FINAL

Programmatic Environmental Assessment

for

Fisheries and Ecosystem Research Conducted and Funded

by the

Alaska Fisheries Science Center

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LIST OF ACRONYMS AND ABBREVIATIONS

μPa	micro Pascal
ABC	Acceptable Biological Catch
ABL	Auke Bay Laboratories
ACES	Arctic Coastal Ecosystem Surveys
ACL	Annual Catch Limit
ADCP	Acoustic Doppler Current Profiler
ADFG	Alaska Department of Fish and Game
AEWC	Alaska Eskimo Whaling Commission
AFSC	Alaska Fisheries Science Center
AI	Aleutian Islands
ANILCA	Alaska National Interest Land Conservation Act
ARPSIF	AFSC Research Protected Species Interaction Form
AWT	Aleutian Wing Trawl
BASIS	Bering Arctic Subarctic Integrated Survey
BiOp	Biological Opinions
BSAIRA	Bering Sea/Aleutian Islands Research Area
CCBSP	Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea
CDQ	community development quota
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CO_2	carbon dioxide
CPUE	catch per unit effort
CSBSRA	Chukchi Sea/Beaufort Sea Research Area
CSESP	Chukchi Sea Environmental Studies Program
dB	decibels
DPEA	Draft Programmatic Environmental Assessment
DPS	distinct population segment
EA	Environmental Assessment
EcoFOCI/ EMA	Ecosystems & Fisheries-Oceanography Coordinated Investigations / Ecosystem Monitoring and Assessment Program
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Orders
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FMA	Fisheries Monitoring and Analysis
FMP	Fishery Management Plan
FMU	Fishery Management Unit
FMZ	Fisheries Management Zones

FONSI	Finding of No Significant Impact
FPEA	Final Programmatic Environmental Assessment
FWCA	Fish and Wildlife Coordination Act
GOA	Gulf of Alaska
GOARA	Gulf of Alaska Research Area
HAPC	Habitat Areas of Particular Concern
HCA	Habitat Conservation Areas
HSFCA	High Seas Fishing Compliance Act
IATTC	Inter-American Tropical Tuna Commission
IFQ	individual fishing quota
IHA	Incidental Harassment Authorization
IMO	International Maritime Organization
IPHC	International Pacific Halibut Commission
IR	infrared
ISC	International Scientific Committee
ITA	incidental take authorization
IWC	International Whaling Commission
KFRC	Kodiak Laboratory in the Kodiak Fisheries Research Center
kHz	Kilohertz
km	Kilometer
km^2	square kilometers
LME	Large Marine Ecosystem
LOA	Letters of Authorization
LOF	List of Fisheries
m	meter
M&SI	mortality and serious injury
MBES	multi-beam echosounder
MBTA	Migratory Bird Treaty Act
mm	millimeter
MMED	Marine Mammal Excluder Device
MML	Marine Mammal Laboratory
MMO	Marine Mammal Observer
MMPA	Marine Mammal Protection Act
MOU	Memorandum of Understanding
MPA	Marine Protected Area
MSA	Magnuson-Stevens Fishery Conservation and Management Act
mt	metric ton
NBS	northern Bering Sea
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
nm	nautical mile

NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOR	Notice of Rule
NPAFC	North Pacific Anadromous Fish Commission
NPFMC	North Pacific Fishery Management Council
NWFSC	Northwest Fisheries Science Center
OFL	Overfishing Limit
OPR	Office of Protected Resources
PBR	Potential Biological Removal
PIFSC	Pacific Islands Fisheries Science Center
POA	Port of Anchorage
PSIT	Protected Species Incidental Take
PSO	Protected Species Observers
PTS	permanent threshold shift
RACE	Resource Assessment and Conservation Engineering Division
RCA	Rookery Cluster Areas
REFM	Resource Ecology and Fisheries Management Division
RFFA	Reasonably foreseeable future action
rms	root mean square
ROV	Remotely Operated Vessel
SAFE	Stock Assessment and Fishery Evaluation
SAR	stock assessment report
SEASWAP	Southeast Alaska Sperm Whale Avoidance Project
SECM	Southeast Alaska Coastal Monitoring
SHPO	State Historic Preservation Officer
SRP	Scientific Research Permit
SWFSC	Southwest Fisheries Science Center
TAC	Total Allowable Catch
TS	threshold shift
TTS	temporary threshold shift
UV	ultraviolet
U.S.	United States
U.S.C.	United States Code
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
WNP	western North Pacific
yr	year

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EXECUTIVE SUMMARY

CHAPTER 1 – INTRODUCTION AND PURPOSE AND NEED

The Federal government has a responsibility to conserve and protect living marine resources in Federal waters of the United States (U.S.), also referred to as the Exclusive Economic Zone [EEZ][1]. Off Alaska, these waters lie three to 200 nautical miles (nm) from the shoreline. The National Oceanic and Atmospheric Administration (NOAA) has the primary responsibility for the stewardship of marine habitats and ocean resources, including finfish and shellfish, certain marine mammal species, and sea turtles. Within NOAA, the National Marine Fisheries Service (NMFS) has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources within the U.S. EEZ.

NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. So central is science-based management to NMFS fishery management efforts, it is listed among the ten National Standards set forth in the Magnuson-Stevens Fishery Conservation and Management Act (MSA); National Standard 2: "conservation and management measures shall be based upon the best scientific information available." (16 United States Code [U.S.C.] § 1801-1884).

This Final Programmatic Environmental Assessment (FPEA) evaluates both a primary and a secondary federal action under the National Environmental Policy Act (NEPA). The purpose and need for the primary action is to continue fisheries research activities conducted and/or funded by the Alaska Fisheries Science Center (AFSC) to produce scientific information necessary for the management and conservation of living marine resources in the North Pacific Ocean and marine waters off of Alaska. This research promotes both the recovery of certain species and the long-term sustainability of these resources. It also generates social and economic opportunities and benefits from their use. The information developed from these research activities is essential to the development of a broad array of fishery, marine mammal, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and Native Alaska authorities. Each of the research activities requires one or more scientific research permits (SRPs) and the issuance of these permits is a part of the primary federal action covered under this NEPA review. The secondary action is the issuance of proposed regulations and subsequent Letters of Authorization (LOA) under Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA) of 1972, as amended (MMPA; 16 U.S.C. 1361 et seq.), the purpose and need of which is to govern the unintentional taking of small numbers of marine mammals incidental to AFSC fisheries research activities.

Fisheries Science Centers

In order to direct and coordinate the collection of scientific information needed to make informed fishery conservation and management decisions, NMFS established six Regional Fisheries Science Centers[2], each a distinct organizational entity and the scientific focal point within NMFS for region-based federal fisheries-related research in the U.S. The Fisheries Science Centers conduct primarily fisheries-independent research studies[3] but may also participate in fisheries-dependent and cooperative research

[1] An Exclusive Economic Zone is an area over which a nation has special rights over the exploration and use of marine resources.

[2] Northeast Fisheries Science Center (FSC), Southeast FSC, Southwest FSC, Northwest FSC, Alaska FSC, and Pacific Islands FSC.

[3] Fisheries-independent research is designed and conducted independent of commercial fishing activity to meet specific research goals, and includes research directed by AFSC scientists and conducted on board NOAA- owned and operated vessels or NOAA-chartered vessels. Fisheries-dependent research is research that is carried out in partnership with commercial fishing vessels. The vessel activity is not directed by the AFSC, but researchers collect data on the commercial catch. Cooperative research programs are those where the AFSC provides substantial support of the research through funding, equipment supply, or scientific

studies. Research is aimed at monitoring fish stock recruitment, survival and biological rates, abundance and geographic distribution of species and stocks, and providing other scientific information needed to improve our understanding of complex marine ecological processes and promote NMFS strategic goal of ecosystem-based fisheries management.

Alaska Fisheries Science Center Research Activities

The AFSC provides scientific support for the NMFS Alaska Regional Office. The AFSC plans, develops, and manages a multidisciplinary program of basic and applied research to generate the best scientific data available for understanding, managing, and conserving the region's living marine resources. This FPEA assesses the impacts of AFSC fisheries and ecosystem research activities in three research areas: 1) Gulf of Alaska Research Area (GOARA), the Bering Sea/Aleutian Islands Research Area (BSAIRA), and the Chukchi Sea/Beaufort Sea Research Area (CSBSRA) (Figure 1.1-2).

The primary responsibilities of the AFSC are to provide scientific data and technical advice to a variety of management organizations and stakeholder groups, including the NMFS Alaska Regional Office, North Pacific Fishery Management Council (NPFMC), State of Alaska, Alaskan coastal subsistence communities, and U.S. representatives participating in international fishery and marine mammal negotiations, as well as the fishing industry and its constituents. The AFSC also coordinates fisheries and marine mammal research with other federal and state agencies, academic institutions, and foreign nations.

In addition to fisheries management organizations, AFSC generates and communicates scientific information to support the recovery of protected species, the establishment of marine protected areas (MPAs), the emergence of marine spatial planning, and to advance scientific understanding of the structure and function of marine ecosystems and the impacts of climate change on these systems.

The specimen archives collected during AFSC research cruises include some of the world’s preeminent collections of plankton, fish, marine invertebrates, and tissue samples for molecular genetics. Sample coverage from different coastal areas is unique in the world because of the long time-series and extensive area from which they have been sampled. These collection archives provide an important record of species diversity, community composition, genetic structure, and an extraordinary record of climate change and other human impacts for current and future studies.

NMFS has prepared this FPEA to evaluate several alternatives for conducting and funding these fisheries and ecosystem research activities as the primary federal action. NMFS is also evaluating a number of mitigation measures that may be implemented to reduce potential impacts on marine mammals as part of the analysis concerning the secondary action, compliance with the MMPA. Additionally, because the proposed fisheries and ecological research activities occur in areas inhabited by a number of marine mammals, birds, sea turtles, and fishes listed under the Endangered Species Act (ESA) as threatened or endangered, this FPEA evaluates activities that could result in unintentional impacts on ESA-listed marine species.

CHAPTER 2 – ALTERNATIVES

In accordance with NEPA, Council on Environmental Quality Regulations, and Agency policies, NMFS is required to consider alternatives to a proposed federal action. The evaluation of alternatives under NEPA assists NMFS with ensuring that any unnecessary impacts are avoided through an assessment of alternative ways to achieve the underlying purpose of the proposed action that may result in less environmental harm.

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collaboration but which are carried out by cooperating scientists (other agencies, academic institutions, commercial fishing-associated groups, or independent researchers) on board non-NOAA vessels.

To warrant detailed evaluation under NEPA, an alternative must be reasonable and meet the stated purpose and need for the proposed actions (see Section 1.3). Additionally, NEPA requires consideration of a “no action” alternative, which is Alternative 1 in this FPEA. NMFS has applied the following screening criteria to a range of alternatives to identify which ones are considered reasonable and should be brought forward for detailed analysis:

Screening Criteria

To be considered “reasonable” for purposes of this FPEA, an alternative must meet the following criteria:

- The action must not violate any federal statute or regulation.
- The action must be consistent with reasonably foreseeable funding levels.
- The action must be consistent with long-term research commitments and goals to maintain the utility of scientific research efforts, or consider no federal funding availability for fisheries research.

To maintain the utility of scientific research efforts, fisheries and marine ecosystem scientific research should address at least some of the following goals related to fisheries management:

- Methods and techniques should provide standardized and objective data consistent with or complementary to past data sets (time-series) in order to facilitate long-term trend analyses.
- Collected data should adequately characterize living marine resource and fishery populations and the health of their habitats.
- The surveys should enable assessment of population status and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.
- Research on new methodologies to collect fisheries and ecosystem information (e.g., active and passive acoustic instruments and video surveys of benthic habitats in lieu of bottom trawl gear) and research oriented toward modifications of fishing gear to address bycatch or other inefficiencies should be conducted under experimental conditions sufficient to allow statistically valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria. Based on this evaluation, the No-Action/Status Quo Alternative and two other action alternatives have been identified as reasonable and were carried forward for more detailed evaluation in this FPEA. NMFS also evaluated a second type of no-action alternative that considers no federal funding for fisheries research activities. This has been called the No Research Alternative to distinguish it from the No-Action/Status Quo Alternative. The No-Action/Status Quo Alternative was used as the baseline to compare all of the other alternatives.

Three of the alternatives include a program of fisheries and ecosystem research projects conducted or funded by the AFSC as the primary federal action. Because this primary action is connected to a secondary federal action (also called a connected action under NEPA), for NMFS to consider promulgation of regulations and subsequent issuance of LOAs under Section 101(a)(5)(A) of the MMPA for the incidental, but not intentional, taking of marine mammals, NMFS must identify as part of this evaluation under the MMPA “(t)he means of effecting the least practicable adverse impact on the species or stock and its habitat”. As a result, NMFS has identified and evaluated a reasonable range of mitigation measures to minimize impacts to marine mammals that occur in AFSC research areas. In addition, because this NEPA document will be used to initiate Section 7 consultations under the ESA and for compliance with other conservation laws, each of which may recommend or require mitigation measures, the consideration of mitigation measures is extended to all protected species. These mitigation measures are considered as part of the identified alternatives in order to evaluate their effectiveness to minimize potential adverse environmental impacts. Protected species include all marine mammals, which are covered under the MMPA, all species listed under the ESA, and bird species protected under the Migratory Bird Treaty Act (MBTA).

In addition, under all three action alternatives, the AFSC would continue to apply to the NMFS Alaska Regional Office for receipt of SRPs for research that will affect species regulated under the MSA and ESA section 10 permits for directed research on all ESA-listed species. While this FPEA may not provide all the information needed to complete these permit processes, it provides a programmatic overview of the AFSC research program in marine waters that provides useful context for those permit efforts. Also, because the proposed research activities likely occur within areas identified as Essential Fish Habitat (EFH), this FPEA evaluates potential impacts to EFH as required under section 305(b)(2) of the MSA.

Alternative 1 - No-Action/Status Quo Alternative - Conduct Federal Fisheries and Ecosystem Research with Scope and Protocols Similar to Past Effort

The No-Action/Status Quo Alternative (hereafter referred to as the Status Quo Alternative) includes fisheries research using the same protocols as were implemented in the recent past (considered to be from 2008 through 2015 for the purposes of this FPEA). These federal research activities are necessary to fulfill NMFS mission to provide science-based management, conservation, and protection of living marine resources in the North Pacific Ocean and marine waters off Alaska. Under Alternative 1, the AFSC would use the same scope of research as in recent years and with current mitigation measures for protected species.

Under the Status Quo Alternative, the AFSC would administer and conduct a wide range of fishery-independent and industry-associated research and survey programs, as summarized in Table 2.2-1. These surveys generally use fishing gear to capture fish and invertebrates for stock assessment or other research purposes, and also include collection of plankton and larval life stages and oceanographic and acoustic data to characterize the marine environment. The main gear types of concern for potential interactions with protected species include bottom trawls, pelagic trawls (surface and mid-water), and various hook-and-line gears (including longline and rod and reel deployments). In addition, the use of certain acoustic instruments and the presence of researchers may lead to behavioral harassment of marine mammals. The scope of past research activities is considered as the basis for analysis of future activities under the Status Quo Alternative.

The Status Quo Alternative research activities include a suite of mitigation measures that were developed to minimize the risk of ship strikes, captures of protected species in fishing gear, and incidental interaction with protected species during fisheries research activities. The following mitigation measures have been implemented on all AFSC surveys since at least the end of 2015, although many surveys implemented them earlier:

- Visual monitoring for protected species prior to and during deployment of gear;
- Use of the “move-on” rule if marine mammals or other protected species are sighted from the vessel prior to deployment of trawl, longline, or any other fishing gear that may pose a risk of interactions with protected species and if the animals appear to be at risk of interaction with the gear as determined by the professional judgment of the Chief Scientist or officer on watch. There are three basic options for the move-on rule: gear deployment is delayed until the protected species have left the area, the research vessel is moved away from the protected species before gear deployment, or the sample station is canceled; and
- Short tow times and set times to reduce exposure of protected species to research gear.

However, these mitigation measures may not be sufficient to reduce the effects of AFSC fisheries research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA (see Alternative 2). Other mitigation measures may be required under the MMPA and ESA processes for the specified research activities conducted by the AFSC.

Alternative 2 – Preferred Alternative - Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Mitigation for MMPA and ESA Compliance

Primary Action: The primary action is to continue fisheries research activities conducted and/or funded by the AFSC to produce scientific information necessary for the management and conservation of living marine resources in the North Pacific Ocean and marine waters off of Alaska. The Preferred Alternative includes a combination of research activities continued from the past and additional, new research surveys and projects as described in Table 2.3-1. Each of the research activities requires one or more SRPs and the issuance of these permits is a part of the primary action.

Secondary Action: Under this alternative, the AFSC would apply to NMFS Office of Protected Resources (OPR)[4] to promulgate regulations governing the issuance of LOAs for incidental take of marine mammals under the MMPA. OPR would consider these activities and mitigation measures and determine whether it should promulgate regulations and issue LOAs as appropriate to the AFSC. If regulations are promulgated and LOAs are issued, they would prescribe: the permissible methods of taking, a suite of mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals and their habitats during the specified research activities, and require monitoring and reporting that will result in increased knowledge of the species and of the level of taking.

In addition, the AFSC has engaged in ESA Section 7 consultations with the NMFS Alaska Regional Office and the U.S. Fish and Wildlife Service (USFWS) for species that are listed as threatened or endangered. Biological Assessments (BAs) have been prepared for ESA-listed species under NMFS jurisdiction (see NMFS 2017a) and USFWS jurisdiction (see NMFS 2017b) and the Biological Opinions (NMFS 2019, USFWS 2018). These consultations will result in the development of Biological Opinions (BiOps) that describe the determinations of NMFS and USFWS whether or not the primary and secondary federal actions are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of any critical habitat. The BiOps may contain incidental take statements for ESA-listed species that include reasonable and prudent measures along with implementing terms and conditions intended to minimize the number and impact of incidental takes of ESA-listed species during AFSC research activities and monitoring and reporting requirements.

The Preferred Alternative also includes the same suite of mitigation measures as the Status Quo Alternative to reduce the risk of adverse interactions with protected species. The AFSC considers the current suite of monitoring and operational procedures to be necessary to minimize adverse interactions with protected species and still allow the AFSC and its cooperating research partners to fulfill their scientific missions. However, some mitigation measures such as the move-on rule require judgments about the risk of gear interactions with protected species and the best procedures for minimizing that risk on a case-by-case basis. Ship captains and Chief Scientists are charged with making those judgments at sea. They are all highly experienced professionals but there may be inconsistencies in how those judgments are made across the range of research surveys conducted and funded by the AFSC. In addition, some of the mitigation measures described in the Status Quo Alternative could also be considered "best practices" for safe seamanship and avoidance of hazards during fishing (e.g., prior surveillance of a sample site before setting trawl gear). At least for some of the research activities considered in this FPEA, explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species have not been formalized and clearly communicated with all scientific parties and vessel operators. The AFSC therefore proposes a series of improvements to its protected species training, awareness, contracting, and reporting procedures under the Preferred Alternative. The AFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described under the Status Quo Alternative and will reduce the effects of AFSC

[4] Permits and Conservation Division, Incidental Take Program

fisheries research activities on marine mammals to the level of least practicable adverse impact, as required under the MMPA.

- Under the Preferred Alternative, the AFSC will initiate a process for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. As noted in the Status Quo Alternative description of mitigation measures, there are many situations where professional judgment is used to decide the best course of action for avoiding protected species interactions before and during the time research gear is in the water. The intent of this training measure would be to draw on the collective experience of people who have been making those decisions in order to introduce consistency in decision-making, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. The AFSC would coordinate not only among its staff and vessel captains but also with those from other NMFS Fisheries Science Centers with similar experience.
- Another new element of the Preferred Alternative is the proposed development of a formalized protected species training program for all crew members that may be responsible for marine mammal monitoring or decisions about marine mammal avoidance. These selected crew trainings would be required for all AFSC research projects, including cooperative research partners. Training programs would be conducted on a regular basis and would include topics such as monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. The AFSC will work with the North Pacific Groundfish and Halibut Observer Program to develop a protected species training program and materials for all appropriate scientists and crew. The implementation of this training program would formalize and standardize the information provided to all crew that might experience protected species interactions during research activities.
- For all AFSC fisheries and ecosystem research projects and vessels, written cruise instructions and protocols for avoiding adverse interactions with protected species will be reviewed and, if found insufficient, made fully consistent with any guidance on decision-making that arises out of training opportunities.
- The AFSC will incorporate specific language into its contracts that specifies all training requirements, operating procedures, and reporting requirements for protected species that will be required for all charter vessels and cooperating research partners.
- A new communication plan to facilitate pre-survey and in-season communication with Alaska Native subsistence communities and co-management organizations intended to reduce the chance that AFSC fisheries research activities might interfere with subsistence activities.
- Develop a communication plan in compliance with the MMPA requirement that activities have no unmitigable adverse impacts on the availability of marine mammal species or stocks for subsistence uses.

Alternative 3 - Modified Research Alternative – Conduct Federal Fisheries and Ecosystem Research (New Suite of Research) with Additional Mitigation

Primary Action: Under Alternative 3, the AFSC would conduct and fund the same scope of fisheries research as described in the Preferred Alternative and would include all of the same mitigation measures considered under the Preferred Alternative.

Secondary Action: Under this alternative, the AFSC would also apply for authorizations under the MMPA for incidental take of protected species during these research activities and initiate Section 7 consultations regarding ESA-listed species. The difference between Alternative 3 and the Preferred Alternative is that Alternative 3 includes a number of additional mitigation measures derived from a variety of sources including: (1) comments submitted from the public on potential mitigation of commercial fisheries impacts, (2) discussions within NMFS OPR as part of the proposed rulemaking process under the MMPA, and (3) a literature review of past and current research into potential mitigation measures. These measures include changes to visual monitoring methods for protected species (e.g., dedicated Protected Species Observers [PSOs] and technological methods to improve detection under poor visibility conditions), operational restrictions on where and when research may be conducted, and adoption of alternative methodologies and equipment for sampling. This Alternative is not considered as an “all or nothing” proposition; one or more of the additional mitigation measures may be considered for implementation during the MMPA and ESA consultation processes.

The AFSC regularly reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluating new mitigation measures includes assessing their effectiveness in reducing risk to protected species, but measures must also pass safety and practicability considerations, meet survey objectives, allow survey protocols to remain compatible with previous data sets, and be consistent with the purpose and need for AFSC research activities. Some of the mitigation measures considered under Alternative 3 (e.g., no night fishing or broad spatial/temporal restrictions on research activities) would not allow survey protocols to remain consistent with previous data sets and would essentially prevent the AFSC from collecting data required to provide for fisheries management purposes under the MSA. Some research surveys necessarily target fish species that are preyed upon by protected species with an inherent risk of interactions during these surveys. The AFSC acknowledges the inherent risk of these surveys and it has implemented a variety of measures to help mitigate that risk. However, the experimental design of many surveys includes the need to sample “hotspots” of marine life, which often include protected species drawn to concentrations of fish and invertebrates. If these surveys could not sample in areas rich in marine life, as indicated by the presence of marine mammals, even if the protected species did not appear to be at risk of interaction with the research gear, the sampling results would not accurately reflect the variability in abundance for different fish species and the ability of the AFSC to provide the “best available” scientific data for fisheries management purposes would be compromised. This type of ecological information is also important to agencies and other institutions concerned about the health of the marine environment important to the protected species themselves. The AFSC currently has no viable alternatives to collecting the data derived from these surveys that meet the research objectives described under the Purpose and Need (Chapter 1). As a result, NMFS does not propose to implement potential mitigation measures that would preclude continuation of these surveys, such as the elimination of night surveys or use of pelagic trawl gear.

The connected federal action covered under this FPEA is the issuance of regulations and subsequent LOAs for incidental takes of marine mammals under the MMPA, which requires NMFS to consider a reasonable range of mitigation measures that may reduce the impact on marine mammals among other factors. As described above, some of these measures could prevent the AFSC from maintaining the scientific integrity of its research programs. These measures would normally be excluded from consideration in the FPEA for not being consistent with the purpose and need (Chapter 1). However, these additional mitigation measures would likely be considered during the MMPA rulemaking process and/or ESA Section 7 consultations and are therefore analyzed in this FPEA.

Alternative 4 - No Research Alternative - No Fieldwork for Federal Fisheries and Ecosystem Research Conducted or Funded by AFSC

Under the No Research Alternative, no direct impacts on the marine environment would occur from the primary or secondary federal actions. The AFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this FPEA in marine waters of the North Pacific and Arctic Oceans. This moratorium on fieldwork would not extend to research that is not in scope of this FPEA, such as directed research on marine mammals and ESA-listed species in other areas of the North Pacific and Arctic Oceans covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (i.e., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its MSA mandate to manage, conserve and protect living marine resources in the U.S. Under this alternative, organizations that have participated in cooperative research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. Any non-federal fisheries research would occur without NMFS funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys would be compatible with the time-series data NMFS has collected over many years, which is the core information supporting NMFS science and management missions and vital to fishery management decisions made by NMFS, the NPFMC and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

CHAPTER 3 – AFFECTED ENVIRONMENT

Chapter 3 presents baseline information on the marine environment affected by AFSC research activities. This information is not intended to be encyclopedic but to provide a foundation for the analysis of environmental impacts of the alternatives and the cumulative effects analysis. Sources of additional information are incorporated by reference.

The marine environment affected by AFSC fisheries research includes the GOARA, BSAIRA, and CSBSRA. There are many areas with special designations to protect various resources and are subject to various levels of conservation and management under a variety of authorities. Classifications of these special resource areas include EFH, fisheries closure areas, Critical Habitat areas, and designated MPAs.

There are hundreds of finfish and shellfish species that occur within the AFSC research areas. Descriptions or lists are provided for ESA-listed species/stocks, including listed Evolutionarily Significant Units (ESUs) of salmonid species (Table 3.2-1). Species targeted by commercial fisheries and subject to AFSC stock assessment research and other species caught frequently in AFSC surveys are also described.

Marine mammal species that occur in the AFSC research area are noted in Table 3.2-6, including 30 stocks of cetaceans (whales, dolphins, and porpoise), 22 stocks of pinnipeds (seals and sea lions), polar bears, and sea otters. All of these species are federally protected under the MMPA regardless of where they occur. Fifteen of these stocks/species are listed as endangered or threatened under the ESA. Information is presented on marine mammal acoustics and functional hearing ranges for several groups of marine mammals. Marine mammals rely on sound production and reception for social interactions (e.g., reproduction and communication), to find food, to navigate, and to respond to predators.

Three ESA-listed bird species and five Birds of Conservation Concern occur in the AFSC research area. These species are described and other species that commonly occur in marine waters off Alaska are noted in Table 3.2-10. All species likely to occur in the U.S. EEZ are protected by the MBTA.

Four species of sea turtles may occur within the AFSC research area, all of which are listed as endangered or threatened under the ESA, although no species are common in Alaska waters. Sea turtles are susceptible to damage of onshore nesting habitat, exploitation of eggs, and interactions with research, sport, and commercial fisheries.

There are no ESA-listed invertebrates in the AFSC research areas. The AFSC conducts research and provides stock abundance and distribution information for management of several commercially valuable invertebrates, including several crab species. Other invertebrates that are frequently caught in AFSC research surveys are noted in Table 3.2-14.

Several components of the social and economic environment are summarized, including the importance of subsistence resources to the economies and culture of many Alaska coastal communities. A number of commercial fisheries harvest marine fish and invertebrates in Alaska waters. Complex associations exist between the fishing industry, fisheries management processes, and the social well-being of many communities. Recreational and subsistence fisheries also play an important role in the well-being of individuals and communities. These fisheries and communities receive scientific and economic benefits from the AFSC research activities as they contribute to the scientific management of sustainable fisheries. In addition, AFSC fisheries research is an important component of the U.S. federal government's trust responsibility to Alaska Natives through co-management relationships relative to living marine resources and habitats. Information is also presented on the basic operating costs of the AFSC (approximately $62 million in fiscal year 2015) and average costs for conducting AFSC research programs. Programmatic expenses include ship time, fuel and supplies, crew, charter vessels, and other logistic support, which directly and indirectly benefits communities on the U.S. West Coast and Alaska.

CHAPTER 4 – ENVIRONMENTAL EFFECTS

NMFS is fundamentally a science-based agency, with its primary mission being the stewardship of living marine resources through science-based conservation and management. Of the four alternatives evaluated in this FPEA, three alternatives maintain an active research program (Status Quo, Preferred, and Modified Research Alternatives) that clearly enables collection and development of additional scientific information and one alternative (No Research) does not. In NMFS view, the inability to acquire scientific information essential to developing robust fisheries management measures that prevent overfishing and rebuild overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy ecosystems, productive and sustainable fisheries, safe resources of seafood, and recover and conserve protected resources. The scientific information provided by AFSC fisheries and ecosystem research programs also allows NMFS to monitor potential effects of climate change and ocean acidification. Long-term, consistent fisheries and ecosystem research programs contribute substantially to developing effective and timely fisheries management actions and assists in meeting U.S. trust responsibilities and international treaty obligations.

The following discussion summarizes the direct and indirect impacts by resource area associated with the alternatives evaluated in Chapter 4 of this FPEA. The effects of the alternatives on each resource category were assessed using an impact assessment criteria table to distinguish between major, moderate, and minor effects within the context of each resource category. The analysis shows that the potential direct and indirect impacts on the physical and biological environments under the three research alternatives are similar and would have minor adverse effects. The three research alternatives would also have minor to moderate beneficial effects on the social and economic environment of fishing communities by providing the scientific information needed for sustainable fisheries management and by providing funding, employment, and services. The similarity of impacts among the three research alternatives is due to the fact that the scope of research activities under these alternatives is similar; they differ primarily in the type of mitigation measures included for protected species. The No Research Alternative, in contrast, would eliminate the direct adverse effects of the research alternatives on the marine environment but would have minor to moderate adverse, indirect effects on several biological resources due to increasing uncertainty in future resource management decisions caused by the loss of scientific information on the marine environment from the AFSC. The No Research Alternative was also considered to have moderate adverse effects on the social and economic environment of fishing communities by having relatively minor to moderate direct economic impacts on various communities as well as long-term and widespread adverse impacts on sustainable fisheries management throughout the Alaska Region. Table ES-1 provides a summary of impact determinations for each resource by alternative.

Table ES-1 Summary of Environmental Effect Conclusions for Each Alternative

Topic	Alternative 1 (Status Quo)	Alternative 2 (Preferred)	Alternative 3 (Modified Research)	Alternative 4 (No Research)
Physical Environment	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Special Resource Areas	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Fish	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to moderate *adverse*
Marine Mammals	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Birds	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Sea Turtles	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*
Invertebrates	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to moderate *adverse*
Social and Economic Environment	Minor to moderate *beneficial*	Minor to moderate *beneficial*	Minor to moderate *beneficial*	Moderate *adverse*

Physical Environment, Special Resource Areas, and EFH

Under the three research alternatives, direct impacts to benthic habitats would occur through the use of several bottom-contact fishing gears (primarily bottom trawl gear). The FPEA includes an analysis of the total footprint of AFSC research on benthic habitat, including EFH, the effects of which are considered small in magnitude, temporary or short-term in duration, and localized in geographic scope and would have minor adverse effects.

Under the No Research Alternative, there would be no direct impacts on the physical environment, special resource areas, or EFH from federal fisheries and ecosystem research. However, the loss of scientific information generated by AFSC research would contribute to greater uncertainty about the effects of climate change and ocean acidification on northern marine ecosystems as well as the status of biological resources in MPAs. Indirect effects on resource management agencies and conservation plans for protected areas would likely be adverse and minor in magnitude under the No Research Alternative.

Fish

The AFSC conducts and funds stock assessment and habitat research for many commercially valuable and culturally important fish species, providing the scientific basis for sustainable fisheries management. AFSC research also provides critical information on oceanographic conditions and the status of other fish species that are not harvested but which play key roles in the marine food web, providing the scientific basis for NMFS goal of ecosystem-based management, as outlined in NMFS Strategic Plan for Fisheries Research (NMFS 2007). Under the three research alternatives, relatively small impacts to fish populations are expected as a result of on-going research activities; for species managed by NMFS under the MSA, these impacts are already considered as part of the fishery specifications processes.

For most species targeted by commercial fisheries and other anglers, mortality due to research surveys and projects is much less than one percent of commercial harvest or fishery management metrics (Acceptable Biological Catch or Annual Catch Limit [ACL]) and is considered to have minor adverse effects for all species. For a few species which do not have a large commercial market due to various market conditions, the research catch exceeds one percent of commercial catch but is still small relative to the population of each species and is considered minor. NMFS Policy Directive 01-108, October 28, 2008, requires SRPs for agency-conducted and/or funded research that will affect species regulated under the MSA. Those proposed research projects that will affect MSA species are reviewed annually before research permits are issued to determine if they are consistent with existing analyses and fishery management goals and objectives and to ensure compliance with the agency's National Standard guidelines under the MSA that require that all sources of mortality be accounted for in the management of each species. See 50 C.F.R. § 600.310(e)(3)(v)(C).

For species that are not managed under Fishery Management Plans (FMPs), research catch is also relatively small and considered to be minor for all species. However, there are differences in research activities between alternatives and effects on specific species. For example, the Preferred Action would conduct about 65% fewer surface trawl tows than the status quo, resulting in a proportional decrease in the number of salmon caught. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. In contrast to this adverse effect on fish, AFSC research also provides long-term beneficial effects on target species populations through its contribution to sustainable fisheries management. Data from AFSC fisheries research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover depleted stocks.

Under the No Research Alternative, there would be no direct adverse impacts on fish from AFSC fisheries research. However, the loss of scientific information for fisheries management could have long-term minor to moderate adverse impacts on fish stocks through increasing uncertainty in fisheries management decisions, which could lead to potential overfishing on some stocks, uncertainty about the recovery of overfished stocks, and increasing uncertainty about the efficacy of fishing regulations designed to protect fish stocks and habitat from overfishing.

Marine Mammals

The primary direct effects of the three research alternatives on ESA-listed and non-listed marine mammals include behavioral responses to sound produced through the use of active acoustic sources and the physical presence of researchers (Level B harassment under the MMPA), incidental capture, entanglement, or hooking in fishing gear but released without serious injury (Level A harassment), and incidental capture, entanglement, or hooking resulting in serious injury or mortality. These all constitute takes of marine mammals under the MMPA. The potential for effects from ship strikes, contamination of the marine environment, and removal of marine mammal prey species was considered minor for all alternatives and species. The MMPA requires applicants for regulations and subsequent LOAs to estimate the number of each species of marine mammal that may be incidentally taken by Level A and Level B harassment or serious injury/mortality during the proposed action. The AFSC LOA application (attached to the FPEA as Appendix C) includes estimates of marine mammal takes in the three AFSC research areas using the scope of research and mitigation measures described in the Preferred Alternative.

The LOA application combines estimated Level A harassment takes with serious injury or mortality takes because the degree of injury resulting from gear interaction cannot be predicted. The estimated take numbers are based on the historical capture of four non-ESA-listed cetaceans (two Dall's porpoises), one pinniped (northern fur seal, Eastern Pacific stock), and one Northern sea otter during AFSC research surveys from 2004 through 2015. The Dall's porpoises and sea otter were captured in surface trawls while the northern fur seal was captured in a bottom trawl. None of the animals were released alive.

For the species that have been taken by entanglement in research gear in the past, the LOA application uses a precautionary approach for estimating future takes, using the average annual number of animals caught in different gear types in the past 12 years (2004-2015), rounding up to the nearest whole number of animals, and assuming this number of animals could be caught every year for the next five years

(MMPA regulations concerning incidental take of marine mammals, if promulgated, and subsequent LOA, would likely be issued for a five-year period). The AFSC considers this estimation method to be precautionary in that it likely overestimates the number of animals that could be caught in the future in order to ensure accounting for a maximum amount of potential take. The FPEA uses the estimated takes in the LOA application to assess the impacts on marine mammals. Given the likelihood that these are overestimates, the actual effects from injury, serious injury or mortality could be substantially less than described.

Other species that have not been captured in the past have been included in the LOA application's request for take authorization based on their similarity to species that have been taken by the AFSC and incidental take in analogous commercial fisheries. Because the scope of research activities under the Status Quo Alternative is very similar to the Preferred Alternative, the estimated take numbers from the LOA application are used as part of the analysis of effects on marine mammals in the AFSC research areas under both alternatives. However, the Preferred Alternative includes expanded communication and protected species training requirements that should reduce the potential of adverse gear interactions with marine mammals relative to the Status Quo Alternative.

The FPEA includes a summary table with the number of estimated Level A harassment/serious injury or mortality takes for each species affected in each of the three AFSC research areas (Table 4.2-12). One of the key elements of the effects analysis is to determine the adverse impact of takes on each species. The FPEA and LOA application compare estimated future takes for each species with its Potential Biological Removal (PBR) as part of this impact determination (Table 4.2-13). The MMPA defines PBR as, "...the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." PBR was intended to serve as an upper limit guideline for fishery-related mortality for each species. Given the similarity of fisheries research to many commercial fisheries and the role research plays in supporting commercial fisheries, it is appropriate to assess the impacts of incidental takes for fisheries research in a similar manner.

PBR is used as one of the criteria for determining the level of adverse impacts on marine mammals in the FPEA (see Section 4.1.2). For the purposes of this analysis under NEPA, research-related incidental serious injury or mortality less than or equal to 10 percent of PBR for the marine mammal stock is considered minor in magnitude for the population. Serious injury or mortality between 10 percent and 50 percent of PBR is considered moderate in magnitude. Serious injury or mortality greater than or equal to 50 percent of PBR is considered major in magnitude.

For all stocks of marine mammals considered to have potential for interactions with AFSC fisheries research and for which PBR has been determined, the average annual requested number of Level A harassment/serious injury and mortality takes in all gear types and all research areas combined is less than 10 percent of PBR for all species. These takes, if they occurred, would likely be rare or infrequent events, would be distributed over large geographic areas, and would be considered to have overall minor adverse effects on the population of each species. The AFSC take request also includes "undetermined dolphin or porpoise" and "undetermined pinniped" takes to account for similar-looking animals that may escape from the net or longline gear before being brought on board or identified. However, for impact analysis purposes, we must assign these undetermined takes to each stock in addition to those takes requested for the particular stock. Under these assumptions the combined take request would still be less than 10 percent of PBR for all stocks and would be considered minor in magnitude.

Level B harassment takes are estimated based on the acoustic properties of sonars and other acoustic equipment used during research, calculations of the volume of water insonified to 160 decibels (dB) root mean square (rms) referenced to 1 micro Pascal (μPa) at one meter (m) or more (NMFS current recommended threshold for Level B harassment from the active acoustic equipment considered in this FPEA), estimates of the densities of marine mammals in different areas, and a partitioning of species that typically do not dive deeper than 200 m and those that do (which affects the size of the insonified area to which they may be exposed). The FPEA includes a summary table of the number of estimated Level B harassment takes by acoustic sources of each species affected in the three AFSC research areas. The FPEA also includes a summary of an assessment of biological effects from AFSC acoustic equipment used during research (Appendix C, Section 7). Output frequencies of some active acoustic sources (i.e., short range echosounders and Acoustic Doppler Current Profilers [ADCPs]) are higher than the functional hearing ranges of marine mammals so no adverse effects are anticipated. Other acoustic sources operate at frequencies within the hearing range of one or more groups of marine mammals and may cause temporary and minor behavioral reactions such as swimming away from an approaching ship. None of the AFSC acoustic equipment is likely to present risks of hearing loss or injury to any marine mammal.

Level B harassment takes also may occur to two species of pinnipeds (Steller sea lions and harbor seals) due to the physical presence and passage of researchers near haulouts (Table 4.2-11). AFSC researchers are very aware of this situation and take precautions to minimize the frequency and scope of potential disturbances, including choosing travel routes as far away from hauled out pinnipeds as possible and moving sample site locations to avoid consistent haulout areas. However, pinnipeds may haul out in new locations on a regular basis and it is essentially impossible for researchers to completely avoid disturbing pinnipeds as they move throughout the region.

The Preferred Alternative includes the same suite of mitigation measures as currently implemented under the Status Quo Alternative, plus some additional training opportunities, communication protocols, and reporting procedures intended to improve the implementation of existing protocols (see summaries of the alternatives in Chapter 2 above). The FPEA does not provide quantitative estimates of how these training opportunities and changes in protocol would decrease adverse interactions with marine mammals, which would be speculative, but states the AFSC belief that actual impacts to marine mammals in the future will likely be less than described under the Status Quo Alternative.

The Modified Research Alternative includes the same scope of research in the AFSC research areas as the Preferred Alternative but considers a number of other potential mitigation measures that the AFSC is not proposing to implement in its LOA application. These include a number of alternative methods for monitoring for protected species (e.g., use of dedicated Protected Species Observers [PSOs] and passive acoustic devices), gear modifications such as marine mammal excluder devices for all trawl gear, and spatial/temporal restrictions on where and when research can occur. The AFSC considers the suite of mitigation measures to be implemented under the Preferred Alternative to represent the most effective and practicable means to reduce the risk of adverse interactions with marine mammals during the conduct of its research program without compromising the scientific integrity of the research program. The potential direct and indirect effects of this alternative on marine mammals would be the same as described for the Preferred Alternative except for the potential of the additional mitigation measures to reduce Level A harassment/serious injury and mortality takes through gear interactions.

