. Those found to have “probable” concern included: chlorinated compounds (e.g., DDT, PCB, Dioxins), metals (e.g., methyl mercury, selenium, butyltins), and polycyclic aromatic hydrocarbons, while many more agents were found to be of possible concern.

Quality

The only water quality concern related to the seismic program is the small, but unlikely, potential for oil spills from the small number of support vessels and onshore storage tank. Increased vessel activity in the action area from the seismic program will temporarily increase the risk of accidental oil spills. Accidental oil spills may occur from a vessel leak or if the vessel runs aground; however, these actions will be minimized by maintaining safe operation and navigational conditions. As such, it is not anticipated that impacts from an oil spill on beluga whales associated with the seismic program will be at a level harmful to beluga whales.

Quantity

The quantity of oil that could be released from the vessels into the waters of Cook Inlet is dependent upon the amount each vessel can hold. It is not anticipated that there will be an accidental oil spill, nor that the amount spilled given the operational timing windows of the action will result in levels of water pollution harmful to beluga whales.

Availability

The availability and conservation function of this essential feature is not expected to be altered by this project, and therefore, the status of PCE 3 is not likely to change.

4.4.4 PCE 4: Unrestricted passage within or between the critical habitat areas

Although many populations of beluga whales are migratory, the Cook Inlet stock has been shown to remain in Cook Inlet year round (Hobbs et al. 2005), with seasonal distribution patterns closely tied to prey availability. Annual aerial surveys (June) and satellite tagging data (June – May) from NMFS have established the distribution and abundance of beluga whales in Cook Inlet. During the spring and summer (May – July), Cook Inlet beluga whales are found in the upper Inlet, primarily concentrated in the Susitna Delta area and to a lesser extent in Knik Arm, Turnagain Arm, and Chickaloon Bay, coinciding with strong runs of eulachon and salmon. In the fall (August – October), belugas follow fish runs in Knik Arm and Turnagain Arm. As the fish runs decline in the fall, the beluga whales then disperse offshore throughout the mid Inlet during the winter (December to March) (Hobbs et al., 2005).

The discussion throughout this section is based on the analysis of the effects of the action on habitat use by the Cook Inlet beluga whale for movement within the critical habitat areas overlapping the action area.

Quality

The areas of high density of belugas from the late spring to early fall are located in the upper inlet, especially around the Susitna Delta, Knik Arm and Turnagain Arm. With the exception of some of the Susitna Delta, these areas are outside the action area of the seismic program. In the winter, belugas are widely distributed throughout the inlet, with more whales in mid inlet. The seismic program has no physical components that would impair passage within the critical habitat areas.

Quantity and Availability

For this PCE, we were not able to draw meaningful distinction between quantity and availability. Noise from the seismic program is likely to degrade this PCE, as whales will detect higher in-water noise levels and likely react by avoiding the sound source or, possibly, abandoning their effort to navigate through and beyond the ensonified area. This impact has been discussed in section 4.1.1 - Noise. While some whales may experience restrictions to passage between habitats (e.g., into or out of a river) due to seismic noise, we do not believe that effect would appreciably reduce the value of critical habitat for the conservation of these whales. This is because: 1) the effect would be temporary as only a small area is ensonified to the 160 dB threshold over a 24 hour period; 2) the airguns are operational only for about 2.5 hours around slack tides; 3) the seismic program has incorporated seasonal windows of opportunity to reduce to the extent possible operating in areas of high beluga density; 4) the seismic activity will not occur in Knik or Turnagain Arm, areas of highest beluga concentrations; 5) aerial flights will be conducted to ensure no large groups of belugas are present prior to operations near river mouths; and 6) any whales affected would have alternative habitat sites available to them.

4.4.5 PCE 5: Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

In Cook Inlet, beluga whales must compete acoustically with natural and anthropogenic sounds. Human-induced noises within the action area include large and small vessels, aircraft, pile driving, shore based activities, dredging, filling, and oil and gas development, and other events. Much of the nearshore areas of Cook Inlet are characterized by shallow depths, sand/mud bottoms, and high background noise from currents and glacial silt (Blackwell and Greene 2002), thereby making it a poor acoustic environment.

In general, Cook Inlet is a noisy environment due to both natural processes such as winds and tidal movements as well as anthropogenic causes. Recent acoustic studies have determined that background noise in lower Knik Arm (with a high level of contribution by wind and tides) exceeds 120 dB. The seismic program will increase in-water noise levels due to additional vessels and aircraft necessary for the program as well as the noise generated by the airguns.

Quality

The seismic program will temporarily and spatially increase in-water noise levels within much of Cook Inlet. This effect is likely the most important aspect of this project with respect to the conservation of Cook Inlet beluga whales. The quality of habitat will be affected primarily from the low frequency, impulsive noise from airguns, which will shoot intermittently over the course of the program, but vessels and aircraft are also sources of noise.

Quantity and Availability

For this PCE, we were not able to draw meaningful distinction between quantity and availability.

Monitoring data of in-water pile driving using vibratory and impact hammering from the POA expansion project, a significant source of in-water noise in upper Cook Inlet, do not indicate abandonment. Despite several years of ongoing construction at the POA, beluga whales have continued to use lower Knik Arm. Unusual behavioral changes were not observed during pile driving (ICRC 2009, 2010). Additionally, onshore observations identified no unusual responses. Subsurface responses, such as changed vocalizations, were not detectable (Cornick and Saxon-Kendall 2009; Širović and Kendall 2009; Cornick et al. 2010). Sightings of belugas within and adjacent to areas where pile-driving and other construction activities took place at the POA indicate belugas that entered Knik Arm did not avoid the area. Anthropogenic noise is common in Knik Arm, and beluga whales may have habituated to these sound disturbances (Markowitz et al. 2005).

The seismic source shots from the airguns would occur for about 2.5 hours around each of the four daily slack tides within a specific patch, averaging 10-12 hours of shooting per 24 hour period. Only one patch will be surveyed at a time and using the largest airgun array (2,400 cui), noise would dissipate below the 180 dB re: 1 µPa injury threshold after 1.72 km and below the 160 dB harassment threshold after 6.41 km. The BA (SAExploration Inc 2011) used an acoustic model which suggested that between 346-458 km^2, depending upon water depth, would be ensonified at or above 160 dB re: 1 µPa over the course of 24 hours. This equates to only 5.3-7% of the total size of the action area (6580 km^2), or 4.4-5.9% of the total critical habitat area (7,809 km^2) being ensonified at or above the 160 dB harassment threshold. We believe this level of noise confined to a small portion of the inlet, over a short duration (a matter of days in any given area) is well below a level to cause permanent abandonment.

It is possible that beluga whales may become habituated to the seismic noises. While some whales may temporarily abandon areas actively undergoing seismic surveys, we do not believe there would be permanent abandonment of any critical habitat areas and thus the seismic program would not appreciably reduce the value of critical habitat for the conservation of these whales. This is because: 1) the seismic source noises are short-term (about 2.5 hours around slack tides); 2) mitigation measures will be employed to reduce the likelihood that belugas would be within the 180 dB injury threshold (e.g., marine mammal observers; passive acoustic monitoring; ramp up and power/shut down of airguns; vessel speed and course alterations); 3) the seismic surveys are not operational in the entire action area at one time, but rather will be operating in one small patch at a time; and 4) the seismic program has incorporated seasonal windows of opportunity to reduce to the extent possible operating in areas of high beluga density.

Given the numerous ports and airfields around Cook Inlet and hence the numerous boats and aircraft in the Cook Inlet area, it is likely that belugas have habituated to these types of noise sources as well. The applicant has incorporated mitigation measures into their project design to further reduce their impact from these sources. As such, we do not believe noise from the vessels or aircraft will result in abandonment of any areas by belugas.

5. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR 402.02 as: "those effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." Cumulative effects are defined differently under the ESA than they are under NEPA (USFWS and NMFS 1998).

Reasonably foreseeable future Federal actions and potential future Federal actions that are unrelated to the proposed action are not considered in the analysis of cumulative effects because they would require separate consultation pursuant to section 7 of the ESA. Most structures and major activities within the range of the Cook Inlet beluga whale require Federal authorizations from one or more agencies, such as the Corps, Environmental Protection Agency (EPA), and Bureau of Ocean Energy Management (BOEM). Such projects require consultation under the ESA on their effects to the Cook Inlet beluga whale, and are therefore not addressed here as cumulative impacts.

Although a number of known and potential threats to the Cook Inlet beluga whale have been identified, the level of impact from many of these threats on an individual and on a collective basis is poorly understood (NMFS 2008a). Additional information is needed to bridge these gaps. Therefore, NMFS recognizes that it is difficult to determine the overall cumulative effects these threats have on the Cook Inlet beluga whale. The following discussion describes the cumulative effects based on the best scientific and commercial data available. The actions described below could result in additional pollutants, vessel traffic, gas and oil spills, displacement from or loss of habitat and could contribute to the cumulative effects of the proposed Cook Inlet 3D Seismic Program.

As with the Cook Inlet beluga whale, it is likely a cumulative effect of multiple factors that are influencing the recovery of the Steller sea lion population (NMFS 2008c). However, the proposed project is located outside Steller sea lion critical habitat, there are no haul-outs or rookeries in the action area with large concentrations of Steller sea lions, and Steller sea lions are rarely observed in the action area; therefore, the cumulative effects discussed below from activities likely to take place in the action area will not have an adverse effect on Steller sea lions.

5.1 Fisheries Interactions

Fishing is a major industry in Alaska. As long as fish stocks are sustainable, subsistence, personal use, recreational and commercial fishing will continue to take place in Cook Inlet. As a result there will be continued prey competition, risk of ship strikes, potential harassment, potential for entanglement in fishing gear and potential displacement from important foraging habitat for the Cook Inlet beluga whales. NMFS and the ADF&G will continue to manage fish stocks and monitor and regulate fishing in Cook Inlet to maintain sustainable stocks.

5.2 Oil and Gas Development

Most of the existing gas and oil development occurs in the action area and it is likely that future oil and gas development will continue to take place in the action area. Impacts from oil and gas development include increased noise from seismic activity, vessel and air traffic, and well drilling; discharge of wastewater; habitat loss from the construction of oil and gas facilities; and contaminated food sources and/or injury from a natural gas blowout or oil spill. The risk of these impacts may increase as oil and gas development increases; however, new development will undergo consultation prior to exploration and development.

Support vessels are required for oil and gas development to transport supplies and products to and from the facilities. Not only will the support vessels from increased oil and gas development likely increase noise in the action area, there is a potential for increased ship strikes with beluga whales.

5.3 Coastal Development

Coastal development may result in the loss of habitat, increased vessel traffic, increased pollutants, and increased noise associated both with construction and with the activities of the projects after construction. In the action area, two main projects are being considered, the Chuitna Coal Mine and the ORPC Tidal Energy Project. The POA is currently expanding their facilities and Port MacKenzie is scheduled to expand their facilities. These port facilities may have an effect on beluga whales in the action area due to increased vessel traffic passing through the area on their way to the ports.

5.3.1 Chuitna Coal Project

The Chuitna Coal Project has the potential to affect Cook Inlet belugas and their critical habitat. PacRim Coal, LP is proposing to develop, construct and operate a coal mine and export facility 19 km (12 mi) northwest of the Native Village of Tyonek. Potential impacts on the Cook Inlet beluga whale from the Chuitna Coal Project would include the construction of the coal export facility and surface water discharge. The coal export facility, which includes an overland coal conveyer and ship loading berth, would extend from shore into Cook Inlet. The conveyer and ship berth would incorporate tower sites approximately 335 m (1,100 ft) apart to allow for uninhibited movement of marine life (PacRim Coal, LP 2011). No chemical or water-based processing of the coal would take place; therefore, the expected sources of discharge from the project would include rainfall, snowmelt and groundwater (PacRim Coal, LP 2011). Prior to discharging water into Cook Inlet, the water would be directed to sediment control structures and meet the water quality criteria described by the Alaska Pollutant Discharge Elimination Systems permit (PacRim Coal, LP 2011).

5.3.2 ORPC Alaska Tidal Energy Projects

ORPC is proposing two tidal energy projects in Cook Inlet. The first tidal energy project would be located on the west side of Fire Island (near Anchorage) and the second project would be located adjacent to the East Foreland in the vicinity of Nikiski on the Kenai Peninsula (ORPC 2011). The tidal energy projects would require the installation of an array of turbine generator units and transmission cables on the seafloor to harness the tidal energy. The tidal energy will be converted to electrical energy at stations on land. These projects are still in preliminary testing and environmental monitoring phases (ORPC 2010, 2011).

5.4 Pollution

As the population in urban areas continue to grow, an increase in the amount of pollutants that enter Cook Inlet is likely to occur. Hazardous materials may be released into Cook Inlet from vessels and aircraft. There is a possibility an oil spill could occur from vessels traveling within the action area, or that oil will migrate into the action area from a nearby spill.

There are many non-point sources of pollution within the action area; such pollution is not federally-regulated. Pollutants can pass from streets, construction and industrial areas, and airports into Cook Inlet and beluga habitat within the action area. Wastewater discharge, gas, oil, and coastal development projects also contribute to pollutants that enter Cook Inlet through discharge. These activities will continue to take place in Cook Inlet; therefore, it would be expected that pollutants could increase in Cook Inlet. However, the EPA and the Alaska Department of Environmental Conservation (ADEC) will continue to regulate the amount of pollutants that enter Cook Inlet from point and non-point sources through NPDES/APDES permits. As a result, permitees will be required to renew their permits, verify they meet permit standards and potentially upgrade facilities.

There have been several past State oil and gas lease sales in the Inlet. Future sales are anticipated annually, including much of the submerged lands of Cook Inlet. While these sales are State matters, many or most of the subsequent actions that might impact beluga whales are likely to have some federal nexus. Location of drilling structures would require authorization from the Corps. Discharges such as muds and cuttings or produced waters require permitting through the EPA or ADEC. Oil spills would be one example of an unauthorized activity.

5.5 Tourism/Whale Watching

There currently are no boat-based commercial whale-watching companies in upper Cook Inlet. The popularity of whale watching and the close proximity of beluga whales to Anchorage make it possible that such operations may exist in the near future. However, it is unlikely this industry will reach the levels of intensity seen elsewhere because of upper Cook Inlet's climate and navigation hazards (e.g., shallow waters, extreme tides, and currents).

Vessel-based whale-watching may cause additional stresses to the beluga population through increased noise and intrusion into beluga habitat not ordinarily accessed by boats. Avoidance reactions have often been observed in beluga whales when approached by watercraft, particularly small, fast-moving craft that are able to maneuver quickly and unpredictably; larger vessels which do not alter course or motor speed around these whales seem to cause little, if any, reaction (NMFS 2008a). The small size and low profile of beluga whales, and the poor visibility within the Cook Inlet waters, may increase the temptation for whale watchers to approach the beluga whales more closely than usually permitted for marine mammals. General marine mammal viewing guidelines would be adopted, and possibly enhanced, for any commercial beluga whale watching tours.

5.6 Subsistence Hunting

Alaska Natives, while not currently hunting belugas, will continue to hunt harbor seals in Cook Inlet for subsistence purposes, as allowed by the MMPA. These are typically boat-based hunts which could temporarily increase noise in the environment and increase the potential for accidental ship strikes of Cook Inlet belugas. Any future hunts of Cook Inlet belugas will likely require a Federal authorization and are not considered under the ESA definition of cumulative impacts.