Scientists at the AFSC regularly review their procedures to see if they can do their work more efficiently and with fewer incidental effects on the marine environment, including effects on marine mammals. However, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It would be speculative to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. The analysis of the Modified Research Alternative provides a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on marine mammals as well as how each measure may affect practicability, time-series data integrity, and other aspects of the research survey work. One element of the Modified Research Alternative (e.g., use of PSOs) would offer mitigation advantages compared to the Status Quo Alternative but is addressed to some extent in the Preferred Alternative with enhanced protected species training for relevant research staff and crew. Operational restrictions such as not allowing trawls to be set at night or in poor visibility conditions and spatial/temporal restrictions to avoid high densities of marine mammals would certainly reduce the risk of taking marine mammals. However, such restrictions would have a serious adverse impact on the ability of the AFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. Some concepts and technologies considered in the Modified Research Alternative are promising as a means to reduce risks to marine mammals and NMFS will evaluate the potential for implementation if they become more practicable.

Under the No Research Alternative, no direct adverse impacts to marine mammals from fisheries and ecological research (i.e., takes by gear interaction and acoustic disturbance) would occur. However, many of the AFSC research projects that would be eliminated under this alternative contribute valuable ecological information important for marine mammal management, especially for ESA-listed species and species considered depleted under the MMPA. The loss of information on marine mammal habitats, including Steller sea lion critical habitats, would indirectly affect resource management decisions concerning the conservation of marine mammals, especially as time went on and uncertainty about the status of the marine environment increased. There are too many unknown variables to estimate the specific effects this lack of information would mean to any particular stock of marine mammals but the No Research Alternative would likely have minor adverse effects for some species.

Birds

The effects of AFSC fisheries research on seabirds include the potential for injury and mortality in fishing gear and ship strikes, changes in food availability, and contamination or degradation of habitat. All three of the research alternatives include the use of fishing gear (i.e., longline gear) that have had substantial incidental catch of seabirds in commercial fisheries off Alaska. However, research gear is generally smaller than commercial gear and research protocols are quite different than commercial fishing practices. In particular, fisheries research uses shorter duration sets than commercial fisheries, thereby greatly reducing the attraction of seabirds to research vessels, and all longline sets include the use of twin tori lines (streamers) to reduce the risk of catching seabirds. From 2004 through 2015 a total of 46 seabirds of four species have been killed during AFSC research activities, all but one during the Alaska Longline Summer Survey. The takes consisted of 39 black-footed albatross, two Laysan albatross, four northern fulmar, and one common murre. The magnitude of these incidental takes are considered minor for the populations of all species.

Some AFSC surveys take bird biologists on board when there is bunk space available to conduct transect surveys for bird distribution and abundance in the AFSC research area. This information is used by NMFS, the USFWS, and other international resource management agencies to help with bird conservation issues and is considered to have indirect beneficial effects on the birds.

Under the No Research Alternative, the risk of direct adverse effects on seabirds from AFSC research would be eliminated, but there could be potential long-term minor adverse impacts to seabirds because resource management authorities would lose ecological information about the marine environment important to seabird conservation.

Sea Turtles

The FPEA analyzes the potential direct and indirect effects of AFSC fisheries research on sea turtles through ship strikes, removal of prey, and contamination of marine habitat. Sea turtles are uncommon or rare in the AFSC research areas; these effects are considered minor adverse for all species under all three research alternatives. Sea turtles hearing range is apparently well below the frequencies of acoustic instruments used in fisheries research so turtles are unlikely to detect these sounds or be affected by them. The AFSC has no history of interactions with sea turtles in research gear and the potential for injury or mortality under all of the research alternatives is very small. The overall potential for effects of the research alternatives on ESA-listed sea turtles would be minimal.

As with seabirds and marine mammals, the No Research Alternative would eliminate the risk of direct adverse effects on sea turtles from AFSC research. However, there could be minor adverse impacts due to the loss of ecological information important to sea turtle conservation, especially concerning climate change and changing oceanic conditions that could affect sea turtle ranges.

Invertebrates

The AFSC conducts stock assessment and habitat research for several important invertebrate species (i.e., crab species) and, similar to the situation described for commercially valuable fish species, the magnitude of mortality due to research sampling is small relative to commercial harvests. The footprint of bottom trawl gear used in research is also relatively small and impacts to benthic infauna and epifauna would be temporary. The AFSC conducts research in several areas closed to commercial fishing but much of this research is the primary means for NMFS to monitor the recovery of benthic habitat and the efficacy of fisheries conservation measures. Under the three research alternatives, minor adverse impacts to invertebrates are expected from AFSC research activities. AFSC research is important for the scientific and sustainable management of these valuable fisheries, helping to prevent overfishing on the stocks and recovery of depleted stocks.

Under the No Research Alternative, direct adverse impacts to invertebrates would be eliminated. However, the loss of stock assessment and marine environment information could indirectly result in minor adverse effects on commercially targeted species through increasing uncertainty in the fishery management environment.

Social and Economic Environment

Under the three research alternatives, long term, beneficial impacts to the social and economic environment are expected from ongoing AFSC fisheries and ecosystem research activities. AFSC research provides important scientific information which is the basis for sustainable fisheries management for some of the most valuable commercial and culturally important fisheries along the U.S. West Coast, which benefits communities that support them. These commercial and recreational fishing industries have large economic footprints, generating billions of dollars’ worth of sales and thousands of commercial fishing-related jobs, and provide millions of people across the country with highly valued seafood. The importance of subsistence fisheries to Alaska Natives goes beyond monetary or nutritional value and is essential to their cultural identity. Many Alaska Natives and Alaska Native corporations participate in various commercial fisheries, which provide important monetary support for subsistence communities. Thousands of recreational fishers also participate and support fishing service industries. AFSC fisheries research activities would also have minor to moderate beneficial impacts to the economies of fishing communities through direct employment, purchase of fuel, vessel charters, and supplies. Continued AFSC fisheries research is important to build trust and cooperation between the fishing industry and NMFS scientists and fisheries managers. It is also essential for fulfilling the trust responsibilities with tribal co-managers of living marine resources.

The AFSC intends to develop and implement a communication plan with Alaska Native subsistence communities under the Preferred Alternative to minimize the risk of AFSC research activities interfering with subsistence activities, especially marine mammal hunting. The great majority of AFSC research occurs well away from nearshore waters and sea ice, where most subsistence activities occur.

The No Research Alternative would likely have moderate adverse impacts on the social and economic environment through greater uncertainty in fisheries management, which could lead to more conservative fishing quotas (i.e., underutilized stocks and lost opportunity) or an increased risk of overfishing, followed by reductions in commercial and recreational fisheries harvests. The lack of scientific information would also compromise efforts to rebuild depleted stocks and monitor the effectiveness of no-fishing conservation areas. These impacts would adversely affect the ability of NMFS to comply with its responsibilities under the MSA. It would also eliminate research-associated federal spending on charter vessels, fuel, supplies, and support services in various communities. The No Research Alternative would also have long-term adverse impacts on the scientific information the AFSC contributes to meet U.S. obligations for living marine resource management under international treaties and co-management agreements.

CHAPTER 5 – CUMULATIVE EFFECTS

Cumulative effects are the impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions (RFFAs) on the human environment over time. An individual action may have only minor or moderate impacts, but the cumulative effects of all actions may be major. NEPA requires an analysis of cumulative effects in order to alert decision makers to the full environmental consequences of a proposed action and its alternatives on resource areas of concern. This analysis looks at the overall cumulative impact and the contribution of fisheries research activities to the overall cumulative impact.

In terms of fisheries, understanding how the cumulative impacts from human activities and trends in the natural environment have influenced the marine environment over time is key to understanding the importance of NMFS role in fisheries management. The need for scientific information from AFSC research activities is in large part the result of past actions that contributed to adverse impacts on fish stocks from foreign fishing, pollution of coastal and ocean areas from accidental and intentional discharges, and degradation of habitat from commercial fishing, coastal development, and natural resource extraction, among other activities. Federal efforts within the last 40 years to reduce pollution, restore degraded habitats, and effectively manage commercial and recreational fishery harvests have reversed some of these trends. A number of important fishery stocks have been restored to healthy levels.

Similarly, cumulative impacts from human activities and trends in the natural environment over time have contributed major adverse impacts to populations of marine mammals, sea turtles, and other marine species. As a result, the MMPA and ESA were enacted to help address specific conservation concerns and many human activities are subject to federal management measures to protect marine species and promote recovery of impacted populations.

Climate change and increase in ocean acidification have the potential to impact populations and distributions of many marine species. Fisheries research activities make an incremental contribution to these long-term, global environmental processes through the burning of fossil fuels. However, long-term, systematic marine research provides important scientific information on the changes and trends in marine ecosystems brought about by climatic and oceanic forces.

In addition to AFSC research efforts, there are many current and reasonably foreseeable activities that may contribute to cumulative impacts on the marine environment, including: conservation efforts, commercial shipping, commercial and recreational fisheries, oil and gas and alternative energy development, military activities, coastal development projects, marine research activities by other agencies and institutions, and other human activities that contribute to global climate change. These actions can produce both adverse and beneficial impacts that directly and indirectly affect ocean resources managed by NMFS and the social and economic environment of fishing communities that rely on them.

This FPEA generally considers the contribution of the three research alternatives to the cumulative effects on given resources to be very similar and they are often discussed together. The contribution of the No Research Alternative to the cumulative effects on resources is quite different and is discussed separately.

As described in the Chapter 4 summary above, AFSC research activities would have minor adverse effects on the various resource components of the physical and biological environments. Because AFSC research activities involve such a small number of vessels compared to other vessel traffic and collect relatively small amounts of biomass compared to commercial and recreational fisheries, the contribution of the three research alternatives to cumulative adverse effects on fish, marine mammal, and other species and resource areas would be small under normal conditions. AFSC scientific research activities will also have beneficial contributions to the cumulative effects on both biological and socioeconomic resources. The research alternatives contribute substantially to the science that feeds into federal fishery management measures aimed at rebuilding and managing fish stocks in a sustainable manner. It also contributes to understanding the nature of changes in the marine environment and adjusting resource management plans accordingly, and it helps meet co-management and international treaty research obligations. The research activities under the three research alternatives help alleviate adverse cumulative impacts on the biological and socioeconomic environments, resulting in long-term beneficial contributions to cumulative effects.

The No Research Alternative would not contribute to direct adverse effects on the marine environment (e.g., research catch of fish and incidental take of marine mammals) but would contribute indirect adverse effects on both the biological and socioeconomic environments based on the lack of scientific information to inform future resource management decisions.

OTHER SECTIONS

In addition to the chapters summarized above, the FPEA includes a description of the laws applicable to AFSC research activities in Chapter 6, cited references in Chapter 7, and a list of persons and agencies consulted in Chapter 8. Appendix A provides a description of the fishing gear, other scientific instruments, and vessels used during AFSC research activities. Appendix B includes tables and figures showing the seasonal distribution of research effort in the AFSC research area. Appendix C is the AFSC's application for promulgating regulations and issuing LOAs for incidental take of marine mammals under the MMPA from NMFS OPR. Appendix D contains proposed mitigation measures as well as handling and data collection procedures for marine mammals, sea turtles, and other protected species that are incidentally caught in AFSC fisheries research activities; these procedures would be implemented after the AFSC receives authorization for such incidental takes when the MMPA LOA and ESA consultation processes are completed. Appendix E describes and evaluates IPHC surveys and research programs that would occur in conjunction with Alternative 2.

CONCLUSION

Based on the analysis in this FPEA, NMFS has not identified any potential adverse environmental impacts that would rise to the level of "significant" under NEPA, thus triggering the requirement for an Environmental Impact Statement (EIS). A final determination on whether potential impacts of the proposed action are significant will be made with consideration of public comments and will be published in the *Federal Register*.

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1.1 NOAA'S RESOURCE RESPONSIBILITIES AND ROLE IN FISHERIES RESEARCH

The Federal government has a responsibility to protect living marine resources in waters of the U.S., also referred to as federal waters. These waters generally lie three to 200 nautical miles (nm) from the shoreline (those waters 3-12 nm offshore comprise territorial waters and those 12-to-200 nm offshore comprise the EEZ), except where other nations have adjacent territorial claims. The U.S. government has also entered into a number of international agreements and treaties related to the management of living marine resources in international waters outside of the U.S. EEZ. To carry out its responsibilities over federal and international waters, Congress has enacted several statutes authorizing certain federal agencies to administer programs to manage and protect living marine resources. Among these federal agencies, the NOAA has the primary responsibility for protecting marine finfish and shellfish species and their habitats. Within NOAA, the NMFS has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources.

Within the area covered by this FPEA, NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the MSA[5], the MMPA, and the ESA. While the USFWS has primary responsibility for protecting marine birds (seabirds) under the MBTA, NMFS is very involved in this activity due seabird interactions with fisheries and seabirds as an indicator of marine ecosystems. Accomplishing the requirements of these statutes requires the close interaction of numerous entities in a sometimes complex fishery management process. In the Alaska Region, the entities involved are the AFSC, NMFS Alaska Regional Office, NMFS Headquarters, the NPFMC, the International Pacific Halibut Commission (IPHC), Alaska Native governments, USFWS, State of Alaska agencies, stakeholder groups, and several other international fisheries management organizations.

1.1.1 Fisheries Science Centers

Six Regional Fisheries Science Centers[6] direct and coordinate the collection of scientific information on living marine resources and their ecosystems to assist resource managers in making sound decisions that build sustainable fisheries, facilitate the protection and recovery of threatened and endangered species, and sustain healthy ecosystems. Each Fisheries Science Center is a distinct entity and is the scientific focal point for a particular region (Figure 1.1-1). The AFSC conducts research and provides scientific advice to manage fisheries and conserve protected species in the oceans around Alaska. This region of nearly 3 million square miles includes the GOA, the Aleutian Islands, Bering Sea, Chukchi Sea, and Beaufort Sea.

[5] 16 U.S.C. §§ 1801-1884, (MSA 2007).

[6] The six Regional Fisheries Science Centers are: 1) Northeast, 2) Southeast, 3) Southwest, 4) Northwest, 5) Alaska, and 6) Pacific Islands.

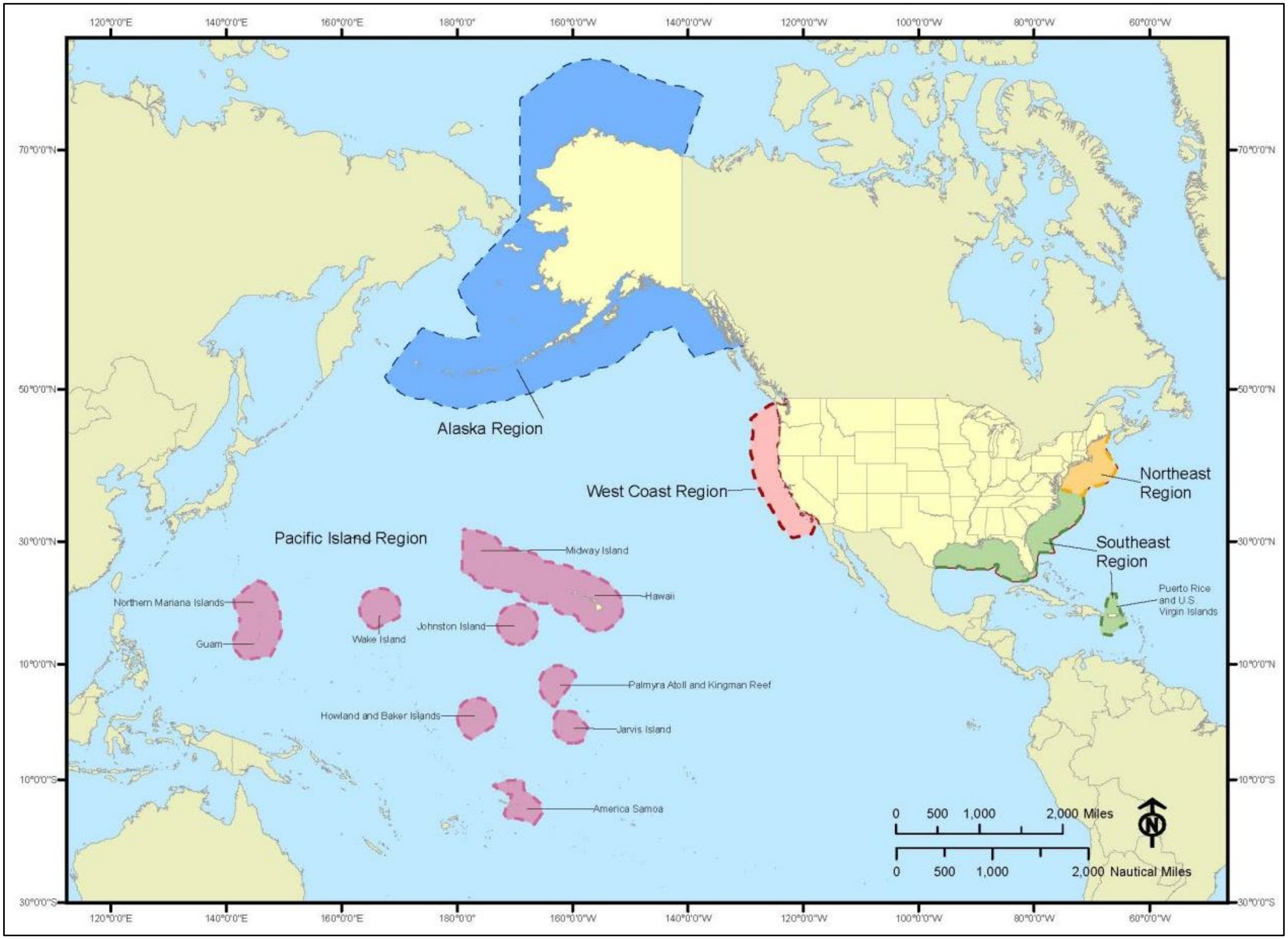

Figure 1.1-1 NMFS Fisheries Regions

1.1.2 Fishery Management Councils

In order to encourage a collaborative approach to fisheries management, the MSA established the nation's eight Regional Fishery Management Councils[7]. The Councils, which include fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others, are designed to provide all resource users and managers a voice in the fisheries management process. Under the MSA, the Councils are charged with developing FMPs and management measures for the fisheries occurring within the EEZ adjacent to their constituent states. The NPFMC has jurisdiction for developing recommendations for fisheries in the EEZ off Alaska. Data collected by Fisheries Science Centers are often used to inform FMPs, as well as to inform other policies and decisions promulgated by the Fishery Management Councils. Such policies and decisions sometimes affect areas that span the jurisdictions of several Fishery Management Councils, and make use of data provided by multiple Fisheries Science Centers.

1.1.3 International Fisheries Management Organizations

In addition to providing information to domestic fisheries management organizations, the AFSC provides scientific advice to support numerous international fisheries councils, commissions, and conventions including the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP), the North Pacific Anadromous Fish Commission (NPAFC), the International Whaling Commission (IWC), and the IPHC. Coordinated international research efforts include those with the NOAA Fisheries Office of International Affairs and other organizations.

The objectives of the CCBSP include the conservation, management, and optimal utilization of pollock resources in the high seas area of the Bering Sea outside of the member nations' EEZs in the area commonly known as the "donut hole." The member nations of the CCBSP include China, Japan, the Republic of Korea, the Republic of Poland, the Russian Federation, and the U.S. The AFSC provides scientific information to support the CCBSP.

The AFSC also provides information to inform decisions made by the NPAFC. The NPAFC was established to promote the conservation of anadromous stocks in the North Pacific Ocean and its adjacent seas north of 33 degrees north latitude beyond the 200-mile zones of the coastal States. Member nations of the NPAFC include Canada, Japan, the Russian Federation, and the U.S.

The IWC was established in 1946 under the International Convention for the Regulation of Whaling for the purpose of conserving whale populations and managing commercial and subsistence whaling efforts. In addition to its whaling management responsibilities, the IWC encourages, coordinates, funds, and publishes the results of scientific whale research. The main duty of the IWC is to keep under review and revise as necessary the measures which govern the conduct of whaling throughout the world. These measures, among other things, provide for the conservation of certain species; designate specified areas as whale sanctuaries; set limits on the numbers and size of whales which may be taken; prescribe open and closed seasons and areas for whaling; and prohibit the capture of suckling calves and female whales accompanied by calves. The compilation of catch reports and other statistical and biological records are also required. The AFSC provides information to the IWC related to the abundance and distribution of whales including work on developing and improving new techniques such as photo-identification studies, acoustic and satellite/radio tracking of whales and genetic analysis of populations.

[7] The eight Fishery Management Councils are New England, Mid-Atlantic, South Atlantic, Gulf of Mexico, Caribbean, Pacific, North Pacific, and Western Pacific.

The IPHC, originally called the International Fisheries Commission, was established in 1923 by a Convention between the governments of Canada and the U.S. Its mandate is research on and management of the stocks of Pacific halibut (*Hippoglossus stenolepis*) within the Convention waters of both nations. The AFSC provides information to the IPHC related to stock assessment and halibut biology, and cooperates with the IPHC to attain survey goals.

1.1.4 Role of Fisheries Research in Federal Fisheries Management

Fisheries managers use a variety of techniques to manage trust resources, a principal one being the development of FMPs. FMPs articulate fishery goals as well as the methods used to achieve those goals, and their development is specifically mandated under the MSA. The AFSC provides scientific information and advice to assist with the development of FMPs prepared by the PFMC, the NPFMC, and NMFS.

Through the AFSC, NMFS conducts both *fisheries-dependent* and *fisheries-independent* research on the status of living marine resources and associated habitats. The results of this research are used in the development of FMPs and to inform other actions undertaken by domestic and international fisheries management organizations. Fisheries-dependent research is research that is carried out in partnership with commercial fishing vessels. The vessel activity is not directed by AFSC, but researchers collect data on the commercial catch. In contrast, fisheries-independent research is designed and conducted independent of commercial or recreational fishing activity to meet specific research goals. Depending on the research, NMFS' role in these activities varies and generally can be described as follows:

- Fishery-independent research directed by AFSC scientists and conducted on board NOAA-owned and operated vessels, NOAA-chartered vessels, or at NOAA facilities (e.g., Little Port Walter Field Station).
- Fishery-independent research directed by cooperating scientists (other agencies, academic institutions, and independent researchers) conducted on board non-NOAA vessels. The AFSC helps fund these types of research efforts.

The AFSC primarily conducts fisheries-independent research on the status of living marine resources and associated habitats but also supports collaborative research and works with a wide spectrum of researchers from government agencies and universities, as well as representatives of the fishing industries, among many others. Through Section 119 of the MMPA Amendments of 1994, NMFS and the USFWS were granted authority to enter into cooperative agreements with Alaska Native organizations. NMFS co-management with Alaska Native organizations is based on the need to ensure a sustainable take of marine mammals for food and handicrafts for subsistence and cultural purposes. One example of a co-management agreement regarding marine mammal protection in Alaska is the Alaska Eskimo Whaling Commission (AEWC). NMFS and the AEWC have developed cooperative agreements to protect the bowhead whale population and associated subsistence culture, with the co-management agreement being amended as recently as 2014 (NOAA 2015). Co-management promotes full and equal participation by Alaska Natives in decisions affecting the subsistence management of marine mammals (to the maximum extent allowed by law) as a tool for conserving marine mammal populations in Alaska. Agreements may involve: (1) developing marine mammal co-management structures and processes with federal and state agencies, (2) monitoring the harvest of marine mammals for subsistence use, (3) participating in marine mammal research, and (4) collecting and analyzing data on marine mammal populations.

The scope of AFSC fisheries and ecosystem research activities evaluated in this FPEA is described in Chapter 2 (see also Section 1.4, below).

1.2 AFSC FISHERIES AND ECOSYSTEM RESEARCH ORGANIZATION

The AFSC is the research arm of NMFS in the Alaska Region. The AFSC plans, develops, and manages a multidisciplinary program of basic and applied research to generate the best scientific data available for understanding, managing, and conserving the region's living marine resources. This FPEA assesses the impacts of AFSC fisheries and ecosystem research activities in three research areas: 1) GOARA, the BSAIRA, and the CSBSRA (Figure 1.1-2).

AFSC scientists compile and analyze broad databases on fishery, oceanography, marine mammal, and environmental research. These data are used to develop policies and strategies for fisheries management within the U.S. EEZ, monitor and assess the health of the region's marine mammal populations, and develop the scientific understanding and predictive methodologies needed to implement NMFS ecosystem approach to management. In addition to ongoing survey and assessment activities, the AFSC is engaged in cutting-edge research on emerging issues such as climate change and the loss of sea ice in northern seas.

The primary responsibilities of the AFSC are to provide scientific data and technical advice to a variety of management organizations and stakeholder groups, including the NMFS Alaska Regional Office, NPFMC, USFWS, State of Alaska, Alaskan coastal subsistence communities, and U.S. representatives participating in international fishery and marine mammal negotiations, as well as the fishing industry and its constituents. The AFSC also coordinates fisheries and marine mammal research with other federal and state agencies, academic institutions, and foreign nations.

The AFSC is headquartered in Seattle at the Sand Point Facility and also includes the Auke Bay Laboratories (including the Ted Stevens Marine Research Institute at Lena Point), Little Port Walter Field Station, Kodiak Laboratory, Pribilof Islands Facilities, Dutch Harbor Field Office, Anchorage Field Office, and the Hatfield Marine Science Center in Newport, Oregon (Figure 1.1-2). AFSC research efforts are divided among five research divisions that are tasked with different roles in collecting scientific information on living marine resources and the ecosystems that sustain them. For more information, see the AFSC website: http://www.afsc.noaa.gov/

Auke Bay Laboratories (ABL) conducts scientific research on fish stocks, fish habitats, and the chemistry of marine environments. Information from this research is widely used by commercial interests such as fishing industries and governmental agencies involved in managing natural resources. The headquarters of ABL is the Ted Stevens Marine Research Institute located at Lena Point, north of Juneau, Alaska. The Ted Stevens Marine Research Institute serves as the focal point for six other ABL facilities. Three ABL facilities are located in the City and Borough of Juneau at Auke Bay, Auke Creek, and downtown Juneau, respectively, the fourth is at Little Port Walter, on Baranov Island, southeast of Sitka, and two are on the Pribilof Islands in the central Bering Sea. ABL facilities include fresh and saltwater laboratories, genetics and biology laboratories, offices, dive and docking facilities, a permanent fish weir and hatchery, and boat repair and storage facilities.

The Resource Assessment and Conservation Engineering Division (RACE) conducts fishery surveys to measure the distribution and abundance of approximately 40 commercially important fish and crab stocks. Data derived from these surveys are supplied to fishery managers and agencies and to the commercial fishing industry. The Kodiak Laboratory in the Kodiak Fisheries Research Center (KFRC) is the primary facility for the RACE Shellfish Assessment Program. The Fisheries Behavioral Ecology Program is located at the Oregon State University Hatfield Marine Science Center in Newport, Oregon. The Fisheries Behavioral Ecology Program conducts laboratory research on the behavioral responses of commercially important marine fishes to environmental factors that are critical to controlling distribution and survival from egg to adult. Research also focuses on defining the factors which affect post capture survival and mortality of fish that are caught as bycatch.

The Resource Ecology and Fisheries Management Division (REFM) conducts research and collects data to support an ecosystem approach to management of Northeast Pacific and eastern Bering Sea fish and crab resources. The REFM also relies on fishery dependent and fishery independent data. More than 25 groundfish and crab stock assessments are developed annually. Division staff are the primary liaison to the USFWS regarding seabird bycatch, management, and research by the NPFMC to set catch quotas. In addition, economic and ecosystem assessments are provided to the NPFMC on an annual basis. Division scientists also evaluate how fish stocks and user groups might be affected by fishery management actions and climate change among other factors.

The Marine Mammal Laboratory (MML) conducts research on marine mammals, with particular attention to issues related to marine mammals off the coasts of Oregon, Washington and Alaska. Much of the research conducted by MML is covered under MMPA section 101 directed research permits on marine mammals. The impacts of this directed research are not in scope for this FPEA but many of the projects considered in this FPEA provide ecological information important to the assessment of marine mammal conservation issues. Research biologists from RACE, REFM, and MML work closely together in the field and on many issues.

The Fisheries Monitoring and Analysis Division (FMA) monitors groundfish and halibut fishing activities in the Federal fisheries and conducts research associated with sampling commercial fishery catches, estimation of catch and bycatch mortality, and analysis of fishery-dependent data. The FMA is responsible for training, briefing, debriefing and oversight of observers who collect catch data onboard fishing vessels and at onshore processing plants and for quality control/quality assurance of the data provided by these observers. The impacts of the North Pacific Groundfish and Halibut Observer Program are not considered in this FPEA because it is part of commercial fisheries management programs implemented under the MSA.

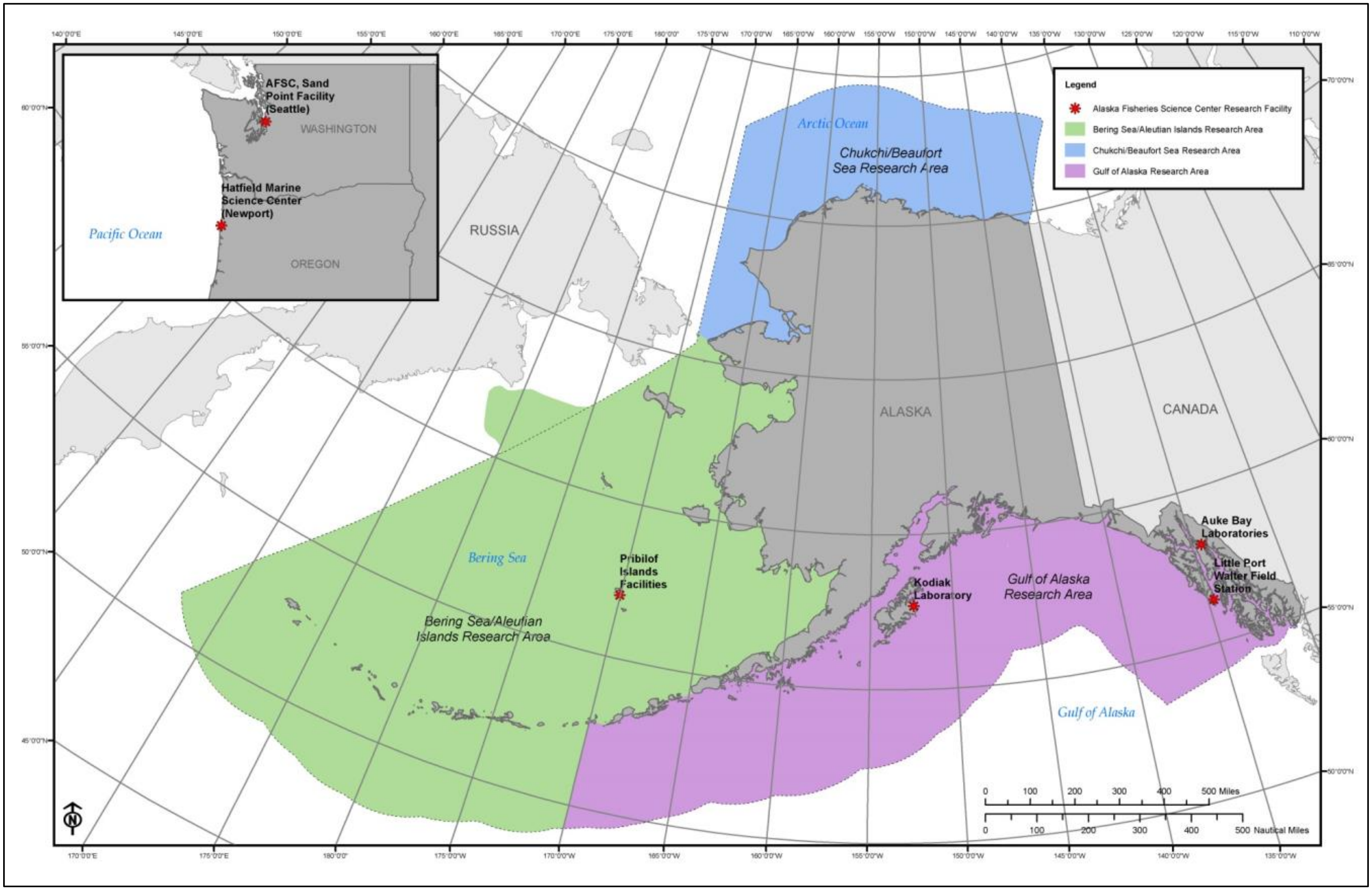

Figure 1.1-2 AFSC Research Areas

1.3 PURPOSE AND NEED

There is both a primary and a secondary action evaluated in this FPEA under the NEPA. Both of these actions are critical for continued scientific research in the North Pacific, in compliance with applicable federal law.

Primary Action: The primary action is the proposed continuation of AFSC fisheries and ecosystem research activities as described above and in Section 2.2. The purpose of this action is to produce scientific information necessary for the management and conservation of domestic and international living marine resources in a manner that promotes both the recovery of certain species and the long-term sustainability and recovery of these resources and generates social and economic opportunities and benefits from their use. The information developed from these research activities is essential to the development of a broad array of fisheries, marine mammal, and ecosystem management actions taken not only by NMFS, but also by other federal, state, and international authorities. Each of the research activities requires one or more SRPs and the issuance of these permits is a part of the primary federal action covered under this NEPA review.

Secondary Action: A secondary, related action — also called a “connected action” under NEPA (Sec. 1508.25) — is the issuance of proposed regulations and subsequent LOA under Section 101(a)(5)(A) of the MMPA of 1972, as amended (MMPA; 16 U.S.C. 1361 *et seq.*) that would govern the unintentional taking of small numbers of marine mammals incidental to the AFSC’s fisheries and ecosystem research activities.

Sections 101(a)(5)(A) and (D) of the MMPA direct the Secretary of Commerce (Secretary) to allow, upon request, the incidental, but not intentional taking of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review. Take, under the MMPA means “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.” The MMPA defines “harassment” as “any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]”.

Under the MMPA, any activities resulting in the take of marine mammals must be authorized by NMFS; this includes research programs conducted by the NMFS Fisheries Science Centers. Because the AFSC’s research activities have the potential to take marine mammals by Level A and B harassment, serious injury and/or mortality, the AFSC is applying to NMFS for an incidental take authorization (ITA) for its fisheries and ecosystem research programs. Authorization for incidental takes shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

The purpose of issuing ITAs is to authorize take that is otherwise prohibited by the MMPA and to ensure that the action complies with the MMPA and NMFS implementing regulations. ITAs may be issued as either: (1) regulations and associated LOAs under Section 101(a)(5)(A) of the MMPA; or (2) an Incidental Harassment Authorizations (IHAs) under Section 101(a)(5)(D) of the MMPA. An IHA can only be issued when there is no potential for serious injury and/or mortality or where any such potential can be negated through required mitigation measures. Because there is a potential for lethal takes and takes that may result in serious injury that could lead to mortality, the AFSC is requesting rulemaking and the issuance of LOAs for this action.

This FPEA analyzes the environmental impacts associated with the proposed authorization of the take of marine mammals incidental to the AFSC's conduct of fisheries research activities in the North Pacific Ocean and the Bering, Chukchi, and Beaufort seas. It also analyzes a reasonable range of mitigation alternatives that may be required if NMFS issues an MMPA authorization. The analysis of mitigation measures includes the consideration of benefits to the affected species or stocks and their habitat, and an analysis of the practicability and efficacy of each measure. This analysis of mitigation measures could potentially be used to support requirements pertaining to mitigation, monitoring, and reporting specified in MMPA regulations and subsequent LOAs, if issued.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA (ESA-listed species), this FPEA evaluates potential impacts to ESA-listed species that may result from either the primary or secondary action. This information will be used to initiate consultation with NMFS and the USFWS under Section 7 of the ESA. Likewise, because the proposed research activities occur partially within the boundaries of EFH), this FPEA evaluates potential impacts to EFH as required under section 305(b)(2) of the Magnuson Stevens Act. The AFSC intends to use this FPEA as the basis for consultations with the appropriate offices and agencies in compliance with these and other applicable laws (Table 1.6-1).

1.4 SCOPE AND ORGANIZATION OF THIS FPEA

In considering the proposed action, NMFS is responsible for complying with a number of federal statutes, regulations, and Executive Orders (EO), including NEPA, as well as co-management agreements with Alaska Native governments. As such, the purpose of the FPEA is to provide an environmental analysis to support the NMFS proposal to continue the research activities under the requirements of a LOA and to encourage and facilitate public involvement in the environmental review process.

Under NEPA, an Environmental Assessment (EA) is prepared to determine if any significant environmental impacts are likely to be caused by a proposed action. If the EA does not identify significant impacts, a Finding of No Significant Impact (FONSI) is prepared to document the decision maker's determination and to approve the proposed action. If at any time during preparation of the EA it appears that significant impacts would result from the proposed action, the agency would prepare an EIS to more thoroughly evaluate the potential impacts and potential ways to reduce or mitigate those impacts. Thus, while the EA objectively evaluates the full extent of potential impacts of a proposed action (from minor to major, adverse or beneficial, short-term to long-term – see discussion below), the FONSI provides the decision maker's rationale with regard to the significance of those impacts.

This FPEA provides a programmatic-level assessment of the potential impacts on the human environment associated with the proposed AFSC research programs. A programmatic approach is used when initiating or re-evaluating a federal program for NEPA compliance. It takes a broad look at issues and alternatives (compared to documents for a specific project or action), and provides a baseline for future management actions. Programmatic documents are often intended to provide NEPA compliance for management and other activities over a fixed period before a formal review is again initiated.

This FPEA assesses not only the potential direct and indirect impacts of the alternatives presented to the physical, biological and socioeconomic systems in the AFSC area of responsibility, but also the potential impacts to the management processes that are used to monitor the health of the resources, develop plans to manage the resources to balance recovery goals and socioeconomic goals, and ensure the sustainability of the resources and affected fishing communities.

The chapters that follow describe the proposed research activities and potential alternatives considered (Chapter 2), the affected environment as it currently exists (Chapter 3), the probable direct and indirect consequences on the human environment that may result from the implementation of the proposed research activities and their alternatives (Chapter 4), and the potential contribution to cumulative impacts from the proposed activities and their alternatives (Chapter 5).

The scope of this FPEA covers research activities of the AFSC and its research partners that meet one or more of the following criteria:

- Contribute to fishery management and ecosystem management responsibilities of NMFS under U.S. law and international agreements.
- Take place in marine waters in the North Pacific Ocean and the Bering, Chukchi, and Beaufort seas.
- Involve the transiting of these waters in research vessels, observational surveys made from the decks of those vessels (e.g., marine mammal and seabird sighting transects that do not involve directed research permits), the deployment of fishing gear and scientific instruments into the water in order to sample and monitor living marine resources and their environmental conditions, and/or use active acoustic devices for navigation and remote sensing purposes.
- Have the potential to interact adversely with marine mammals and protected species of fish, turtles, seabirds, and invertebrates. However, the research activities covered under this FPEA involve only *incidental* interactions with protected species, not *intentional* interactions with those species. The primary focus of this FPEA is on fisheries-related research but several other types of surveys are also included because they deploy fishing gear and other instruments similar to those used in fisheries research in order to monitor the environment important to protected species and therefore involve the same potential risks of incidental interactions with protected species.
- The FPEA covers both short-term and long-term AFSC fisheries research projects of limited size and magnitude and where cumulative effects are deemed negligible. Therefore, information within the FPEA would inform the issuance of a SRP to conduct AFSC fisheries research. However, any information not included in this FPEA may need to be captured in a supplemental EA.

This FPEA does NOT cover:

- Directed research on protected species, such as studies involving intentional capture of marine mammals for tagging and tissue sampling, which require directed SRPs under the MMPA or ESA which involve their own environmental review processes and consultations under applicable regulations. However, this FPEA does include some research activities that have associated MMPA section 101 permits for research involving marine mammals. Such directed research permits may not cover incidental effects from other aspects of the research project (e.g., acoustic disturbance from echosounders or incidental capture in fishing gear used to sample prey fields), which is a focus of this FPEA.
- The potential effects of research conducted by scientists in NMFS Fisheries Science Centers other than the AFSC.
- Other activities of the AFSC that do not involve the deployment of vessels or gear in marine waters, such as evaluations of socioeconomic impacts related to fisheries management decisions, taxonomic research in laboratories, fisheries enhancements such as hatchery programs, and educational outreach programs.
- Implementation of the North Pacific Groundfish and Halibut Observer Program. The impacts of the Observer Program are considered under FMP NEPA processes.
- Other fisheries research programs conducted and funded by other agencies, academic institutions, non-governmental organizations, and commercial fishing industry research groups without material support from the AFSC.

1.5 PUBLIC REVIEW AND COMMENT

The NEPA process and NOAA policy and procedures for implementing NEPA[8] are intended to enable NMFS to make decisions based on an understanding of the environmental consequences to the proposed action. Public involvement is an essential part of this process under NEPA. Therefore, NMFS provided the public opportunities to comment during the development of this PEA and the public process pursuant to the MMPA. NMFS made the DPEA and the AFSC LOA application available for public review and comment in the Federal Register (FR) on August 10, 2016 (81 FR 52830) and October 18, 2016 (81 FR 71709), respectively, and separately, published the proposed rule on August 1, 2018 (83 FR 37638). The Federal Register notices for the DPEA, LOA application, proposed rule and the corresponding public comment periods for these documents were instrumental in providing the public with information on relevant environmental issues and offering the public a meaningful opportunity to provide comments for our consideration in the NEPA and MMPA decision-making processes. In addition, NMFS initiated Government-to-Government Consultation during scoping by contacting potentially affected federally-recognized tribal governments.