6. SYNTHEIS AND INTEGRATION

Pursuant to Section 7(a)(2) of the ESA, Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed endangered and threatened species or result in the destruction or adverse modification of designated critical habitat. "Jeopardize the continued existence of" is defined in regulations as "to engage any action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

In this section, we assess the effects from the seismic program on Cook Inlet belugas and integrate those effects with the environmental baseline and cumulative effects. Finally, we consider the implication of those effects on the continued existence of the belugas and the destruction or adverse modification to their critical habitat.

In particular, we examine the scientific data available to determine if an individual beluga's probable responses to the action's effects are likely to have consequences for the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When individual animals exposed to an action's effects are expected to experience reductions in fitness, we would expect reductions in the abundance, reproduction rates, and/or growth rates (or increase the variance in these measures) of the population those individuals represent. On the other hand, when animals are not expected to experience reductions in fitness, we would not expect the action to have adverse consequences on the population's viability.

As described, the proposed Cook Inlet 3D Seismic Program is unlikely to affect the Steller sea lion population or their critical habitat because 1) Steller sea lions are rarely observed within the action area, 2) the proposed project is located outside of Steller sea lion critical habitat, 3) there are no haul-outs or rookeries in the action area, and4) mitigation measures incorporated into the project description will be implemented to reduce the impacts from noise associated with the seismic activity on Steller sea lions. In the unlikely event a Steller sea lion is in the immediate vicinity of the active seismic program, the possibility exists that noise from the airguns may adversely affect that individual sea lion, but the possibility of an adverse effect from noise (hearing impairment or habitat avoidance) would not rise to the level at which this growing population will be affected. Since effects to individuals are unlikely, there will be no population level effects to Steller sea lions from the proposed seismic program, and the remaining discussion is specific to Cook Inlet beluga whales

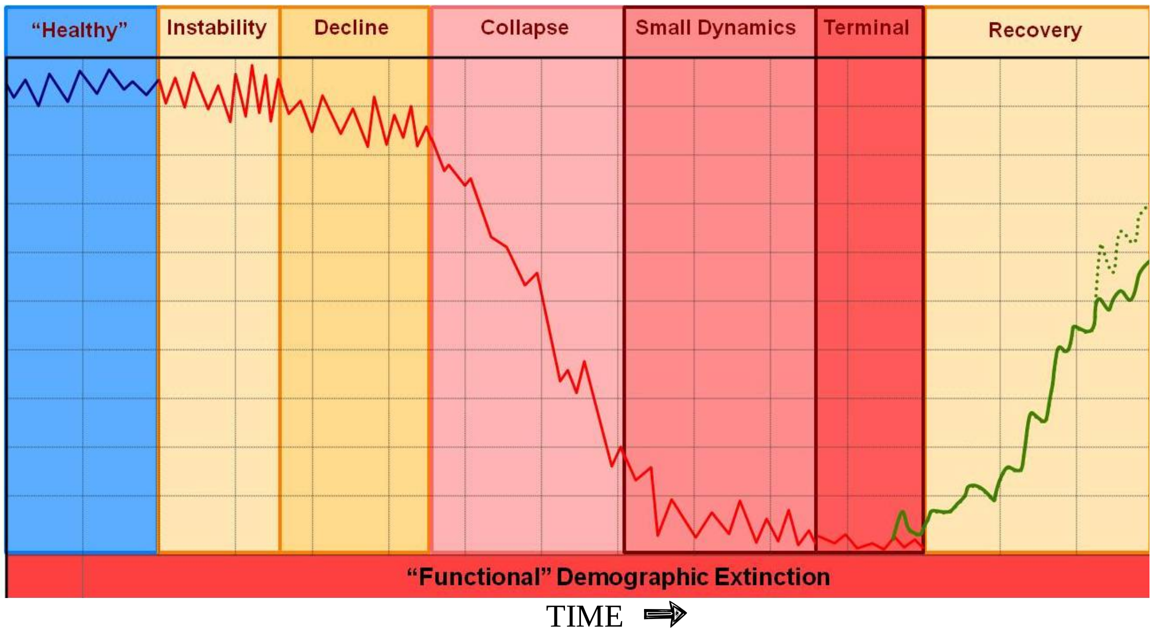
In determining whether individual Cook Inlet beluga whales would be affected, it is necessary to analyze when, where, and how an animal would be exposed to the various activities associated with the seismic program. During the analysis, several assumptions were made about their habitats, hearing abilities, and behaviors to reach the conclusions. The ESA does not require scientific certainty. In this biological opinion, NMFS has utilized the best available scientific data to evaluate the consequences from the seismic program on the endangered Cook Inlet beluga. Despite this fact, there exist numerous data deficiencies and uncertainties that limit our ability to accurately forecast the future with this activity. These include biological, ecological, political, social, and economic uncertainties. When we encounter uncertainty, we have attempted to assign significance to it with respect to our analysis of impacts and its possible consequence in our determinations.

In considering uncertainty here, we are cautious not to draw upon speculation and unsupported assumptions, but rather consider uncertainty as an adjunct to a decision making process built on scientific understandings. For example, the seismic program is likely to result in the taking of beluga whales by noise harassment. NMFS scientists have developed population viability models and extinction risk analyses that describe the population impacts from mortalities within this DPS to their survival and recovery. Those models, however, do not include a conversion factor by which harassment takes can be assessed; how many harassments would equate to a mortality event? While science has not produced an answer to this question (uncertainty), a reasonable impact assessment can still be conducted by considering the status of the population, current growth trends, the whales' reactions to harassment, the consequence of that reaction to individual whales, the impact of those individual reactions to the population, and the uncertainty of the relationship between harassments and mortalities. Were we to find little likelihood of a relationship between harassment and mortality, for example, the overall impact to this DPS might be low or moderate. But, by including a finding of a high likelihood that harassments are linked with some mortality, the overall impact may become significant.

Uncertainty is also considered as we manage risk. We know the Cook Inlet beluga DPS exists at a highly precarious state; having a twenty-six percent probability of extinction within 100 years. The consequence of uncertainty to our ability to recover these whales is great. To avoid Type II errors, (i.e., concluding that the animal was not affected when in fact it was) in situations with many unknowns or uncertainties, we may assume an effect would occur, thereby providing the "benefit of the doubt" to the species. The acceptability of risk is clearly dependent on the status of the species/habitat in question; the acceptability of risk is extremely low for populations such as the Cook Inlet beluga.

The Cook Inlet beluga whale exists as a small and distinct population that is both physically and genetically isolated from other beluga whale stocks. The population may have numbered more than 1,300 prior to unsustainable levels of removals by subsistence hunting during the past several decades. The 2011 population is estimated at 284 whales (Hobbs et al. 2011) and has been designated as endangered under the ESA. Our best population model places the risk of extinction at 26 percent within the next 100 years. The additional annual loss of even a single whale would add significantly to this probability (Hobbs et al. 2006, 2008; Hobbs and Shelden 2008). The Cook Inlet DPS can be considered to have collapsed and now lies within the "small population dynamics" phase of a population (Figure 20). In this phase, certain biological factors and stochastic (random) events are expected to have disproportionally larger impacts on this population. Beluga whales have a low calving rate and only give birth to a single calf every two to three years. Cook Inlet beluga whales have a small range and appear confined to Cook Inlet. Because these whales occupy the most populated and developed region in the state, they must compete with various anthropogenic stressors, including habitat development, pollution, and harassment. These whales often occur in dense aggregations within small near shore areas, where they are predisposed to adverse effects such as oil spills, noise, poaching, pollution, ship strikes, and disease outbreaks. Live strandings are not uncommon for Cook Inlet beluga whales, and have resulted in deaths due to prolonged exposure. Killer whale forays into the upper Inlet to feed on beluga whales is an example of the disproportionate impact associated with the "small population dynamics" phase. Should a killer whale pod take ten whales annually, a population with 1,000 or more animals could easily sustain that level of removal. However, with a population of 284 whales, this predation rate would represent a significant portion of that year's

FIGURE 20: Population trajectory phases representing phases of the extinction process[11]



recruitment (growth) rate. The longer a population exists within the "small population dynamics" zone, the higher the extinction risk. Unfortunately, the Cook Inlet beluga may exist at this zone for some time because of its: 1) low abundance, 2) low growth potential, and 3) lack of observed recovery, despite restrictions on subsistence harvest, believed to be the principle stressor to the population. Throughout this critical zone, NMFS believes extraordinary caution is warranted for any actions that may impair the performance of individuals within this DPS.