During the public review period for the DPEA in September 2016, NMFS received a comment letter from Ahtna Incorporated in support of Alternative 2 and a joint comment letter from the Humane Society of the U.S. (HSUS) and Whale and Dolphin Conservation (WDC). During the public review period for the Notice of Rule (NOR) of AFSCs initial LOA application in October 2016, NMFS received joint comments from the HSUS/WDC. This letter incorporated the same comments previously submitted to NMFS by HSUS/WDC during the public review period for the DPEA. Following the comment periods for the DPEA and AFSCs initial LOA application, AFSC prepared and submitted a revised LOA application to include fisheries research conducted by the IPHC. Subsequently, NMFS published a second NOR for AFSCs revised LOA application on September 14, 2017 (82 FR 43223) but did not receive comments in response to this NOR. During the public review period for NMFS proposed rule for AFSC, NMFS received comments from the Marine Mammal Commission (Commission), the Ecological Sciences Communication Initiative and the public. All comments received in response to the publication of the DPEA, the initial AFSC LOA application and the proposed rulemaking were considered and used to inform the analysis in this FPEA. The responses to comments received for the DPEA and initial LOA application is summarized below and a summary of the comments received for the AFSC proposed rule, and NMFS' responses to those comments, will be included in the Federal Register notice for the final rule. The substantive issues in the two HSUS/WDC letters and responses are below.

- The HSUS/WDC letter expressed concern that examining a time frame from 2004-2015 is precautionary when assessing take data for surface, mid-water, and bottom trawl as a longer time series may be more representative. They further commented that the sparse take data in the record for research activities and acknowledgement in the documents that there is a need to require better crew training in assessing interactions lends support to the possibility that past takes were not always properly or completely documented.
    - *Response:* Investigators complete field and electronic notebooks and because extraordinary events are witnessed by several scientists, significant encounters would normally be brought to light as they are rare; and, therefore, take circumstances have been thoughtfully recorded or reported. Since 2008 and 2009, successive agency memos and directives (Merrick 2017 and Friedman 2015) have identified procedures to mitigate, handle and report incidental

[8] NOAA Administrative Order (NAO) 216-6A "Compliance with the National Environmental Policy Act, Executive Orders 12114, Environmental Effects Abroad of Major Federal Actions; 11988 and 13690, Floodplain Management; and 11990, Protection of Wetlands" issued April 22, 2016 and the Companion Manual for NAO 216-6A "Policy and Procedures for Implementing the National Environmental Policy Act and Related Authorities" issued January 13, 2017."

takings of protected species, and these directives were disseminated to AFSC field staff. These memos and directives remain the current guidance.

- The HSUS/WDC letter expressed concern that there needs to be more clarification regarding tables summarizing take requests. Specifically, according to DPEA Table 4.2-9, there were only four research-related takes of marine mammals from three species during the 11 years of data analyzed. However, understanding how each was derived was not always clear from the text and charts. Additionally, the DPEA Table 4.2-12 summarizes species and number of marine mammals for which the region is seeking take authorization, and the permit application provides several different summary charts that are intended to show derivation of the total number of takes requested. These takes appear to be summed in the LOA application, but this is not easy for readers to follow. The LOA application notes that there are tables to provide summaries for all requested takes and this is true, but the structure and discussion in the LOA application complicates understanding of the derivation of all numbers. For example, it is not always clear why some takes in commercial fisheries were considered analogous to the Center's research methodology but others may not have been included.
    - *Response:* The approach and methodology of deriving the marine mammal takes is detailed in the LOA application at Section 6 in Sections 6.1.1 to 6.1.12. In particular, Section 6.1.1 second paragraph, discusses the phased approach and Section 6.1.10 discuss in detail the application of each data set in developing the integrated take request for each species or species group that appear in Table 6.7. The potential take of each species by past experience, by analogous species to AFSC research gear takes, and by commercial gear analogy are discussed in detail. Section 6.1.12 relates how these potential takes integrate into the AFSC total take scenario - Tables 6.1 to 6.6 are not necessarily additive but where similar species takes are derived by each source, the maximum take of one source is used and not the sum of the three sources. As stated in Section 6.1.7, the five year take of five Western DPS Steller Sea Lion is not doubled by the five year take derived for the AFSC historical takes. The LOA application states that research gears are used less frequently and are of small size in comparison to commercial gears and or deployed infrequently in comparison to commercial effort and with the mitigation plan to be implemented, the potential takes listed in Table 6.7 are expected to be a logical projection of the future but that likely takes will be substantially lower than those being requested. In preparing the LOA application AFSC reviewed the methodology for other fisheries science centers and this approach is a consistent method for evaluating takes.
- The HUS/WDC letter states that the LOA application Table 6-4 lists the species and number of marine mammals for which the region is seeking authorization. Although using gear types known to interact with marine mammals, only a single take is projected for the five year period of the authorization. However, the LOA application at Table 6-7, shows far greater take authorization being requested.
    - *Response:* As stated in the LOA application at Section 6.1.12, Table 6.7 is a summary of Tables 6.1-6. Because not all stocks interact with commercial fisheries in all of the research areas, there are far fewer listed species and stocks in Table 6.4 than in the integrated Table 6.7. For example, several stocks of Harbor seal and the California stock of northern fur seal appear in Table 6.3 and not Table 6.4 but do appear in the summary Table 6.7. Similarly, the beluga whale stocks of the CSBSRA appear in Table 6.5 but not Table 6.4 but do appear in Table 6.7, and the two undetermined species of Table 6.6 appear in Table 6.7 but not Table 6.4.
- The HUS/WDC letter states that some of the projected takes are based on analogy to species taken in commercial fisheries. However, the most recent stock assessments indicate that fisheries

are generally in categories where observer coverage is a low priority. This region has several problems that may, therefore, hinder attempts to accurately reflect takes by analogy to commercial fisheries using similar gear. Additionally, the stock assessment data are from 2011 or older so they are outdated. Further, almost all of the data on species and numbers of takes in Alaskan commercial fisheries are from logbooks and fisher self-reports. NMFS and the U.S. Fish and Wildlife Service have concluded that fisher self-reports are at best a minimum estimate of incidental takes.

- o Response: Regarding Lack of Observed Fisheries in negatively biasing derived takes by analogous take by commercial gears, Helker et al. (2016) updates the list of human-caused injury and mortality of NMFS-managed Alaska Marine Mammal Stocks, 2010-2014 (NOAA Technical Memorandum NMFS-AFSC-315). This this report covers part of the period when observer coverage was extended to the small boat fishery for groundfish and the small boat halibut fleet. While self-reporting may be negatively biased, unobserved salmon troll and gillnet fisheries were reported to cause some of the most frequent fishery mortalities and injuries to large and small cetaceans and second most for pinnipeds. Regardless of these findings, the AFSC research take history and the cited List of Fisheries still reflects the likely take of marine mammals during the next five years. AFSC use of gillnets is infrequent compared to commercial fisheries and the net dimensions are much smaller than commercial gillnets. The takes for trawl and longline gears reflect that the listed takes for species are similar to the new mortality and injury reports. With regard to sperm whales and killer whales collective data for a depravation event has not led to a conclusion that the cause was fisheries research activities.

- The HUS/WDC letter states that there are a number of species for which take is requested where the NMFS Stock Assessment lists the Potential Biological Removal level as "undetermined." As a result, no impact assessment is possible or would be reliable. This dynamic is not adequately discussed in the DPEA/LOA application.
  - o *Response:* LOA application at Section 7.1 and DPEA Section 5.5 discuss the Level A take with regard to marine mammals and includes the stocks for which the PBR is undetermined. As stated in these documents, the LOA application is based on the best, currently available information and will be updated when new information is available. Because of the low level of historical interactions, as well as the low level of predicted future takes (mortality, serious injury, and Level A harassment) associated with AFSC fisheries research activities, the AFSC believes that their activities will not affect annual rates of recruitment or survival or the health and condition of the species or stock of the requested species. The average annual human-caused mortality for these species is estimated to be less than the PBR, and as discussed above in the species accounts, they are not classified as "strategic" stocks under the MMPA. Based on this the AFSC believes that its fisheries research activities sufficiently explains the issues of unavailable PBRs.
  - o The AFSC considered historic marine mammal interactions available from 2004 through 2015 to calculate the total take request over the five-year authorization period in the LOA application. AFSC estimated potential encounters with survey gear based on historical interactions during 2004-2015 in surface, mid-water, and bottom trawl nets. Historical data was used to determine the average takes per year and the likelihood of taking a particular marine mammal.
  - o Although serious injury or mortality are rare during AFSC research activities, the AFSC requests that the LOA application authorize a small number of incidental, non-intentional, injurious or lethal takes of marine mammals in the event that they might occur, and in spite of the monitoring and mitigation efforts described in Appendix C. AFSC believes any actual

takes will be substantially lower than its take estimates, and many of the species/stocks for which it estimated take would not be taken. Nevertheless, the AFSC considers the take estimates presented as the best approximation of future events because they are based on the best information available. There is substantial inherent uncertainty in estimating numbers and species that could be potentially taken, and the AFSC take estimates reflect this uncertainty.

  - The AFSC believes the methodology it used to estimate takes is appropriate and conservative in that it likely overestimates the number of animals potentially affected. The MMPA and ESA permitting processes are designed to provide opportunities for adaptive management; if the status of a stock changes substantially in the future or the relative impacts of AFSC fisheries research become a concern, NMFS can review the conditions of the MMPA authorization during the annual issuance of LOAs and may re-initiate ESA Section 7 consultation at any time.

- Regarding mitigation HSUS/WDC commented that other than providing training workshops for some of its scientists and crew, NMFS proposes to make no changes from its status quo and cannot say with certainty when, or even if, status quo measures will be taken, as use of mitigation is discretionary. In the FPEA, AFSC, AFSC acknowledges that the use of mitigation measures are generally considered best practices but the use of these minimal strategies would be at the discretion of the ships' captains and chief scientists on each vessel who will receive training on injury determinations.
  - *Response:* the Preferred Alternative stipulates required training for crew, new communication protocols during fisheries research activities, communication regarding past experiences in handling and avoiding protected species, written instructions and protocols for avoiding adverse impacts, adding contract language regarding operating procedures, and reviews of seasonal encounters and takes to improve avoidance and handling procedures. Regarding mitigation measures described in Section 2.3.1, AFSC believes that for the Preferred Alternative what is currently employed as mitigation measures, best practices and training and as stated in the LOA application are effective as there has not been a take in the last 5 years of research activities. The mitigation measures described under the Preferred Alternative in Section 2.3.1 are what AFSC is working towards immediately implementing in terms of new mitigation measures. As described in Section 2.3.1, final mitigation measures have been determined through consultation with USFWS and NMFS as described in the consultation documents, the Biological Opinions (NMFS 2019 and USFWS 2018) and summarized in Chapter 6. The AFSC and the IPHC will implement avoidance and minimization measures, specified by vessel and gear type, during research activities as described in the USFWS Biological Opinion (2018) and in the NMFS Biological Opinion (2019).

- The HUS/WDC letter commented that the status quo alternative discusses a "move-on rule" for vessels towing gear in which "most research vessels engaged in trawling will have their station in view for 15 minutes or 2 nm prior to reaching the area" and "many vessels will inspect the tow path before deploying the trawl gear." This stipulation for inspecting the area and moving on if animals are sighted in or near the tow path is not a requirement; it merely reflects what AFSC says that "many" (but clearly not even most) vessels will do prior to deploying potentially entangling gear. At the very least, NMFS must require that all vessels undertake a minimum 15-30 minute visual inspection of the area and move on from the area if animals are in or near the projected tow path.
  - *Response:* regarding the "Move-On" rule and sufficiency for inspecting a station for protected species not all vessels conducting towing operations will search the seafloor for

their assigned station. For example, vessels operating on the bottom trawl survey of the Eastern Bering Sea Shelf where there is a regular lattice of stations and smooth sea floor terrain, tows will be initiated when the vessel arrives on station. However, as the vessel approaches at approximately 9 knots, the station location will be visible at approximately 5 miles away, and it will 30 minutes for the vessel to reach the station and perhaps 15 minutes in poor weather. Therefore, the station location and any protected species should be visible well before (15-30 minutes) the station is occupied and the gear is ready for deployment as stated in the LOA application and PEA.

- The HUS/WDC comment letter states that in Alternative 3, the DPEA indicates that AFSC is rejecting any requirement for dedicated protected species observers (PSOs); the use of dedicated PSOs is said to be impractical. Instead, some undefined portion of the crew will be trained. This training may or may not be as thorough as that required of a regular PSO. This does not appear likely to result in having the equivalent of a PSO aboard. Under Alternative 3, the AFSC also rejects the idea of using marine mammal excluders on nets even if they were to prove practicable. This should be required in nets where it may be practicable.
    - *Response:* AFSC does not plan to adopt Alternative 3. All crew will not receive protected species training, only those whose responsibilities include monitoring, avoiding, or handling marine mammals. This will typically include the chief scientist (Field Party Chief) and the Deck Lead. AFSC has identified that protected species training will be adapted from the marine mammal and seabird training provided to North Pacific Fishery Observers. This training is recognized as an effective program and will be modified to the AFSC. Appendix D of the PEA has been developed to document the mitigation and monitoring procedures and a training program is being tailored to the research and non-fishery needs of the AFSC research program from the North Pacific Observer Program. Use of marine mammal excluders is not applicable to AFSC research activities due to the survey gear employed during research activities. Marine mammal excluders are still being evaluated by other science centers and are not yet ready for use. The application of marine mammal excluders would be impracticable because they would influence the scientific capture process and the survey time series. Excluders are not required because of the naturally low frequency of marine mammal encounters coupled with the enhanced training and mitigation program.
- The HUS/WDC letter states that when referencing the proposed takes in Table 6-7, the application for a LOA stipulates that additional mitigation measures may be implemented if take far exceeds the maximum number estimated per year, such that it appears that the total estimated take over the five-year authorization period may be exceeded. The meaning of the term “far exceeds” is not clear but should have been better quantified. Further, it appears that additional mitigation is not required but just considered. In addition, the decision to undertake additional mitigation is left to the discretion of the vessel operator or staff in the region, but the means by which additional mitigation would be determined is not adequately discussed. It is important to define the level of take that would trigger the need to re-evaluate the sufficiency of the mitigation measures and to specify the requirement for, and nature of, additional measures.
    - *Response:* Regarding take requests and the term “Far Exceeds” in the LOA application in reference to annual and five-year take requests, AFSC believes that the quoted section, “Recognizing these uncertainties, additional mitigation measures may be implemented if take far exceeds the maximum number estimated per year, such that it appears that the total estimated take over the five-year authorization period may be exceeded” clarifies what is meant by the “far exceeds” term. Actual annual takes will be compared to estimated annual takes and the five-year requested take. If AFSC is taking a species at an annual or five-year period rate that will likely exceed the authorized take, then additional mitigation measures or

adaptive management will be required. The use of adaptive management allows the consideration of new information from different sources to determine (with input from the AFSC regarding practicability) on an annual or biennial basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggests that such modifications would have a reasonable likelihood of reducing adverse effects to marine mammals and if the measures are practicable.

- HUS/WDC commented that in describing the areas and/or fisheries with interactions with marine mammals, Appendix C of the DPEA stipulates that acoustic pingers are used in research gillnets around hatchery net pens to prevent interactions and tangling of local harbor seals. Pingers have generally proven to be ineffective in deterring seals and sea lions and may actually attract pinnipeds to the gear.
  - *Response:* Regarding the use of acoustic pingers to deter seals from nets AFSC's continued practice to use pingers to deter seals from research gillnet encounters has not resulted in any seal mortalities. It continues to be prudent to use pingers.

1.6 REGULATORY REQUIREMENTS

NMFS is the lead federal agency for the proposed research activities evaluated in this FPEA. These activities trigger a broad range of regulatory compliance issues because they have the potential to impact public resources regulated by various statutes, and contribute to reducing impacts caused by other activities, such as fishing, that are also regulated by those same statutes. Chapters 4 and 5 assess the impacts of the research activities on protected species and habitat. Because these research activities are necessary for NMFS to carry out its regulatory mandates, Chapters 4 and 5 also describe potential impacts to NMFS's ability to effectively monitor and manage fishery resources under the alternatives evaluated. A detailed description of these statutory requirements is provided in Chapter 6, "*Applicable Laws*."

Table 1.6-1, below, presents a brief summary of some of the applicable laws and treaties. This information is provided to aid the reader in understanding the material presented later in the FPEA and is not intended to be a complete listing of all applicable statues, orders or regulations applicable to the proposed action and alternatives.

Table 1.6-1 Applicable Laws and Treaties

Law	Description
National Environmental Policy Act (NEPA)	Requires federal agencies to evaluate potential environmental effects of any major planned federal action and promotes public awareness of potential impacts by requiring federal agencies to prepare an environmental evaluation for any major federal action affecting the human environment.
Magnuson-Stevens Fishery Conservation and Management Act (MSA)	Authorizes the U.S. to manage fishery resources in an area from a State's territorial sea (extending 3nm from shore) to 200 nm off its coast (termed as the Exclusive Economic Zone [EEZ]). Includes 10 National standards to promote domestic commercial and recreational fishing under sound conservation and management principles, and provide for the preparation and implementation of fishery management plans (FMPs).
Marine Mammal Protection Act (MMPA)	Prohibits the take of marine mammals in U.S waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the U.S. Allows, upon request, the "incidental," but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing or directed research on marine mammals).
Endangered Species Act (ESA)	Provides for the conservation of endangered and threatened species of fish, wildlife, and plants. Administered jointly by NMFS and the USFWS.
Migratory Bird Treaty Act (MBTA)	Protects approximately 836 species of migratory birds from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations.
Fish and Wildlife Coordination Act (FWCA)	Requires USFWS and NMFS to consult with other State and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies.
National Historic Preservation Act (NHPA)	Section 106 requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties.
Executive Order (EO) 12989, Environmental Justice	Directs federal agencies to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law.
High Seas Fishing Compliance Act	The United Nations Agreement to Promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas establishes the responsibility of each nation for the actions of vessels fishing under that nation's flag on the high seas. The High Seas Fishing Compliance Act (HSFCA) is the domestic legislation enacted in 1995 to provide authority to the Secretary of Commerce to implement this U.N. Agreement.
EO 13158, Marine Protected Areas	The purpose of this order is to strengthen and expand the Nation's system of MPAs to enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations.
EO 13175, Government to Government Consultation	EO 13175 requires federal departments and agencies to consult with federally recognized Indian tribal governments when considering policies that would impact tribal communities. NOAA 13175 Policy establishes procedures for Government–to-Government to Consultation with federally recognized Indian tribes and Alaska Native corporations established under the Alaska Native Claims Settlement Act (ANCSA) of 1971.
EO 13112, Invasive species	This order (64 CFR 6183, February 3, 1999) directs federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

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2.1 INTRODUCTION

In accordance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality (CEQ) Regulations, NMFS is required to consider a range of alternatives to the Proposed Action as well as the No Action. The evaluation of alternatives under NEPA assists NMFS with ensuring that any unnecessary impacts are avoided through an assessment of alternative ways to achieve the purpose and need of the Proposed Action that may result in less environmental harm. Therefore, NMFS applied the screening criteria and considerations outlined below to the alternatives to identify which alternatives to carry forward for analysis. Accordingly, reasonable alternatives are carried forward for evaluation under NEPA while alternatives considered but determined not to meet purpose and need are not carried forward for evaluation. Section 2.6 describes the potential alternatives considered but not carried forward for evaluation because they did not meet the purpose and need of the proposed action.

Screening Criteria – To be considered 'reasonable' for the purposes of this FPEA, an alternative must meet the following criteria:

The action must not violate any federal statute or regulation.

The action must be consistent with reasonably foreseeable funding levels.

The action must be consistent with long-term research commitments and goals to maintain the utility of scientific research efforts, or consider no federal funding availability for fisheries research.

To maintain the utility of scientific research efforts, fisheries and marine ecosystem scientific research should address at least some of the following goals related to fisheries management:

1. Methods and techniques should provide standardized and objective data consistent with past data sets (time series) in order to facilitate long-term trend analyses.
2. Collected data should characterize living marine resources and fishery populations and the health of their habitats.
3. The surveys should enable assessment of population status and provide predictive capabilities required to respond to changing ecosystem conditions and manage future fisheries.
4. Research on new methodologies to collect fisheries and ecosystem information (e.g., active and passive acoustic instruments and video surveys of benthic habitats in lieu of dredge gear or bottom trawls), and research oriented toward modifications of fishing gear to address bycatch or other inefficiencies should be conducted under experimental conditions sufficient to allow statistically valid comparisons with relevant alternatives.

NMFS evaluated each potential alternative against these criteria and requirements. Based on this evaluation, the No-Action/Status Quo Alternative and two other action alternatives were identified as reasonable and are carried forward for more detailed evaluation in this FPEA. NMFS also evaluates a second type of no-action alternative that considers no federal funding for fisheries research activities. This alternative is called the No Research Alternative to distinguish it from the No Action/Status Quo Alternative (hereafter referred to in the text as the Status Quo Alternative).

The Status Quo Alternative is used as the baseline for comparison of the other alternatives. Three of the alternatives include fisheries and ecosystem research projects conducted or funded by the AFSC as the primary federal action. These three alternatives also include suites of mitigation measures intended to minimize potentially adverse interactions with protected species. Protected species include all marine mammals, which are covered under the MMPA, all species listed under the ESA, and bird species protected under the MBTA.

The three alternatives involving research activities in the marine environment trigger marine mammal protection requirements under the MMPA. For this reason, NMFS must evaluate the alternatives to ensure that they would fulfill the purpose and need of NMFS issuing regulations and LOA under Section 101(a)(5)(A) of the MMPA to the AFSC, which is the secondary federal action considered in this FPEA. The LOA, if issued, would provide an exception to the AFSC from the take prohibitions for marine mammals under the MMPA, incidental to the conduct of the AFSC's research activities, namely: (1) the issuance of an LOA for the take of marine mammals by Level A and Level B harassment, and by serious injury or mortality incidental to the AFSC's conduct of research activities; and (2) compliance with the MMPA which sets forth specific findings and prescriptions (e.g., no unmitigable adverse impact on the availability of a species or stock for subsistence uses, negligible impact on a species or stock, and mitigation, monitoring, and reporting requirements) that must be made in order for NMFS to issue an LOA. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate a reasonable range of mitigation measures to minimize impacts to marine mammals to the level of least practicable adverse impact. This range of mitigation measures has been incorporated as part of the identified alternatives in order to evaluate their ability to minimize potential adverse environmental impacts. The efficacy and practicability of all potential mitigation measures is assessed in Chapter 4.

Further, because the proposed research activities occur in known habitat areas of species that are listed as threatened or endangered under the ESA, this FPEA evaluates potential impacts to ESA-listed species and their habitats that may result from either the primary or secondary action. Likewise, because the proposed research activities likely occur within areas identified as EFH, this FPEA evaluates potential impacts to EFH as required under section 305(b)(2) of the MSA.

2.2 ALTERNATIVE 1 – NO-ACTION/STATUS QUO ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH WITH SCOPE AND PROTOCOLS SIMILAR TO PAST EFFORT

As discussed in Chapter 1, the AFSC collects a wide array of information necessary to evaluate the status of fishery resources and the marine environment. AFSC scientists conduct fishery-independent research onboard NOAA owned and operated vessels or on chartered vessels in the GOARA, the BSAIRA, and the CSBSRA. Under the Status Quo Alternative, the AFSC would administer and conduct a wide range of fishery-independent research and survey programs as they have been in the recent past (2008-2015), as summarized in Table 2.2-1. Appendix A provides an illustrated description of the fishing gear and scientific instruments used during AFSC research. Under this alternative, the AFSC would continue to apply for section 10 directed research permits for the intentional take of marine mammals or ESA-listed species and SRPs for research that will affect MSA species managed under FMPs.

2.2.1 AFSC and Cooperating Research Partner Activities

Table 2.2-1 summarizes the fisheries activities and fisheries research programs conducted by the AFSC. The fisheries and ecosystem research activities funded and conducted by AFSC and the IPHC fishery-independent activities sponsored by AFSC are referred to herein as “AFSC fisheries research activities”. The AFSC also provides some funding to the Alaska Department of Fish and Game (ADFG) to conduct fishery-independent research during some of their research cruises in areas of common interest. The sampling activities conducted by ADFG collect and deliver catch and biological information for specified groundfish species in certain areas which would otherwise require a separate, more expensive, effort by AFSC. The sampling efforts conducted by the ADFG on behalf of the AFSC are covered under this FPEA but other research efforts of the ADFG that are not funded by the AFSC are not covered under this FPEA. For the purposes of this FPEA, AFSC research activities are described as occurring in one or more of three geographic research areas: the GOARA includes marine waters offshore from Canada north to Alaska and west to longitude 170° W, including marine waters in the archipelagos of Southeast Alaska, Prince William Sound, Cook Inlet, Kodiak, and the Alaska Peninsula (Figure 1.1-2). The BSAIRA includes marine waters west of longitude 170° W along the Aleutian chain and north to the Bering Strait, primarily east of the international date line but also including an area west of the date line south of the Gulf of Anadyr (Figure 1.1-2). The CSBSRA includes waters of the Chukchi and Beaufort seas within the U.S. EEZ (Figure 1.1-2).

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Table 2.2-1 Summary Description of AFSC Fisheries Research Conducted on NOAA Vessels and NOAA-chartered Vessels under the Status Quo Alternative

Many surveys use more than one gear type; each survey/research project is listed under one predominant gear type to avoid duplication or splitting projects into multiple components in the table. See Appendix A for descriptions of the different gear types and vessels used. Appendix B includes figures showing the spatial/temporal distribution of fishing gears used during AFSC research. Mitigation measures are described in Section 2.2.1. Units of measurement are presented in the format data was collected. Abbreviations used in the table: ABC = Acceptable Biological Catch; ADCP = Acoustic Doppler Current Profiler; ADFG = Alaska Department of Fish and Game; AI = Aleutian Islands; AWT = Aleutian Wing Trawl; CTD = Conductivity Temperature Depth; DAS = days at sea; cm^2 = square centimeter; CO_2 = carbon dioxide; EcoFOCI/EMA = Ecosystems & Fisheries-Oceanography Coordinated Investigations / Ecosystem Monitoring and Assessment Program; ESA = Endangered Species Act; freq = frequency; ft = feet; hr = hour; in = inch; kHz = kilohertz; km = kilometer; kts = knots; L = liter; m = meter; max = maximum; MHz = megahertz; mi = miles; min = minutes; mm = millimeter; NA = Not Available or Not Applicable; nm = nautical miles; PNE = Poly Nor'eastern bottom trawl; PSBT = Plumb Staff Beam Trawl; TBD = to be determined; yr = year; ~ = approximately.

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
GULF OF ALASKA RESEARCH AREA							
Survey Using Trawl Gear							
Acoustic Assessment of Snakehead Bank *(Survey not continued in the Preferred Alternative)*	Acoustic survey to estimate rockfish abundance. Video and still images of the species in their habitats were collected. A modified bottom trawl with a heavy footrope and mid-water doors was used aboard a chartered fishing vessel to collect rockfish in areas considered untrawlable by standard survey trawls. The seafloor was also mapped during the survey.	Gulf of Alaska - shallow bank near the continental shelf southwest of Kodiak Island	Fall, 7-31 DAS	Large chartered fishing vessel (>20 m) *Note: The size of fishing vessels used in this table follows the U.S. Coast Guard classifications.*	Bottom trawl with net sounders	Net type and size: Poly Nor'eastern bottom trawl (PNE) with rock hopper gear and fitted with a 1.25 cm (0.5 in) codend liner. 27.2 m (89.1 ft) headrope with 24.7 m (81 ft) chain fishing line attached to a 24.9 m (81.6 ft) footrope constructed of 1 cm (0.4 in) wire rope wrapped with polypropylene rope. Vertical opening = 5.8 m (19 ft). Also rigged with triple 54.9 m (180 ft) galvanized wire rope dandylines. The rollergear was constructed with 36 cm (14 in) rubber bobbins spaced 1.5 to 2.1 m (5 to 7 ft) apart. A solid string of 10 cm (4 in) rubber disks separated some of the bobbins in the center section of the roller gear. Tow speed: 3 kts Tow duration: 15 min Depth: 100-200 m Marport headrope and wing sounders, 40 kHz	6 trawls
					Fisheries echosounder system	SIMRAD EK60 echosounder frequencies: 38 and 120 kHz	Continuous during sampling
					Drop underwater camera system	The electronic components of the drop cameras are housed in a (1 m x 0.75 m x 0.5 m) cage constructed from aluminum tubing. Two machine-vision cameras spaced approximately 3 cm apart in underwater housings are connected via ethernet cables to a computer also in an underwater housing within the cage.	6 deployments with trawl
Acoustic Trawl Rockfish Study	The acoustic-trawl rockfish study was conducted to assess whether the variance of survey biomass estimates for patchily-distributed rockfish could be reduced by allocating increased trawl sampling in high-density rockfish patches (as determined in real-time from acoustic backscatter).	Yakutat area of the Gulf of Alaska	Conducted in conjunction with Pollock Summer Acoustic Trawl Survey as funding allows; samples day and night	Large chartered fishing vessel	Bottom trawl with net sounders	Net type and size: PNE, as described above Tow speed: 3 kts Tow duration: 10 min Depth: 200-450 m Marport headrope and wing sounders, 40 kHz	59 trawls
					Fisheries echosounder system	SIMRAD EK60 echosounder frequencies: 38 and 120 kHz	Continuous

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
ADFG Large-mesh Trawl Survey of Gulf of Alaska and Eastern Aleutian Islands	Bottom trawl surveys are conducted annually to estimate the abundance and condition of Tanner crab and red king crab populations. Although the trawl survey was developed primarily to assess crab resources, this effort provides additional groundfish abundance and size composition data critical for fish stock assessment. One bottom trawl tow is made in each of approximately 380 stations. Survey areas are divided into inshore and offshore stations. The size of offshore stations average approximately 62.8 km^2 and inshore stations average approximately 19.6 km^2.	Gulf of Alaska - Aleutian Islands	Summer, annually, 30-90 DAS; daytime samples only	ADFG R/V *Resolution*	Bottom trawl with net sounders	Net type: Eastern otter trawl net Net size: 12.2 m (40 ft), headrope 400-mesh Tow speed: 2.6 kts Tow duration: 10-25 min Depth:15-263 m (49-863 ft) Marport headrope and wing sounders, 40 kHz	~ 380 trawls
ADFG Small-mesh Shrimp and Forage Fish Survey *(Survey not continued in the Preferred Alternative)*	Small-mesh bottom trawl survey for shrimp and forage fish. Trawl areas of historic commercial exploitation and other areas of known shrimp habitat. Main trawl catch plus subsample of catch. Measure and count all commercially important species; fish density, species composition data and length frequencies	Gulf of Alaska - historically productive shrimp grounds in nearshore waters around Kodiak Island, Shelikof Strait, and bays along the south side of the Alaska Peninsula	Fall, annually 7-31 DAS	ADFG R/V *Resolution*	Bottom trawl	Net type: High-opening shrimp trawl Net size: 18.6 m x 18.6 m (61 ft), 3.1 cm stretch mesh Tow speed: 2 kts Tow duration: 30 min Depth: varies up to 113 m (371 ft)	150 trawls
Conservation Engineering *(see also effort conducted in the BSAIRA)*	We develop and test modifications to fishing gear and methods to reduce incidental effects on habitat and non-target fish. Development stages include: observation and analysis of fish behavior and gear performance with conventional gear, design modifications and iterative observations to confirm design functions, performance testing (bycatch reduction or reduced effect on habitat). Initial stages focus on observations with cameras and imaging sonar, while later stages use comparisons of catches under commercial fishing conditions.	Gulf of Alaska - Aleutian Islands	All seasons, annually; 7 DAS; daytime samples only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: Various commercial bottomtrawls Net size: Operating net width 18-24 m, height 4-8 m. Mesh size 8 in (forward sections) to 5.5-4 inch (aft sections). Footropes large bobbins or disks (18-24 inch diameter) with substantial (18-48 in) spacing in between Tow speed: 3-3.5 kts Tow duration: Experimental tows - 0.75-6.5 hrs; Depth: 66-154 m (217-505 ft) Marport headrope and wing sounders, 40 kHz	Variable, ranging 20-40 tows per season.
					Mid-water Trawl	Net type: Various Commercial mid-water trawls Net size: Operating net width 75-136 m, height 10-20 m, with size highly dependent on vessel power. Very large meshes (128-64 m) forward tapering gradually to 4 inch in aft sections Tow speed: 3-3.5 kts Tow duration: Experimental tows - 0.75-3 hrs; Depth: 66-154 m (217-505 ft)	Variable, ranging 20-40 tows per season.
					High frequency net imaging	DIDSON unit 31 cm x 17 cm x 14 cm, 12 MHz	With tows
					Underwater camera in housing attached to net headrope	Camera and housing - The device is 20 x 9 x 4.5 in and is a complete integrated unit with internal LED light and battery. This is typically deployed on fishing gear by clipping it to the gear.	With tows
Cooperative Acoustic Surveys in the Western Gulf of Alaska *(Survey not continued in the Preferred Alternative)*	Conduct small-scale surveys of walleye pollock in nearshore areas of the western Gulf of Alaska using a calibrated echosounder aboard commercial fishing vessels.	Gulf of Alaska - Shumagin Islands	Fall, winter, annually, 1-7 DAS	Large chartered fishing vessel	Mid-water trawl	Net type: Aleutian Wing Trawl (AWT) Net size: headrope/foot rope = 82.3 m (270 ft), vertical opening = 27.4 m (90 ft), codend liners = 1.25 cm (0.5 in) Tow speed: 3-4 kts Tow duration: 10-30 min Depth: 80-200 m (262-656 ft)	5-7 mid-water trawls

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
					Fisheries echosounder system	SIMRAD EK60 echosounder frequencies: 38 kHz	Continuous
EcoFOCI/ EMA Age-1 Walleye Pollock Assessment Survey and Ecosystem Observations in the Gulf of Alaska	This survey assesses the distribution and condition of age-1 walleye pollock immediately after the first winter; evaluates recruitment potential of emergent age-1s, a full year prior to assessment during acoustic or bottom trawl surveys. Survey determines the abundance, distribution, size structure, and survival of other key economic and ecological species in the region, and investigates the effects of climate variability on transport pathways from spawning to potential nursery locations for juveniles.	Gulf of Alaska	Winter, biennially, 7-31 DAS; samples day and night	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: PNE, as described above Tow speed: 3-5 kts Tow duration: 20 min Depth: 150-700 m Marport headrope and wing sounders, 40 kHz	50 trawls
					Bongo Net	Net type: Plankton net Net size: 20 cm and 60 cm Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	250 tows with each bongo net
					CTD	Seabird 911 plus	250 casts
EcoFOCI/ EMA Young-of-the-Year Walleye Pollock Assessment Survey and Ecosystem Observations in the Gulf of Alaska	Research is critical to understanding how environmental variability and change affects abundance, distribution, and recruitment of commercially and ecologically important juvenile fishes. Provides an assessment of abundance and condition of age-0 walleye pollock prior to the onset of the first winter. Physical and biological data are collected and ecosystem observations are made.	Gulf of Alaska	Fall, biennially, 7-31 DAS; samples day and night	Large chartered fishing vessel or NOAA ship R/V *Oscar Dyson*	Mid-water trawl	Net type: Anchovy trawl or equivalent Net size: 12 m x 12 m, 3 mm cod end liner Tow speed: 2-3 kts Tow duration: depth dependent, up to 1 hr Depth: oblique to bottom (<200 m)	50-75 trawls
					Beam Trawl	Net type: beam trawl Net size: 1m x 1m, 3- mm mesh, 4 mm cod end liner Tow speed: 1 -2 kts Tow duration: 10 min Depth: 50-200 m	50-75 trawls
					Bongo Net	Net type: Plankton net Net size: 20 cm and 60 cm Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	200 tows with each bongo net
					CTD	Seabird 911 plus	200 casts
EVOSTC Long-term Monitoring - Apex Predators	This study will evaluate the impact by humpback whales and other apex predators on forage fish populations, and will continue to monitor the seasonal trends and abundance of humpback whales. Prey selection by humpback whales will be determined through acoustic surveys, visual observation, scat analysis, and prey sampling. Chemical analysis of blubber samples (stable isotopes and fatty acid analysis) will provide a longer term perspective on whale diet and shifts in prey type. These data will be combined in a bioenergetic model to determine numbers of fish consumed by whales, with the long term goal of enhancing the age structure modeling of population with better estimates of predation mortality. This project operates under ESA section 10 directed research permit for marine mammal work.	Gulf of Alaska and Southeast Alaska	All seasons, monthly, 7-31 DAS; samples day and night	Large chartered fishing vessel, motorized skiff	Mid-water Trawl	Net type: otter trawl Net size: 6 m headrope Tow speed: 2-3 kts Tow duration: 20 min Depth: 0-150	10 trawls
					Surface Trawl	Net type: otter trawl Net size: 6 m headrope Tow speed: 2-3 kts Tow duration: 20 min Depth: surface	10 trawls
					Bongo Net	Net type: 333/500 micron bongo net Net size: 0.5 m diameter Tow speed: 2 kts Tow duration: 15 min Depth: 1-300 m	50 tows
					Tucker Trawl	Net type: Tucker Trawl 500 micron Net size: 1x1 m Tow speed: 2 kts Tow duration: 15 min Depth: 1-300 m	50 tows

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
					Gillnet with pingers	Net type: scientific gill net Net size: 10 m x 2 m Mesh size: variable Set duration: 30 min Pingers: 10 kHz, 132 dB	10 sets
					Cast Net	Net type: cast net Net size: 12 ft diameter Mesh size: 1/4 in Set duration: 1 min	100 casts
					Dip Net	Net type: pool skimmer Net size: 0.25 m diameter Mesh size: 500 micron Set duration: 30 sec	50 samples
Growth and Survival of Released Hatchery Red King Crab *(Survey not continued in the Preferred Alternative)*	Examine survival and growth of red king crab juveniles; examine the effects of density on survival and growth; determine the effects of red king crab on the ecosystem and the effect of predators.	Gulf of Alaska around Kodiak Island	Monthly in fall and winter 1-7 DAS	Chartered vessel (6-20 m), motorized skiff	Beam Trawl	Net type: Polyprylene Net size: 2 m opening Tow speed:1.5 kts Tow duration: 3-5 min Depth:15m	10 tows
Gulf of Alaska Biennial Shelf and Slope Bottom Trawl Groundfish Survey	Multi-species bottom trawl surveys are conducted to monitor trends in abundance and distribution of groundfish populations. The survey is based upon a stratified-random design and the area-swept method of estimating abundance. The crew identifies all living organisms, weighs and counts them, and takes biological samples from key groundfish species or other species of interest. The catch data is used to estimate relative abundance, and to determine ABC and TAC.	Gulf of Alaska - continental shelf and upper continental slope (out to 1000 m depth) from Islands of Four Mountains to Dixon Entrance	Summer, biennially, 225 DAS; daytime samples only	Three large chartered fishing vessels working collaboratively, 75 DAS each	Bottom trawl with net sounders	Net type: PNE, as described above Tow speed: 3 kts Tow duration: 15 min (1.4 km tow length) Depth: out to 1000 m depth	820 survey stations, 884 attempted stations
Gulf Project - Upper Trophic Level *(Survey reduced in scope and renamed the "Gulf of Alaska Assessment" under the Preferred Alternative)*	Identify and quantify major ecosystem processes for key groundfish species in Gulf of Alaska (GOA). Concentration on predatory & commercially important species. Surface trawl, oceanographic & mid-water acoustic data collected in transects running cross shelf, nearshore to offshore locations	Gulf of Alaska, Along the shelf, slope, and basin waters of the GOA from southeast Alaska to Kodiak.	Mid-July to early Oct., annually, 30-90 DAS; samples day and night	Large chartered fishing vessel	Surface trawl	Net type: Cantrawl Net size: 55 m width, 25 m depth Tow speed: 3.5 to 5 kts Tow duration: 30 min Depth: surface to 25 m depth	225 trawls
					Bongo Net	Net type: 333/500 micron bongo net Net size: 0.5 m diameter Tow speed: 2 kts Tow duration: 15 min Depth: 1-200 m	225 tows
					CTD with rosette water sampler	Tow speed: 0 kts Tow duration and depth: variable	225 casts
Pollock Summer Acoustic Trawl Survey - Gulf of Alaska *(Preferred Alternative includes additional camera gear)*	The objective of the survey is to estimate the mid-water abundance and distribution of walleye pollock in the GOA shelf. Acoustic data are collected along a series of parallel transects with a scientific echosounder. Five split-beam transducers (18, 38, 70,	Gulf of Alaska shelf/slope from approximately 50 m bottom depth out to 1000 m bottom depth between the Islands of Four Mountains and Yakutat Trough.	Summer, biennially, 60 DAS; daytime trawl sampling only but other listed work occurs at night.	NOAA ship R/V *Oscar Dyson*	Bottom trawl with net sounders	Net type: PNE, as described above Tow speed: 3 kts Tow duration:10-20 min Depth: 50-600 m Marport headrope and wing sounders, 40 kHz	20 trawls