6.1 Synthesis

The primary concern associated with the impacts of the proposed action on the Cook Inlet beluga whale has to do with potential effects due to noise. Exposure to anthropogenic noise may affect these whales by impacting their hearing (temporary threshold shifts or permanent threshold shifts indicating mechanical damage to the ear structure), by masking whale communications, or affecting their behavior (harassment). Therefore, the subject of noise receives much attention in our analysis. There is still uncertainty about the potential impacts of sound on marine mammals, on the factors that determine response and effects, and especially, on the long-term cumulative consequences from increasing noise in the world's oceans from multiple sources (e.g., NRC 2005). Beluga whales are classified as mid-frequency sensitive, and have hearing sensitivities between 40 Hz and 150 KHz.

Ketten (1997) reported that hearing loss can be caused by exposure to sound that exceeds an ear's tolerance (i.e., exhaustion or overextension of one or more ear components). Hearing loss could result in an inability to 1) communicate effectively with other members of its species, 2)

[1]C. Johnson, NMFS, unpublished data.

detect approaching predators or vessels, or 3) echolocate (in toothed whales). Some studies have shown that following exposure to a sufficiently intense sound, marine mammals may exhibit an increased hearing threshold (a threshold shift) after the sound has ceased (Nachtigall et al. 2004; Kastak et al. 1999; Schlundt et al. 2000; Finneran et al. 2002). Thus, a threshold shift indicates that the sound exposure resulted in hearing loss causing decreased sensitivity. This type of hearing loss is called a temporary threshold shift if the individual recovers its pre-exposure sensitivity of hearing over time, or a permanent threshold shift if it does not.

Whether a temporary threshold shift or a permanent threshold shift occurs will be determined primarily based on the extent of inner ear damage the received sound and the received sound level caused (Ketten 1997). In general, whether a given species will tend to be damaged by a given sound depends on the frequency sensitivity of that species. Permanent threshold shifts are less species dependent and more dependent on the length of time the peak pressure lasts and the signal rise time. Usually if exposure time is short, hearing sensitivity is recoverable. Noise can also cause modification to an animal's behavior (e.g., approach or avoidance behavior, or startle response).

When noise interferes with sounds used by marine mammals (e.g., interferes with their communication or echolocation), it is said to "mask" the sound (e.g., a call to another whale might be masked by an icebreaker operating a certain distance away). Noises can mask the sounds that marine mammals need to hear to function (Erbe et al. 1999). In a given environment, the noise impact on cetacean detection of signals would likely be influenced by both the noise frequency and the temporal characteristics, its signal-to-noise ratio, and by the same characteristics of other sounds occurring in the same vicinity (e.g., a sound could be intermittent but contribute to masking if many intermittent noises were occurring). It is not known whether (or which) marine mammals can and do adapt their vocalizations to background noise (Erbe and Farmer 1998).

Available evidence indicates that behavioral reaction to sound, even within a species, may depend on the listener's gender and reproductive status, age, accumulated hearing damage, type of activity engaged in at the time or, in some cases, group size. For example, reaction to sound may vary depending on whether females have calves accompanying them, or whether individuals are feeding or migrating. Response may be influenced by whether, how often, and in what context, the individual animal has heard the sound before. All of this specificity greatly complicates our ability, in a given situation, to predict the behavioral response by a species, or on classes of individuals within a species, to a given sound. Therefore, we attempt to take a conservative approach in our analyses and base conclusions about potential impacts or potential effects on the most sensitive members in a population.

This does not necessarily mean that a beluga whale that is harassed would be prevented from an essential activity. It is meant to differentiate reactions with possible biological significance from other reactions without consequence; such as slight changes in direction or a slowing of swim speed. In Cook Inlet, it is difficult to observe harassment of an animal because beluga whales dive or stay submerged and the waters in Cook Inlet are turbid. It is not known in most instances if behavioral patterns would be disrupted, if the animal is unable to complete some reproduction-related, feeding, or other activity; or if the animal is likely to be injured. In order to avoid committing a Type II error, we assume that animals are harassed when their behavior appears to be disrupted, such as ceasing to feed or exhibiting avoidance reactions upon exposure to human-made sounds. Information on whether an animal would be disrupted by certain environmental factors is available through published studies and observations. At times, information on closely related species was applied to the Cook Inlet beluga whale in this biological opinion.

The ESA prohibits the unauthorized take of threatened or endangered species, and defines the term "take" to include harassment. Some beluga whales will be harassed by this action as they respond behaviorally or physiologically to sounds associated with the airguns and vessels. The ESA, however, does not define harassment. The U.S. Fish & Wildlife Service has promulgated a regulation that defines it as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." 50 C.F.R. § 17.3. Under the Marine Mammal Protection Act, there is a definition of what is referred to as Level B harassment: "any act of pursuit, torment, or annoyance which . . . has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." 16 U.S.C. §1362(18)(A)(ii). While the incidental harassment authorization concerns only MMPA Level B harassment as has been defined under the MMPA, this opinion considers all potential takes associated with this action, including the ones covered under the more inclusive MMPA definition of harassment. In doing so, we rely on the take estimates provided by the Office of Protected Resources, NMFS, as they provide a reasonable and conservative estimate for purposes of evaluating jeopardy. Since our analysis does not find that there will be additional takes apart from those estimated by the Office of Protected Resources, we have included those estimates in the incidental take statement.

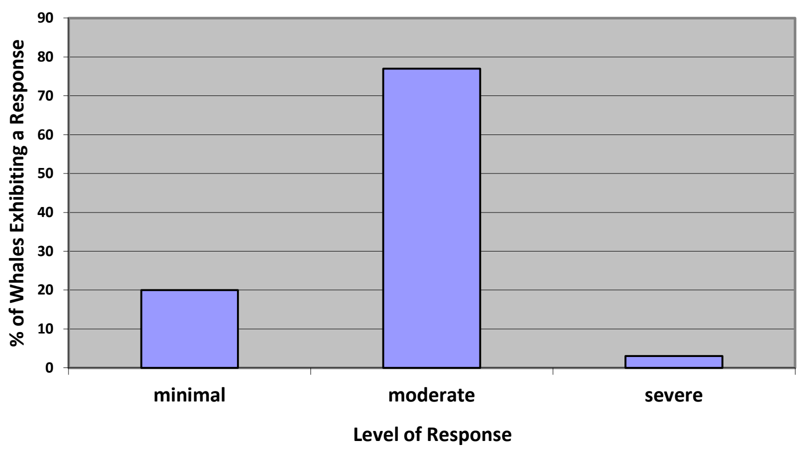
It is also important to note that, regardless of the definition of harassment applied to authorize the number of takes requested for MMPA authorization, this opinion's analysis of effects of the action is not confined to harassment. Rather, it considers all potential stressors associated with the action that may adversely affect the Cook Inlet beluga whale, its critical habitat, and the western DPS of Steller sea lions, and it evaluates all potential reactions or consequences to those stressors, such as inducement of stress enzymes or displacement from certain areas.

Tertiary effects, those resulting in population-level changes including increased mortality, reduced reproductive rate, or habitat abandonment, are not well understood. A metric for the impacts of noise exposure on critical biological parameters such as growth, survival, and reproduction is needed. Unfortunately, as Wartzok et al. (2004) points out, no such metric is currently available, and it is likely to take decades of research to provide the analytical framework and empirical results needed to create such a metric, if one in fact is ultimately even viable (Southall et al. 2007).

While NMFS has yet to promulgate regulations or issue guidance positing specific numerical dB thresholds under the MMPA or ESA, NMFS has been in the practice of using 160 db re: 1 μPa for impulsive sound and 125 dB re: 1 μPa for continuous sound as proxies for "take" acoustic harassment in Cook Inlet. This step function approach represents a compromise to afford reasonable protection to a large suite of marine mammals (e.g., mid-frequency cetaceans), and may not be accurate thresholds for beluga whales. There is research to suggest that the harassment levels currently accepted by NMFS might be significantly below the levels of noise that actually harass or injure beluga whales (Southall et al. 2007). Also, an acoustic source may have radically different effects depending on operational and environmental variables, and on the physiological, sensory, and psychological characteristics of exposed animals. In many cases, specific acoustic features of the sound and contextual variables (e.g., proximity, subject experience and motivation, duration, or recurrence of exposure) may be of considerably greater relevance to the behavioral response than simple acoustic variables such as the received sound level. These factors make it difficult or impossible to justify basing broad, objective determinations of impact thresholds on received levels alone (Southall et al. 2007).

Therefore it is likely the reactions of Cook Inlet belugas to in-water noise do not tightly follow the 125/160/180 dB step function NMFS currently recognizes as the thresholds for harassment takes by continuous noise, impulsive noise, and injurious takes, respectively. Rather, it is likely that a few whales exposed to moderate to high noise levels (e.g. 120-180 dB) will show little or no reaction (Figure 21). The majority of whales will experience some level of reaction that might include behavioral changes of no biological significance, or more significant reactions that could cause whales to avoid the sound source, change surfacing behavior, or alter their vocalizations. Finally, a small number of whales could have acute reactions to these sounds. We would describe acute reactions as those presenting higher biological significance to individuals than a "take", and might include injury through PTS or abandonment of important habitats (such as feeding, rearing, or predator-avoidance habitat) with consequence to their well being.

FIGURE 21. Level of Behavioral Reaction of Cook Inlet Beluga Whales to Noise



Underwater sound levels in the Cook Inlet are comprised of multiple sources, including physical noise, biological noise, and man-made noise. Physical noise includes wind, waves at the surface, currents, earthquakes, ice, and atmospheric noise. Biological noise includes sounds produced by marine mammals, fish, and invertebrates. Man-made noise consists of vessels (small and large), oil and gas operations, dredging, construction noise, and aircraft over flights.

Blackwell and Greene (2002) reported ambient levels, devoid of industrial sounds, at Birchwood in Knik Arm (north of the action area) at approximately 95 dB, to more than 120 dB for locations in lower Knik Arm near the POA. At the mouth of Eagle River they reported ambient levels at approximately 107.2 dB re: 1 μPa. Blackwell (2005) reported background levels, not devoid of industrial sounds, without strong currents at 115 to 118 dB. Background levels with strong currents were measured between 125 and 132 dB. URS (2007) reported ambient levels at 105 to 120 dB when no industrial sounds were identified to background levels between 120 and 140 dB when vessels were operating. Scientific Fishery Systems, Inc. (2009) indicated background levels ranged from 120 to 155 dB, depending heavily on wind speed and tide level. All of these studies indicate measured background levels are rarely below 125 dB, except in conditions with no wind and slack tide. This means that in-water continuous noise levels at which NMFS determines whales to be "taken" by harassment are commonly exceeded by ambient conditions in Knik Arm, with the whales obviously having adjusted to such levels. These areas are outside the action area for the seismic program, and since they are near the largest urban area of Alaska, are likely to have higher levels of noise than the majority of the action area.

This biological opinion has considered the effects from the seismic program on endangered Cook Inlet beluga whales. These actions are likely to adversely affect these whales due to the low frequency, impulsive noise from the airguns. Elevated noise levels in the marine environment could alter a whale's hearing ability, causing temporary or permanent threshold shifts. However, we would not expect whales to remain within ensonified areas long enough to cause such effects. Similarly, increased levels of in-water noise may mask communication between beluga whales. Erbe (2000) predicted low speed vessels could mask killer whale sounds at a range of 1 km. Any such effect would be partially mitigated by the difference in frequencies between the seismic sounds and beluga calls. Beluga whales have been found to adjust their echolocation clicks to higher frequencies in the presence of background noise (Au et al. 1985). Nonetheless, seismic activities present concerns with respect to hearing, and should be closely conditioned and monitored to avoid these effects.

The applicant estimated the maximum total take of Cook Inlet beluga whales during the first year of the seismic program would be 30. These takes are likely to be by harassment due to acoustic exposure to seismic noise; no lethal takes are expected and none will be authorized. Further, these estimates concern "takes" as defined by the Marine Mammal Protection Act, and are not necessarily indicative of all direct and indirect effects to beluga whales or their habitat. Cook Inlet beluga whales could be exposed to seismic noise exceeding 180 dB. These levels are believed to be capable of damaging hearing in whales by creating permanent threshold shifts. The numbers of whales expected to be so-exposed is very small, and should be mitigated to a large extent by the timing of the areas surveyed (see Figure 6 – Windows of Opportunity) to avoid high-use periods, and visual and acoustic monitoring to power or shut down the airguns when whales are within or about to enter the specified safety zones. These estimates for harassment takes were derived through density estimates from various sources that may not reflect the actual numbers of whales in these particular areas, sound propagation figures which are derived from models that may differ from actual conditions, and an assumed "take" received sound level of 160 dB (for intermittent noise), which may be higher or lower than the actual levels that elicit biologically-significant response from the whales. However, the estimates appear reasonable in view of reported data for other projects in Cook Inlet.

As discussed earlier, there is concern that received levels below these thresholds are detectable by whales and may cause some behavioral reaction. The numbers of animals so-effected cannot be determined or estimated, and are dependent on many factors, including the specific sound propagation characteristics in the area as well as the numbers, location, age and gender of the receiving whales. There is concern that whales may abandon feeding areas when exposed to loud noises or that noise from the seismic program will prevent whales from milling, feeding, or traveling through the action area. However, as described previously, Cook Inlet belugas may be tolerant to noise or disturbance in feeding areas and have remained in these areas despite significant disturbance (notably the continued occupation of the Susitna Delta by feeding whales despite being actively pursued and hunted during past subsistence harvests). The only primary/high density feeding area within the action area is the Susitna Delta. The Susitna Delta is planned to be surveyed as part of Area 3 (the last area to be surveyed) and is scheduled for surveys in the late fall, after mid-October (Figure 6 – Windows of Opportunity). This timing is after the high density use period (May-September) by belugas in the Susitna Delta. As has been noted in several papers, beluga whale reactions to sound stimuli is more closely related to context (i.e., the recent experience of the whale with the sound stimulus, their current activity, and their motivation to remain or leave) than received sound levels (Wartzok et al. 2004; Southall et al 2007), so it is unlikely that noise associated with the proposed seismic program will cause whales to abandon the Susitna Delta.