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
	120, and 200 kHz) are mounted on the vessel. Whenever sufficient echosign is encountered, trawl sampling is conducted to identify insonified targets. Net sounders are used to position the trawl in the water column and monitor the catch taken. Physical oceanographic measurements are made throughout the cruise.				Mid-water Trawl with net sounders	Net type: AWT, as described above Tow speed: 3 kts Tow duration: 10 min-1 hr Depth: 50-600 m Simrad ITI door sensors, 40 kHz Simrad FS70 3rd wire, 200 and 333 kHz	100 trawls
					Small Mid-water Trawl	Net type: Methot or similar Tow speed: 3 kts Tow duration: up to 1 hr Depth: 50-600 m	10 tows
					Echosounder with five split-beam transducers	Frequencies: 18, 38, 70, 120, and 200 kHz	Continuous
					CTD	Seabird 911	120 casts
Pollock Winter Acoustic Trawl Survey - Shelikof Strait	The objective of the survey is to collect acoustic and trawl data to estimate mid-water abundance and distribution of walleye pollock in the region surrounding Kodiak Island. Acoustic data are collected along a series of parallel transects with a scientific echosounder. Whenever sufficient echosign is encountered, trawl sampling is conducted to identify insonified targets. Net sounders are used to position the trawl in the water column and monitor the catch taken. Physical oceanographic measurements are made throughout the cruise.	Gulf of Alaska - shelf/slope waters around Kodiak Island, including Shelikof Strait, Chirikof Island shelf break, Alitak Bay, Barnabus Trough, Chiniak Trough and Marmot Bay	Winter, spring, annually, 7-31 DAS; samples day and night	NOAA ship R/V *Oscar Dyson*	Bottom trawl with net sounders	Net type: PNE, as described above Tow speed: 3 kts Tow duration: variable Depth: 50-300 m Marport headrope and wing sounders, 40 kHz	10 trawls
					Mid-water Trawl with net sounders	Net type: AWT, as described above Tow speed: 3 kts Tow duration: 10 min-1 hr Depth: 50-600 m Simrad ITI door sensors, 40 kHz Simrad FS70 3rd wire, 200 and 333 kHz	20 trawls
					Echosounder with five split-beam transducers	18, 38, 70, 120, and 200 kHz	Continuous
					CTD	Seabird 911	30 casts
Pollock Winter Acoustic Trawl Survey – Shumagin/Sanak Islands	The objective of the survey is to collect acoustic and trawl data to estimate mid-water abundance and distribution of walleye pollock in the Shumagin Island area. Acoustic data are collected along a series of parallel transects with a scientific echosounder. Whenever sufficient echosign is encountered, trawl sampling is conducted to identify insonified targets. Net sounders are used to position the trawl in the water column and monitor the catch taken. Physical oceanographic measurements are made throughout the cruise.	Gulf of Alaska - shelf waters surrounding the Shumagin Islands, Sanak Trough, Morzhovoi Bay, and Pavlov Bay. In alternate years, survey is expanded to include bays along the Kenai Peninsula and Prince William Sound.	Winter, annually, 7-31 DAS; samples day and night	NOAA ship R/V *Oscar Dyson*	Bottom trawl with net sounders	Net type: PNE, as described above Tow speed: 3 kts Tow duration: variable Depth: 50-300 m Marport headrope and wing sounders, 40 kHz	10 trawls
					Mid-water Trawl with net sounders	Net type: AWT Net size: as described above Tow speed: 3 kts Tow duration: 10 min-1 hr Depth: 50-600 m Simrad ITI door sensors, 40 kHz Simrad FS70 3rd wire, 200 and 333 kHz	20 trawls
					Echosounder with five split-beam transducers	18, 38, 70, 120, and 200 kHz	Continuous
					CTD	Seabird 911	30 casts

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Rockfish Habitat Studies/Reproduction of Groundfish	The research will measure how the productivity of commercially important groundfish species varies with physical and biological changes to the ecosystem. Specific research objectives include examining the productivity of federally managed fish species in a variety of habitat types; specifically focusing on rockfish in high relief rocky/boulder, high relief sponge/coral, and low relief habitats and examining interannual variability of commercially important rockfish species maturity, fecundity, and reproductive development.	Gulf of Alaska - continental shelf region between Kodiak Island and Prince William Sound	Spring, annually, 7-31 DAS; daytime sampling only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: Commercial bottom/pelagic trawl Net size: commercial trawl Tow speed: 3 kts Tow duration: 5-10 min Depth: 120-300 m Marport headrope and wing sounders, 40 kHz	4-8 tows/cruise
					Bongo Net	Net type: Bongo net Net size: 500-µm and 1000-µm Tow speed: 1-2 kts Tow duration: 5 min Depth: 5-10 m from bottom	13 tows
					Cameras	Paired video cameras housed and mounted in a metal frame. Deployment duration ~45 min Depth 45-100 m.	15 stations
Rockfish Reproduction Charters	The overarching goal of this study was to re-examine and update maturity parameters for a variety of rockfish species found within the Gulf of Alaska including Pacific ocean perch, northern rockfish, rougheye rockfish, blackspotted rockfish, and shortraker rockfish.	Gulf of Alaska, directly offshore of the port of Kodiak, AK	Winter (November-January), 10 DAS; daytime sampling only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: Commercial bottom/pelagic trawl Net size: commercial trawl Tow speed: 3 kts Tow duration: 5-45 min Depth: 80-350 m Marport headrope and wing sounders, 40 kHz	6 - 8 tows/cruise
Sablefish Maturity Study *(Survey not continued in the Preferred Alternative)*	Single survey to collect a size-range of sablefish, sample ovaries, and develop new maturity at size and maturity at length estimates. Collect samples for fecundity estimation and place archival tags for understanding movement patterns.	Gulf of Alaska	Fall, winter 15 DAS	Large chartered fishing vessel	Bottom Trawl	Net type: Bering Sea Combo 92/122 Net size: 92 ft. Headrope Tow speed: 2-3 kts Tow duration: 10-30 min Depth:100-500 m	41 tows
Southeast Alaska Coastal Monitoring (SECM)	The Southeast Alaska Coastal Monitoring (SECM) project monitors intra- and inter-annual biophysical features in the coastal marine ecosystem in relation to the distribution, abundance, feeding, bioenergetics, and migratory behavior patterns of wild and hatchery juvenile salmon and associated epipelagic ichthyofauna. Sampling is conducted to identify processes or factors that influence growth and survival of salmon in different marine habitats along seaward migration corridors and in the Gulf of Alaska.	Gulf of Alaska, Inland Southeastern Alaska (Icy Strait, Clarence Strait)	Summer, monthly, 1-7 DAS; daytime sampling only	Large chartered fishing vessel	Surface Trawl	Net type: Nordic 264 surface rope trawl Net size: 20 m x 20 m Tow speed: 3 kts Tow duration: 20 min Depth: 1-20 m	96 trawls per year
					Bongo Net	Net type: Bongo tandum Net size: 0.6 m each ring (mesh 505 mu and 333 mu) Tow speed: 1 kts Tow duration: 15-45 min Depth: 1-200 m	64 samples per year
Surveys Using Longline Gear							
Alaska Longline Survey *(see also effort conducted in the BSAIRA)*	The purpose of the survey is to monitor and assess the status of sablefish and other groundfish resources in Alaska. The AFSC conducts an annual longline survey to assess and monitor sablefish and other groundfish resources. Whale depredation is a common occurrence during the survey by both killer whales (Bering Sea, Aleutian Islands, Western GOA, Central GOA) and sperm whales (Central GOA, Eastern GOA). Opportunistic whale depredation studies occur during the survey which are designed to help quantify the amount of depredation that is occurring.	Gulf of Alaska, Aleutian Islands, Bering Sea Slope	Summer, fall, alternates annually between GOA and BSAI, 30-90 DAS; daytime sampling only	Large chartered fishing vessel	Longline	Mainline length: 16 km Set Depth: bottom Gangion length: 1.5 m Gangion spacing: 2 m Hook size and type: 13/0 circle # of hooks and bait: 7,200 hooks baited with squid Soak time: 3 hrs	75 stations

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Barotrauma and Tagging of Deep-water Rockfish	Short sets of longline gear (<300 hooks) are set in southeast Alaska to sample deep-water rockfish. Fish are tagged and immediately placed into pressurized tanks. Rockfish are also tagged and released ~200 ft, in the water column, but not on-bottom using weighted gear. In subsequent years there will be more efforts to tag and recapture tagged rockfish using the longline gear. Fish may also be fitted with acoustic tags.	Inland Southeastern Alaska	Summer, fall, spring, annually, 1-7 DAS; daytime sampling only	Large chartered fishing vessel, smaller boats	Longline	Mainline length: 600 m Set Depth: 200 m Gangion length: 0.5 m Gangion spacing: 10 m Hook size and type: 13/0 circle # of hooks and bait: <300 hooks Soak time: 2 hrs	7 sets
Surveys Using Seine or Gillnet Gear							
Juvenile Cod Survey *(Survey not continued in the Preferred Alternative)*	Multiyear seasonal survey to examine annual abundance, growth and mortality in age-0 Pacific cod (*Gadus macrocephalus*) to both forecast recruitment as and understand pre-settlement survival and/or delivery to nearshore nurseries	Gulf of Alaska - Along the coast of Kodiak, AK	Summer, biennially	Motorized skiff	Beach Seine	Net type: Seine Net size: 25 m Mesh size: 8 mm Set duration: 15 min	16 sites - Each site sampled a total of 4 times (twice in July, and twice in August)
Little Port Walter Research Station and Experimental Hatchery	Survey methods include a weir at Sashin Creek, fish aggregation device in the inner bay, fish culture and hatchery facilities, boat surveys and sampling, and freshwater sampling.	Inland Southeastern Alaska	All seasons; continual operation day and night	Large chartered fishing vessel, smaller boats	Gillnet with pingers	Net type: Monofilament Net size: 150 ft length x 15 ft depth Mesh size: 8 in stretch Set duration: used intermittently June-August, 2-4 hrs per set Pingers: 10 kHz, 132 dB	50 sets
					Beach Seine	Net type: Nylon Net size: 150 ft length x 30 ft depth Mesh size: 1in Set duration: Used intermittently July-August, 30 min per set	50 sets
					Cast Net	Net type: Monofilament Net size: 12 ft diameter Mesh size: 1/2 in Set duration: used intermittently May-September, 2 min per set	50 sets
					Hoop Net	Net type: Monofilament Net size: 150 ft length x 15 ft depth Mesh size: 8 in stretch Set duration: used intermittently June-August, 2-4 hrs per set	20 sets
					Fyke Net	Net type: Nylon Net size: 40 ft length Mesh size: ½ in Set duration: Used intermittently in fresh water only April-June, 4 hrs per set	20 sets
					Net Pen	Net type: Nylon Net size: 20 ft length x 20 ft width x 20 ft depth Mesh size: 3/8 in Set duration: Year round	1 set
					Dip Net	Net type: Cotton Net size: 12 in length x 8 in width x 12 in depth Mesh size: ¼ in Set duration: Used intermittently Year round, 30 sec per set	>100 sets

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
TSMRI Outreach *(Survey not continued in the Preferred Alternative)*	Scientists at TSMRI engage in outreach activities that include hands on activities involving marine science. Marine organisms are sometimes collected by NOAA scientists for outreach field activities. Hands-on activities include beach seining, zooplankton	Gulf of Alaska, Chukchi Sea, Beaufort Sea, Inland Southeastern Alaska	All seasons	Large chartered fishing vessel, smaller boats, travel on land	Beach Seine	Net type: Seine Net size: 37 m x 5 m Mesh size: 3.2 mm Set duration: 10 min round haul	2 sets
					Dip Net	Net size: 0.5 m Mesh size: 505 micron Set duration: 5 seconds	4 samples
					Cast Net	Net size: 12 ft Mesh size: 0.5 in Set duration:	2 casts
					Pole Seine	Net size: 10 m Mesh size: 0.25 in Set duration: >5 min	4 sets
Projects Using Other Gears							
Acoustic Research and Mapping to Characterize EFH (FISHPAC) *(see also effort conducted in the BSAIRA and CSBSRA)*	This study collects acoustic and other environmental data in trawl survey areas to develop numerical habitat models for groundfish and shellfish. Bathymetric data are also collected for nautical chart updates.	Gulf of Alaska	Summer, triennially (rotate among three research areas), 21-25 DAS; samples day and night	NOAA ship R/V *Fairweather*	Scientific Single Beam and Multibeam Echosounders; Side-scan Sonar	Frequencies used: Single beam echosounder (38 kHz); multi-beam echosounders (50, 100 kHz); Side-scan sonar (180, 455 kHz)	Continuous
					SEABOSS bottom sampler	0.1 m^2 van Veen grap in frame with ~ 1 m^2 footprint; weight 295 kg; usually 2 grabs per station; depths <200 m	50 stations
					TACOS: 2-part towed camera system	0.8 m^2 combined footprint; 285 kg; usually 1 300-500 m tow per station; depths <200 m	20 stations
					Free-Fall Cone Penetrometer	Dropped from stationary or underway vessel to seafloor with < 3 m penetration. Cross-sectional area = 0.004 m^2; weight in air 49.7 kg.	92 stations
A Miniaturized Acoustic Transponder for Red King Crab *(Survey not continued in the Preferred Alternative)*	Build and deploy prototype transponders and test their functionality at sea on red king crab in a realistic study scenario; tracked with WASSP multi-beam echo-sounder; deploy additional transponders on a fishing line to assess the range capability of the entire system (transponder and multi-beam echo-sounder) in deeper water (190 m).	Kodiak, Is., Womens Bay	Summer, one time, 1-7 DAS	Skiff	WASSP multibeam sounder	Freq: 160 kHz 3 king crabs fitted with transponders were tracked for 3 days	3
Auke Bay Lab Dive Checkouts/Facilities Dives	ABL staff perform proficiency dives to keep diver's certification active, and to inspect and maintain the site's saltwater intakes.	Gulf of Alaska - Small dock in Auke Bay, Southeast Alaska	All seasons, monthly; daytime dives only	None	Diving	SCUBA / snorkeling	12
Alaska Sea Week Program	Auke Bay Laboratories (ABL) has been involved in Sea Week activities from the very beginning. Annually we provide interpretive programs for approximately 1,200 students, teachers and parents during the months of April and May.	Inland Southeastern Alaska	Spring, annually; daytime sampling only	None	Dip Net	Net size: 0.5 m Mesh size: 505 micron Set duration: 5 seconds	4 samples
					Ring Net	Net size: 0.5 m diameter Mesh size: 333 micron	4 casts

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Auke Creek Weir and Research Hatchery	Study involves installing a 2-way weir at Auke Creek and annually operate the weir. All fish migrating to and from Auke Lake are captured and monitored. Hatchery operations include the retention of a limited number of adult salmon, the collection of gametes, incubation of eggs, and short-term rearing of fry for stocking into Auke Lake.	Inland Southeastern Alaska	All seasons, annually; continual operation day and night	None	Weir	Across mouth of Auke Creek	Continuous
Cold Water Coral Recruitment	Determine recruitment and recovery rates of the deep-water gorgonian coral *Calcigorgia spiculifera*, to help determine long-term effects of anthropogenic disturbances, such as commercial fishing, on the population dynamics of benthic habitats.	Gulf of Alaska - Kelp Bay, Southeast Alaska	Summer, biennially, 1-7 DAS; daytime sampling only	Large chartered fishing vessel	Diving (SCUBA / snorkeling)/ tags	Depth: <30 m	4
Deep Sea Coral and Sponge Distribution *(see also effort conducted in the BSAIRA)*	This project uses a combination of statistical modeling and ground-truthing to predict the distribution of coral and sponge species in the Aleutian Islands and Gulf of Alaska. The field study consists of 15-minute camera drops at randomly selected locations in the AI and GOA.	Gulf of Alaska, Aleutian Islands, Inland Southeastern Alaska	Opportunistic, spring, summer, fall, annually; intermittent, 30 DAS; daytime sampling only	Large chartered fishing vessel	Camera system	Stereo camera sled with two cameras four strobe lights contained in an aluminum frame. Designed to be drifted or towed along the seafloor at a distance of ~ 1 m off the seafloor. Tow duration is 15 min	~150 per year
Deep Water Sponge Recovery *(Survey not continued in the Preferred Alternative)*	Document moderate to long term recovery of deep-water sponges and sea whips following disturbance from fishing gear.	Gulf of Alaska - southwest of Salisbury Sound	Summer, one time, 1-7 DAS	Large chartered fishing vessel	Submersible	Delta Submersible; 3.5 kts max. speed, 50-75 m depth	16 dives
Diver Training, Maintenance, and Collection Operations	Diver checkouts/training, recovery/ replacement of sea water system intake screens, retrieval of temperature loggers, collection of live aquarium specimens for outreach displays at the TSMRI, Kodiak Lab, and other similar operations.	Gulf of Alaska	Annually as needed, 5-7 DAS; daytime diving only	Motorized and unmotorized skiffs	Diving	SCUBA/ snorkeling	As needed
EcoFOCI/EMA Larval Walleye Pollock Assessment Survey and Ecosystem Observations in the Gulf of Alaska	This study assesses the abundance, distribution, size structure, and survival of larvae of key economic and ecological species (walleye pollock, Pacific cod, arrowtooth flounder, sablefish, rockfish), and investigates the effects of climate variability on the mechanisms leading to recruitment including transport pathways from spawning to potential nursery locations.	Gulf of Alaska	Spring, biennially, 7-31 DAS; samples day and night	Large chartered fishing vessel	Bongo Net	Net type: Plankton Net size: 20 cm and 60 cm Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	150 tows (20 cm bongo net) 150 tows (60 cm bongo net)
					Multiple-Opening and Closing Net	Net type: Plankton Net size: 1 m^2 Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 60 min Depth: 0 - 1000 m	30 tows
					Neuston Net	Net type: Plankton Net size: 0.25 m^2 Tow speed: 1.5 - 2.5 kts Tow duration: 10 min Depth: surface	150 tows
					CTD	Seabird 911	150 casts
Effects of Ocean Acidification on Larval Tanner Crab *(Survey not continued in the Preferred Alternative)*	The project examines the effects of ocean acidification on Tanner crabs. We held brooding females in CO^2 acidified water and determined its effects on embryo viability, embryo development, hatching success, fecundity, and maternal health. Further, we examine the effects of ocean acidification on the health and survival of larvae.	Gulf of Alaska - Chiniak Bay, Kodiak	Spring, annually, 7-31 DAS	Chartered vessel, motorized skiff	Beam Trawl	Net type: Beam trawl Net size: 7 mm mesh, 4 mm cod end liner Tow speed: 1 - 2 kts Tow duration: 10 min Depth: 50-200 m	14 tows

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Juvenile Flatfish and Tanner Crab Habitat Studies in the Gulf of Alaska *(Survey not continued in the Preferred Alternative)*	Data gathered from field surveys is used to evaluate environmental factors mediating density and growth of age-0 flatfish and Tanner crabs in near-shore nursery areas off the eastern end of Kodiak Island, Alaska.	Gulf of Alaska - Middle, Monashka, Shakmanof, and Kalsin Bays near Kodiak Island	Summer, spring, seasonally, 7-31 DAS	Chartered vessel	Beam Trawl	Net type: Plumb Staff Beam Trawl (PSBT) Net size: 2 m Tow speed: 1 kts Tow duration: approx. 200 m Depth: <50 m	15-40 trawls
					Epi-benthic sled	Net type: sled Net size: 0.68 m^2 Tow speed: <1 kt Tow duration: 2 min Depth: <40 m	90 per year
Juvenile Sablefish Tagging	The goal of the cruise will be to tag and release juvenile sablefish with 1,000 numerical spaghetti tags and 80 surgically implanted electronic archival tags. Electronic archival tags will be programmed to continuously record temperature and depth and both numerical and electronic tags will be recovered as sablefish recruit to the commercial fishery at ages 4 and 5.	Gulf of Alaska, Inland Southeastern Alaska - St. John the Baptist Bay, Salisbury Sound	Summer, annually, 14 DAS; daytime sampling only	Chartered vessel	Hook-and-Line/ Depth sounder/ Tags	4 rod-and-reel combos, fishing 3-4 2/0 hooks per jigging rig, with 3-4 oz bank sinkers. Squid is the bait.	Sample size is about 240 rod-hrs/yr over 5 days, with between 300-1000 of the target species tagged (sablefish) and roughly an equivalent number of bycatch species that are caught and released.
Octopus Gear Trial and Maturity Study	The primary objectives of this conservation engineering project were 1) to determine the best methods and gear rigging for fishing habitat pot gear for octopus (all species), and 2) to collect octopus specimens for biological and life-history research. Catch rates of different types and materials of habitat pots were recorded, and all octopus captured were identified to species, measured, and weighed. Any incidental catch and the majority of octopus were returned to the sea. A selected subset of octopus caught was retained for maturity analyses. All octopus captured were giant Pacific octopus.	Gulf of Alaska	Spring, summer, fall, weekly, 30-90 DAS; daytime sampling only	Chartered vessel	Different types of pots deployed on a longline	Mainline length: approximately 1 km Set Depth: 60-225 m Gangion length: 1-2.5 m Gangion spacing: 10-20 m Pots and traps constructed of variety of materials (plywood, spruce, plastic) 3-4 strings of 40-45 pots, no bait Soak time: up to 3 months	Discarded Alive: 199, Sampled: 120
Seasonal Distribution and Habitat Use of Managed Fish Species in Upper Cook Inlet, Alaska	This project is part of a regional initiative supporting the NOAA Fisheries Habitat Blueprint. Nearshore fishes in upper Cook Inlet will be sampled. Beach seine and small shrimp trawl will be used near Fire Island. Habitat types sampled will be determined by ShoreZone imagery but are largely limited to soft bottoms (e.g., mudflats).	Gulf of Alaska, Cook Inlet – Fire Island	May, July, September, 1-7 DAS; daytime sampling only	Motorized skiff	Bottom Trawl	Net type: small bottom trawl Net size: 5 m x 2.5 m x 1.2 m Towspeed: 3 kts Tow duration: 5 min Depth: 8 m	3 trawls per sampling location (2) per sampling period (3) for a total of 25 trawls annually
					Beach Seine	Beach seine	5 seine hauls per sampling location (2) per sampling period (3) for a total of 25 seine hauls

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Sun to Sea Science Camp	The camp schedule included activities such as hydro acoustics to listen to whale vocalizations, beach seining, tide pool exploration, clam digging to get clams for PSP testing, Ocean Acidification experiments, boat trips to conduct oceanographic data collections.	Inland Southeastern Alaska	Summer, annually, 6 DAS; daytime sampling only	Chartered vessel	Beach Seine	Net size: 37 m x 5 m Mesh size: 3.2 mm Set duration: 10 min round haul	2 sets
					Ring Net	Net size: 0.5 m diameter Mesh size: 333 micron	4 per year
Survey and Impact Assessment for Derelict Crab Pots in the Juneau, Southeast Alaska, Dungeness Crab Fisheries *(Survey not continued in the Preferred Alternative)*	This study was a survey of Dungeness crab habitat in Southeast Alaska to estimate the abundance of derelict commercial Dungeness crab pots as well as the entrapped crabs. The impact of ghost fishing in the commercial Dungeness crab fishery in Southeast Alaska was estimated via the use of side scan sonar surveys followed by diver assisted retrievals.	Inland Southeastern Alaska	Summer, fall, annually	Large chartered fishing, smaller vessels	Side Scan Sonar Diving	A subset of crab pots were retrieved using SCUBA divers	
BERING SEA/ALEUTIAN ISLANDS RESEARCH AREA							
Surveys Using Trawl Gear							
Aleutian Islands Biennial Shelf and Slope Bottom Trawl Groundfish Survey	The AFSC conducts comprehensive bottom trawl surveys in the Aleutian Islands (AI) designed principally to monitor trends in abundance and distribution of groundfish populations. The AI Bottom Trawl Survey is a multi-species survey based upon a stratified-random design and the area-swept method of estimating abundance. The catch is processed by the scientific crew who identifies all living organisms, weighs and counts them, and takes biological samples from key groundfish species or other species of interest.	Aleutian Islands - continental shelf and upper continental slope (out to 500 m depth); from Islands of Four Mountains west to Stalemate Bank.	Summer, biennially, 30-90 DAS; daytime sampling only	Large chartered fishing vessel,	Bottom trawl with net sounders	Net type: PNE bottom trawl with roller gear Net size: 24 m head and footrope Tow speed: 3 kts Tow duration: 15 min Depth: out to 500 m Marport headrope and wing sounders, 40 kHz	420 survey stations sampled, 450 attempted stations on average
					SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous
Arctic Ecosystem Integrated Survey *(see also effort conducted in the CSBSRA)*	Objectives include surveying distribution and abundance of pelagic fish species and biological and physical oceanographic indices to evaluate the effect of climate change on the health of pelagic fish in this region. The status of juvenile salmon populations are evaluated as a secondary objective.	Northern Bering Sea, Chukchi Sea - from 60N to 72N and from nearshore (20 m depth) to near the Russia/US border	Summer, fall, annually, 50 DAS; daytime sampling only	Large chartered fishing vessel	Mid-water trawl (for acoustic targets)	Net type: Marinovich or similar net Net size: 15 m horizontal by 5 m depth Tow speed: 1 to 3 kts Tow duration: 15 to 60 min Depth: 15 m to near bottom depths	35 trawls
					Surface Trawl	Net type: Cantrawl Net size: 55 m horizontal by 25 m depth Tow speed: 3 to 5 kts Tow duration: 30 min Depth: surface to 15 m depth	75 trawls
					Bongo Net	Net type: Bongo Net size: 2 x 60 cm with 505 micron mesh nets and 2 x 20 cm 150 micron mesh nets Tow speed: 1 kts Tow duration: 10 to 20 min Depth: surface to near bottom depth	75 tows
					SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Atka Mackerel Tag Movement and Abundance in the Aleutian Islands	Atka mackerel are tagged with t-bar spaghetti tags and recovered with bottom trawls. Fish are tagged and released inside and outside of trawls exclusion zones of Steller sea lions to estimate prey abundance and movement with respect to those fisheries closures. Abundance and movement of Atka mackerel are estimated with integrated tagging models using maximum likelihoods.	Aleutian Islands	Spring, summer, biennially, 7-31 DAS; samples day and night	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: Bering Sea Combo 101/130, modified with rock hopper footrope. Net size: 101 ft headrope, 130 ft footrope Tow speed: 2-3 kts Tow duration: 10-90 min Depth: 40-250 m Marport headrope and wing sounders, 40 kHz	Varies; total of 884 tows over 10 years
Bering Arctic Subarctic Integrated Survey (BASIS)	This survey is an integral part of the EMA/FOCI partnership designed to examine early marine ecology of important groundfish, western Alaska salmon, forage fish, and oceanographic indices affecting early marine and overwinter survival of groundfish.	Bering Sea Shelf, Bering Sea Slope	Summer, fall, biennially 50 DAS; samples day and night	Large chartered fishing vessel or NOAA Vessel R/V *Oscar Dyson*	Surface Trawl	Net type: Cantrawl Net size: 55 m width, 25 m depth Tow speed: 3.5 to 5 kts Tow duration: 30 min Depth: surface to 25 m depth	110
					Bongo Net	Net type: Bongo zooplankton Net size: 505 µm and 143 µm mesh Tow speed: 1 m/sec Tow duration: depends on depth Depth: surface to 1 m off bottom	200
Bering Sea Shelf Bottom Trawl Survey	The primary objectives of this survey are to provide the following: 1) Data on the distribution, abundance, and biological condition of commercially important groundfish and crab species for the North Pacific Fishery Management Council, 2) Catch per unit effort (CPUE) and size and age composition data for the commercial fisheries of the U.S., and 3) Support for sundry studies on the biology, behavior, and dynamics of key ecosystem components.	Bering Sea Shelf - from Bristol Bay north to latitude 62°N	Spring, summer, annually, 130 DAS; daytime sampling only	Large chartered fishing vessels, two vessels operating cooperatively	Bottom trawl with net sounders	Net type: 83-112 Eastern otter trawl Net size: 83 ft headrope, 112 ft footrope Tow speed: 3 kts Tow duration: 30 min Depth: 20 to 200 m Marport headrope and wing sounders, 40 kHz	376 stations, fixed sites
					Bottom trawl fished as a mid-water trawl	Net type: 83-112 Eastern otter trawl Net size: 83 ft headrope, 112 ft footrope Tow speed: 3 kts Tow duration: 30 min Depth: 20 to 200 m	25 samples per boat
					SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous
Conservation Engineering *(see also effort conducted in the GOARA)*	See above-Gulf of Alaska	Gulf of Alaska - Aleutian Islands, Bering Sea Shelf, Bering Sea Slope	All seasons, annually, 14 DAS; daytime sampling only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: Various commercial bottom trawls Net size: Operating net width 18-24 m, height 4-8 m. Mesh size 8 in (forward sections) to 5.5 to 4 in (aft sections). Footropes large bobbins or disks (18-24 in diameter) with substantial (18-48 in) spacing in between18 m (59 ft) Tow speed: 3-3.5 kts Tow duration: Experimental tows - 0.75-6.5 hrs; Depth: 66-154 m (217-505 ft) Marport headrope and wing sounders, 40 kHz	Not systematic: Experimental tows ranges 40-90 tows per year

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
					Mid-water Trawl	Net type: Various Commercial mid-water trawls Net size: Operating net width 75-136 m, height 10-20 m, with size highly dependent on vessel power. Very large meshes (128-64 m) forward tapering gradually to 4 inch in aft sections Tow speed: 3-3.5 kts Tow duration: Experimental tows - 0.75-3 hrs; Depth: 66-154 m (217-505 ft)	See above
					High frequency net imaging	DIDSON unit 31 cm x 17 cm x 14 cm, 12 MHz	
					Net camera	Camera and housing - The device is 20 in x 9 in x 4.5 in and is a complete integrated unit with internal LED light and battery. This is typically deployed on fishing gear by clipping it to the gear.	Variable,, ranging 10-20 tows per seasons
Eastern Bering Sea Upper Continental Slope Trawl Survey Summer	The goals of the study are to locate and successfully trawl stratified random locations on a variety of slope habitats; describe the composition, spatial and depth distribution, and relative abundance of groundfish and invertebrate resources; collect biological data from a variety of commercially and ecologically important species; and to collect environmental parameters.	Eastern Bering Sea, Upper Continental Slope	Summer, biennially, 30-90 DAS; daytime sampling only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: PNE Net size: 90 ft headrope, 100 ft footrope Tow speed: 2.5 kts Tow duration: 30 min Depth: 200-1200 m Marport headrope and wing sounders, 40 kHz	200 trawls
					SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous
EcoFOCI/EMA Age-1 Walleye Pollock Assessment Survey and Ecosystem Observations in the Bering Sea	This survey assesses the distribution and condition of age-1 walleye pollock immediately after the first winter; evaluates recruitment potential of emergent age-1s, a full year prior to assessment during acoustic or bottom trawl surveys. Survey determines the abundance, distribution, size structure, and survival of other key economic and ecological species in the region, and investigates the effects of climate variability on transport pathways from spawning to potential nursery locations for juveniles.	Bering Sea Shelf, Bering Sea Slope	Winter, biennially, 7-31 DAS; samples day and night	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: PNE bottom trawl with rock hopper gear and fitted with a 1.25 cm (0.5 in) codend liner Net size: 90 ft headrope, 100 ft footrope Tow speed: between 3 and 5 kts Tow duration: 20 min Depth: Between 197 and 647 m Marport headrope and wing sounders, 40 kHz	50 bottom trawls
					Mid-water Trawl	Net type: Anchovy trawl (12m x 12m) Net size: 3 mm cod end liner Tow speed: 2-3 kts Tow duration: depth-dependent Depth: oblique to bottom (<200 m)	50 mid-water trawls
					Bongo Net	Net type: Plankton net Net size: 20 cm and 60 cm Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	50 tows with each net

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
EcoFOCI/EMA Ecosystem Observations	This research is focused on the effects of climate variability on habitat and habitat utilization by species covered under the Marine Mammal Protection Act, some of which are also endangered (e.g., bowhead whales). A secondary objective is to develop an understanding of the resident fin and shellfish communities in the arctic, in particular their early life histories and how they might be impacted by loss of sea ice. In addition, physical and biological data are collected.	Bering Sea Shelf, Bering Sea Slope	Fall, spring, seasonally, annually, 7-31 DAS; samples day and night	Large chartered fishing vessel	Bongo Net	Net type: Plankton Net size: 20 cm and 60 cm Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	75 tows with each net
					Neuston Net	Net type: Plankton Net size: .25 m^2 Tow speed: 1 - 3 kts Tow duration: 10 min Depth: surface	150 tows
EcoFOCI/EMA Young-of-the-Year Walleye Pollock Assessment Survey and Ecosystem Observations in the Bering Sea	Research is critical to understanding how environmental variability and change affects abundance, distribution, and recruitment of commercially and ecologically important juvenile fishes. Provides an assessment of abundance and condition of age-0 walleye pollock prior to the onset of the first winter. Physical and biological data are collected and ecosystem observations are made.	Bering Sea	Fall, biennially, 55 DAS; samples day and night	Large chartered fishing vessel	Mid-water Trawl	Net type: Anchovy trawl Net size: 3 mm cod end liner Tow speed: 2-3 kts Tow duration: depth dependent Depth: oblique to bottom (<200 m)	50-75 trawls
					Beam Trawl	Net type: Beam trawl Net size: 7 mm mesh, 4 mm cod end liner Tow speed: 1 - 2 kts Tow duration: 10 min Depth: 50-200 m	50-75 trawls
					Bongo Net	Net type: Plankton Net size: 20 cm and 60 cm Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0-300 m	150 tows with each net
Pollock Summer Acoustic Trawl Survey - Bering Sea *(Preferred Alternative includes additional camera gear)*	The objective of the survey is to estimate the mid-water abundance and distribution of walleye pollock in the eastern Bering Sea. Acoustic data are collected along a series of parallel transects with a scientific echosounder. Five split-beam transducers (18, 38, 70, 120, and 200 kHz) are mounted on the vessel. Whenever sufficient echosign is encountered, trawl sampling is conducted to identify insonified targets. Net sounders are used to position the trawl in the water column and monitor the catch taken. Physical oceanographic measurements are made throughout the cruise.	Eastern Bering Sea shelf/slope from the Aleutian peninsula to the U.S.-Russian Convention Line	Summer, biennially, 62 DAS; daytime sampling only	NOAA ship R/V *Oscar Dyson*	Bottom trawl with net sounders	Net type: 83-112 (without roller gear) Net size: Net mesh sizes ranged from 10.2 cm (4 in) forward and 8.9 cm (3.5 in) in the codend to .5 in. in the codend liner. Headrope and footrope lengths were 25.6 m and 34.1 m (83.9 ft and 111.9 ft), respectively, and the breastlines measured 3.4 m and 3.2 m (11.3 ft and 10.5 ft). Tow speed: 3 kts Tow duration: variable Depth: 40-200 m Marport headrope and wing sounders, 40 kHz	15 trawls
					Mid-water Trawl with net sounders	Net type: AWT, as described above Tow speed: 3 kts Tow duration: 10 min - 1 hr Depth: 40-500 m Simrad ITI door sensors, 40 kHz Simrad FS70 3rd wire, 200 and 333 kHz	100 trawls
					SIMRAD EK60 echosounder with five split-beam transducers	Freq: 18, 38, 70, 120, and 200 kHz	Continuous
					CTD	Seabird 911	115 casts

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Pollock Winter Acoustic Trawl Survey - Bogoslof Island	The objective of the survey is to estimate the mid-water abundance and distribution of walleye pollock in the Bogoslof Island region. Acoustic data are collected along a series of parallel transects with a scientific echosounder. Five split-beam transducers (18, 38, 70, 120, and 200 kHz) are mounted on the vessel. Whenever sufficient echosign is encountered, trawl sampling is conducted to identify insonified targets. Net sounders are used to position the trawl in the water column and monitor the catch taken. Physical oceanographic measurements are made throughout the cruise.	Aleutian Islands - Bogoslof Island region in the southeastern Aleutian Basin	Winter, biennially, 7-31 DAS; samples day and night	NOAA ship R/V *Oscar Dyson*	Bottom trawl with net sounders	Net type: PNE, as described above Tow speed: 3 kts Tow duration: variable Depth: 50-600 m Marport headrope and wing sounders, 40 kHz	10 trawls
					Mid-water trawl with net sounders	Net type: AWT, as described above Tow speed: 3 kts Tow duration: 10 min - 1 hr Depth: 50-600 m Simrad ITI door sensors, 40 kHz Simrad FS70 3rd wire, 200 and 333 kHz	10 trawls
					SIMRAD EK60 echosounder with five split-beam transducers	Freq: 18, 38, 70, 120, and 200 kHz	Continuous
					CTD	Seabird 911	20 casts
Yukon Delta Nearshore Surveys	Collecting juvenile salmon in delta habitats for energetics and diets.	Yukon Delta	May-August, annually, 20-24 DAS plus 75 field days for shore-based work; daytime sampling only	Small boats	Push Trawls	Mesh size: 6 mm Net size: 5 x 7 x 15 ft Tow speed: 3 kts Tow duration: 20 min Depth: 5-7 ft	50 trawls
					Pelagic Trawls	Mesh size: 6 mm Net size: 5 ft x 7 ft x 15 ft Tow speed: 3 kts Tow duration: 20 min Depth: 5-7 ft	150 trawls
					Kodiak Trawls	Mesh size: 6 mm Net size: 3 m x 4 m x 8 m Tow speed: 3 kts Tow duration: 15 min Depth: 12 ft	50 trawls
					Ring net	Mesh size: 6 mm Net size: 6 x 21 ft Depth: 30 ft	50 casts
Surveys Using Longline Gear							
Alaska Longline Survey *(see also effort conducted in the GOARA)*	See above-Gulf of Alaska	Gulf of Alaska, Aleutian Islands, Bering Sea Slope	Summer, fall, alternates annually between GOA and BSAI, 30-90 DAS; daytime sampling only	Large chartered fishing vessel	Longline	Mainline length: 16 km Set Depth: bottom Gangion length: 1.5 m Gangion spacing: 2 m Hook size and type: 13/0 circle # of hooks and bait: 7,200 hooks baited with squid Soak time: 3 hrs (haul-back takes up to 8 hrs)	75 stations

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Projects Using Other Gears							
Acoustic Research and Mapping to Characterize EFH (FISHPAC) *(see also effort conducted in the GOARA and CSBSRA)*	This study collects acoustic and other environmental data in trawl survey areas to develop numerical habitat models for groundfish and shellfish. Bathymetric data are also collected for nautical chart updates.	Aleutian Islands, Bering Sea Shelf, Northern Bering Sea	Summer, triennially (rotate among three research areas), 21-25 DAS	NOAA ship R/V *Fairweather*	Scientific Single Beam and Multibeam Echosounders; Side-scan Sonar	Frequencies used: Single beam echosounder (38 kHz); multi-beam echosounders (50, 100 kHz); Side-scan sonar (180, 455 kHz)	Continuous
					SEABOSS bottom sampler	0.1 m^2 van Veen grap in frame with ~ 1 m^2 footprint; weight 295 kg; usually 2 grabs per station; depths <200 m	50 stations
					TACOS: 2-part towed camera system	0.8 m^2 combined footprint; 285 kg; usually 1 300-500 m tow per station; depths <200 m	20 stations
					Free-Fall Cone Penetrometer	Dropped from stationary or underway vessel to seafloor with < 3 m penetration. Cross-sectional area = 0.004 m^2; weight in air 49.7 kg.	92 stations
Deep Sea Coral and Sponge Distribution *(see also effort conducted in the GOARA)*	See above-Gulf of Alaska	Gulf of Alaska, Aleutian Islands, Inland Southeastern Alaska	Spring, summer, fall, annually, intermittent, 30 DAS; daytime sampling only	Large chartered fishing vessel	Camera system	Stereo camera sled with two cameras four strobe lights contained in an Aluminum frame. Designed to be drifted or towed along the seafloor at a distance of ~ 1 m off the seafloor. Tow duration: 15 min	300 tows
EcoFOCI/EMA Larval Walleye Pollock Assessment Survey and Ecosystem Observations in the Bering Sea	This survey in the Bering Sea is a joint effort on behalf of EMA and EcoFOCI to assesses the abundance, distribution, size structure, and survival of larvae of key economic and ecological species (walleye pollock, Pacific cod, rock sole, yellowfin sole, flathead sole, arrowtooth flounder), and investigates the effects of climate variability on the mechanisms leading to recruitment including transport pathways from spawning to potential nursery locations.	Bering Sea Shelf, Bering Sea Slope	Spring, biennially, 7-31 DAS; samples day and night	Large chartered fishing vessel	Bongo Net	Net type: Plankton net Net size: 20 cm and 60 cm diameter Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	150 tows with each net
					Multiple-Opening and Closing Net	Net type: Plankton Net size: 1 m^2 Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 60 min Depth: 0 - 1000 m	30 tows
					Neuston Net	Net type: Plankton Net size: 0.25 m^2 Tow speed: 1.5 - 2.5 kts Tow duration: 10 min Depth: surface	150 tows

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
CHUKCHI SEA/BEAUFORT SEA RESEARCH AREA							
Surveys Using Trawl Gear							
Arctic Coastal Ecosystem Surveys (ACES)	Fish utilization of nearshore habitats (coastal and lagoons) and their health.	Barrow area, Beaufort and Chukchi sea coasts	Summer, 20 DAS; daytime sampling only	Small boat	Beach seine	Net size: 37 x 5 m Mesh size: 3.2 mm Set duration: 10 min round haul	50 sets
					Bottom trawl	Net type: PSBT Net size: 5 x 2.5 x 1.2 m Tow speed: 3 kts Tow duration: 30 min Depth: <20 m	24 trawls
					Mid-water trawl	Net type: Modified Maranovich Net size: 5 x 2.5 x 1.2 m Tow speed: 3 kts Tow duration: 30 min Depth: <10 m	24 per year
Arctic Ecosystem Integrated Survey *(see also effort conducted in the BSAIRA)*	See above - Bering Sea	Northern Bering Sea, Chukchi Sea from 60°N to 72°N and from nearshore (20 m depth) to near the Russia/US border	Summer, fall, annually, 50 DAS; daytime sampling only	Large chartered fishing vessel	Surface trawl also deployed as mid-water trawl	Net type: Cantrawl or similar small mid-water trawl Net size: 55 m width, 25 m depth Tow speed: 3.5 - 5 kts Tow duration: 30 min Depth: surface to 25 m	70 trawls
					Bongo net	Net type: Bongo zooplankton Net size: 505 µm and 143 µm Tow speed: 1 m/sec Tow duration: depends on depth Depth: surface to 1 m off bottom	55 tows
					SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous
Chukchi Sea Bottom Trawl Survey	The primary objective of the Chukchi Sea bottom trawl surveys is to collect baseline data to monitor the distribution, abundance, and general ecology of marine animals living on or near the seafloor to determine the effects of climate change and potential impacts from further industrialization.	Chukchi Sea	Summer; 1976, 1990, 2012, 2013, and intermittent in the future, 30 DAS; daytime sampling only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: 83-112 Eastern otter trawl Net size: 83 ft headrope, 112 ft footrope Tow speed: 3 kts Tow duration: 15 min Depth: 10 - 100 m Marport headrope and wing sounders, 40 kHz	143 trawls
					Bottom Trawl	Net type: 3 m PSBT Net size: 3 m wide Tow speed: 1.5 kts Tow duration: 3 min Depth: 10 - 100 m	40 trawls
EcoFOCI Arctic Ecosystem Observations	This research is focused on the effects of climate variability on habitat and habitat utilization by species covered under the Marine Mammal Protection Act, some of which are also endangered (e.g., bowhead whales). A secondary objective is to develop an understanding of the resident fin and shellfish communities in the arctic, in particular their early life histories and how they might be impacted by loss of sea ice. In addition, physical and biological data are collected.	Chukchi Sea	Summer, annually, 17 DAS; samples day and night	Large chartered fishing vessel	Bongo Net	Net type: Plankton Net size: 20 cm and 60 cm diameter Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	100 tows (20 cm bongo net) 100 tows (60 cm bongo net)
					Multiple-Opening and Closing Net	Net type: Plankton Net size : 1 m^2 Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	200 tows

Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Yearly Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
					Neuston Net	Net type: Plankton Net size: 0.25 m^2 Tow speed: 1 - 3 kts Tow duration: 10 min Depth: surface	100 tows
Projects Using Other Gears							
Acoustic Research and Mapping to Characterize EFH (FISHPAC) ***(see also effort conducted in the GOARA and BSAIRA)***	This study collects acoustic and other environmental data in trawl survey areas to develop numerical habitat models for groundfish and shellfish. Bathymetric data are also collected for nautical chart updates.	Chukchi Sea	Summer, triennially (rotate among three research areas), 21-25 DAS; samples day and night	NOAA ship R/V *Fairweather*	Scientific Single Beam and Multibeam echosounders; Side-scan Sonar	Frequencies used: Single beam echosounder (38 kHz); multi-beam echosounders (50, 100 kHz); Side-scan sonar (180, 455 kHz)	Continuous
					SEABOSS bottom sampler	0.1 m^2 van Veen grap in frame with ~ 1 m^2 footprint; weight 295 kg; usually 2 grabs per station; depths <200 m	50 stations
					TACOS: 2-part towed camera system	0.8 m^2 combined footprint; 285 kg; usually 1 300-500 m tow per station; depths <200 m	20 stations
					Free-Fall Cone Penetrometer	Dropped from stationary or underway vessel to seafloor with < 3 m penetration. Cross-sectional area = 0.004 m^2; weight in air 49.7 kg.	92 stations

2.2.2 Mitigation Measures for Protected Species

The Status Quo Alternative consists of the research activities described in Table 2.2-1 (see also Appendix A for an illustrated description of different gear types used and Appendix B for a summary of the spatial/temporal distribution of research efforts). The Status Quo also includes mitigation measures that were developed by the AFSC in consultation with protected species experts and are currently implemented on AFSC surveys (e.g., standard avoidance procedures and the move-on rule). Seabird mitigation measures were also developed and tested in conjunction with Washington Sea Grant. These mitigation measures apply to all research activities regardless of whether they occur on NOAA owned vessels or on charter vessels. Current contract provisions for chartered vessels require pre-cruise briefings that include directives about the implementation of mitigation measures and post-cruise briefings that include discussions of any interactions or perceived problems. The ADFG has a rigorous set of mitigation protocols it follows when conducting their research activities, including sampling efforts conducted on behalf of the AFSC. Where these ADFG procedures differ from those of the AFSC, they will be noted in the descriptions below.