A significant issue with regard to the seismic program's effect on beluga whale concerns changes in their behavior (which may not rise to the level of take) when confronted with acoustic disturbance during the surveys. Often, intense disturbance will cause animals to shift habitats, even at the cost of reduced access to resources, or to remain in preferred habitats if alternative sites are either not available or are of such low quality that the net benefit to remain exceeds the benefit of alternative habitats. Numerous studies on large mammals (Frid and Dill 2002) document the detrimental effects of human-caused disturbance on behavior, reproductive success, and parental investment. Even non-lethal anthropogenic disturbance may evoke reactions similar to those associated with the appearance of a predator. High levels of predation risk (or human disturbance) may indirectly effect survival and reproduction by causing prey (in this case, beluga whales) to divert a large proportion of time and energy away from resource acquisition, so that body condition deteriorates and survival and reproductive success are reduced (Frid and Dill 2002). We considered this effect in our evaluation. Such a theory is consistent with the lack of recovery by this population despite the fact that hunting has not been a significant factor since 1999. The reasons for this lack of observed recovery are unknown, but may include killer whale predation, strandings, habitat loss, or pollution. The areas most affected by noise from the proposed seismic surveys do not include primary feeding habitats (with the exception of the Susitna Delta after the anadromous fish runs and during periods of low beluga use). Rather, the ensonified areas would primarily constitute passage and resting habitats, albeit some degree of feeding is likely occur in these areas as well. Since the survey areas are not primary feeding areas, any diminished use of these areas is not likely to result in significant effects to individual fitness. We note that the observations from the POA monitoring and TEK indicate Cook Inlet beluga whales will continue to utilize important habitats despite the presence of disturbing stimuli; this should hold true for lesser value habitats as well. Beluga hunters report that the whales did not leave the feeding areas off the Susitna River during the spring even as their hunt progressed.

An uncertainty in this analysis concerns whether beluga whales' continued passage through and use of the areas would be impaired, diminished, or prevented during seismic operations. The significance of this uncertainty is important to our assessment. We consider the probability that most whales would abandon or fail to reoccupy the survey sites even after the cessation of seismic activity in a specific area to be extremely low. However, the consequence of these whales permanently abandoning these areas could be very great, particularly if this exclusion or diminished use deprives them of important habitat areas that provide for vital life history functions, such as feeding or calving; and if alternative habitat sites cannot be utilized. Impulsive noise from the airguns will increase in-water noise levels and could be significant, but will be largely mitigated by the monitoring and power/shut down measures designed to limit the most significant sources of in-water noise when beluga whales are observed in the safety zones. Seismic effects due to noise are not anticipated or projected to reach levels capable of harassment within the most important beluga whale habitats in Knik Arm and Turnagain Arm.

Long-term beluga whale observations in Knik Arm suggest that construction activity noises are not influencing beluga whale abundance or habitat use around the POA (POA et al. 2009). In general, scientific literature describes the following reactions as most common by marine mammals with exposure to anthropogenic noise: altered headings; fast swimming; changes in dive, surfacing, respiration, feeding patterns; and changes in vocalizations. Death and injury are recorded but are very rare, and associated with much higher source levels in-water than presented by the proposed project. Though behavioral reactions are possible, monitoring reports of construction at the POA show no apparent observable reaction by Cook Inlet beluga whales to construction noises and suggest that construction activities are not influencing beluga whale abundance or habitat use around the Port of Anchorage (USDOT 2009). There could be many reasons for this, including, but not limited to: 1) Cook Inlet beluga whales have demonstrated a tolerance or adaptation to commercial vessel traffic and industrialization around the POA, or may have habituated to such noise; 2) Cook Inlet is a naturally noisy environment which raises ambient sound levels; 3) beluga responses to construction and dredging are not detectable by existing data collection methods; and 4) the need to meet certain life history requirements, such as acquiring food, overrides avoidance reactions. Research on the effects of ship noise on southern resident killer whales in the San Juan Islands (Bain et al. 2006) found whales spent more time travelling and less time foraging in the presence of boats within 400 meters. These killer whales also travelled in less direct paths and had longer average durations between breaths when vessels were present compared to when absent within 1000 meters. They found no significant difference in swim course or speed due to vessel traffic. This study concerned whale watching vessels that were approaching the killer whales at various distances. The results may not be applicable to the seismic program, both due to the different species involved and the fact that seismic vessels are not chasing whales and generally will move in slow, straight line paths.

Opportunistic sighting reports and those from marine mammal observations describe beluga whales vocalizing around tugs and barges; swimming near and around ships; and feeding around working vessels. While beluga whales may be exposed to greater noise levels during seismic surveys, background sound levels in Cook Inlet are already generally higher than many marine and estuarine systems, due to strong currents and eddies; wind; recreational vessel traffic; commercial shipping traffic entering and leaving the inlet; and military, private, and commercial aircraft operating in the immediate vicinity. It appears unlikely that belugas would alter their behavior in a way that would impact their fitness or reproductive success. This conclusion is supported by the fact that noise from construction and dredging have been regular events at the POA for decades, during which time beluga whales have consistently been seen in these waters. Beluga whales are routinely observed within the footprint of the POA expansion project, often in areas closest to the port, within 0.5 km of shore (Cornick and Kendall 2008). Similarly, it is not expected that the seismic program would cause the beluga whales to abandon their habitat altogether. Any small numbers of whales, which may be temporarily displaced from the action area due to seismic operations, are likely to select alternative habitat sites that provide the same function elsewhere in Cook Inlet. The capacity of these other habitats to support any displaced whales should be adequate, given the presently small population size, and given the fact that there will be no seismic activity in Knik or Turnagain Arms (prime habitat areas). The productivity and habitat value of alternative sites should provide the small number of belugas their nutritional and other requirements should the whales experience any reduced use of the area actively being surveyed.

Our assessment of possible behavioral reactions to the seismic program also considered site fidelity by beluga whales. Site fidelity is likely within the Cook Inlet belugas, especially to several upper-Inlet sites during the ice-free months, but few data presently exist regarding any demographic divisions within this population. Fidelity to habitat sites is strong within some other beluga populations (e.g., St. Lawrence), and less so with other populations such as the Eastern Beaufort Sea beluga whale stock. Rugh et.al (2010) found Cook Inlet beluga distribution has changed during the last decades and suggested this may be due to their reduced numbers, which allows the whales to select only the most productive habitat areas. This apparent redistribution to the extreme upper inlet during the summer indicates this characteristic is at least somewhat flexible for the Cook Inlet belugas, and that any reduction in the use of areas of mid and lower inlet might be offset by their preference for habitat in the extreme upper inlet (which are known feeding and possible breeding sites). Field observations (Funk et al. 2005) have noted higher percentages of calves within beluga groups in Knik Arm than in the Susitna River area. Traditional ecological knowledge (TEK) has also identified upper Knik Arm as a traditional nursery site. Also, the fact that juveniles and calves are often observed in Knik Arm indicates the present gauntlet) from noise (e.g., noise from port construction and operations, vessel traffic, military training activities, aircraft, etc.) in lower Knik Arm does not prevent the beluga whales from accessing and utilizing habitats in Eagle Bay, Goose Bay, and other areas of upper Knik Arm.

Any reduction in the availability of, or access to, foraging habitat could have consequence to individual fitness. Williams and Hammond (2006) considered the impact of exposure to vessels (these were mostly fishing vessels rather than whale-watching vessels) by northern resident killer whales in British Columbia. They found these whales reduced the time spent feeding from 13 percent to 10 percent when boats were present, but concluded the net energetic effect of this was small; increasing only by three percent in the presence of vessels. However, they estimated the lost opportunity to feed resulted in a 28 percent decrease in 12 hour energetic gain. This study found that, while northern resident killer whales may be able to balance the energetic costs of avoiding boats, such short-term behavioral responses can carry energetic costs that could have long-term population effects if the population were food-limited. At this time, NMFS is not aware of evidence to support the theory that the Cook Inlet beluga whale population is so-limited.