The AFSC has had very few interactions with protected species over the years, which may be attributable in part to the fact that their research activities have been conducted by highly experienced researchers and fishermen using good seamanship and fishing practices to avoid hazardous situations (e.g., reconnaissance of trawl sites with sonar and visual observations to look for commercial fishing gear or underwater obstacles prior to setting the research gear). If any marine mammals had been seen during the reconnaissance period and were considered at risk of interaction with the gear, they would have been treated as a “hazard” and the sets would have been delayed or moved. The mitigation measures described below may be required under the MMPA and ESA processes for the specified research activities conducted by the AFSC. However, these mitigation measures may not be sufficient to reduce the effects of AFSC activities on marine mammals and other protected species to the level of least practicable adverse impact (see Alternative 2). The AFSC regularly reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluations of new mitigation measures include assessments of their effectiveness in reducing risk to protected species. Implementation of any such measures must also be subject to safety and practicability considerations, allow survey results to meet research objectives, and maintain consistency with previous data sets.

CFR Section 18.118 (2) (i) states that ‘Operating conditions for operational and support vessels’ requires that vessels must be st*affed with dedicated marine mammal* observers *to alert crew of the presence of walruses and polar bears, and further specified adaptive mitigation responses that must be initiated by the vessel if a walrus or polar is observed’*. In compliance with this requirement, AFSC will ensure that a designated Protected Species Observer (PSO) will be assigned for each survey cruise. The PSO will be the Chief Scientist or their designee. PSOs are trained in marine mammal and other protected species identification and trained in the AFSC Mitigation and Monitoring protocols including active avoidance, (the move-on rule), recording, and reporting. PSOs perform those duties as a dedicated marine mammal observer but the PSO’s scope of responsibilities also includes monitoring for threatened and endangered species such as short-tailed albatrosses, spectacled and Steller’s eiders, and sea turtles.

PSOs will receive formal training in species identification, mitigation procedures, and reporting requirements that are identified in the AFSC Mitigation and Monitoring Plan or that are specifically required by NMFS or USFWS. When the PSO is not on the bridge, the vessel operator will take up those essential functions to identify and avoid protected species and report any interaction to the PSO. In particular, the PSOs will alert the vessel operator and vessel crew to the presence of walruses, polar bears, and sea otters. Under those circumstances, the PSO will direct all vessel action necessary to initiate mitigation procedures such as the move-on rule. The vessel will not approach within 1 mile of any group of walruses on land or within 0.5 miles of polar bears observed on land or ice. The PSO will always use the AFSC Protected Species Interaction Form to report all marine mammal sightings and interactions including walrus, polar bear, and North Pacific right whale.

For surveys operating in the Bering, Chukchi, and Beaufort Seas, AFSC survey managers will file a polar bear/walrus interaction plan with the USFWS identifying the time, location, and type of activity that will occur during the research operation. This will also include a food and waste management plan, personnel training procedures, site at-risk locations and situations, walrus and bear observation and reporting procedures, and bear avoidance and encounter procedures.

2.2.2.1 Vessel Strikes

When research vessels are trawling or deploying other types of sampling gear (other than acoustic equipment), vessel speeds are less than five knots, a speed at which the probability of collision with large whales and other marine mammals is negligible. When transiting between sampling stations or while conducting acoustic surveys, AFSC research vessels cruise at speeds from six to 13 knots, occasionally reach speeds of 14 knots in high current areas, but average ten knots which is generally below the speed at which studies have noted reported increases of marine mammal injury or death (Laist *et al.* 2001). In addition, AFSC research vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them. There are currently no Marine Mammal Observers (MMOs) aboard the vessels dedicated to watching for marine mammals to minimize the risk of collisions, although the large NOAA vessels (e.g., R/V *Oscar Dyson*) operated by the NOAA Office of Marine and Aviation Operations include one bridge crew dedicated to watching for obstacles at all times, including marine mammals. When research vessels are operating in areas and times when many marine mammals have been seen or are likely to be present, e.g., Seguam Pass during humpback whale migration, additional crew are often brought up to the bridge to monitor for whales. In such cases vessel captains may also reduce speed to improve the chances of observing whales and avoiding them. At any time during a survey or in transit, any bridge personnel that sights protected species that may intersect with the vessel course immediately communicates their presence to the helm for appropriate course alteration or speed reduction as possible to avoid incidental collisions, particularly with large whales.

2.2.3 Mitigation Measures for Protected Species during Research with Trawl Gear

2.2.3.1 Monitoring methods

- The officer on watch, Chief Scientist (also called the Field Party Chief on some cruises) or other designated member of the scientific party, and crew standing watch on the bridge visually scan for marine mammals and ESA-listed species (protected species) prior to, during, and until all trawl operations are completed. Sea turtles have rarely been seen in marine waters off Alaska but unusually warm ocean currents may carry turtles north of their normal range. AFSC monitoring efforts are therefore more oriented to marine mammals and ESA-listed birds but if sea turtles were spotted the same avoidance protocols would apply. Some sets may be made at night or other limited visibility conditions.

2.2.3.2 Operational procedures

- “Move-On” Rule. If any marine mammals are sighted around the vessel before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear. Most research vessels engaged in trawling will have their station in view for 15 minutes or 2 nm prior to reaching the station, depending upon the sea state and weather. Many vessels will inspect the tow path before deploying the trawl gear, adding another 15 minutes of observation time and gear preparation prior to deployment. If marine mammals are observed at or near the station, the Chief Scientist and the vessel operator will determine the best strategy to avoid potential takes based on the species encountered, their numbers and behavior, their position and vector relative to the vessel, and other factors. For instance, a whale transiting through the area and heading away from the vessel may not require any move, or may require only a short move from the initial sampling site, while a pod of dolphins gathered around the vessel may require a longer move from the initial sampling site or possibly cancellation of the station if the dolphins follow the vessel. After moving on, if marine mammals are still visible from the vessel and appear to be at risk, the Chief Scientist may decide, in consultation with the vessel operator, to move again or to skip the station. In many cases, the survey design can accommodate sampling at an alternate site. In most cases, trawl gear is not deployed if marine mammals have been sighted from the ship in its approach to the station unless those animals do not appear to be in danger of interactions with the trawl, as determined by the judgment of the Chief Scientist or officer on watch. The efficacy of the "move-on" rule is limited during night time or other periods of limited visibility; although operational lighting from the vessel illuminates the water in the immediate vicinity of the vessel during gear setting and retrieval. In these cases, it is again the judgment of the Chief Scientist as based on experience and in consultation with vessel operator to exercise due diligence and to decide on appropriate course of action to avoid unintentional interactions.

- Once the trawl net is in the water, the officer on watch, Chief Scientist, or other designated scientist, and/or crew standing watch continue to monitor the waters around the vessel and maintain a lookout for marine mammals as environmental conditions allow (as noted previously, visibility can be limited for various reasons). If marine mammals are sighted before the gear is fully retrieved, the most appropriate response to avoid incidental take is determined by the professional judgment of the officer on watch, in consultation with the Chief Scientist and vessel operator as necessary. These judgments take into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (net opening, depth, and distance from the stern), the time it would take to retrieve the net, and safety considerations for changing speed or course. If marine mammals are sighted during haul-back operations, there is the potential for entanglement during retrieval of the net, especially when the trawl doors have been retrieved and the net is near the surface and no longer under tension. The risk of catching an animal may be reduced if the trawling continues and the haul-back is delayed until after the marine mammal has lost interest in the gear or left the area. The appropriate course of action to minimize the risk of incidental take of protected species is determined by the professional judgment of the officer on watch, vessel operator, and the Chief Scientist based on all situation variables, even if the choices compromise the value of the data collected at the station.
- In operations in areas of southeast Alaska deploying surface nets, several additional measures have been employed to minimize the likelihood of marine mammal encounters, including no offal discard prior to or during the trawling at a station, trawling of short duration and seldom at night, no trawling less than one kilometer from pinniped rookeries or haul outs, and deployment of porpoise deterrent acoustical pingers attached on the trawl foot or head ropes. Acoustic pingers are underwater sound emitting devices that are intended to deter the presence of marine mammals and therefore decrease the probability of entanglement or unintended capture of marine mammals (see Appendix A).

2.2.3.3 Tow duration

- Standard bottom trawl survey tow durations are 15-30 minutes or less at targeted depth, excluding deployment and retrieval time, which reduces the likelihood of attracting and incidentally taking protected species. These short tow durations decrease the opportunity for curious marine mammals to find the vessel and investigate. The resulting tow distances are typically one to two nm, depending on the survey and trawl speed. Some trawl gear, such as the FOCI midwater tows, may take one hour to retrieve.

2.2.4 Mitigation Measures for Protected Species during Research with Longline Gear

2.2.4.1 Monitoring methods

- The officer or vessel operator on watch, Chief Scientist or other designated member of the scientific party, and any crew standing watch visually monitor the area of operation for marine mammals and other protected species such as short-tailed albatross prior to and during all longline operations.

2.2.4.2 Operational procedures

- The "move-on" protocol may be implemented if protected species are present near the vessel and appear to be at risk of interactions with the longline gear; longline sets are not initiated if marine mammals are detected and represent a potential interaction with the longline gear, as determined by the professional judgment of the Chief Scientist or officer on watch. The location of the sampling station may be altered to avoid potentially adverse interactions.
- The Alaska Longline Survey uses bottom longline gear with a 16 kilometer (km) long mainline. Sets are made in the morning if no whales are present and the longline gear is allowed to soak for three hours before haul-back begins. Due to the length of the mainline and numbers of hooks involved, it takes up to eight hours to complete the haul-back. Whales have learned the sounds associated with longline operations and typically arrive on scene as the gear is being retrieved. Efforts have been made to avoid depredation by allowing the line to sink back down but such strategies have proved impractical as whales can wait in the area for days and fish caught on the line are then eaten by crabs and other marine organisms. The only practical way to minimize depredation if whales find the vessel is to continue retrieving the gear as quickly as possible. As killer whales may also follow the survey vessel between stations, the station order is altered to disrupt the survey pattern as a means to dissuade the animals from this behavior and to avoid continued interactions.
- Tori lines, which are paired streamers, are deployed with every longline set to mitigate entanglement of seabirds diving on baited hooks. The tori line gear and deployment protocols are consistent with the seabird-avoidance measures required by federal regulation in the commercial longline fleet in the Alaska groundfish fisheries. A crewman is responsible for ensuring the tori lines meet performance standards and are working properly and the Chief Scientist is present during the set to ensure protocols are being followed. Additionally, the vessel is instructed to set at a slow speed to ensure the line sinks quickly. Seven pound lead balls are attached at the end of each skate to increase the sink rate and ensure the groundline reaches the seafloor.
- AFSC longline protocols specifically prohibit chumming before or during the longline setting operations (i.e., releasing additional bait to attract target species to the gear). However, longline surveys are conducted on contracted commercial fishing catcher/processor vessels and fish are processed as the longline is retrieved. Spent bait and processing offal are discarded away from the longline gear as it is being retrieved, which often serves to attract seabirds and marine mammals away from the longline. Due to the volume of fish caught with each set and the length of time it takes to retrieve the longline (up to eight hours), the retention of spent bait and offal until the gear is completely retrieved is not possible and the attraction of birds and marine mammals to the vessel are unavoidable.

2.2.5 Mitigation Measures for Protected Species during Research with Gillnet Gear

2.2.5.1 Monitoring methods

- The monitoring procedures for gillnets are similar to those described for trawl gear.

2.2.5.2 Operational procedures

- Gillnets are not deployed if marine mammals have been sighted on arrival at the sample site. The exception is for animals that, because of their behavior, travel vector or other factors, do not appear to be at risk of interaction with the gillnet gear.
- If no marine mammals are present, the gear is set and monitored continuously during the soak. If a marine mammal is sighted during the soak and appears to be at risk of interaction with the gear, then the gear is pulled immediately.

2.2.6 Plankton Nets, Oceanographic Sampling Devices, Echosounders and other Acoustic Equipment, Video Cameras, SCUBA Divers, and Remotely Operated Vessel (ROV) Deployments

- The AFSC deploys a wide variety of gear to sample the marine environment during all of their research cruises, including but not limited to plankton nets, oceanographic sampling devices, video cameras, high-frequency active acoustics, AUVs, ROVs, and a variety of less commonly used small nets. It is not anticipated that these types of gear or equipment would interact with protected species, or are used rarely, and are therefore not subject to specific mitigation measures. However, the officer on watch and crew monitor for any unusual circumstances that may arise at a sampling site and use their professional judgment and discretion to avoid any potential risks to protected species during deployment of all research equipment.

2.2.7 Handling Procedures for Incidentally Captured Individuals

2.2.7.1 Marine Mammals

- Incidentally captured marine mammals are released from research gear and returned to the water as soon as possible with no gear or as little gear remaining on the animal as possible (see Appendix D). Animals are released without removing them from the water if possible. Data collection is conducted in such a manner as not to delay release of the animal(s) and includes species identification, sex identification (if genital region was visible), estimated length, disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal, etc.) and photographs. The Chief Scientist and crew collect as much data as possible from captured animals considering the disposition of the animal; if it is in imminent danger of drowning, it is released as quickly as possible. Immediately following an incidental capture, a set of pre-determined contacts are made to report the incident and to determine the course of action for the remainder of the survey.
- NMFS has established a formal incidental take reporting system, the Protected Species Incidental Take (PSIT) database, requiring that incidental takes of MMPA and ESA-listed species be reported within 24 hours of the occurrence. The PSIT generates automated messages to agency leadership and other relevant staff and alerts them to the event and that updated information describing the circumstances of the event have been inputted into the database. The PSIT represents not only a valuable real-time reporting and information dissemination tool, but also an archive of information that could be mined at later points in time to study why takes occur, by species, gear, etc.

- If a large whale is alive and entangled in fishing gear, the vessel should immediately call the U.S. Coast Guard (USCG) at VHF Ch. 16 and/or the appropriate Marine Mammal Health and Stranding Response Network for instruction. Entangled whales will be reported to the regional NOAA Fisheries entanglement reporting hotline (1-877-767-9425).

2.3 ALTERNATIVE 2 – PREFERRED ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH MITIGATION FOR MMPA AND ESA COMPLIANCE

The Preferred Alternative is comprised of a combination of research activities continued from the past and additional, new research surveys and projects. Several surveys and research projects described in Table 2.2-1 under the Status Quo Alternative will not be continued under the Preferred Alternative. Those surveys have been noted in Table 2.2-1 and include the following:

- Acoustic Assessment of Snakehead Bank
- ADFG Small-mesh Shrimp and Forage Fish Survey
- Cooperative Acoustic Surveys in the Western Gulf of Alaska
- Growth and Survival of Released Hatchery Red King Crab
- Gulf Project - Upper Trophic Level (reduced in scope and renamed the "Gulf of Alaska Assessment" under the Preferred Alternative)
- Sablefish Maturity Study
- Juvenile Cod Survey
- A Miniaturized Acoustic Transponder for Red King Crab
- Deep Water Sponge Recovery
- Effects of Ocean Acidification on Larval Tanner Crab
- Juvenile Flatfish and Tanner Crab Habitat Studies in the Gulf of Alaska
- Survey and Impact Assessment for Derelict Crab Pots in the Juneau, Southeast Alaska, Dungeness Crab Fisheries
- Reconnaissance Habitat Survey of Pribilof Canyon
- TSMRI Outreach

Several new surveys and research projects have been added to the Preferred Alternative that were not included in the Status Quo Alternative; these projects are summarized in Table 2.3-1. This level of research effort will be considered, along with the applicable research efforts described in Table 2.2-1, as the collective level of research activities under the Preferred Alternative. Future proposals for research funding will be compared to the scope of research described in these tables to assess whether the projects are consistent with the NEPA analysis presented in this FPEA.

Under this alternative, the AFSC would apply for authorization under the MMPA for incidental take of marine mammals during these research activities (see LOA application, Appendix C of this FPEA). NMFS OPR would consider these activities and mitigation measures and determine whether it should promulgate regulations and issue LOAs as appropriate to the AFSC. If regulations are promulgated and LOAs are issued, they would prescribe the permissible methods of taking; a suite of mitigation measures intended to reduce the risk of potentially adverse interactions with marine mammals and their habitats during the specified research activities; and require reporting that will result in increased knowledge of the species and the level of taking.

In conjunction with this alternative, AFSC is including IPHC surveys and research programs occurring within the U.S. EEZ. These surveys and research programs are described and evaluated separately in Appendix E of this FPEA.

In addition, the AFSC has engaged in ESA Section 7 consultations with the NMFS Alaska Regional Office and the USFWS for species that are listed as threatened or endangered. Biological Assessments (BAs) have been prepared for ESA-listed species under NMFS jurisdiction (see NMFS 2017a) and USFWS jurisdiction (see NMFS 2017b). These consultations resulted in the development of Biological Opinions (BiOp) (NMFS 2019 and USFWS 2018) that describe the determinations of NMFS and USFWS whether or not the primary and secondary federal actions are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of any critical habitat. The BiOps may contain incidental take statements for ESA-listed species that include reasonable and prudent measures along with implementing terms and conditions intended to minimize the number and impact of incidental takes of ESA-listed species during AFSC research activities and monitoring and reporting requirements.

Table 2.3-1 Summary Description of the AFSC Fisheries Research Considered under the Preferred Alternative

These surveys and projects are in addition to those described under the Status Quo Alternative in Table 2.2-1. Units of measurement are presented in the format data was collected. Abbreviations used in the table are the same as those in Table 2.2-1Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
GULF OF ALASKA RESEARCH AREA							
Projects Using Trawl Gear							
Gulf of Alaska Assessment	Identify & quantify major ecosystem processes for key groundfish and salmon species in Gulf of Alaska (GOA). Concentration on predatory & commercially important species.	Gulf of Alaska, along the shelf, slope, and basin waters of the GOA in southeast Alaska.	July, annually 24 DAS; samples day and night	Large chartered fishing vessel	Surface trawl	Net type: Cantrawl Net size: 55 m width, 25 m depth Tow speed: 3.5 to 5 kts Tow duration: 30 min Depth: surface to 25 m depth	80 trawls
					Bongo Net	Net type: bongo net Net size: 20 and 60 cm diameter Tow speed: 2 kts Tow duration: 15 min Depth: 1-200 m	80 tows
					CTD with rosette water sampler	Tow speed: 0 kts Tow duration and depth: variable	80 casts
Ongoing Rockfish Biological Sampling and Sampling Theory Research *(See also effort in the BSAIRA)*	Rockfish biological, movement and distributional data is still limited in Alaska. Several previous studies have investigating alternative sampling designs to improve precision of biomass estimates. Our purpose is to potentially investigate new sampling designs, improve rockfish maturity estimates, and study underwater tagging methods.	Gulf of Alaska and Aleutian Islands	Summer, spring, 7-31 DAS; daytime sampling only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: PNE, as described in Table 2.2-1 Tow speed: 3-3.5 kts Tow duration: 15-30 min Depth: 50-250 m Marport headrope and wing sounders, 40 kHz	30 trawls in GOARA
Pollock Summer Acoustic Trawl Survey - Gulf of Alaska *(includes additional camera gear from Status Quo)*	Objective as described in Table 2.2-1 New camera work: We will build a prototype and up to 9 replicate low-cost 'camera traps', to unobtrusively determine the distribution of fish in relation to the seafloor. Replicate units are essential to provide adequate target densities and spatial coverage. Stereo-camera methods would be used to quantitatively determine the distribution of fishes relative to the seafloor during acoustic surveys.	Gulf of Alaska shelf/slope from approximately 50 m bottom depth out to 1000 m bottom depth between the Islands of Four Mountains and Yakutat Trough.	Summer, biennially, 60 DAS; daytime trawl sampling only but other listed work occurs at night	Large chartered fishing vessel	Bottom trawl, mid-water trawl, small mid-water trawl, and sonars	As described in Table 2.2-1	20 bottom trawls, 100 mid-water trawls, 10 small mid-water trawls
					Camera traps	Each unit will consist of paired consumer grade still cameras and strobe lights mounted on a robust frame (crab pot) lying on the seafloor. The camera will be triggered using an infra-red detector that will fire the cameras when a fish moves into the range of the camera lens.	Up to 10 deployments

These surveys and projects are in addition to those described under the Status Quo Alternative in Table 2.2-1. Units of measurement are presented in the format data was collected. Abbreviations used in the table are the same as those in Table 2.2-1Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Using Trawl Cameras instead of Bottom Trawls to Estimate Fish Abundance in the Gulf of Alaska and Aleutian Islands *(See also effort in the BSAIRA)*	To minimize damage to the seafloor and extraction of fishes new methods need to be developed to assess fish abundance in Alaska. One potential method would be the use of cameras to determine fish abundance rather than traditional bottom trawls. This study will use cameras mounted inside bottom trawls to estimate abundance of groundfish species. A series of camera trawls will be conducted and compared to side-by-side bottom trawl catches to detect significant differences in catch rates, length and species compositions between the two.	Gulf of Alaska and Aleutian Islands	Summer, 1-7 DAS; samples day and night	Large chartered fishing vessel	Bottom trawls with and without video cameras	Net type: PNE (as previously described) Tow speed:3-3.5 kts Tow duration:15-30 min Depth:50-200 m Marport headrope and wing sounders, 40 kHz Camera and housing - The device is 20 in x 9 in x 4.5 in and is a complete integrated unit with internal LED light and battery. This is typically deployed on fishing gear by clipping it to the gear.	40 trawls total (20 replicate sites with 2 trawls per site)
Projects Using Longline Gear							
Deep Water Groundfish Surveys	This is a possible survey that will collect biological information on deep water species such as grenadiers for use in stock assessments. This is a possible survey that will take place in the future. It is likely that a random or systematic design will be used to observe deep water species with an AUV or capture them with longlines.	Gulf of Alaska, Inland Southeastern Alaska	Summer, biennially, 7-31 DAS; daytime sampling only	Large chartered fishing vessel	Bottom longline gear	Mainline length: 16 km Set Depth: bottom Gangion length: 1.5 m Gangion spacing: 2 m Hook size and type: 13/0 circle # of hooks and bait: 7,200 hooks baited with squid Soak time: 3 hrs	20 sites
Projects Using Other Gears							
Acoustic Assessment of Rockfish in Untrawlable Areas	We will generate rockfish density estimates in untrawlable (and trawlable) areas in the GOA to assess the potential impact that these estimates can have on stock assessment efforts. An acoustic-camera survey method will be used to provide abundance estimates for the dominant rockfish species in untrawlable and trawlable habitats. The survey data will be collected in both habitats throughout much of the central and western GOA.	Central and Western Gulf of Alaska	Summer, biennially, 30-90 DAS; samples day and night	Large chartered fishing vessel	SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous during sampling
					Camera system	The electronic components of the drop cameras are housed in a (1 m x 0.75 m x 0.5 m) cage constructed from aluminum tubing. Two machine-vision cameras spaced approximately 3- cm apart in underwater housings are connected via ethernet cables to a computer also in an underwater housing within the cage	Up to 100 camera drops per survey
					CTD	Tow speed: 0 Duration: 5-15 min	100 casts
Crab Studies in Kodiak Island Area	Researchers at the Kodiak Laboratory conduct small scale studies and collections in the nearshore Kodiak Archipelago to support studies and outreach on crab biology, ecology, movement, and culturing.	Central Gulf of Alaska, Kodiak Archipelago	All seasons, monthly; daytime sampling only	Skiffs or small vessel	Pot	Crab pots of various sizes constructed of rebar and webbing Bait: fish or squid Soak time: up to 3 days	25 sets
					Diving	SCUBA/Snorkeling	25 collections

These surveys and projects are in addition to those described under the Status Quo Alternative in Table 2.2-1. Units of measurement are presented in the format data was collected. Abbreviations used in the table are the same as those in Table 2.2-1Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
					Beach Seine	Net type: Seine Net size: 61 m x 5 m Mesh size: 3.2 mm Set duration: 10 min	10 sets
					Beam Trawl	Net type: Beam trawl Net size: 3 m x 15 m Mesh size: 2-7 cm Tow speed: <1 kts Tow duration: 10 min	20 sets
***Primnoa* Distribution, Recovery and Genetic Connectivity in the Gulf of Alaska**	*Primnoa* corals are an important habitat feature in the Gulf of Alaska. The purpose of this project is to map thickets of *Primnoa*, use in situ measurements to examine growth and recovery rates for the species and collect samples for genetic connectivity among north Pacific populations of *Primnoa*.	Gulf of Alaska - Offshore shelf, offshore slope	Summer, 7-31 DAS; daytime sampling only	Large chartered fishing vessel	Towed camera vehicle	Still cameras w/strobe lighting, Towing speed: 5 kts	10 transects at 4-6 sites
					Simrad EK 6060 Echosounders	38 and 120 kHz	Continuous
					CTD Profiler	Duration: 5-15 min	5-20 casts
Reproductive Ecology of Red Tree Coral	Study will involve periodic sampling of individually tagged red tree coral colonies at depths between 10 and 30 m.	Gulf of Alaska	Winter, annually, 1-7 DAS; daytime sampling only	Motorized skiff	SCUBA divers	Sampling depth: 10-30 m	1 site
Response of Fish to Drop Camera Systems	This project will describe the behavioral response of fishes to a drop camera during deployments to estimate fish density and length.	Gulf of Alaska - Offshore shelf	Summer, 1-7 DAS; samples day and night	Large chartered fishing vessel	SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous
					Camera	The electronic components of the drop cameras are housed in a (1 m x 0.75 m x 0.5 m) cage constructed from aluminum tubing. Two machine-vision cameras spaced approximately 3 cm apart in underwater housings are connected via ethernet cables to a computer also in an underwater housing within the cage.	~20 transects at 2 sites
					High frequency net imaging	DIDSON unit 31 cm x 17 cm x 14 cm, 12 MHz	~20 transects at 2 sites
St. John Baptist Bay Sablefish Ecology	This is an ecological study of juvenile sablefish in St. John Baptist Bay. The project aims to identify the unique features of the bay that support sablefish populations. Diet and prey fields will be documented, and basic oceanographic information will be collected.	Gulf of Alaska - St. John Baptist Bay, Chichagof Island, Southeast Alaska	Spring, summer, fall, seasonally, 1-7 DAS; daytime sampling only	Large chartered fishing vessel, Motorized skiff	Bongo net	Net type: Plankton Net size: 20 cm and 60 cm diameter Tow speed: 1.5 - 2.5 kts Tow duration: 10 - 30 min Depth: 0 - 300 m	~50 hauls per season (150 per year)
					Ring net	Mesh size: 6 mm Net size: 6 x 21 ft Depth: 30 ft	~50 casts per season (150 per year)

These surveys and projects are in addition to those described under the Status Quo Alternative in Table 2.2-1. Units of measurement are presented in the format data was collected. Abbreviations used in the table are the same as those in Table 2.2-1Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
BERING SEA/ALEUTIAN ISLANDS RESEARCH AREA							
Projects Using Trawl Gear							
Habitat, Blue King Crabs, and the Benthic Community: Comparisons within Space and Time	The study objectives are to define the essential fish habitat for blue king crabs; to determine the pattern of blue king crab larval dispersal and settlement in relation to the benthic habitat; to determine the distribution and habitat specific densities of all benthic life history stages of blue king crab; to examine the habitat-specific composition of the benthic assemblages; to identify blue king crab predators and understand trophic linkages; and to compare results from this study between the Pribilof Islands and St. Mathew, and with historical data.	Bering Sea Shelf - Pribilof and St. Matthew Islands	Fall, spring, seasonally, 7-31 DAS; daytime sampling only	Large chartered fishing vessel	Beam trawl	3 m PSBT Net size: 3 m wide Tow speed: 1.5 kts Tow duration: 3 min Depth: 5-40 m	200 stations (100 in each area); beam trawl or rock dredge used based on habitat data
					Rock dredge	Virginia crab style dredge fitted with a half inch nylon mesh liner Dredge size: 6 ft wide Tow: 3 kts	
Larval Supply, Juvenile Settlement, and Habitat Use by Red King Crab	This project would map both the distribution and the habitat associations of juvenile red king crabs in the Bering Sea.	Bering Sea Shelf - likely Bristol Bay and Norton Sound areas	Fall, 7-31 DAS; daytime sampling only	Large chartered fishing vessel, boat (6-20 m)	Beam trawl	3 m PSBT Net size: 3 m wide Tow speed: 1.5 kts Tow duration: 3 min Depth: 10-50 m	100-300 trawls
					Rock dredge	Dredge type: Virginia crab style dredge fitted with a half inch nylon mesh liner Dredge size: 6 ft wide Dredge size: Tow speed: 3 kts Tow duration:	~ 100 hauls
Locating Essential Spawning Grounds for Red King Crab *(additional work from Status Quo Bering Sea Shelf Bottom Trawl Survey)*	The study proposes to use pop-up satellite tags to track the gross movement of oviparous females and to locate the precise location of larval release. This, in turn, will help to identify what areas represent important spawning areas, by implication habitats, and thus help managers decide on the trawl closure areas. The gross movement of the female crabs will also help us understand movement patterns of red king crab in Bristol Bay and will provide important estimates of natural mortality rates for females during the inter-molt period. This study will take place during the Bering Sea Shelf Bottom Trawl Survey.	Bering Sea Shelf	Summer, 30-90 DAS; daytime sampling only	Large chartered fishing vessel	Specimens collected during Bering Sea Shelf Bottom Trawl Survey	Net type: 83-112 Eastern otter trawl Net size: 83 ft headrope, 112 ft footrope Tow speed: 3 kts Tow duration: 30 min Depth: 20 to 200 m	Up to 10 tows (60 crabs tagged)

These surveys and projects are in addition to those described under the Status Quo Alternative in Table 2.2-1. Units of measurement are presented in the format data was collected. Abbreviations used in the table are the same as those in Table 2.2-1Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Northern Bering Sea Bottom Trawl Survey	The AFSC RACE Division conducts the NBS (northern Bering Sea) shelf bottom trawl survey on a triennial basis The NBS has no large-scale commercial fisheries; however, climate change and the impacts of industrialization are a concern because of their potential to fundamentally alter the biological community thereby impacting fishes, crabs, marine mammals, and the subsistence fisheries of western Alaska fishing communities. The primary objective of the NBS bottom trawl surveys is to collect baseline data to monitor the distribution, abundance, and general ecology of marine animals living on or near the seafloor to determine the effects of climate change and potential impacts from further industrialization.	The NBS area is bounded by the shelf break and the U.S.-Russian Convention Line in the west, the Bering Strait in the north, and Norton Sound in the east.	Summer, biennially, 45 DAS; daytime sampling only	Large chartered fishing vessel, motorized skiff	Bottom trawl with net sounders	Net type: 83-112 Eastern otter trawl Net size: 83 ft headrope, 112 ft footrope Tow speed: 3 kts Tow duration: 30 min Depth: 20 to 200 m Marport headrope and wing sounders, 40 kHz	160 trawls
					CTD	Tow speed: 0 Duration: 5-15 min	160 samples
					Simrad ES60 echosounders	Freq: 38 kHz and 120 kHz.	Continuous
Ongoing Rockfish Biological Sampling and Sampling Theory Research *(See also effort in the GOARA)*	See description above in GOARA	Gulf of Alaska and Aleutian Islands	Summer, spring, 7-31 DAS; daytime sampling only	Large chartered fishing vessel	Bottom trawl with net sounders	Net type: PNE, as described above, and yet to be determined prototype alternate designs (of similar dimensions) Tow speed: 3-3.5 kts Tow duration: 15-30 min Depth: 50-250 m Marport headrope and wing sounders, 40 kHz	30 trawls in BSAIRA
Pollock Summer Acoustic Trawl Survey - Bering Sea *(includes additional camera gear from Status Quo)*	Objective as described in Table 2.2-1 New camera work: We will build a prototype and up to 9 replicate low-cost 'camera traps', to unobtrusively determine the distribution of fish in relation to the seafloor. Replicate units are essential to provide adequate target densities and spatial coverage. Stereo-camera methods would be used to quantitatively determine the distribution of fishes relative to the seafloor during acoustic surveys.	Eastern Bering Sea shelf/slope from the Aleutian peninsula to the U.S.-Russian Convention Line	Summer, biennially, 62 DAS; daytime sampling only	NOAA ship R/V *Oscar Dyson*	Bottom trawl, mid-water trawl, sonar gear	As described in Table 2.2-1	15 bottom trawls, 100 mid-water trawls
					Camera traps	Each unit will consist of paired consumer grade still cameras and strobe lights mounted on a robust frame (crab pot) lying on the seafloor. The camera will be triggered using an inexpensive infra-red detector that will fire the cameras when a fish moves into the range of the camera lens.	Up to 10 deployments
Using Trawl Cameras instead of Bottom Trawls to Estimate Fish Abundance in the Gulf of Alaska and Aleutian Islands *(See also effort in the GOARA)*	See description above in GOARA	Gulf of Alaska and Aleutian Islands	Summer, 1-7 DAS; samples day and night	Large chartered fishing vessel	Bottom trawls with and without video cameras	Net type: PNE (as previously described) Net size: Tow speed:3-3.5 kts Tow duration:15-30 min Depth:50-200 m Marport headrope and wing sounders, 40 kHz Camera and housing - The device is 20 in x 9 in x 4.5 in and is a complete integrated unit with internal LED light and battery. This is typically deployed on fishing gear by clipping it to the gear.	40 trawls total (20 replicate sites with 2 trawls per site)

These surveys and projects are in addition to those described under the Status Quo Alternative in Table 2.2-1. Units of measurement are presented in the format data was collected. Abbreviations used in the table are the same as those in Table 2.2-1Research Activity Name	Survey Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessel Used	Gear Used	Gear Details	Number of Samples
Projects Using Other Gear							
The Distribution and Habitat Association of Juvenile *Chionoecetes* crab	This study is a survey of suspected juvenile Tanner and snow crab habitat and distribution in Bering Sea. We would use a camera mounted on a benthic scrap to both identify the habitat and capture juveniles.	Bering Sea Shelf	Summer, fall; 2017, 2018	Large chartered fishing vessel	Bottom sled with camera	Design to be determined (see http://doc.nprb.org/web/research/research%20pubs/615_habitat_mapping_workshop/Individual%20Chapters%20High-Res/Ch7%20Rooper.pdf)	Expectation: 10-20 tows (capture up to 400 juvenile crabs)

2.3.1 Mitigation Measures for Protected Species

Under the Preferred Alternative, the AFSC would apply for authorizations under the MMPA and the ESA for incidental take of protected species while conducting the suite of research activities described above. The Preferred Alternative also includes the same suite of mitigation measures described in the Status Quo Alternative to reduce the risk of adverse interactions with protected species. The AFSC considers the current suite of monitoring and operational procedures to be necessary to avoid adverse interactions with protected species and still allow the AFSC to fulfill its scientific missions. However, some mitigation measures such as the move-on rule require judgments about the risk of gear interactions with protected species and the best procedures for minimizing that risk on a case-by-case basis. Ship captains and Chief Scientists are charged with making those judgments at sea. They are all highly experienced professionals but there may be inconsistencies across the range of research surveys conducted and funded by the AFSC in how those judgments are made. In addition, some of the mitigation measures described in the Status Quo Alternative could also be considered "best practices" for safe seamanship and avoidance of hazards during fishing (e.g., prior surveillance of a sample site before setting trawl gear). At least for some of the research activities considered in this FPEA, explicit links between the implementation of these best practices and their usefulness as mitigation measures for avoidance of protected species may not have been formalized and clearly communicated with all scientific parties and vessel operators. The AFSC therefore proposes a series of improvements to its protected species training, awareness, and reporting procedures under the Preferred Alternative. The AFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described under the Status Quo Alternative.