Morton and Symonds (2002) describe the effects of acoustic harassment devices on killer whales in Johnstone Strait near Vancouver Island. Operation of those devices, designed to deter harbor seals, coincided with a marked decrease in the numbers of killer whales in the area. The harassment devices operated at 10kHz, a frequency that would be particularly sensitive to mid-frequency cetaceans such as killer whales and beluga whales. However, when the use of the devices ended, killer whale occurrence re-established to baseline levels. We would expect any diminished use by beluga whales of the action area as a result of noise by the seismic program to recover shortly after the survey ceases.

6.2 Integration

We have considered the ***project effects*** to Cook Inlet beluga whales and their critical habitat. We believe the seismic program will result in the harassment of beluga whales. The majority of such harassment would be due to impulsive noise associated with airguns. The most likely manifestations from this harassment would be a temporary change in behavior, avoiding the sound source by navigating around it, or passing through the ensonified area with fewer surfacing intervals. There is little data describing beluga behaviors outside the upper inlet, but whales in the action area are generally dispersed and in small groups and are generally presumed to be travelling, resting or feeding. Whales are not expected to be significantly impacted by noise from the project because of 1) the small area actively being surveyed at any given time, 2) the windows of opportunity the applicant must work around, 3) the visual and acoustic monitoring program in place, 4) ramp-up and power/shut-down procedures to reduce harassment to belugas, and 5) setbacks from specific anadromous streams and river mouths.

Studies have estimated one hundred or more beluga whales may occur in Knik Arm during one observation; or approximately thirty-five percent of the total population. Rugh et. al (2010) reported that over 95% of all belugas are found north of a line between the Beluga River and Pt. Possession in the summer. The applicant will not be conducting seismic surveys in Cook Inlet waters in this area (critical habitat area 1) during the summer, thereby have reduced the likelihood of ever encountering, and potentially harassing, large groups of whales. Although unlikely, it is possible that a small percentage of whales may be reluctant to continue to reoccupy areas recently surveyed. Those whales would likely move into alternative sites with similar habitat properties. Impacts to beluga whales from the seismic program are unlikely to have significant adverse consequence to individuals or to the population.

The ***baseline condition*** experienced by the Cook Inlet beluga whale DPS is characterized by its very low abundance, no observable recovery within the population (NMFS currently estimates an annual decline of 1.1 percent), and a high (26 percent) probability of extinction within the next 100 years. The additional annual mortality of a single animal would accelerate this extinction timeframe. At the same time, this population faces continuing, but unquantified, threats from both anthropogenic and natural sources. Although NMFS believes past excessive harvest removals are largely responsible for the decline of this DPS, we are not able to identify the present cause(s) for the lack of recovery. While coastal development in the upper inlet and oil and gas development in the mid inlet have been extensive, and are important aspects of the baseline condition, we have no evidence such work has had any significant detrimental impact to individual whales, nor to this population.

Cook Inlet beluga whales are currently being “harassed,” as that term is defined in the ESA and MMPA, due to authorized construction at the POA and by certain scientific research. These takes have been determined not to be significant to the recovery of this DPS. Illegal harassment is likely occurring as a result of small vessels operations, aircraft overflights, and other actions by humans, but there is no data available as to the extent of this harassment or how such harassment may be affecting the beluga population. We are unaware of any on-going lethal or injurious takes, although unobserved, unreported, and illegal harvests are possible. Therefore, a cautious and conservative approach to threats is appropriate and necessary in view of the baseline condition.

Our review of the ***cumulative impacts*** to Cook Inlet beluga whales also found some unquantified level of threats from activities without a federal nexus, and for which no consultation would occur under the ESA. Of these, we believe recreational vessel traffic may be of most concern, with the potential to harass beluga whales, displace them from important feeding habitat near the mouths of certain salmon streams entering the upper Inlet, and to injure whales due to strikes. However, it appears beluga whales continue to occupy feeding areas despite small boat traffic (indeed, beluga whales remained within feeding habitat at the Susitna Delta despite being actively pursued and hunted during past subsistence harvests). Ship strikes have not been identified as the cause of death for any stranded whales, although many stranding investigations are inconclusive.

On integrating the effects from the proposed seismic program on beluga whales and their critical habitat with the environmental baseline and cumulative effects, we expect that individual or small groups of whales are likely to be harassed by impulsive noise from the airguns, but we do not believe this project would have significant adverse consequences at the population/DPS level. Beluga whales are unlikely to be killed or injured by this project, and harassment would be expected to be localized and temporary. Whales will experience higher than ambient noise levels should they be undetected before and during actual seismic shots. The most pronounced increase in noise levels would occur from the use of the 2,400 cui airgun array. However, the use of this array will be intermittent, and only lasting approximately 2.5 hours around each slack tide during the seismic shooting phase of the patch shooting process. While beluga whales are being taken under the environmental baseline and through cumulative effects, we believe such takes are non-lethal and are mostly due to harassment and disturbance by noise. It is not presently possible to quantify the effects of this harassment to the extinction risk probabilities for this DPS. However, we believe it unlikely that non-injurious takes, such as unintentional harassment due to noise, would elicit consequences to the survival or reproductive capacity of the Cook Inlet beluga whales.

Conservation measures are included in this biological opinion, which, along with operational conditions and mitigation measures in the proposed action, would further reduce the likelihood for biologically significant impacts to individual whales or this DPS.

6.3 Mitigation Measures

In the BA (SAExploration Inc 2011), the applicant has identified the following mitigation measures, which are adopted as part of the proposed action (see section 1.3.3 of this document for detailed descriptions of these measures). We believe these measures will lessen the effects of the seismic program on Cook Inlet beluga whales. Further, such measures may be associated with conditions necessary for authorization of this work under section 101(a)(5) of the Marine Mammal Protection Act. We note that some of the measures proposed are not specific or do not include detailed descriptions. NMFS will coordinate on these matters as the project planning process continues to ensure the objectives will be implemented and effective. The mitigation measures include:

- modeling and monitoring acoustic safety radii;
- conducting visual monitoring for marine mammals from vessels, aircraft, and when practical, land-based platforms;
- utilizing real-time passive acoustic monitors to detect belugas, especially during times of limited visibility;
- using a ramp-up procedure to slowly increase the number of guns firing (and thus in-water noise from the airguns), rather than starting with the full array in order to give whales in the area time to move away;
- using power-down and shut-down procedures to avoid injury to whales when they are seen approaching the 180 dB zone;
- altering vessel speed and course heading to avoid collisions with belugas or to reduce harassment by noise if belugas are spotted heading towards the harassment/injury zones;
- implementing NMFS vessel operation and marine mammal viewing guidelines to minimize vessel and aircraft impacts;
- discharging airguns at depths greater than 2 m (~6.6 ft);
- only operating in a small portion of the action area at a time; and
- avoiding operating within 10 miles of the MHHW line of the Susitna Delta (Beluga River to the Little Susitna River) between mid-April and mid-October so as to avoid any effects to belugas in this critical feeding and potential breeding area.

7. CONCLUSION

After reviewing the current status of beluga whales and Steller sea lions in Cook Inlet, the environmental baseline, the effects of the proposed action, and the cumulative effects, it is the opinion of NMFS that the implementation of the proposed action, as described in this opinion, is not likely to jeopardize the continued existence of the Cook Inlet beluga whale or Steller sea lion populations, nor to destroy or adversely modify Cook Inlet beluga whale critical habitat.

8. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

While adopting the following conservation recommendations is not a condition of the findings in this biological opinion, these measures are designed to minimize adverse effects to Cook Inlet beluga whales from in-water noise generated by the airguns used in the seismic program.

1. Evaluate and consider using new research and techniques (e.g., by the Joint Industry Program) for reducing the horizontal spread of noise associated with the airguns.

2. In addition to conducting aerial surveys at river mouths prior to shooting, NMFS AKR recommends that aerial surveys also be conducted to verify there are no large congregations of marine mammals (5 or more) present in an area before initiating work in a non-contiguous patch (i.e., if moving from patch A to patch B, no overflight is necessary, but if moving from patch A to patch M, conduct an overflight).

3. It is preferable to reduce the total acoustic energy being put into the marine environment. As such, NMFS AKR recommends that the mitigation gun not be used in between the main designated shooting periods (i.e., only use the mitigation gun during the active shooting period, the 2.5 hours around slack tides). Instead, the operator should initiate the ramp-up procedure at the start of each new shooting period. This will result in approximately 10-12 hours of noise from the airguns and 12-14 hours of "quiet time" over a 24-hour day.

4. Since the acoustic model predicts that the 160 dB zone for the 2,400 cui airgun array extends 6.41 km (~4 mi), and belugas generally swim 2-6 mi per hour, 30 minutes may not be sufficient time for a whale to swim out of the harassment zone. NMFS AKR recommends extending the ramp up procedure from 30 minutes to 45 minutes to provide belugas more time to get beyond the 6.41 km harassment radius.

5. Although the applicant has committed to conducting a sound source verification study at the start of each year, NMFS AKR recommends this study be conducted in both the nearshore and offshore areas (as used in the acoustic model) so as to consider a harassment/harm zone for each depth category used in the model. This would allow for a more accurate delineation of the 160/180 dB isopleths (be it larger or smaller than what the model identifies) and confirms the size of monitoring areas for the Protected Species Observers. Water depth is the most important predictor of sound propagation loss and we feel it is consistent with the two categories in the applicant's acoustic model.

In order for the NMFS, Alaska Region to be kept informed of actions minimizing or avoiding adverse effects or benefiting the endangered Cook Inlet beluga whales, we request notification of the implementation of any conservation recommendations.

9. REINITIATION OF CONSULTATION

This concludes formal consultation on this action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded in any operational year; 2) new information reveals effects from this action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this biological opinion; 3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this biological opinion; or 4) a new species is listed or critical habitat designated that may be affected by the identified action.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined in regulations to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

Section 7(b)(4)(C) of the ESA provides that the operator needs to obtain authorization under section 101(a)(5) of the MMPA before this incidental take statement can become effective. Accordingly, the terms of this statement and the exemption from Section 9 of the ESA that the statement affords are conditional upon the issuance of MMPA authorization to take the marine mammals identified here. Similarly, this biological opinion and incidental take statement cover the entire scope of the proposed activities, *i.e.*, three years of seismic survey operations in Cook Inlet. The operator will need MMPA authorization each year for this take statement to become effective. Absent such authorization, this statement is inoperative.

Amount or Extent of the Take

Available information indicates that incidental acoustic harassment of small numbers of Cook Inlet beluga whales and Steller sea lions may occur during Apache's Cook Inlet 3D Seismic Program. NMFS does not expect beluga whales or sea lions to be injured or killed by the Apache marine surveys. It is possible that the hearing systems of marine mammals very close to an airgun would be at risk of temporary or permanent hearing impairment, and temporary hearing threshold shift is a possibility for animals in close proximity to the source. However, planned monitoring and mitigation measures are designed to avoid sudden onsets of seismic pulses at full power, to detect marine mammals occurring near the array, and to avoid exposing them to sound pulses that may cause hearing impairment.

NMFS AKR anticipates that the non-lethal incidental take of no more than 30 Cook Inlet beluga whales and no more than 20 Steller sea lions per year for three operational years[12] as a result of exposure to impulsive sounds with received levels $\geq$ 160 dB re:1 μPa_{RMS}. The amount of take authorized by this ITS will be exceeded if the number of beluga whales or Steller sea lions taken exceeds this level in any yearly operational year.

Reasonable and Prudent Measures:

NMFS AKR believes the following Reasonable and Prudent Measure are necessary and appropriate to minimize and monitor the impact of incidental take of the endangered Cook Inlet beluga whale and Steller sea lion.

[12] An operational year is defined as the period covered by the IHA(s) or incidental take authorization(s).

1) This ITS is valid only for activities associated with conducting the surveys as described in this Biological Opinion.

2) All seismic-related activity must comply with all terms, conditions, and requirements listed in each valid, current Incidental Harassment Authorization (IHA), or incidental take authorization, issued under MMPA section 101(a)(5) and 50 CFR 216.107 to the operator for this project.

3) The taking of Cook Inlet beluga whales and Steller sea lions shall be by incidental harassment only. The taking by serious injury or death, or the taking by harassment of greater numbers of animals than authorized in this ITS, is prohibited and may result in the modification, suspension, or revocation of the ITS.

4) A comprehensive monitoring and reporting program shall be implemented to ensure that Cook Inlet beluga whales and Steller sea lions are not taken in numbers or in a manner not anticipated by the biological opinion.

Terms and Conditions:
For any incidental takes that result from the actions of NMFS PR1, Corps, or their applicant Apache and its contractors to be exempt from the prohibitions of section 9 of the ESA, the action which causes the take must comply with the following terms and conditions. These terms and conditions implement the reasonable and prudent measures described above and are non-discretionary.

1) The sound source verification studies using the actual airgun arrays shall be conducted prior to beginning any in-water seismic operations in order to obtain definitive measurements for received sound levels that are below 190, 180 and 160 dB re: 1 μPa for each airgun size (10, 440, and 2,400 cui). During these studies, the modeled acoustic radii shall be monitored.

2) All mitigation measures as outlined in section 1.3.3 of this Biological Opinion must be implemented.

3) At all times when it is conducting seismic-related activity, the operator must possess on board the seismic source vessel a current and valid Incidental Harassment Authorization or incidental take authorization issued by NMFS to Apache under section 101(a)(5) of the MMPA. Any take must be authorized by one or more valid, current IHAs or incidental take authorizations issued by NMFS to Apache under section 101(a)(5) of the MMPA, and such take must occur in compliance with all terms, conditions, and requirements included in such authorizations.

4) The taking of any marine mammal in a manner other than that described in this ITS must be reported immediately to the NMFS AKR, Protected Resources Division at 907-271-5006.

5) Submit copies of all reports required by all MMPA authorizations and within the same timeframes to:

NMFS AKR
ATTN Mandy Migura
222 W. 7th Ave, Box 43
Anchorage, AK 99513

mandy.migura@noaa.gov

6) In addition to the above-mentioned reports, submit a report at the end of each operational year summarizing the content provided in the monthly reports as well as the operational plan (specific locations and dates) for the next operational year to NMFS AKR.

7) In the event that the specified activity clearly causes the take of a marine mammal in a manner other than that described by this ITS, such as serious injury or mortality (e.g., Level A harassment; ship-strike; gear interaction; and/or entanglement), Apache shall immediately cease the specified activities and immediately report the incident to NMFS AKR Protected Resources Division at 907-271-5006, and/or by email to Brad.Smith@noaa.gov and Mandy.Migura@noaa.gov.

Effective Date:
This ITS will be in effect immediately upon issuance of an IHA, or MMPA incidental take authorization, for the first operational year and remain in effect through January 31, 2015, provided the operator possesses a current and valid MMPA IHA or incidental take authorization at all times throughout each operational year. Should the operator fail to possess such an authorization, this ITS shall become ineffective immediately and shall remain ineffective until such time as the operator again possesses a current and valid IHA or incidental take authorization.

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