- Under the Preferred Alternative, the AFSC will initiate a process for its Chief Scientists and vessel captains to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. As noted in the Status Quo Alternative description of mitigation measures, there are many situations where professional judgment is used to decide the best course of action for avoiding marine mammal interactions before and during the time research gear is in the water. The intent of this mitigation measure would be to draw on the collective experience of people who have been making those decisions, provide a forum for the exchange of information about what went right and what went wrong, and try to determine if there are any rules-of-thumb or key factors to consider that would help in future decisions regarding avoidance practices. The AFSC would coordinate not only among its staff and vessel captains but also with those from other fisheries science centers, the Alaska Regional Office, and other institutions with similar experience.
- Another new element of the Preferred Alternative is the proposed development of a formalized protected species training program for all crew members that may be posted on monitoring duty or handle incidentally caught protected species that would be required for all AFSC research projects. Training programs would be conducted on a regular basis and would include topics such as monitoring and sighting protocols, species identification, decision-making factors for avoiding take, procedures for handling and documenting protected species caught in research gear, and reporting requirements. The AFSC will work with the North Pacific Fisheries Groundfish and Halibut Observer Program (Observer Program) to customize a new protected species training program for researchers and ship crew. The Observer Program currently provides protected species training (and other types of training) for NMFS-certified observers placed on board commercial fishing vessels. AFSC Chief Scientists and appropriate members of AFSC research crews will be trained using streamlined protocols and training for protected species developed in collaboration with the Observer Program and implemented through AFSC's Fishery Monitoring and Analysis Division. All AFSC research crew members that may be assigned to monitor for the presence of marine mammals during future surveys will be required to attend an initial training

course and refresher courses annually or as necessary. The implementation of this training program would formalize and standardize the information provided to all research crew that might be involved with protected species interactions during research activities.

- For all AFSC research projects and vessels, written cruise instructions and protocols for avoiding adverse interactions with protected species will be reviewed and, if found insufficient, made fully consistent with the training materials and any guidance on decision-making that arises out of the two training opportunities described above. In addition, the AFSC Mitigation and Monitoring Manual (Appendix D) will be reviewed and updated as necessary for consistency and accuracy. All AFSC research cruises already include pre-sail review of protected species protocols for affected crew but the AFSC will review its briefing instructions for consistency and accuracy.
- The AFSC will incorporate specific language into its contracts that specifies all training requirements, operating procedures, and reporting requirements for protected species that will be required for all charter vessels and cooperating partners.
- Following the first year of implementation of the LOA, the AFSC will convene a workshop with the Alaska Regional Office Protected Resources, AFSC fishery scientists, NOAA research vessel personnel, and other NMFS staff as appropriate to review data collection, marine mammal interactions, and refine data collection and mitigation protocols, as required.

Final mitigation measures were determined through consultation with USFWS and NMFS as described in the consultation documents, the Biological Opinions (NMFS 2019 and USFWS 2018) and summarized in Chapter 6. The AFSC and the IPHC will implement avoidance and minimization measures, specified by vessel and gear type, during research activities as described in the USFWS Biological Opinion on the Effects of Groundfish research Surveys by the AFSC in Alaska (USFWS 2018) and the NMFS AFSC Biological Opinion (2019).

2.3.1.1 Consistency with Mitigation and Monitoring Requirements for Other Projects

In order to maintain consistency with mitigation and monitoring requirements for other projects in Alaska, USFWS requested that AFSC will implement the same measures proposed and agreed to by the NMFS Northwest Fisheries Science Center (NWFSC) (NMFS 2017d). The protocol for the NWFSC requires the following:

- The vessel captain and bridge crew monitor for marine mammals during transit and, on surface trawl surveys, are joined by designated members of the scientific party assigned to watch for marine mammals as part of the pre-set responsibilities.
- When crew are assigned to monitor for marine mammals, they are dedicated to that task (i.e., they do not have any other duties while monitoring).
- As the vessel approaches the station, the captain and at least one assigned science crew monitor for marine mammals.
- During mid-water and bottom trawl surveys, the Chief Scientist must confirm with the captain or the bridge that no marine mammals have been seen within 500 meters of the ship or appear to be approaching the ship during a 10-minute period prior to the deployment of any trawl gear. Thus, the monitoring period for marine mammals begins before the vessel arrives on station and extends continuously through gear deployment, typically for over 30 minutes on all trawl types.
- During surface trawls, monitoring all around the ship continues until the trawl retrieval begins, at which point the focus is on the stern and the trawl itself.

- During mid-water and bottom trawls, once the trawl doors are deployed the net sinks to the intended depth and continued monitoring of animals at the surface would not be helpful in assessing marine mammal activity at the depth of the net. There have been no NWFSC historical interactions of marine mammals when using bottom trawls and only one interaction when using the Modified Cobb mid-water trawl. The risk of interactions with these gears once the trawl doors are deployed appears to be low and monitoring efforts are reduced to the bridge crew while scientific crew attend to other duties.
- In the case of surveys conducted aboard smaller research or chartered fishing vessels, the number of individuals and the amount of their time that may be devoted to serving as marine mammal observers may be limited. Under these circumstances more reliance may be placed on the captain and/or Chief Scientist to maintain a watch.

To address the USFWS concerns, AFSC has modified protocols and clarified the roles of the Chief Scientist and vessel operator in order to conform to the Code of Federal Regulations (CFR) Section 18.118 and the requirements to monitor and mitigate potential effects of AFSC research activities on marine mammals and other protected species.

CFR Section 18.118 (2) (i) states that, *"Operating conditions for operational and support vessels' requires that vessels must be staffed with dedicated marine mammal observers to alert crew of the presence of walruses and polar bears, and further specified adaptive mitigation responses that must be initiated by the vessel if a walrus or polar is observed."* In compliance with this requirement, AFSC will ensure that a designated Protected Species Observer (PSO) will be assigned for each survey cruise. The PSO will be the Chief Scientist or their designee. PSOs are trained in marine mammal and other protected species identification and trained in the AFSC Mitigation and Monitoring protocols, including active avoidance (the move-on rule), recording, and reporting. PSOs perform those duties as a dedicated marine mammal observer but the PSO's scope of responsibilities also includes monitoring for threatened and endangered species such as short-tailed albatrosses, spectacled and Steller's eiders, and sea turtles.

PSOs will receive formal training in species identification, mitigation procedures, and reporting requirements that are identified in the AFSC Mitigation and Monitoring Plan or that are specifically required by NMFS or USFWS. When the PSO is not on the bridge, the vessel operator will take up those essential functions to identify and avoid protected species and report any interaction to the PSO. In particular, the PSOs will alert the vessel operator and vessel crew to the presence of walruses, polar bears, and sea otters. Under those circumstances, the PSO will direct all vessel action necessary to initiate mitigation procedures such as the move-on rule. The vessel will not approach within 1 mile of any group of walruses on land or within 0.5 miles of polar bears observed on land or ice. The PSO will always use the AFSC Protected Species Interaction Form to report all marine mammal sightings and interactions including those involving walrus, polar bear, and North Pacific right whale.

For surveys operating in the Bering, Chukchi, and Beaufort Seas, AFSC survey managers will file a polar bear/walrus interaction plan with the USFWS identifying the time, location, and type of activity that will occur during the research operation. This will also include a food and waste management plan, personnel training procedures, site at-risk locations and situations, walrus and bear observation and reporting procedures, and bear avoidance and encounter procedures.

2.3.1.2 Handling Procedures for Protected Species

Another difference between the Status Quo and the Preferred Alternative involves handling and data collection procedures for incidentally captured marine mammals. Certain types of data are needed to evaluate the severity of marine mammal injuries, which has implications for marine mammal stock assessments and classification of takes for MMPA and ESA compliance purposes. The Chief Scientist or other designated scientists will receive training on the types of information needed to make injury determinations through the protocols and training described above. If the safety of the crew and captured animal will not be compromised, the scientific party or trained crew will attempt to collect biological information from captured, live marine mammals before they are released, including species identification, sex identification (if genital region is visible), estimated length, and photographs. This information will be recorded on standardized forms developed for the purpose (Appendix D). If the safety of the crew or the captured animal would be compromised by this data collection effort, the animal will be immediately released. In addition to gathering data on incidentally caught animals, the Chief Scientist or trained crew would be required to remove as much gear as possible from an animal before release. Gear remaining on an animal has the potential to cause future entanglements and generally increases the chances that an injury will be serious. Human safety is paramount when considering whether and how to disentangle or dehook a marine mammal.

The Chief Scientist will submit data on all captured animals to marine mammal experts at the MML who will use specific criteria to determine whether the injury is considered serious (i.e., more likely than not to result in mortality). If insufficient data has been collected for any reason, the marine mammal experts may not be able to determine the severity of the injury. However, the marine mammal experts may use other types of information to assign the injury to either the serious or non-serious categories.

2.3.2 Unknown Future AFSC Research Activities

In addition to the activities identified above, the AFSC may propose additional surveys or research activities within the timeframe covered by this programmatic analysis. Because of the annual cycle under which decisions to fund and/or conduct research are made, the AFSC cannot identify in advance all the potential fisheries and ecosystem research activities that may take place in the future. For purposes of this programmatic analysis, NMFS has examined the research activities as it was conducted in the recent past (2008 – 2015 for the purposes of this FPEA), as well as known, planned future research, and used this information as a proxy for unknown, future research activities. Taken together, these activities comprise the actions evaluated within this FPEA under the Preferred Alternative.

In the future, as future congressional appropriations and NMFS fisheries research budgets are established, the AFSC will evaluate the proposed future research to determine if the activities are within the scope of actions considered under the Preferred Alternative. To be considered ‘within scope’ under this FPEA, future proposals for specific research projects must be consistent with the gear types, spatial/temporal distribution of research activities, and types of effects analyzed within this document. If a research activity is determined to be within the scope of research activities evaluated in this PEA, then no further NEPA analysis would be required. Scientific Research Permits would explain that the type of research being authorized has been reviewed under this PEA. If future research projects are not consistent with the type or scope of fisheries research activities analyzed in this FPEA, they will be subject to additional NEPA, ESA, and MMPA evaluations.

More specifically, the basic methodology used to evaluate any proposed future research activity will be as follows:

1. **Evaluate the activity to determine if it would be conducted within the geographic scope of the region evaluated in the FPEA.** The evaluation described in Chapter 4 of this FPEA is based on the historic spatial distribution of research surveys. Any future research activities proposed within the geographic areas described in Chapter 4 would pass this step of the evaluation. Any proposed research in those areas may require additional evaluation.
2. **Evaluate the seasonal distribution of the activity.** The activities evaluated in this FPEA are conducted throughout the year but certain surveys are only conducted in specific time frames/seasons. If a program was proposed that was similar in methodology to past surveys but

significantly shifted the timing of research activities from what was analyzed in this FPEA, additional evaluation may be required.

3. **Evaluate the gear types proposed.** The gear types that were included in the analysis are described in Appendix A. If the proposed future research activity used the same or similar gear in the same manner analyzed in this FPEA, then the research activity would fall within the analysis conducted. The research activity would not have to exactly match the descriptions in this FPEA, because the same impacts would be expected from similar gear types and activities. For example, if a new side-scan sonar were to be deployed, but the signal strength and frequency were within the ranges evaluated for bottom sounding sonar evaluated in this FPEA, then the impacts would be similar because only the area swept by the sonar would be changing. If a new type of gear was to be deployed, or if a gear type was to be used in substantially different ways than described, environmental impacts not considered in this FPEA could result and additional NEPA analysis would be required.
4. **Evaluate the status of the resources that may be affected by the research.** The FPEA uses an average level of catch and bycatch as well as the frequency and nature of past interactions with various protected species to determine the impacts of research on marine resources. The FPEA considers the effects of past research on living marine resources based on their current or recent status in regard to population level or conservation concern. However, the status of those resources, e.g., fish stocks, varies over time and by fishery management region. If a future project proposes to conduct research on a fish or invertebrate stock that is overfished or depleted at the time, or if it would occur in areas and with gear that would likely result in substantial bycatch of overfished stocks, the potential effects of the proposed research project could be much greater than estimated in the FPEA and additional NEPA analysis would be required.

To reiterate, any proposed action 1) conducted in regional areas described in this FPEA, 2) during times of the year considered, 3) using gear types and methods generally equivalent to the methods evaluated, and 4) being directed at fish or invertebrate stocks that would not be affected substantially by the research, would be considered covered by the conclusions drawn in this FPEA. If future proposed research activities, projects, or programs are not consistent with the type or scope of fisheries research activities analyzed in this FPEA, they would be subject to additional NEPA evaluations.

If new information or new circumstances arise that are relevant to environmental concerns and bear on the proposed action or its impacts as analyzed in this FPEA, then the AFSC will prepare a supplement to this FPEA (40 CFR 1502.9(c)(1)). If the AFSC makes substantial changes to the proposed action, which in this case would mean substantial changes in the research activities it conducts, then the AFSC may either supplement this FPEA (40 CFR 1502.9(c)(1)) or prepare a separate NEPA analysis to evaluate the new research activities.

2.4 ALTERNATIVE 3 – MODIFIED RESEARCH ALTERNATIVE - CONDUCT FEDERAL FISHERIES AND ECOSYSTEM RESEARCH (NEW SUITE OF RESEARCH) WITH ADDITIONAL MITIGATION

Under Alternative 3, the AFSC would continue fisheries research as described in Section 2.3 and Appendix A and would apply for authorizations of incidental take of protected species under the MMPA and the ESA. Alternative 3 would include all of the same mitigation measures required by the MMPA and ESA authorization procedures as described for the Preferred Alternative. The difference between Alternative 3 and the Preferred Alternative is that Alternative 3 includes a number of additional mitigation measures derived from a variety of sources including: (1) comments submitted from the public on similar fisheries actions, (2) discussions within NMFS as a part of the proposed rulemaking process, and (3) a literature review of past and current research into potential mitigation measures. This Alternative is not considered as an "all or nothing" proposition; one or more of the additional mitigation measures may be considered for implementation during the MMPA and ESA consultation processes.

The AFSC regularly reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its ongoing survey programs. Evaluating new mitigation measures includes assessing their effectiveness in reducing risk to protected species, but measures must also: pass safety and practicability considerations, meet survey objectives, allow survey results to remain consistent with previous data sets, and be consistent with the purpose and need for AFSC research activities (Section 1.3). Some of the mitigation measures considered in this alternative (e.g., no night fishing or broad spatial/temporal restrictions) would essentially prevent the AFSC from collecting data required to provide for fisheries management purposes under the MSA. Some research surveys necessarily target fish species that are preyed upon by marine mammals with an inherent risk of interactions with marine mammals during these surveys. The AFSC acknowledges the inherent risk of these surveys and it has implemented a variety of measures to mitigate that risk. The AFSC currently has no viable alternatives to collecting the data derived from these surveys and does not propose to implement potential mitigation measures that would preclude continuation of these surveys, such as the elimination of night surveys or use of pelagic trawl gear. An analysis of the potential efficacy and practicability of the additional mitigation measures considered in this alternative is presented in Section 4.4.

The secondary federal action covered under this FPEA is the issuance of requested regulations and subsequent LOA under Section 101(a)(5)(A) of the MMPA that would govern the unintentional taking of small numbers of marine mammals incidental to the AFSC's research activities. In order to authorize incidental take of marine mammals under the MMPA, NMFS must identify and evaluate a reasonable range of mitigation measures to minimize impacts to marine mammals to the level of "least practicable adverse impact". As described above, some mitigation measures could prevent the AFSC from maintaining the utility of ongoing scientific research efforts, and those mitigation measures would normally be excluded from consideration in the FPEA under screening criteria 3 (Section 2.1). However, such mitigation measures would likely be considered during the MMPA ITA process and/or ESA Section 7 consultation and are therefore considered under Alternative 3 in this FPEA.

2.4.1 Additional Mitigation Measures for Protected Species

2.4.1.1 Monitoring methods

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

- Visual surveillance by dedicated PSOs. This measure would require the AFSC to use trained PSOs whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel to implement mitigation measures and appropriate modifications of research operations. This dedicated observer position would be different than having marine mammal and/or bird biologists on board whose job is to conduct abundance and distribution surveys (as is sometimes the practice on some surveys when bunk space is available). Considerations include the use of dedicated observers for all surveys or during surveys of particular concern.
- Use of a camera or underwater video system to monitor any interactions of protected species with trawl gear. Underwater video technology may allow the AFSC to determine the frequency of interactions with the trawl gear and to evaluate the effectiveness of a measure’s ability to mitigate injurious or lethal interactions.
- Use of passive acoustic monitoring for marine mammal vocalizations to aid in the detection of marine mammals present in the survey area and to implement appropriate modifications of research operations.
- Use of aircraft, unmanned aerial vehicles, or autonomous underwater gliders to provide additional detection capabilities.
- Use of infrared (IR) technologies to detect marine mammals.
- Use of night-vision devices to detect marine mammals.

2.4.1.2 Operational restrictions

- This measure would alter the move-on rule by requiring the AFSC to implement a minimum 30 minute monitoring period before any research trawl gear is put in the water. Assigned personnel would be dedicated to the role of protected species observer and would visually scan around the vessel as far as environmental conditions allow. If any marine mammals are seen over the 30 minute period, the gear would not be deployed. If the marine mammals leave the area or dive and are not seen again, a new 30 minute monitoring period would be conducted under the same protocols. Alternatively, the Chief Scientist may decide to abandon the station and move to the next sampling station to avoid potential marine mammal interactions.
- This measure would require the AFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with marine mammals that would be difficult to detect by visual monitoring.
- Decoy vessels for longline projects. This measure would require use of a decoy research vessel or remotely operated buoy system playing pre-recorded longline fishing sounds to distract marine mammals away from active longline operations.

2.4.1.3 Acoustic and visual deterrents

- This measure would require the AFSC to use deterrents on gear that does not already include such deterrents, such as acoustic pingers or such as recordings of predator vocalizations (e.g., killer whale) to deter interactions with trawl gear, or use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal interactions with the gear.

2.4.1.4 Gear modifications

- This measure would require the AFSC to use marine mammal excluder devices on all of its trawl nets or on a subset of those gears considered to have a high risk of marine mammal interactions. There are excluder devices currently used in commercial trawl fisheries that may be adaptable to trawl nets used for research. The AFSC would need to examine the alternatives for excluder devices for each type of net that would be deployed in areas and seasons where marine mammals could be at risk of capture and conduct analyses as to their compatibility with research objectives. Under this alternative, the AFSC would integrate any such devices into their research trawl nets that prove practicable.
- Video sampling with an open cod end: Under the Preferred Alternative, the AFSC is planning to investigate the use of video cameras to identify fish and their encounter rates in lieu of a closed cod end on trawl surveys, which may take marine mammals as well as target fish. This approach could be appropriate for swept area surveys designed to determine the density of fish or verification of acoustic target identification. However, it would not be appropriate for surveys designed to determine the reproductive condition of adult fish or the growth rates of fish as these measurements require the dissection of specimens. Considerable insight and experience may be gained by experimenting with open cod end trawls and associated high-resolution, high-speed video cameras, particularly with real-time video feeds to the ship. In some cases this experience could lead to routine use of cameras instead of capture. In other situations the number of closed cod end trawls required for estimating vital rates could be reduced. While it would not be the primary objective, video camera data may also provide documentation of marine mammal interactions with trawl gear and may thus provide insight into the efficacy of other measures intended to reduce the interactions with marine mammals (e.g., excluder devices).

2.4.1.5 Temporal or geographic restrictions

- Spatial/temporal restrictions are one of the most direct means of reducing adverse impacts to protected species. By reducing the overlap in time and space of the survey's footprint with known concentrations of protected species, the AFSC may reduce the amount of incidental take of such species. This measure would require the AFSC to identify areas and times that are most likely to result in adverse interactions with protected species (e.g., areas of peak abundance) and to avoid, postpone, or limit their research activity to minimize the risk of such interactions with protected species as long as such spatial/temporal restrictions do not conflict with the ability of the AFSC to conduct scientifically valid surveys and to provide the best scientific information available for purposes of managing commercial fisheries. This may include limits on specific locations, physical or oceanographic features, biologically important times, and/or gear types.
- Avoidance of federal and state MPAs. This measure would disallow or restrict AFSC trawl surveys in federal and/or state MPAs (Section 3.1.2.4).

2.5 ALTERNATIVE 4 – NO RESEARCH ALTERNATIVE - NO FIELD RESEARCH CONDUCTED OR FUNDED BY AFSC

Under the No Research Alternative the AFSC would no longer conduct or fund fisheries research involving fieldwork in marine waters of the GOARA, BSAIRA, or CSBSRA. This moratorium on fieldwork would not extend to research that is not in scope of this FPEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (e.g., harvest data) and state or privately supported fishery-independent data collection surveys or programs to fulfill its responsibility to manage, conserve and protect living marine resources in the U.S. Any non-federal fisheries research would occur without NMFS funding, direct control of program design, or operational oversight. It is unlikely that these non-NMFS fisheries research surveys would be consistent with the time series data NMFS has collected over many years, which is the core information supporting NMFS science and management missions and vital to fishery management decisions made by the Fishery Management Councils, NMFS, and other marine resource management institutions, leading to greater uncertainty for fishery and other natural resource management decisions.

Currently, fisheries and marine ecological research is also being conducted or funded by the U.S. Navy, National Science Foundation, Bureau of Ocean and Energy Management, state agencies, other international agencies, and research institutes in the U.S., sometimes with funding support from the AFSC. However, this research does not cover many fisheries topics currently investigated by the AFSC. Under the No Research Alternative, it is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the AFSC. No agencies or other entities would likely conduct marine research to replace the research abandoned by the AFSC in the three research areas under the No Research Alternative.

2.6 ALTERNATIVES CONSIDERED BUT REJECTED FROM FURTHER ANALYSIS

In developing the proposed action, various alternatives were identified but were not considered for detailed analysis because they did not meet the purpose and need as stated in Section 1.3 or the screening criteria described in Section 2.1. The alternatives eliminated from further consideration are described below.

2.6.1 Sole Reliance on Commercial Fishery Data

One alternative that NMFS considered was to rely solely on commercial fisheries data such as Catch Per Unit Effort (CPUE), seasonal and geographic distribution of harvests, and other harvest data to assess the status of commercially important stocks. This alternative was rejected from further analysis because it would not provide sufficient information on the age/size class structure of exploited fish stocks and would be insufficient to track fish population dynamics or provide other types of predictive capabilities required to manage the fisheries. This approach would also not meet the need to maintain a standardized, objective, and unbiased sampling approach provided by independent surveys.

Conclusion: This alternative does not meet the purpose and need or screening criteria 1 or 3. It would not meet statutory obligations because directed research activities would not be conducted. It would not maintain scientific integrity of research programs because the results would not maintain the consistency of data with prior research efforts. For these reasons this alternative is not carried forward for detailed evaluation.

2.6.2 New Methodologies

Another alternative considered was to adopt other types of survey methodologies or develop new methodologies based primarily on their potential to eliminate or greatly reduce interactions with protected species or effects on habitat, as opposed to adopting new methods and gear for fisheries research purposes. Although NMFS continues to place a high priority on avoiding adverse interactions with protected species and is continually reviewing potential mitigation measures for research activities, the purpose and need for conducting fisheries research requires future sampling methodologies be consistent with past data sets to maintain long-term trend analyses for commercially fished and ecologically important species. NMFS is currently evaluating alternative sampling methods for fisheries and marine ecosystem research, some of which may reduce the potential for incidental takes of protected species or effects on benthic habitats. However, these new methodologies will be evaluated primarily for consistency with the purpose and need for fisheries and marine ecosystem research and whether they provide information that can build on and supplement past data sets.

Conclusion: This alternative did not meet the purpose and need or screening criterion 3. It would not maintain scientific integrity of research programs because the results would not maintain the consistency of data with prior research efforts. Therefore, this alternative is not carried forward for detailed evaluation.

2.6.3 Alternative Research Program Design

In this alternative the types of research conducted would be revised to determine if alternative levels of a particular research would result in different levels of impacts. The design of research programs is a scientific process, not a policy decision. This alternative would emphasize minimizing potential adverse environmental impacts when designing research activities. Other factors, such as maximizing efficient use of scientific research funding and maintaining the integrity of long-term data sets, would not be considered in this approach.

Conclusion: This alternative was rejected because it would not meet the purpose and need or screening criterion 3 and would intrude on inherently technical and scientific decisions. Therefore, this alternative is not carried forward for detailed evaluation.

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3.1 PHYSICAL ENVIRONMENT

The AFSC research activities occur in three research areas that overlap with five distinct Large Marine Ecosystems (LMEs). The GOARA includes much of the GOA LME; the BSAIRA includes the East Bering Sea and West Bering Sea LMEs; and the CSBSRA includes the Chukchi Sea and Beaufort Sea LMEs. AFSC research surveys occur both inside and outside the U.S. EEZ, and sometimes span across multiple ecological, physical, and political boundaries.

3.1.1 Large Marine Ecosystems

LMEs are large areas of coastal ocean space. LMEs generally include greater than 200,000 square kilometers (km^2) of ocean surface area, and are located in coastal waters where primary productivity is generally higher than in open ocean areas. LME physical boundaries are based on four ecological criteria: bathymetry, hydrography, productivity, and trophic relationships. Based on these four criteria, five LMEs have been delineated for the coastal marine waters of Alaska, and a total of 64 distinct LMEs have been delineated around the coastal margins of the world's oceans (Sherman and Hempel 2009, Arctic Council 2013). Figure 3.1-1 shows the LMEs off the coast of Alaska. Each color represents a distinct LME.

Globally, LMEs are the source of 80 to 95 percent of the world's marine fish harvest, and are centers of economic activity for oil and gas, shipping, and tourism industries. The LME concept provides a practical framework for the application of ecosystem-based approaches to fisheries assessment and management, habitat restoration, and research on pollution and ecosystem health. NOAA and NMFS have implemented a management approach designed to improve the long-term sustainability of LMEs and their resources by using practices that focus on ensuring the sustainability of the productive potential for ecosystem goods and services. For more detailed information on the LME management concept and trends in ecosystem health, see *The UNEP Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas* (Sherman and Hempel 2009).

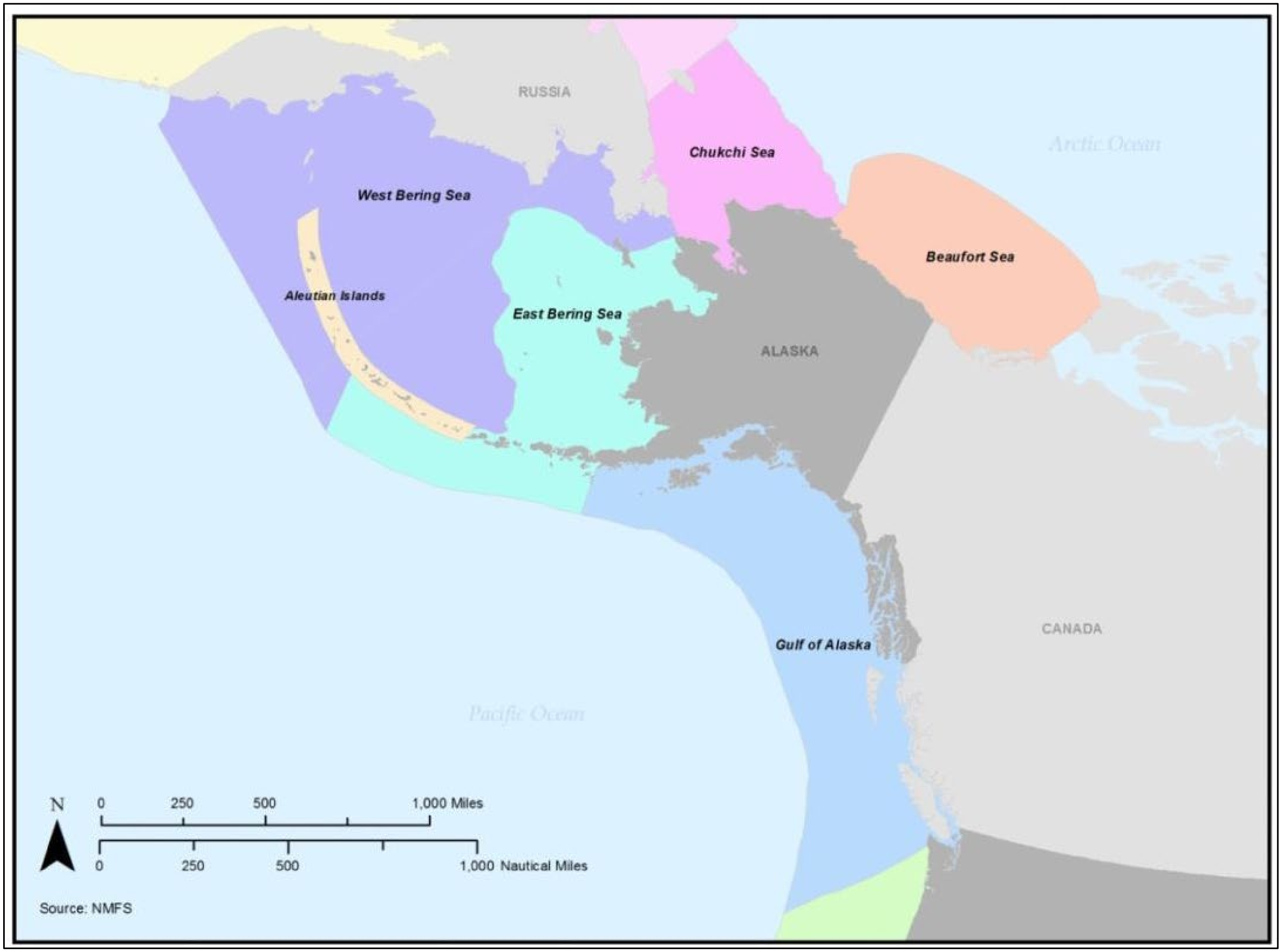


Figure 3.1-1 Large Marine Ecosystems in the North Pacific

3.1.1.1 Gulf of Alaska LME

The GOA LME includes areas of the North Pacific Ocean, exclusive of the Bering Sea, between the eastern Bering Sea LME and Vancouver Island off the western coast of Canada (Figure 3.1-2). Kitchingman et al. (2007) report that the GOA LME includes 0.52% of the world's sea mounts. The GOA LME encompasses NMFS Reporting Areas 620, 630, 640, 649, 650, and 659. Note that the GOA LME, as depicted here, extends beyond the boundary of the U.S EEZ, and into both Canadian and international waters.

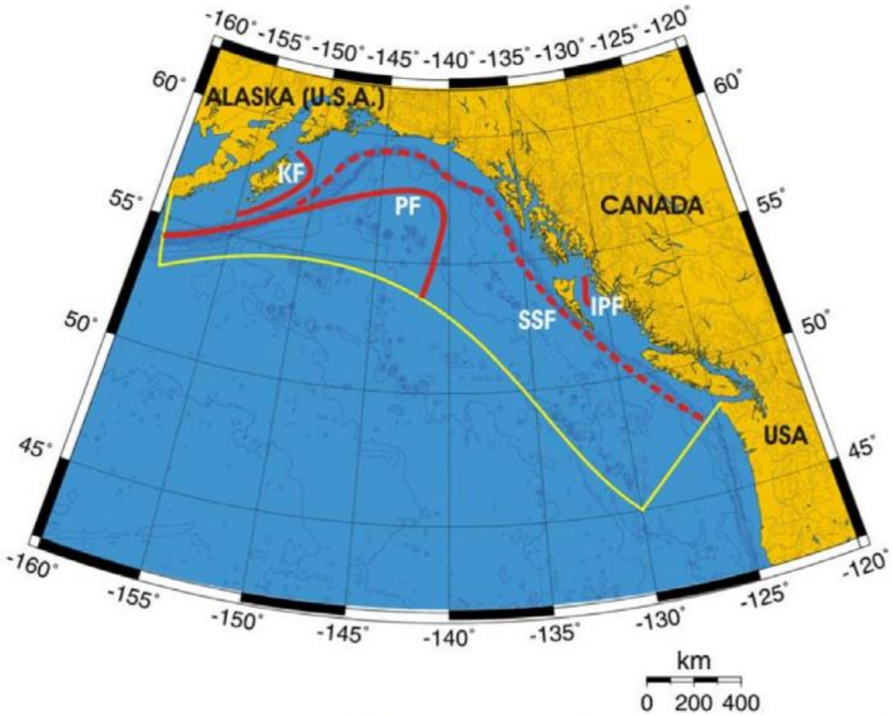


Figure XIV-46.1. Fronts of the Gulf of Alaska LME. IPF, Inner Passage Front; KF, Kodiak Front; PF, Polar Front; SSF, Shelf-Slope (most probable location). Yellow line, LME boundary. After Belkin et al. (2009).

Source: Belkin et al. 2009

Figure 3.1-2 Fronts of the Gulf of Alaska LME

The GOA LME has approximately 160,000 km^2 of continental shelf and is a relatively open marine system with land masses to the east and the north. The dominant circulation in the GOA LME is characterized by the cyclonic flow of the Alaska gyre (Musgrave et al. 1992). The circulation consists of the eastward-flowing Subarctic Current system at approximately 50º N and the Alaska Coastal Current (Alaska Stream) system along the northern GOA. Large seasonal variations in wind-stress curl in the GOA affect the meanders of the Alaska Stream and nearshore eddies. The variations in these nearshore flows and eddies affect much of the region's biological variability.

The Polar Front exists year-round in the western part of the GOA (Belkin et al. 2002, 2009). This front is associated with the Subarctic Current that crosses the North Pacific from Hokkaido, Japan to the GOA where it retroflects and flows along the Aleutian Island Chain, branching first into the Eastern Bering Sea, then into the Western Bering Sea. Several fronts develop in summer over the Alaskan Shelf (Belkin & Cornillon 2003, Belkin et al. 2003). The conspicuous Kodiak Front is observed east and south of Kodiak Island, where its quasi-stable location is controlled by local topography. The Inner Passage Front is located in a strait between the Queen Charlotte Islands and the British Columbia coast (Belkin et al. 2009).

The GOA has a variety of seabed types including mud, sand, and areas of hardrock (Hampton et al. 1986). The GOA shelf (< 200 m) between Cape Cleare (148º W) and Cape Fairweather (138º W) is relatively wide (up to 100 km). Shelf sediment in this area is comprised primarily of clay silt originating from the Copper River and Bering and Malaspina glaciers. When the sediments enter the GOA, they are generally transported westward across the shelf. Sandy sediment is deposited in nearshore areas, especially near the Copper River and the Malaspina Glacier. Most of the western GOA shelf (west of Cape Igvak) consists of steep slopes interspersed with banks and reefs with coarse, clastic, or rocky bottoms. In contrast, the shelf near Kodiak Island consists of flat relatively shallow banks cut by transverse troughs. The substrate in the area from Near Strait and close to Buldir Island, Amchitka, and Amukta Passes is mainly bedrock outcrops and coarsely fragmented sediment interspersed with sand bottoms.

The GOA LME is considered a Class II, moderately productive ecosystem (Sherman and Hempel 2009). Cold, nutrient-rich waters within the LME support a biologically diverse ecosystem, and large-scale atmosphere-ocean interactions affect the productivity of this LME. Changes in zooplankton biomass have been observed in both the GOA LME and the adjacent California Current LME. These biomass changes appear to be related to a well-documented climatic regime shift, which occurred in the late 1970s and caused an eastward change in the location of the Alaska gyre (Anderson & Piatt 1999, Brodeur et al. 1999, Lagerloef 1995). Brodeur et al. (1999) suggested that populations of GOA salmon could increase as a result of such long-term oceanographic shifts, which may have led to increases in plankton biomass in the GOA over the last decade. See Hollowed et al. (1998) for additional information on climate variability and its effects on marine organisms of the GOA.

3.1.1.2 Bering Sea LMEs

The BSAIRA includes the East Bering Sea LME and parts of the West Bering Sea LME.

The East Bering Sea LME extends south along the Aleutian peninsula, westward to Amchitka Pass and Bowers Ridge, and north to Cape Prince of Wales in the Bering Strait. It includes the extremely wide, gradually sloping shelf of the Eastern Bering Sea and the narrow shelf and deep passes along the Aleutian Islands chain (Figure 3.1-3). The surface area is about 1.4 million km². The East Bering Sea LME contains 0.07% of the world's sea mounts (Sherman and Hempel 2009). In addition to the eastern Bering Sea, the East Bering Sea LME includes the eastern Aleutian Islands westward to Amchitka Pass and Bowers Ridge. The Aleutian Basin and western Aleutian Islands are included in the Western Bering Sea LME.

The West Bering Sea LME lies off Russia's northeast coast and borders the Aleutian Trench (Figure 3.1-4). The LME has a surface area of nearly 2 million km^2, and contains 0.51% of the world's sea mounts (Sea Around Us 2007). The bottom topography includes the deep Aleutian Basin, Kamchatka Basin and Bowers Basin. Note that the West Bering Sea LME extends beyond the 200 mile EEZ border and into international waters.

Five major oceanic fronts influence the East Bering Sea shelf and slope: 1) the Coastal Front, 2) the Inner Shelf Front, 3) the Mid-Shelf Front, 4) the Outer Shelf Front, and 5) the Shelf-Slope Front (Belkin et al. 2003, Belkin and Cornillon 2005, Belkin et al. 2009, Sherman and Hempel 2009).

The Coastal Front consists of three segments, the Bristol Bay Front, the Kuskokwim Bay Front, and the Shpanberg Strait/Norton Sound Front, all of which flow approximately parallel to the Alaskan Coast at a depth of 10 to 20 m. Farther offshore, the Inner Shelf Front is located at depths of 20 to 40 m, and the Mid-Shelf Front is found at 40 to 60 m.

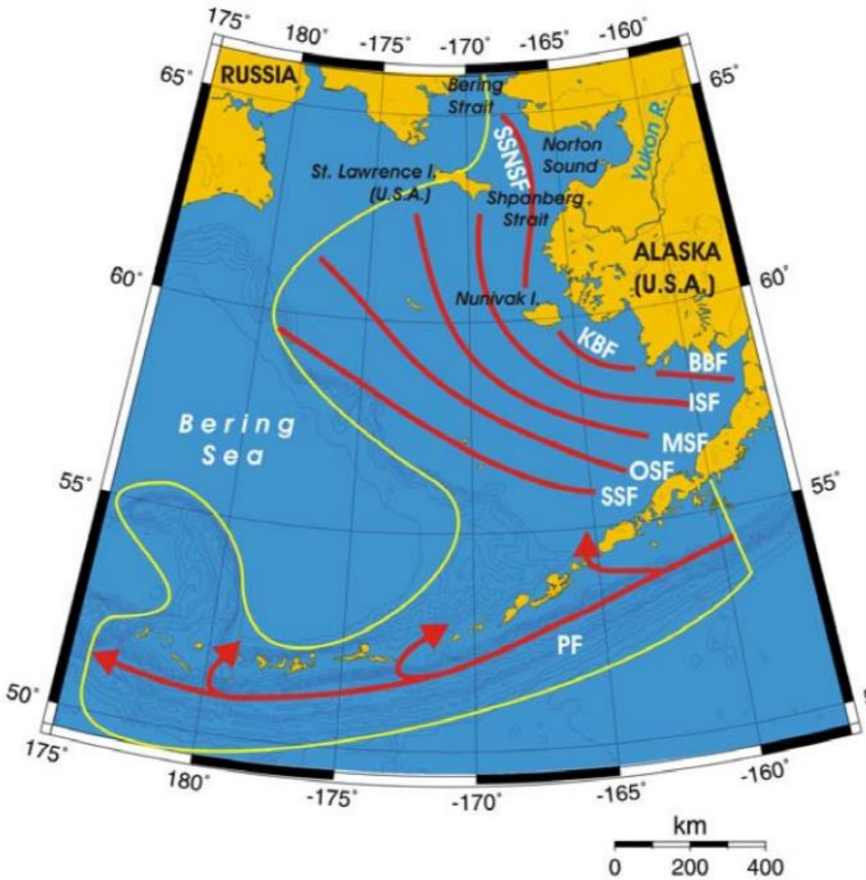


Figure XIV-45.1. Fronts of the East Bering Sea LME. BBF, Bristol Bay Front; ISF, Inner Shelf Front; KBF, Kuskokwim Bay Front; MSF, Mid-Shelf Front; OSF, Outer Shelf Front; PF, Polar Front; SSF, Shelf-Slope Front; SSNSF, Shpanberg Strait-Norton Sound Front. Yellow line, LME boundary. After Belkin *et al.* (2009).

Source: Belkin et al. 2009

Figure 3.1-3 Fronts of the East Bering Sea LME

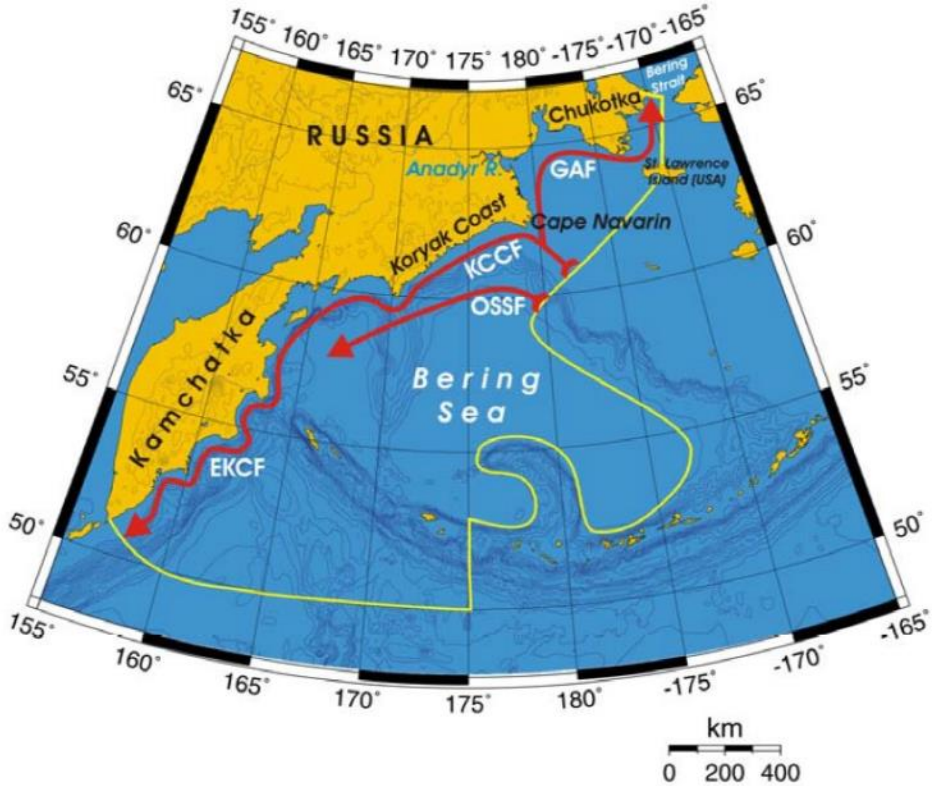


Figure X-27.1. Fronts of the West Bering Sea LME. EKCF, East Kamchatka Current Front; GAF, Gulf of Anadyr Front; KCCF, Koryak Coast Current Front; OSSF, Outer Shelf -Slope Front. Yellow line, LME boundary. After Belkin et al. (2009).

Source: Belkin et al. 2009

Figure 3.1-4 Fronts of the West Bering Sea LME

The most distant offshore fronts, the Outer Shelf Front (60-100-m depth) and the Shelf-Slope Front (100-200-m depth within this LME) are not isobathic. They extend from relatively shallow depths in the east, off Bristol Bay, to significantly greater depths in the west, where the Shelf-Slope Front crosses the shelf break to continue over the deep basin as it leaves the East Bering Sea LME and enters the West Bering Sea LME.

The Aleutian Archipelago and West Bering Sea are influenced by three primary currents: the Aleutian North Slope Current in the Bering Sea, and the Alaska Coastal Current and Alaskan Stream in the North Pacific (Favorite et al. 1976, Stabeno et al. 1999). East of Samalga Pass (approximately 170°W), the ACC flows southwestward along the southern side of the Aleutian Islands. This relatively fresh and shallow current hugs the shoreline and turns northward entering the Bering Sea through the eastern passes (Unimak, Akutan, Umnak, and Samalga) (Ladd et al. 2005). West of Samalga Pass, the shelf south of the islands is much narrower. This narrow shelf allows the Alaskan Stream (the deep current that flows along the continental slope in the western GOA), to come close to the islands. The Alaskan Stream flows southwestward along the southern side of the islands, connecting the GOA to the Aleutian Islands region (Favorite et al. 1976). Waters from the Alaskan Stream flow northward through the central and western Aleutian Passes to feed the Aleutian North Slope Current, which flows northeastward along the northern side of the islands (Reed and Stabeno 1999).

While oscillating tidal currents are responsible for the extreme current speeds and mixing within the passes, the net northward transport of water from the Pacific to the Bering Sea plays a role in transport of nutrients and biota. There is evidence that transport in the Alaskan Stream influences transport in some passes.

Due to the influence of the Alaska Coastal Current, the shallow, narrow passes east of Samalga Pass (170° W.) can be classified as a coastal environment with a strong influence of coastal freshwater discharge. These waters are warmer, fresher, more strongly stratified, and nitrate poor compared with the Aleutian waters west of Samalga Pass. West of Samalga Pass in the WBS LME, the passes are deeper and wider. The marine environment can be classified as oceanic with primary influence from the Alaskan Stream (Ladd et al. 2005). The wider passes allow bidirectional currents with mean flow to the north (from the Pacific to the Bering) on the eastern side of the passes and to the south on the western side (Stabeno et al. 1999). However, the northward flow is generally stronger, more consistent, and occurs over most of the cross-section of the passes. So the net transport through the Aleutian Passes is northward from the Pacific Ocean to the Bering Sea, except in Kamchatka Strait far to the west.

The Bering Sea is a semi-enclosed, high-latitude sea. Of its total area of 2.3 million km^2, 44 percent is continental shelf, 13 percent is continental slope, and 43 percent is deep-water basin. The East Bering Sea contains approximately 300 species of fish, 150 species of crustaceans and mollusks, 50 species of seabirds, and 26 species of marine mammals (Livingston and Tjelmeland 2000). The broad continental shelf of the East Bering Sea is one of the most biologically productive areas on Earth. Pack ice covers most of the eastern and northern Bering Sea shelf during winter and spring, and the ice edge provides important habitat for birds, marine mammals, and numerous other species.

Water circulation in the East Bering Sea begins with the passage of North Pacific water (the Alaska Stream) into the EBS through the Aleutian Islands (Favorite et al. 1976). Water is transported eastward along the north side of the Aleutian Islands, and then turns northward at the continental shelf break and at the eastern perimeter of Bristol Bay. Eventually water exits the East Bering Sea northward through the Bering Strait, or westward and south along the Russian coast, entering the North Pacific through the Kamchatka Strait. Some EBS water joins with North Pacific water at Near Strait, and sustains a permanent cyclonic gyre around the deep basin in the central Bering Sea.

EBS sediments include the full range of grain sizes of mud, sand, and gravel (Smith and McConnaughey 1999). Sand and silt are the primary components over most of the seafloor, with sand predominating the sediment in waters with a depth less than 60 m. Overall, the fraction of finer-grade sediments tends to increase (and average grain size tends to decrease) with increasing depth and distance from shore. This trend is particularly noticeable on the southeastern Bering Sea continental shelf in Bristol Bay and immediately westward. McConnaughey and Smith (2000) and Smith and McConnaughey (1999) use available sediment data for the EBS shelf to describe four habitat types. The first, situated around the shallow eastern and southern perimeter and near the Pribilof Islands, has primarily sand substrates with a little gravel. The second, across the central shelf out to the 100 m contour, has mixtures of sand and mud. A third, west of a line between St. Matthew and St. Lawrence islands, has primarily mud and silt substrates. Finally, the areas north and east of St. Lawrence Island, including Norton Sound, have a complex mixture of substrates.

The Aleutian Islands archipelago includes approximately 150 islands that form a partial geographic barrier to the exchange of northern Pacific marine waters with EBS waters. The Aleutian Islands extends about 2,260 km westward from the Alaska Peninsula toward the Kamchatka Peninsula, thus marking a line between the Bering Sea and the Pacific Ocean. The Aleutian Islands continental shelf is narrow compared with the EBS shelf, ranging in width on the north and south sides of the islands from about 4 km to 46 km; the shelf broadens in the eastern portion of the Aleutian Islands arc. The Aleutian Islands region has mixes of substrates, including a significant proportion of hard substrates (pebbles, cobbles, boulders, and rock). Bowers Ridge, is a submerged geographic structure forming an arc off the west-central Aleutian Islands about 550 km long and 75 to 110 km wide. The summit of the ridge lies in water approximately 150 to 200 m deep in the southern portion, deepening to about 800 to 1,000 m at its northern edge. Bowers Ridge forms the western boundary of the EBS LME in the Aleutian Islands region.

The Aleutian Islands region of the WBS has a mixture of substrates, including a significant proportion of hard substrates (pebbles, cobbles, boulders, and rock). Two distinct zones are evident. East of Samalga Pass, the Aleutian Islands rise from shallow continental shelf covered by several sediment types deposited mainly during periods of glaciation. West of Samalga, steep rocky slopes to the north and south surround a mostly submerged mountain range resting on the Aleutian ridge (Hampton 1983). Cold-water corals and sponge communities are a dominant feature of benthic communities on the steep rocky slopes of the Aleutian Islands and likely provide important habitat for a variety of fish and invertebrate species (Heifetz et al. 2005). The geographical split in substrate type at Samalga Pass is coincident with shifts in biological community structure. Many environmental attributes change in the vicinity of Samalga Pass, suggesting that the marine ecosystem of the archipelago may be differentiated into multiple, ecologically distinct regions (Hunt and Stabeno 2005).

Temperature, currents and seasonal oscillations influence the productivity of the East Bering Sea, West Bering Sea, and Aleutian Archipelago. Shifts in the spatial distributions of some populations and changes in overall productivity and trophic structure of the BSAIRA may depend upon changes in current regimes, water temperatures, and sea-ice cover, all of which are subject to climate-driven variation. Over the past century, the extent of the winter pack ice has decreased.

3.1.1.3 Chukchi Sea and Beaufort Sea LMEs

The CSBSRA includes both the Chukchi Sea LME and Beaufort Sea LME. The Chukchi Sea LME (Figure 3.1-5) connects Alaska's northwestern coast with Russia's Chukchi Peninsula in Siberia. This LME is a relatively shallow marginal sea and an extensive continental shelf with a total surface area of 776,643 km^2 (Sea Around Us 2007).

The Chukchi Sea LME is characterized by the annual formation and deformation of sea ice. The extent of the sea ice edge is affected by a multitude of factors including the volume and temperature of the water flowing north through the Bering Strait (Muench 1990).

The Beaufort Sea LME (Figure 3.1-6) is the northernmost LME in the Alaska EEZ. It extends from Point Barrow eastward across the northern coast of Alaska and across the international Alaska/Canada boundary. The Beaufort Sea LME has a surface area of about 770,000 km^2, and contains 0.1% of the world's sea mounts (Sea Around Us 2007).

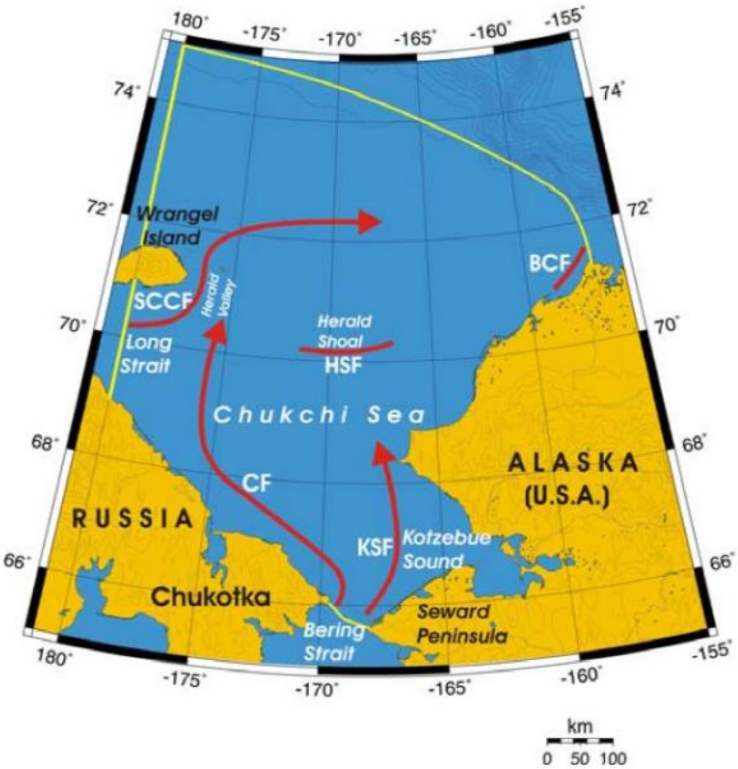


Figure XI-31.1. Fronts of the Chukchi Sea LME. BCF, Barrow Canyon Front; CF, Chukotka Front; HSF, Herald Shoal Front; KSF, Kotzebue Sound Front; SCCF, Siberian Coastal Current Front. Yellow line, LME boundary. After Belkin *et al.*, 2003; Belkin *et al.*, 2009).

Source: Belkin et al. 2009

Figure 3.1-5 Fronts of the Chukchi Sea LME

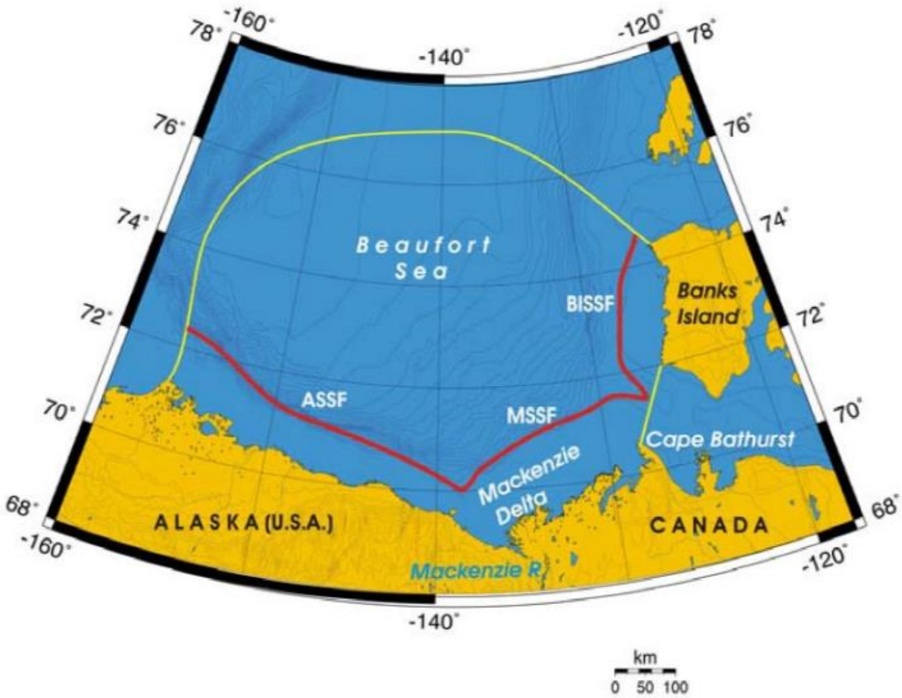


Figure XI-30.1. Fronts of the Beaufort Sea LME. ASSF, Alaskan Shelf-Slope Front; BISSF, Banks Island Shelf-Slope Front; MSSF, Mackenzie Shelf-Slope Front. Yellow line, LME boundary. After Belkin et al. (2009).

Source: Belkin et al. 2009

Figure 3.1-6 Fronts of the Beaufort Sea LME

Five fronts are found within the Chukchi Sea LME (Belkin et al. 2003, Belkin et al. 2009):

- The Kotzebue Sound Front bounds the northward Bering inflow.
- Low-salinity Bering Sea waters flow around Chukotka northwestward along the Chukotka Front toward Herald Valley.
- The Siberian Coastal Current/Front enters the Chukchi Sea through Long Strait, rounds Wrangel Island and continues northward via Herald Valley.
- The Herald Shoal Front is situated over the steep southern slope of the namesake shoal.
- The Barrow Canyon Front extends along Barrow Canyon.

The Shelf Break/Shelf-Slope Front is the most robust front within this LME. The Shelf Break/Shelf-Slope Front extends along the shelf break and upper continental slope. The stability of the Shelf Break/Shelf-Slope Front is at maximum where the shelf break is best defined and where the upper slope is the steepest, e.g., off Cape Bathurst in the Canadian Beaufort Sea (Belkin et al. 2003, Belkin et al. 2009). This place is well known as the site of Cape Bathurst Polynya, and is a "hot spot" of marine life where sea birds and marine mammals congregate. Transient fronts form at the dynamic boundary of the Mackenzie River plume and also within this plume (Belkin et al. 2009).

The long-term warming of the Chukchi Sea over the last 50 years was modulated by strong interannual variability, with a magnitude of about 0.5-1.0°C, as well as decadal variability and at least one regime shift. Two regimes can be distinguished: (1) overall cooling until 1983; (2) overall warming since 1983.

The long-term warming accelerated in the Chukchi Sea LME after the all-time minimum temperature of -1.0°C in 1983, and by 2005 sea surface temperature reached 0.3°C, a 1.3°C increase over 22 years. The Chukchi Sea is affected by warm water influx from the Bering Sea through the Bering Strait. The impact of the Bering Sea inflow is two-fold, since this inflow consists of two components, eastern and western, with potentially different thermal signatures (Weingartner et al. 2005, Woodgate et al. 2006).

The Chukchi Sea bottom habitat has a mix of substrates, defined in part by the continental shelf, continental break, and deep-water basins. The Chukchi Sea contains a broad shallow shelf similar to the Bering Sea.

Climate change is expected to have a profound ecological impact in the Arctic LMEs. The Arctic climate is warming rapidly and much larger changes are expected (ACIA 2004, Doney et al. 2012, Melillo et al. 2014). Species ranges are projected to shift, bringing new species into the Arctic while severely limiting some of the species currently present.

The Beaufort Sea bottom habitat has a mix of substrates, defined in part by the continental shelf, continental break, and deep-water basins. The Beaufort Sea has a narrow coastal shelf that lies adjacent to a deep water basin.

In the 1970s, marine researchers discovered anomalous seafloor sites in relatively shallow waters in Stefansson Sound in the central Alaskan Beaufort Sea. Characterized by patches of rocks, pebbles, and boulders, these provide substrate for a rich flora, including extensive kelp beds (summarized in Streever and Wilson 2001). This rocky area and its associated growth of marine life was subsequently designated the Boulder Patch and, although boulders (1-2 m in diameter) constitute some of the substrate, the rocky substrate is more in the pebble to cobble size (1-10 cm) range.

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

The dominant plant in the Boulder Patch, *Laminaria solidungula*, stores carbon during the short summer months when sufficient light is available, but then in the absence of photosynthesis it completes up to 90 percent of its growth in the dark winter months using stored carbon (Dunton 1985, Dunton and Schell 1986). Kelp production in the Beaufort Sea may contribute substantially to overall primary production in this marine ecosystem (Dunton and Dayton 1995).

The annual formation and melting of sea ice influence the productivity of the Chukchi Sea LME by storing nutrients and releasing them into the melt water. Biological community structure varies seasonally as the Chukchi Sea provides habitat for numerous migratory species including fish, birds, and mammals (Carletonet al. 1993). . The Chukchi Sea LME is considered a Class II, moderately high productivity ecosystem (150-300 g carbon per m^2 per yr) (Sherman and Hempel 2009).

During much of the year, light penetration in the Beaufort Sea LME is limited because of ice cover. Productivity is relatively high only in the summer when the ice melts. As a whole, the Beaufort Sea is considered oligotrophic. However, the coastal region supports a diversity of organisms, many of which are unique to the area. The Beaufort Sea LME is considered a Class II, Moderately productive ecosystem (150-300 g carbon per m^2 per yr) (Sherman and Hempel 2009).

3.1.2 EFH and Special Resource Areas

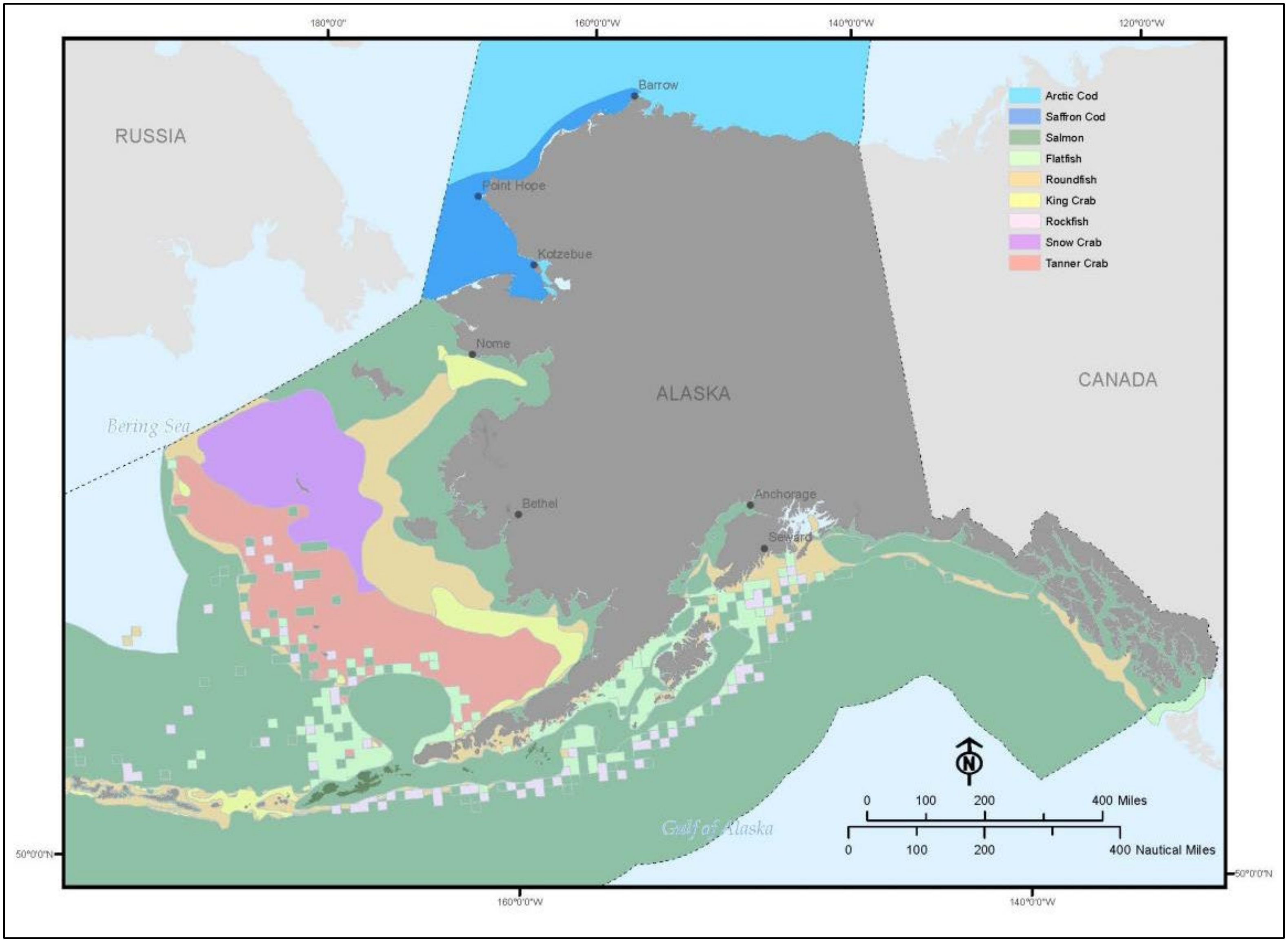
3.1.2.1 Essential Fish Habitat

EFH is comprised of the waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. 1802 sec. 3(10)). Regulatory guidelines explain that EFH should be sufficient to "support a population adequate to maintain a sustainable fishery and the managed species' contributions to a healthy ecosystem" (50 CFR 600, subpart J). EFH applies to federally managed species in both state and federal jurisdictional waters throughout the range of the species within U.S. waters. The designation of EFH by itself does not confer any protection of the areas from non-fishing or fishing impacts. Instead, it is a tool used by managers to reduce impacts and improve fisheries management. It is described and identified in FMPs that are developed by regional Fishery Management Councils. NMFS regional offices implement FMPs to facilitate long-term protection of EFH through conservation and management measures.

The EFH for a managed species is designated separately for each life stage: eggs, larvae (normally pelagic), juveniles, and adults (pelagic and/or demersal). In certain species, EFH is also designated for spawning adults. Many species require different habitats for different life stages, sometimes resulting in vast areas of EFH for a single species.

As shown in Figure 3.1-7, when EFH areas are combined, almost all Alaska waters are included. In Alaska, EFH has been designated for:

- Groundfish (GOA and BSAI Research Areas)
- Crab in the BSAI Research Area
- Scallops off the Alaska coast (GOA and BSAI Research Areas)
- Salmon (GOA and BSAI Research Areas)
- Arctic cod, saffron cod, and snow crab in the Chukchi Sea/Beaufort Sea Research Area



Source: NPFMC 2009a, NPFMC 2011, NPFMC 2014b

Figure 3.1-7 Essential Fish Habitat Offshore Alaska

Gulf of Alaska Research Area and Bering Sea/Aleutian Island Research Area

NMFS refers to boundaries meaningful to EFH as defined by a Fishery Management Unit (FMU) for the FMP as the Gulf of Alaska Management Area and Bering Sea/Aleutian Island Management Area, referenced in this FPEA as AFSC research areas. EFH is described below for groundfish, crab, salmon, and scallop (NPFMC 2011, NPFMC 2012, NPFMC 2014a, NPFMC 2014b, NPFMC 2015a).

Groundfish EFH

The groundfish FMP for BSAI (NPFMC 2014a) describes EFH for walleye pollock (eggs, larvae, late juveniles/adults), Pacific cod (larvae, late juveniles/adults), sablefish (larvae, late juveniles/adults), yellowfin sole (late juveniles/adults), Greenland turbot (eggs, larvae, late juveniles/adults), arrowtooth flounder (late juveniles/adults), Kamchatka flounder (late juveniles/adults), northern rock sole (larvae, late juveniles/adults), Alaska plaice (eggs, late juveniles/adults), rex sole (late juveniles/adults), dover sole (late juveniles/adults), flathead sole (eggs, larvae, late juveniles/adults), rockfish (larvae), Pacific ocean perch (late juveniles/adults), northern rockfish (adults), shortraker rockfish (adults), blackspotted and rougheye rockfish (late juveniles/adults), dusky rockfish (adults), thornyhead rockfish (late juveniles/adults), Atka mackerel (eggs, larvae, adults), squid species (late juveniles/adults), sculpin (adults), and skates (eggs, adults) (NPFMC 2014a).

The groundfish FMP for GOA (NPFMC 2015a) describes EFH for walleye Pollock, pacific cod, sablefish, yellowfin sole, southern rock sole, Alaska plaice, dover sole, rex sole, arrowtooth flounder, flathead sole, pacific ocean perch, northern rockfish, shortraker rockfish, blackspotted/rougheye rockfish, dusky rockfish, yelloweye rockfish, thornyhead rockfish, Atlka mackerel, skates, octopuses, sharks, sculpins, squids, and forage fish complex.

Most of the EEZ is EFH for groundfish within the BSAI and GOA Research Areas. Detailed descriptions of EFH per life stage are available in the FMPs (NPFMC 2014a, 2015a).

Crab EFH

The King and Tanner Crabs FMP for BSAI (NPFMC 2011) describes EFH for eggs, late juveniles and adults of five species of crab: red king crab (*Paralithodes camtschaticus*), golden (brown) king crab (*Lithodes aequispinus*), blue king crab (*P. platypus*), Tanner crab (*C. bairdi*), and snow crab (*C. opilio*). Detailed descriptions per life stage are as follows:

Red King Crab

Eggs - inferred from the general distribution of egg-bearing female crab.

Larvae, Early Juveniles – insufficient information is available.

Late Juveniles - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting of rock, cobble, and gravel and biogenic structures such as boltenia, bryozoans, ascidians, and shell hash.

Adults - general distribution area for this life stage, located in bottom habitats along the nearshore (spawning aggregations) and the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting of sand, mud, cobble, and gravel.

Golden King Crab

Eggs - general distribution of egg-bearing female crab.

Larvae, Early Juveniles - Insufficient information is available.

Late Juveniles - general distribution area for this life stage, located in bottom habitats along the along the upper slope (200 to 500 m), intermediate slope (500 to 1,000 m), lower slope (1,000 to 3,000 m), and basins (more than 3,000 m) of the BSAI where there are high-relief living habitats, such as coral, and vertical substrates, such as boulders, vertical walls, ledges, and deep water pinnacles.

Adults - general distribution area for this life stage, located in bottom habitats along the along the outer shelf (100 to 200 m), upper slope (200 to 500 m), intermediate slope (500 to 1,000 m), lower slope (1,000 to 3,000 m), and basins (more than 3,000 m) of the BSAI where there are high relief living habitats, such as coral, and vertical substrates such as boulders, vertical walls, ledges, and deep water pinnacles.

Blue King Crab

Eggs - EFH of the blue king crab eggs is inferred from the general distribution of egg-bearing female crab.

Larvae, Early Juveniles - insufficient information is available.

Late Juveniles - EFH for late juvenile blue king crab is the general distribution area for this life stage, located in bottom habitats along the nearshore where there are rocky areas with shell hash and the inner (0 to 50), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting of rock, cobble, and gravel.

Adults - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting of sand and mud adjacent to rockier areas and areas of shell hash.

Tanner Crab

Eggs - inferred from general distribution of egg-bearing female crab.

Larvae, Early Juveniles - insufficient information is available.

Late Juveniles - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting mainly of mud.

Adults - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting mainly of mud.

Snow Crab

Eggs - inferred from the general distribution of egg-bearing female crab.

Larvae, Early Juveniles - insufficient information is available.

Late Juveniles - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting mainly of mud.

Adults - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting mainly of mud.

Scallop EFH

The FMP for the Scallop Fishery off Alaska (NPFMC 2014b) describes EFH for late juvenile and adult weathervane scallops. Detailed descriptions per life stage are as follows:

Eggs, Larvae, Early Juveniles - insufficient information is available.

Late Juveniles - general distribution area for this life stage, located in the sea floor along the inner (1 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf in concentrated areas of the GOA and BSAI where there are substrates of clay, mud, sand, and gravel that are generally elongated in the direction of current flow.

Adults - general distribution area for this life stage, located in the sea floor along the inner (1 to 50 m), middle (50 to 100 m) and outer (100 to 200 m) shelf in concentrated areas of the GOA and BSAI where there are substrates of clay, mud, sand, and gravel that are generally elongated in the direction of current flow.

Salmon EFH

The Salmon FMP (NPFMC 2012) describes EFH for pink salmon, chum salmon, sockeye salmon, Chinook salmon, and coho salmon. For all five species, EFH is described for freshwater eggs, freshwater larvae and juvenile, estuarine juvenile, marine juveniles, marine immature and maturing adults, and freshwater adults. Detailed descriptions per life stage are available in the FMP (NPFMC 2012).

Marine EFH for the salmon fisheries in Alaska includes all estuarine and marine areas used by Pacific salmon of Alaska origin, extending from the influence of tidewater and tidally submerged habitats to the limits of the U.S. EEZ (see Figure 3.1-7).

This habitat includes waters of the Continental Shelf, which extends to about 30 to 100 km offshore from Dixon Entrance to Kodiak Island, then becomes narrower along the Pacific Ocean side of the Alaska Peninsula and Aleutian Islands chain. In BS areas of southwest and western Alaska and in Chukchi and Beaufort Seas areas of northwest and northern Alaska, the Continental Shelf becomes much wider. In oceanic waters beyond the Continental Shelf, the documented range of Alaska salmon extends from lat. 42 degrees North, north to the Arctic Ocean and to longitude 160 degrees East. In the deeper waters of the Continental Slope and ocean basin, salmon occupy the upper water column, generally from the surface to a depth of about 50 m. Chinook and chum salmon, however, use deeper layers, generally to about 300 m, but on occasion to 500 m. The range of EFH for salmon is the subset of this habitat that occurs within the 320 km EEZ boundary of the United States. Foreign waters (i.e., off British Columbia in the GOA and off Russia in the Bering Sea) and international waters are not included in salmon EFH because they are outside U.S. jurisdiction.

<u>Chukchi Sea/Beaufort Sea Research Area</u>

Describing EFH by text using static boundaries is challenging in Alaska due to the size, increasing habitat knowledge, and habitat usage in the Arctic. To address this challenge, NMFS refers to the boundaries as defined by a FMU for the FMP as the Arctic Management Area, referenced in this report as the Chukchi Sea/Beaufort Sea Research Area. EFH is described for Arctic cod, saffron cod, and snow crab (NPFMC 2009a, Table 3.1-1).

Table 3.1-1 EFH Information Availability for the CSBSRA

	Life History Stage			
	Eggs	**Larvae**	**Late Juvenile**	**Adult**
Arctic cod	-	-	Yes	Yes
Saffron cod	-	-	Yes	Yes
Snow crab	Yes	-	Yes	Yes

Source: (NPFMC 2009a)

Arctic Cod EFH

Arctic cod (*Boreogadus saida*) is identified as a keystone species which needs to remain close to current carrying capacity in order for the marine ecosystem to retain its present structure. No other keystone species are identified. Arctic cod had the highest biomass estimates of fish species in the Beaufort Sea 2008 survey, Arctic cod is harvested for subsistence purposes. In open water and ice edge habitats, Arctic cod are a key link to convert production of small animals (pelagic zooplankton and ice-associated small invertebrates) into forage for birds and mammals. Multiple predator diets (Beluga whales, ringed seals, ribbon seals, spotted seals, black-legged kittiwakes, glaucous gulls, ivory gulls, black guillemots, thick-billed murres, northern fulmars, and loons) are at least 50 percent Arctic cod in the Beaufort Sea, and sometimes over 90 percent, especially during winter for foraging seals (NPFMC 2009a). Detailed descriptions per life stage are as follows:

Eggs, Larvae, and Early Juveniles - insufficient information is available.

Late Juveniles - general distribution areas for this life stage located in pelagic and epipelagic waters from the nearshore to offshore areas along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout Arctic waters and often associated with ice floes which may occur in deeper waters.

Adults - general distribution area for this life stage located in pelagic and epipelagic waters from the nearshore to offshore areas along the entire shelf (0 to 200 m) and upper slope (200 to 500 m) throughout Arctic waters and often associated with ice floes which may occur in deeper waters.

Saffron Cod EFH

Saffron cod (*Eleginus gracilis*) is harvested for subsistence purposes. It is a locally abundant species in the Arctic and a critical component of pelagic food webs. Detailed descriptions per life stage are as follows:

Eggs, Larvae, and Early Juveniles - insufficient information is available.

Late Juveniles - general distribution area for this life stage, located in pelagic and epipelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m) shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel.

Adults - general distribution area for this life stage, located in pelagic and epipelagic waters along the coastline, within nearshore bays, and under ice along the inner (0 to 50 m) shelf throughout Arctic waters and wherever there are substrates consisting of sand and gravel.

Snow Crab EFH

Snow crab (*Chionoecetes opilio*) biomass was more than double that recorded for Arctic cod in the Chukchi Sea in 1990. Snow crab had the highest biomass estimates for invertebrate species in the Beaufort Sea 2008 survey (NPFMC 2009a). Detailed descriptions per life stage are as follows:

Eggs - EFH of snow crab eggs is inferred from the general distribution of egg-bearing female crab.

Larvae and Early Juveniles - insufficient information is available.

Late Juveniles - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Cape Lisburne, wherever there are substrates consisting mainly of mud.

Adults - general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m) and middle (50 to 100 m) shelf in Arctic waters south of Cape Lisburne, wherever there are substrates consisting mainly of mud.

3.1.2.2 Habitat Areas of Particular Concern

The EFH provisions of the MSA (50 CFR part 600) recommend that specific areas of habitat within EFH are identified as "habitat areas of particular concern." Habitat Areas of Particular Concern (HAPC) are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. FMCs may designate a specific habitat area as a HAPC for one or more of the following reasons: the importance of the ecological function provided by the habitat; the extent to which the habitat is sensitive to human-induced environmental degradation; whether and to what extent development activities are, or will be, stressing the habitat type; and the rarity of habitat type.

The intended goal of identifying HAPC is to focus conservation efforts on the most important areas. While the HAPC designation does not trigger any specific regulatory process or confer any specific protection, it highlights certain habitat types that are of high ecological value. This designation is manifested in EFH consultations, during which NMFS can recommend protective measures for specific HAPC.

The NPFMC has designated several HAPC in the GOA and BSAI Research Areas; none have been designated in the Chukchi Sea/Beaufort Sea Research Area.

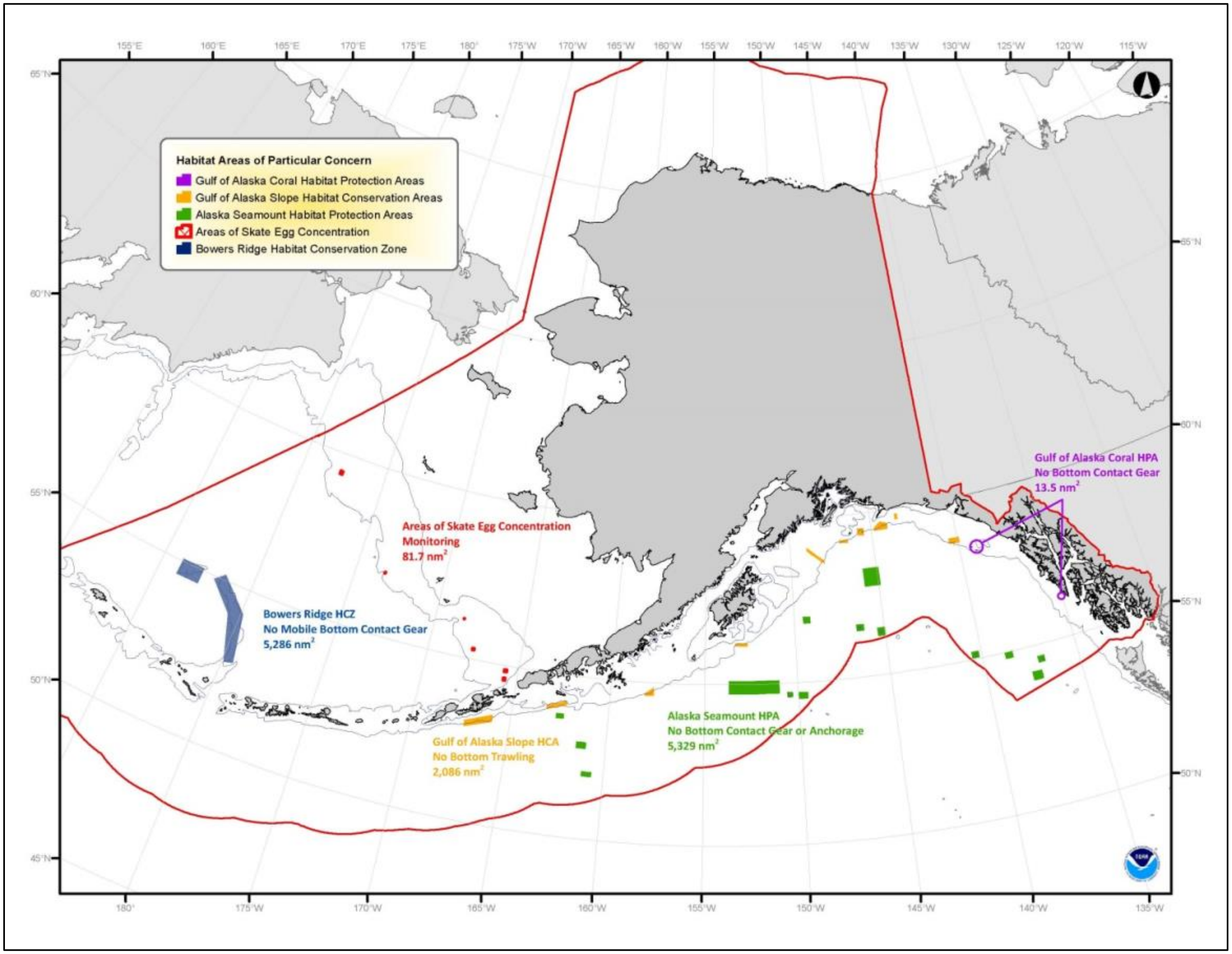
Restricted areas in the GOA and BSAI Research Areas include a variety of designations, including HAPC, Habitat Conservation Areas (HCA, areas where fishing restrictions are implemented for the purposes of habitat conservation), Habitat Protection Areas, and Habitat Conservation Zones.

These include the Pribilof Islands HCA, Aleutian Islands HCA, Bering Sea HCA, St. Matthew Island HCA, St. Lawrence Island HCA, Nunivak Island, Etolin Strait, and Kuskokwim Bay HCA, Northern Bering Sea Research Area, Aleutian Islands HCA, Aleutian Islands Coral Habitat Protection Area, Alaska Seamount Habitat Protection Area, Bowers Ridge Habitat Conservation Zone, and the Sitka Pinnacles Marine Reserve. Table 3.1-2 is a list of the HAPC in Alaska waters, their total area, fishery management application, and establishing regulation. Figure 3.1-8 shows the location of the HAPC.

Within the Aleutian Islands HCA, nonpelagic trawl gear fishing is prohibited year-round. The Aleutian Islands Coral Habitat Protection Area prohibits the use of bottom contact gear, as well as anchoring by federally permitted fishing vessels (NPFMC 2011).

Table 3.1-2 Habitat Areas of Particular Concern in the AFSC Research Areas

HAPC	Individual HAPC's	Total Area	Fishery Management Application	Specific Regulation
GOARA				
Alaska Seamount Habitat Protection Areas	Dickens Seamount Denson Seamount Brown Seamount Welker Seamount Dall Seamount Quinn Seamount Giacomini Seamount Kodiak Seamount Odessey Seamount Patton Seamount Chirikof & Marchand Seamounts Sirius Seamount Derickson Seamount Unimak Seamount Bowers Seamount	5,300 nm^2	No federally permitted vessel may fish with bottom contact gear[i]. 50 CFR 679.22(a)(12)	Federal Register 50 CFR Part 679 Volume 71, No.124 Wednesday, June 28,2006 http://www.fakr.noaa.gov/frules/71fr36694.pdf
GOA Coral Habitat Protection Areas	Cape Ommaney 1 Fairweather FS1 Fairweather FS2 Fairweather FN1 Fairweather FN2	14 nm^2	No federally permitted vessel may fish with bottom contact gear [iii]. 50 CFR 679.22(b)(9)	Same as above
GOA Slope Habitat Conservation Areas	Yakutat Cape Suckling Kayak Island Middleton Island east Middleton Island west Cable Albatross Bank Shumagin Island Sanak Island Unalaska Island	1,892 nm^2	No federally permitted vessel may fish with nonpelagic trawl gear [iv]. 50 CFR 679.22(b)(10)	Same as above
BSAIRA				
Bowers Ridge Habitat Conservation Zone	Bowers Ridge Ulm Plateau	5,330 nm^2	No federally permitted vessel may fish with mobile bottom contact gear [ii]. 50 CFR 679.22(a)(15)	Same as above
Skate Nursery Areas	Bering 1 Bering 2 Bristol Pribilof Zhemchug Pervenets	81.7 nm^2	Monitoring Priority	Federal Register Vol. 80, No. 6 Friday, January 09, 2015 http://alaskafisheries.noaa.gov/frules/80fr1378.pdf



Source: NMFS 2015a

Figure 3.1-8 Habitat Areas of Particular Concern in Alaska Waters

3.1.2.3 Closed Areas

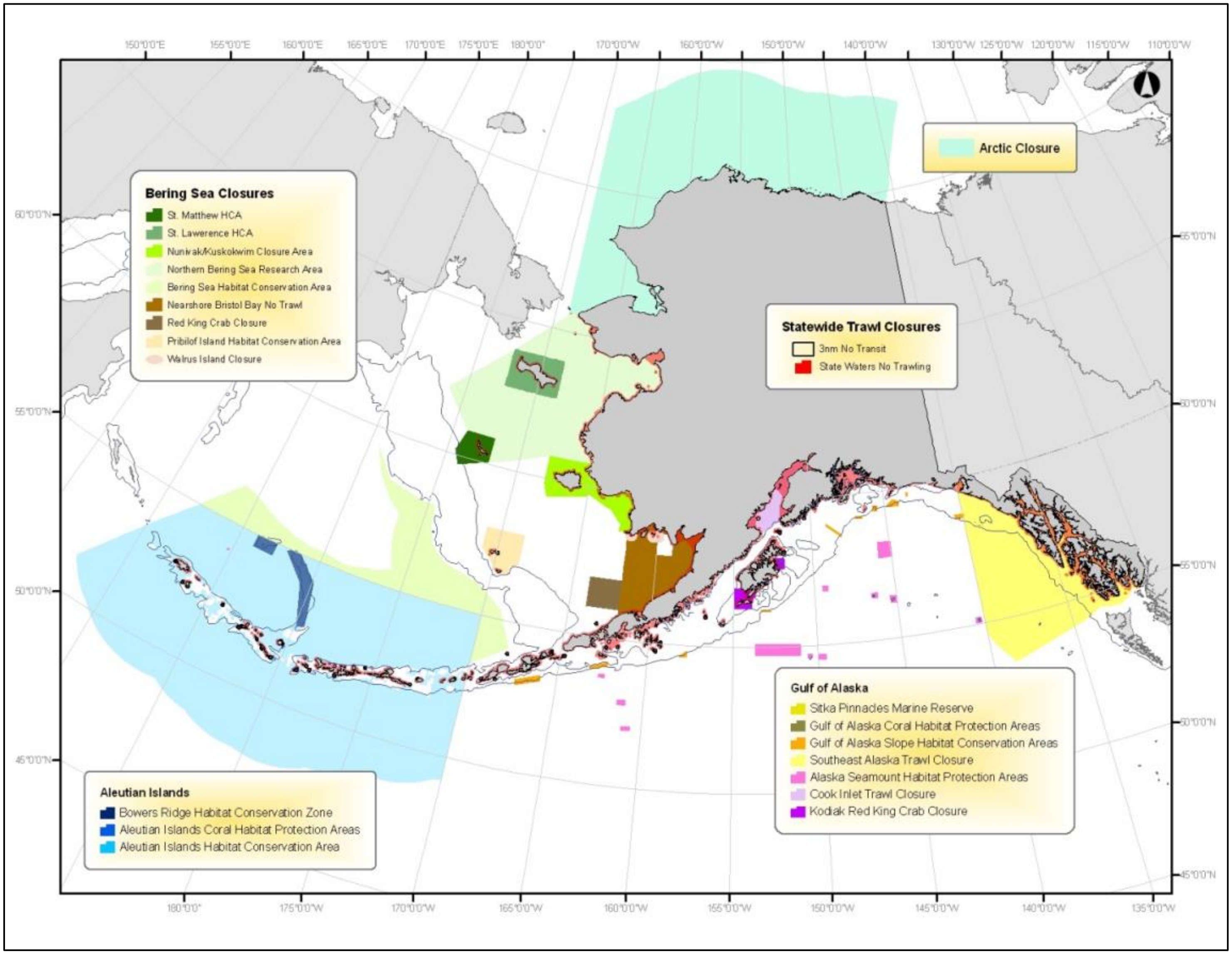
The NPFMC has established seasonal and year-round areas closed to all fishing gear and specific to trawl gear within the three AFSC research areas. Figure 3.1-9 shows the locations of these areas as well as State of Alaska closed areas. Table 3.1-3 provides a complete list of the closed areas, restrictions, and level of government protection. All of these closed areas are also considered MPAs (see Section 3.1.2.4).

Table 3.1-3 Closed Areas in the GOARA and BSAIRA

Closed Area	Restriction	Government
GOARA		
Cook Inlet	Commercial and Recreational Fishing	Federal
Black rockfish closure areas	Commercial fishing	State
Demersal shelf rockfish closed area – Southeast Alaska	Commercial fishing	State
Groundfish Closed Area – Edgecumbe Pinnacles Marine Reserve	Commercial Fishing Restricted	State
Groundfish Pot Fishing Closed Area - Kachemak and Kamishak Bay	Commercial fishing	State
Groundfish Pot Fishing Closed Area - Prince William Sound	Commercial fishing	Federal
Kodiak Island, Trawls Other Than Pelagic Trawls - Type I Closures	Commercial fishing	Federal
Kodiak Island, Trawls Other Than Pelagic Trawls – Type II Closures	Commercial Fishing	Federal
Non-Pelagic Trawl Gear Restriction Area - Alaska Peninsula	Commercial fishing	State
Non-Pelagic Trawl Gear Restricted Area – Alaska Peninsula	Commercial Fishing Restricted	State
Non-Pelagic Trawl Gear Restriction Area - Central Gulf of Alaska	Commercial Fishing Restricted	State
Non-Pelagic Trawl Gear Restriction Area - Eastern Aleutian Islands	Commercial Fishing Restricted	State
Non-Pelagic Trawl Gear Restriction Area - Westward Gulf of Alaska (Restricted Area)	Commercial Fishing Restricted	State
Pollock Trawl Gear Restricted Area - Prince William Sound	Commercial Fishing Restricted	State
Resurrection Bay Lingcod Closure	Commercial Fishing	State
Rockfish, Genus Sebastes, Closed Area - Monashka Bay	Commercial Fishing	State
Scallop Closed Areas - Cook Inlet Districts	Commercial Fishing	State
Scallop Closed Areas - Cook Inlet Outer District	Commercial Fishing	State
Scallop Closed Areas - Kodiak Island to Cape Kumlik	Commercial Fishing	State
Scallop Closed Areas - Prince William Sound Vicinity	Commercial Fishing	State
Scallop Closed Areas - Westward Gulf, South Alaska Peninsula	Commercial Fishing	State
Scallop Commercial Fishery Closed Areas - Yakutat Bay	Commercial Fishing	State
Shrimp Fishery Closure, All gear types - Cook Inlet, Kenai Peninsula	Commercial Fishing	State

Closed Area	Restriction	Government
Shrimp Pot Fishery Closure - Prince William Sound	Commercial Fishing	State
Shrimp Trawl Fishery Closure - Southeast Alaska	Commercial Fishing	State
Shrimp Trawl Fishery Closure - Western and Central Gulf of Alaska	Commercial Fishing	State
Sitka Sound Lingcod Closure	Commercial Fishing	State
Southeast Alaska Dive Fishery Research Areas	Commercial Fishing	State
Southeast Alaska Trawl Closure	Commercial Fishing	Federal
Steller Sea Lion Protection Areas, Gulf of Alaska - Atka Mackerel Closure	Commercial Fishing	Federal
Steller Sea Lion Protection Areas, Gulf of Alaska - Groundfish, Pollock, and Pacific Cod Closures	Commercial Fishing	Federal
Trawl Gear Restricted Areas - Prince William Sound	Commercial Fishing	State
BSAIRA		
Halibut longline closure area	Commercial fishing	Federal
King Crab Closed Areas - St. Matthews, Hall and Pinnacles Islands	Commercial fishing	Federal
Chum salmon saving area	Commercial fishing	Federal
Groundfish Closed Waters – St. Matthew, Hall, & Pinnacle Islands	Commercial Fishing Restricted	State
Red King Crab saving area	Commercial and Recreational Fishing Restricted	Federal
Nearshore Bristol Bay Trawl Closure	Commercial and Recreational Fishing Restricted	Federal
Pribilof Islands Habitat Conservation Area	Commercial and Recreational Fishing Restricted	Federal
Scallop Closed Areas - Western Bering Sea / Aleutian Islands	Commercial Fishing	State
Steller Sea Lion Protection Areas, Aleutian Islands Subarea - Groundfish, Pollock, Pacific Cod, and Atka Mackerel Closures	Commercial Fishing	State
Steller Sea Lion Protection Areas, Aleutian Islands Subarea - Seguam Foraging Area	Commercial Fishing	State
Steller Sea Lion Protection Areas, Bering Sea Subarea - Bogoslof Area	Commercial Fishing	State
Steller Sea Lion Protection Areas, Bering Sea Subarea - Groundfish, Pollock, Pacific Cod, and Atka Mackerel Closures	Commercial Fishing	State
Steller Sea Lion Protection Areas, Bering Sea Subarea - Pollock Restriction Area	Commercial Fishing	State
Zone 1 (512) Closure to Trawl Gear	Commercial Fishing	Federal
Zone 1 (516) Closure to Trawl Gear	Commercial Fishing	Federal
Trawl Gear Restricted Area - Bristol Bay	Commercial Fishing	State
Scallop Closed Areas - Eastern Aleutian Islands	Commercial Fishing	State
Scallop Closed Areas - Eastern Bering Sea	Commercial Fishing	State
Walrus Islands Federal Closures	Commercial Fishing Restricted	State

Source: http://www.mpatlas.org/mpa/sites/8616/



Source: NPFMC 2015b

Figure 3.1-9 Year-round Groundfish Closures in the U.S. EEZ off Alaska

3.1.2.4 Marine Protected Areas

There are 65 MPAs within the GOA and BSAI Research Areas (Tables 3.1-3 and 3.1-4) and one in the Chukchi Sea/Beaufort Sea Research Area.

A MPA is defined by Executive Order (EO) 13158 as "any area of the marine environment that has been reserved by federal, state, tribal, territorial, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein." They are a group of sites, networks, and systems established and managed by federal, state, tribal, and local governments. Most MPAs have legally established goals, conservation objectives, and intended purposes. MPAs generally address one or more of three areas of conservation focus:

Natural Heritage: established and managed wholly or in part to sustain, conserve, restore, and understand the protected area's natural biodiversity, populations, communities, habitats, and ecosystems; the ecological and physical processes upon which they depend; and, the ecological services, human uses and values they provide to this and future generations.

Cultural Heritage: established and managed wholly or in part to protect and understand submerged cultural resources that reflect the nation's maritime history and traditional cultural connections to the sea.

Sustainable Production: established and managed wholly or in part with the explicit purpose of supporting the continued extraction of renewable living resources (such as fish, shellfish, plants, birds, or mammals) that live within the MPA, or that are exploited elsewhere but depend upon the protected area's habitat for essential aspects of their ecology or life history.

MPAs encompass a large portion of the area where research surveys are conducted in the BSAI and GOA. They contain state MPAs, National Wildlife Refuges, National Parks, National Estuarine Research Reserves, and NOAA Fisheries MPAs. MPAs vary widely in the level and type of legal protection afforded to the site's natural and cultural resources and ecological processes. Many of the MPAs within the AFSC Research Areas have various levels of fishing restrictions. Details of MPAs located in Alaska can be found on the NOAA Fisheries – NMFS Alaska Region website at https://alaskafisheries.noaa.gov/habitat/mpa/default.htm.

The only Marine Reserve in Alaska is the Sitka Pinnacles Marine Reserve in Southeast Alaska, near Sitka, AK.

Table 3.1-4 Marine Protected Areas in Alaska

Name	Research Area
Alaska Maritime National Wildlife Refuge[1]	Gulf of Alaska
	Bering Sea/Aleutian Islands
	Chukchi Sea/Beaufort Sea
Alaska Seamount Habitat Protected Area[2]	Gulf of Alaska
Aleutian Islands Coral Habitat Protected Area[2]	Bering Sea/Aleutian Islands
Aleutian Islands Habitat Conservation Area[2]	Bering Sea/Aleutian Islands
Arctic National Wildlife Refuge[1]	Arctic
Bowers Ridge Habitat Conservation Zone[2]	Bering Sea/Aleutian Islands
Glacier Bay National Park and Preserve[1]	Gulf of Alaska
Gulf of Alaska Habitat Conservation Areas[2]	Gulf of Alaska
Gulf of Alaska Coral Habitat Protected Area[2]	Gulf of Alaska

Name	Research Area
Kachemak Bay National Estuarine Research Reserve[2]	Gulf of Alaska
Katmai National Park and Preserve[2]	Gulf of Alaska
Kuskokwim Bay National Estuarine Research Reserve[2]	Bering Sea/Aleutian Islands
Sitka National Historic Park[2]	Gulf of Alaska
Sitka Pinnacles Marine Reserve[2]	Gulf of Alaska
Yukon Delta National Wildlife Refuge[1]	Bering Sea/Aleutian Islands
Walrus Protection Areas[2]	Bering Sea/Aleutian Islands

[1] MPA is part of the National System of MPAs. See http://marineprotectedareas.noaa.gov/nationalsystem/framework/final-mpa-framework-0315.pdf for details.

[2] MPA is eligible, but not part of the National System of MPAs.

Sitka Pinnacles Marine Reserve

The Sitka Pinnacles Marine Reserve in Southeast Alaska encompasses 2.5 square nm of highly productive habitat off Cape Edgecumbe, near Sitka, AK. Fishing for groundfish or anchoring is prohibited (NPFMC 2015). This reserve has been closed to all bottom fishing and anchoring since 1999 to protect lingcod, rockfish, and corals. The pinnacles habitat is fragile, and the concentration of fishes in a compact area can lead to overfishing of certain species, particularly lingcod, at sensitive life stages (NOAA Fisheries 2011). Although the area is relatively small (3.1 mi^2; 8.1 km^2), it encompasses a wide range of depths and a variety of rock habitats. Bottom habitat types include cobble, gravel, and lava flow. Closed area margins occur in water depths between 180 and 150 m. One pinnacle rises 70 m and the other 40 m from the surface (ADFG 2015a).

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 Fish

Several hundred finfish species occur within the three AFSC research areas. There is a general simplification in the diversity of groundfish species in the Bering Sea compared to the more southern regions of the GOA and Washington to California. Certain species inhabiting the Bering Sea are some of the largest groundfish resources found anywhere in the world and there is a fairly complex system for management of these species. Pacific herring management is assigned to the State of Alaska, Pacific salmon in the EEZ is managed jointly with the State of Alaska and NMFS, and Pacific halibut is jointly managed with the IPHC and NMFS. These species are considered to be "prohibited" for catch in commercial groundfish fisheries managed by NMFS and only in a few cases are they targeted by AFSC fisheries research (Table 2.2-1).

This section of the FPEA provides baseline information for all species important to the analysis of effects in Chapter 4. Threatened and endangered fish species (including Pacific salmon and steelhead) are discussed in Section 3.2.1.1. Prohibited fish are discussed in Section 3.2.1.2. Target fish in the GOARA and BSAIRA are discussed in Section 3.2.1.3. Non-managed fish species in the GOARA and BSAIRA are mentioned in Section 3.2.1.4 and Arctic fish resources are discussed in Section 3.2.1.5. It is important to note that the regional FMPs utilize different categories to describe the various managed and non-managed species. These categories have been simplified here in order to more simply describe the impacts of AFSC surveys.

3.2.1.1 Threatened and Endangered Species

There are currently no ESA-listed threatened and endangered fish species that spend their entire life cycle in the AFSC research area. However, a brief discussion of Pacific salmonids is provided below since individuals from threatened and endangered stocks of these species have been found to migrate into AFSC research areas. Additionally, threatened and endangered species and critical habitats under NMFS jurisdiction are described and evaluated in the Biological Assessment (NMFS 2017a) and Biological Opinion (NMFS 2019).

<u>Pacific salmonids</u>

Seven species of salmonids from the genus *Oncorhynchus* occur within the AFSC research areas; five species of Pacific salmon: Chinook (*Oncorhynchus tshawytscha*), chum (*O. keta*), sockeye (*O. nerka*), coho *(O. kisutch*), and pink (*O. gorbuscha*), and two trout species: Steelhead (*O. mykiss*) and coastal cutthroat trout (*O. clarkii clarkii*). Pacific salmon spawn in freshwater and undergo several developmental stages in freshwater until they out-migrate to the ocean as fry or smolts. Juvenile salmon feed and grow to maturity, ranging widely over the North Pacific Ocean, GOA, EBS, and Chukchi Sea. Pacific salmon often migrate tremendous distances to reach their freshwater natal streams, where they spawn and then die.

Steelhead trout (*Oncorhynchus mykiss*) occur along the entire U.S. Pacific Coast from Mexico to Kuskokwim Bay in western Alaska (ADFG 2015b). *O. mykiss* can be anadromous (referred to as steelhead) or freshwater residents (referred to as rainbow trout), and, under some circumstances, can yield offspring of the alternate life history form (72 FR 26722).

Coastal cutthroat trout (*Oncorhynchus clarkii clarkii*) is a subspecies of cutthroat trout that occurs in coastal and freshwaters of the Western U.S. from Southeast Alaska to Northern California (NMFS 1999). *O. clarkii clarkii* can breed more than once in their life and can have a diverse life history, spending their entire life cycle in fresh water or making migrations into saltwater, although they rarely overwinter in the sea (NMFS 1999).

Salmonids are generally abundant in Alaska and this can be attributed to a number of factors. These include (1) an abundance of high quality habitats with minimal impacts from extensive development, (2) favorable ocean conditions that permit high juvenile survival rates, (3) improved fisheries management by state and federal agencies (4) cessation of high-seas driftnet fisheries by foreign nations, (5) hatchery production, and (6) bycatch reduction of other species in commercial fisheries (Heard and Loh 2005). Alaska salmonid management continues to focus on maintaining high quality habitats and ensuring adequate escapements and the AFSC research activities are a significant part of this effort.

No stocks of Pacific salmonids originating from freshwater habitat in Alaska are listed under the ESA, and there are no listed stocks of coastal cutthroat trout anywhere. However, ESA-listed ESUs of Pacific salmon ESUs and distinct population segments (DPSs) of steelhead that originate in freshwater habitat in Washington, Oregon, Idaho, and California migrate into marine waters off Alaska and have been found in coded wire tag retrieval data in Prince William Sound (Brase and Sarafin 2004). In Alaska waters, ESA-listed salmonid stocks mix with hundreds to thousands of other stocks originating from the Pacific coast, Alaska, and Asia.

Table 3.2-1 lists all currently ESA-listed Pacific salmon and steelhead stocks, with those 14 stocks that are likely to migrate into AFSC research areas (NMFS 2015b) noted in the table. No pink salmon stocks are currently listed under the ESA. Of the nineteen listed salmon ESUs, only the Upper Willamette River and Lower Columbia River Chinook salmon ESUs have been recovered in the BSAI groundfish fishery (NPFMC 2009b). Chinook from the Lower Columbia River, Upper Columbia River Spring-run, and Upper Willamette River ESUs have been reported caught as bycatch in GOA trawl fisheries (NPFMC 2014c). For detailed life history information on Pacific salmon ESUs, the reader should refer to the 2005 NOAA Technical Memorandum NMFS-NWFSC-66, Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead, available online at www.nwfsc.noaa.gov.

Table 3.2-1 Occurrence of ESA-listed Salmonid Species within AFSC Research Areas

ESA-listed Species	Status	Likely Ranging in AFSC Research Area Waters
CHINOOK SALMON ESU		
California Coastal	Threatened	
Central Valley Spring- run	Threatened	
Lower Columbia River	Threatened	X
Puget Sound	Threatened	X
Sacramento River Winter-run	Endangered	
Snake River Fall-run	Threatened	X
Snake River Spring/Summer-run	Threatened	X
Upper Columbia River Spring-run	Endangered	X
Upper Willamette River	Threatened	X
CHUM SALMON ESU		
Columbia River	Threatened	
Hood Canal Summer- run	Threatened	X
COHO SALMON ESU		
Central California Coast	Endangered	
Lower Columbia River	Threatened	X
Oregon Coast	Threatened	

ESA-listed Species	Status	Likely Ranging in AFSC Research Area Waters
Southern Oregon/Northern California Coast	Threatened	
SOCKEYE SALMON ESU		
Ozette Lake	Threatened	X
Snake River	Endangered	X
STEELHEAD DPS		
Central Valley	Threatened	
Central California Coast	Threatened	
Lower Columbia River	Threatened	X
Middle Columbia River	Threatened	X
Northern California	Threatened	
Puget Sound	Threatened	
Snake River	Threatened	X
South Central California Coast	Threatened	
Southern California	Endangered	
Upper Columbia River	Threatened	X
Upper Willamette River	Threatened	X

Green Sturgeon - Southern Distinct Population Segment

Green sturgeon (*Acipenser medirostris*) occur in the southern end of the action area. Two DPSs of green sturgeon are recognized based on genetic data and spawning locations: a Northern DPS consisting of populations originating from coastal watersheds north of and including the Eel River (i.e., the Klamath and Rogue rivers); and the Southern DPS of green sturgeon consists of populations originating from coastal watersheds south of the Eel River, with the only known spawning population in the Sacramento River (68 FR 4433; January 29, 2003). On April 7, 2006, NMFS listed the Southern DPS of green sturgeon as threatened under the ESA (71 FR 17757). Based on the 2005 status review, NMFS concluded that the Northern DPS did not warrant listing under the ESA, but designated the species as a NMFS Species of Concern (70 FR 17386; April 6, 2005). A recovery plan has not been prepared for the southern DPS of green sturgeon. Critical habitat for the Southern DPS of green sturgeon was designated on October 9, 2009 (74 FR 52300). There is no reliable population estimate or trend for the Southern DPS of green sturgeon.

Green sturgeon spend a large portion of their lives in coastal marine waters as sub-adults and adults. Therefore, the marine distribution of both DPSs is considerably larger than the limited freshwater habitat, and the marine distribution extends from Mexico into Alaska. The distributions of the northern and southern DPSs of green sturgeon outside of natal waters generally overlap (Erickson and Hightower 2007; Lindley et al. 2008; Moser and Lindley 2007). Both Northern DPS and Southern DPS green sturgeon occupy coastal estuaries and coastal marine waters from southern California to Alaska, including Humboldt Bay, the lower Columbia River estuary, Willapa Bay, Grays Harbor, and coastal waters between Vancouver Island, British Columbia, and southeast Alaska (Israel et al. 2009; Lindley et al. 2008; Moser and Lindley 2007).

Generally, green sturgeon inhabit estuaries on the northern California, Oregon, and Washington coasts during the summer, and move to coastal marine waters along the central California coast and waters off of

Vancouver Island and southeast Alaska over the winter (Lindley et al. 2008). Green sturgeon likely inhabit these estuarine and marine waters to feed and to optimize growth (Moser and Lindley 2007). The large aggregations of these fish that occur in the Columbia River estuary and Washington estuaries include green sturgeon from all known spawning populations (Moser and Lindley 2007). Fish tagging and telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Vancouver Island to Monterey Bay, California (Lindley et al. 2011; Lindley et al. 2008; Moser and Lindley 2007) and within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays (Huff et al. 2012).

The Southern DPS at present contains only a single spawning population in the upper Sacramento River. Recent habitat evaluations conducted in the upper Sacramento River for salmonid recovery planning have indicated that significant green sturgeon habitat was probably altered or made inaccessible by dam construction (NMFS 2015i). Northern DPS green sturgeon primarily spawn in the Rogue River in Oregon and the Klamath-Trinity system in California and occupy coastal areas from Mexico to Alaska.

NMFS designated critical habitat for the threatened Southern DPS on October 9, 2009 (74 FR 52300) but critical habitat for the Southern DPS does not include marine waters of Alaska.

The green sturgeon is infrequently encountered at the extreme boundaries of its range (Colway and Stevenson 2007; Rosales-Casian and Almeda-Jauregui. 2009). In Alaska, green sturgeon are listed as a "nominee" species in the State of Alaska Wildlife Action Plan and designated as a "Species of Greatest Conservation Need" under the Aquatic Habitat Implementation Plan, which is part of the Comprehensive Wildlife Conservation Strategy (NMFS 2015i). The ADFG indicates that information about green sturgeon presence is limited to a few anecdotal reports of sightings and captures in State of Alaska waters, occurring mostly in southeastern Alaska (encompassing the mouths of the Stikine and Taku rivers). ADFG has received no reports of recurrent sightings of sturgeon.

Studies confirm that North American green sturgeon are rare in Alaskan waters (NMFS 2015i). Lindley et al. (2008) tagged 213 sub-adult and adult Northern and Southern DPS green sturgeon from Oregon, Washington, and California and observed only one tagged green sturgeon taken in a commercial gillnet fishery in southeast Alaska, further supporting the assumption that green sturgeon only rarely enter Alaskan waters. The tagged green sturgeon was later confirmed as belonging to the Southern DPS (NMFS 2015e).

The North Pacific Groundfish Observer Program, which observes federal groundfish fisheries off Alaska within the action area, has recorded rare encounters with green sturgeon in trawl fisheries in the Bering Sea for over three decades (1982:1; 1984:2; 2005:1; 2006:3; 2009:1; 2012:1; 2013:1; 2015:1l; reported in NMFS (2015i)). It is unknown whether these green sturgeon belonged to the Northern DPS or the Southern DPS. However, it follows that given the reduced scale of the research surveys as compared to the commercial fisheries that encounters with sturgeon would be even less likely in the research program. In fact, during the same three decade period there have been no takes of green sturgeon reported from any of the fishery surveys considered in the proposed action.

3.2.1.2 Prohibited Species

In Alaska marine waters, several species of fish have been determined to be "prohibited" for catch and sale in commercial groundfish fisheries managed by NMFS. This is primarily due to management agreements between NMFS and either the State of Alaska or the IPHC. Salmonids are described in the ESA-listed species section above; king crab and Tanner crab are described in Section 3.2.5 (invertebrates), Pacific halibut and Pacific herring are described below.

Pacific Halibut

Pacific halibut (*Hippoglossus stenolepis*) range from Santa Barbara, California to Nome, Alaska, along the North American Pacific coastline. Pacific halibut are considered to be a single stock from the U.S. West Coast to the Bering Sea. Pacific halibut are commonly found along the northeast Pacific continental shelf during summer months. Males can grow to exceed 36 kg and can live up to 27 years, and females can grow to over 225 kg and can live up to 42 years.

Spawning takes place from December through February. Adults make seasonal migrations from the summer feeding grounds on the continental shelf to deeper spawning habitats. Most spawning occurs off the continental shelf edge at depths ranging from 400 to 600 m. Males become sexually mature at 7 or 8 years of age, females mature at 8 to 12 years. Fecundity is age related and females over 113 kg may produce up to 4 million eggs annually (Canada 2002). Fertilized eggs float free in the water column for approximately 15 days before hatching. Larvae and post-larvae are pelagic, drifting westward on the prevailing currents for up to another 6 months before eventually reaching shallower waters that serve as nursery grounds (IPHC 1998).

Juvenile halibut spend 5 to 7 years in shallow waters before migrating to feeding or “home” areas. The migration of halibut from their western nursery grounds to home areas appears to be a unidirectional clockwise movement (IHPC 1998).

Pacific Herring

Pacific herring (*Clupeapallasi*) occur from Baja California through the GOA and Bering Sea to Japan. Herring can reach a total length of 46 cm and a weight of 550 grams (NMFS 2015c), but average length in Alaska as reported by Mecklenburg et al. (2002) is 25 cm. In Alaska, Pacific herring begin spawning in mid-March in southeastern Alaska and as late as June in the Bering Sea. Adult Pacific herring migrate inshore, entering estuaries to breed once per year, with timing varying by latitude. They do not feed from the start of this migration through spawning, a period of up to two weeks or so. The herring spawn in shallow areas along shorelines, between the subtidal and intertidal zones. Eggs are deposited on kelp, eelgrass (*Zostera marina*), and other available structures. After spawning, herring return to their summer feeding areas.

It is generally thought that after hatching, herring larvae remain in nearshore waters close to their spawning grounds where they feed and grow in the protective cover of shallow water habitats. After 2 to 3 months, the larvae metamorphose into juveniles. During the summer of their first year, these juveniles form schools in shallow bays, inlets and channels. These schools disappear in the fall and then move to deep water for the next 2 to 3 years.

3.2.1.3 Target Species in the BSAIRA and GOARA

This section presents descriptions of target species encountered during AFSC surveys in the BSAIRA and GOARA between 2009 and 2013, and summarizes life history traits and their environment. For the purposes of this FPEA, target species are those fish which:

- Are managed for commercial fisheries,
- Belong to a species category defined in the regional FMP, and
- Are the subject of AFSC research surveys for stock assessment purposes.

Some management groups in the FMPs are defined as composing a single species, and some consist of several species (known as a “stock complex”). A full list of species and stock complexes can be found in the FMP for each region. Annual Stock Assessment and Fishery Evaluation (SAFE) reports are prepared by AFSC assessment scientists and the NPFMC Plan Teams (committees made up of scientists from the AFSC, ADFG, and other agencies and universities). The SAFE report (e.g., NPFMC 2014d, 2014e) is a scientific account provided to the NPFMC for determining annual commercial harvest specifications; documenting significant trends or changes in stocks, the marine ecosystem, and fisheries over time; and assessing the relative success of existing State and Federal fishery management programs.

All target species that had an average research catch of over one metric ton (mt) (2009 - 2013) within the GOARA are shown in Table 3.2-2; all target species that had an average research catch of over one mt (2009 - 2013) within the BSAIRA are shown in Table 3.2-3. Also shown in these tables is stock status information from the most recent available update (first quarter of 2015, available online at http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html). Stock status is calculated to determine whether or not a stock has overfishing occurring on it, or whether or not it is considered to be overfished. For many species, there is uncertainty in stock status calculations, and for these species stock status is unknown. There are currently no authorized fisheries in the CSBSRA and the species encountered there are discussed in Section 3.2.1.4.

Table 3.2-2 Target Species in the GOARA

Species are listed in alphabetical order of stock name. Only survey species with average total catch greater than one metric ton (1 mt = 1000 kilograms) are listed.

GOA Management Group	Stock Status	Species	*Scientific Name*
Arrowtooth flounder	No overfishing, not overfished	Arrowtooth flounder	*Atheresthes stomias*
Atka mackerel	No overfishing, overfished status unknown	Atka mackerel	*Pleurogrammus monopterygius*
Big skate	No overfishing, overfished status unknown	Big skate	*Beringraja binoculata*
Deep water flatfish	No overfishing, not overfished	Dover sole	*Microstomus pacificus*
Demersal shelf rockfish	No overfishing, overfished status unknown	Yelloweye rockfish	*Sebastes ruberrimus*
Dusky rockfish	No overfishing, not overfished	Dusky rockfish	*Sebastes variabilis*
Flathead sole	No overfishing, not overfished	Flathead sole	*Hippoglossoides elassodon*
Forage fish species	Status unknown	Eulachon	*Thaleichthys pacificus*
Grenadiers	Status unknown	Giant grenadier	*Albatrossia pectoralis*
		Pacific grenadier	*Coryphaenoides acrolepis*
Longnose skate	Status unknown	Longnose skate	*Raja rhina*
Northern Rockfish	No overfishing, not overfished	Northern rockfish	*Sebastes polyspinus*
Other rockfish	No overfishing, overfished status unknown	Harlequin rockfish	*Sebastes variegatus*
		Redbanded rockfish	*Sebastes babcocki*
		Sharpchin rockfish	*Sebastes zacentrus*
		Silvergray rockfish	*Sebastes brevispinis*
Other skates	No overfishing, overfished status unknown	Aleutian skate	*Bathyraja aleutica*
		Bering skate	*Bathyraja interrupta*
Pacific cod	No overfishing, not overfished	Pacific cod	*Gadus macrocephalus*
Pacific Ocean Perch	No overfishing, not overfished	Pacific ocean perch	*Sebastes alutus*

GOA Management Group	Stock Status	Species	*Scientific Name*
Rex sole	No overfishing, not overfished	Rex sole	*Glyptocephalus zachirus*
Rougheye and Blackspotted rockfish	No overfishing, not overfished	Blackspotted rockfish	*Sebastes melanostictus*
		Rougheye rockfish	*Sebastes aleutianus*
Sablefish	No overfishing, not overfished	Sablefish	*Anoplopoma fimbria*
Sculpins	No overfishing, overfished status unknown	Great sculpin	*Myoxocephalus polyacanthocephalus*
		Plain sculpin	*Myoxocephalus jaok*
		Yellow Irish lord	*Hemilepidotus jordani*
Shallow-water flatfish	No overfishing, not overfished	Alaska plaice	*Pleuronectes quadrituberculatus*
		Butter sole	*Isopsetta isolepis*
		English sole	*Parophrys vetulus*
		Northern rock sole	*Lepidopsetta bilineatus*
		Southern rock sole	*Lepidopsetta bilineata*
		Starry flounder	*Platichthys stellatus*
		Yellowfin sole	*Limanda aspera*
Sharks	No overfishing, overfished status unknown	Pacific sleeper shark	*Somniosus pacificus*
		Spiny dogfish	*Squalus suckleyi*
Shortraker rockfish	No overfishing, overfished status unknown	Shortraker rockfish	*Sebastes borealis*
Thornyhead rockfish	No overfishing, overfished status unknown	Longspine thornyhead	*Sebastolobus altivelis*
		Shortspine thornyhead	*Sebastolobus alascanus*
Walleye pollock	No overfishing, not overfished	Walleye pollock	*Gadus chalcogrammus*

Table 3.2-3 Target Species in the BSAIRA

Species are listed in alphabetical order of management group. Only survey species with average total catch greater than one metric ton (1 mt = 1000 kilograms) are listed.

BSAI Management Group	Stock Status	Species	Scientific Name
Alaska plaice	No overfishing, not overfished	Alaska plaice	*Pleuronectes quadrituberculatus*
Arrowtooth flounder	No overfishing, not overfished	Arrowtooth flounder	*Atheresthes stomias*
Atka mackerel	No overfishing, not overfished	Atka mackerel	*Pleurogrammus monopterygius*
Flathead sole	No overfishing, not overfished	Flathead sole	*Hippoglossoides elassodon*
Greenland turbot	No overfishing, not overfished	Greenland turbot	*Reinhardtius hippoglossoides*
Forage fish species	Status unknown	Capelin	*Mallotus villosus*
		Eulachon	*Thaleichthys pacificus*
Grenadiers	Status unknown	Giant grenadier	Albatrossia pectoralis
		Popeye grenadier	Coryphaenoides cinereus
Kamchatka flounder	No overfishing, not overfished	Kamchatka flounder	*Atheresthes evermanni*
Northern Rockfish	No overfishing, not overfished	Northern rockfish	*Sebastes polyspinus*
Other flatfish	No overfishing, overfished status unknown	Rex sole	*Glyptocephalus zachirus*
		Starry flounder	*Platichthys stellatus*
Other rockfish	No overfishing, overfished status unknown	Shortspine thornyhead	*Sebastolobus alascanus*
Pacific cod	No overfishing, not overfished	Pacific cod	*Gadus macrocephalus*
Pacific Ocean Perch	No overfishing, not overfished	Pacific ocean perch	*Sebastes alutus*
Rock soles	No overfishing, not overfished	Northern rock sole	*Lepidopsetta bilineatus*
		Southern rock sole	*Lepidopsetta bilineata*

BSAI Management Group	Stock Status	Species	Scientific Name
Blackspotted and rougheye rockfish	No overfishing, not overfished	Blackspotted rockfish	*Sebastes melanostictus*
		Rougheye rockfish	*Sebastes aleutianus*
Sablefish	No overfishing, not overfished	Sablefish	*Anoplopoma fimbria*
Sculpins	No overfishing, overfished status unknown	Bigmouth sculpin	*Hemitripterus bolini*
		Darkfin sculpin	*Malacocottus zonurus*
		Great sculpin	*Myoxocephalus polyacanthocephalus*
		Plain sculpin	*Myoxocephalus jaok*
		Warty sculpin	*Myoxocephalus verrucosus*
		Yellow Irish lord	*Hemilepidotus jordani*
Shortraker rockfish	No overfishing, overfished status unknown	Shortraker rockfish	*Sebastes borealis*
Skates	No overfishing, not overfished	Alaska skate	*Bathyraja parmifera*
		Aleutian skate	*Bathyraja aleutica*
		Bering skate	*Bathyraja interrupta*
		Commander skate	*Bathyraja lindbergi*
		Leopard skate	*Bathyraja panthera*
		Mud skate	*Bathyraja taranetzi*
		Whiteblotched skate	*Bathyraja maculata*
Walleye pollock	Status unknown	Walleye pollock	*Gadus chalcogrammus*
Yellowfin sole	Not overfished	Yellowfin sole	*Limanda aspera*

The following species accounts cover the most common groups found in the GOARA and BSAIRA, and most are included in both the GOA and BSAI FMPs. The information is primarily from the AFSC website (online at http://www.afsc.noaa.gov/default.htm). Additional species life history information can be found in the following documents: 1) Alaska Groundfish Fisheries PSEIS (NMFS 2004), and 2) the SAFE Reports for the groundfish resources of the BSAI and GOA Regions available online at http://www.afsc.noaa.gov/REFM/Stocks/assessments.htm.

The majority of fish caught by AFSC research were captured by the following surveys:

- Bering Sea Shelf Bottom Trawl Survey;
- Aleutian Islands Biennial Shelf and Slope Bottom Trawl Groundfish Survey;
- Alaska Longline Survey (Gulf of Alaska);
- Gulf of Alaska Biennial Shelf and Slope Bottom Trawl Groundfish Survey;
- ADFG Large-mesh Trawl Survey of Gulf of Alaska and Eastern Aleutian Islands;
- Conservation Engineering (various research activities, Bering Sea);
- Eastern Bering Sea Upper Continental Slope Trawl Survey;
- Conservation Engineering (various research activities, Gulf of Alaska);
- Alaska Longline Survey (Bering Sea); and
- Alaska Longline Survey (Aleutian Islands).

<u>Roundfish</u>

Atka mackerel

Atka mackerel (*Pleurogrammus monopterygius*) is a schooling, semi-demersal species distributed from the east coast of the Kamchatka Peninsula, Russia, throughout the Komandorskiye and Aleutian Islands, north to the Pribilof Islands, and eastward through the GOA to Southeast Alaska. Their center of abundance has been in the Aleutian Islands region, particularly from Buldir Island to Sequam Pass.

Atka mackerel begin to recruit to the commercial fishery at age 2 and many survive to 14 years. Fifty percent of the female population is estimated to have reached maturity at 31 cm (about 3.6 years old). Atka mackerel migrate from the shelf edge to shallow coastal waters (5-30 m) to spawn. Spawning occurs in July -September along the Aleutian Islands. Eggs are adhesive and deposited in rock crevices. These nests are guarded by the males until hatching, which occurs about 40-45 days later. Atka mackerel eat copepods and euphausiids and, in turn, are prey for other fish, seabirds, Steller sea lions, and other marine mammals.

Grenadiers

Grenadiers (Family Macrouridae) are deep-sea fishes related to cods and hakes. In Alaska, they are abundant on slopes but also found in abyssal waters. At least seven species are known in Alaska waters, but only three are found in areas where they can be encountered by commercial fisheries or AFSC surveys. These are the giant grenadier (*Albatrossia pectoralis*), Pacific grenadier (*Coryphaenoides acrolepis*), and popeye grenadier (*Coryphaenoides cinereus*).

Giant grenadier and Pacific grenadier range from Baja California northward along the Pacific coast to Japan, while popeye grenadier range from Oregon northward along the Pacific coast to Japan. Popeye and Pacific grenadiers appear to be most abundant in waters greater than 1,000 m, whereas giant grenadier tends to be found more often at shallower depths. Giant grenadier is caught more often in surveys and in commercial fisheries in Alaska, and appears to be the most abundant and best understood grenadier species. Giant grenadier in Alaska is estimated to have a maximum age of up to 58 years and females appear to be more common at shallower depths.

Pacific Cod

Pacific cod (*Gadus macrocephalus*) is a moderately fast growing and relatively short-lived fish, with a maximum age of approximately 18 years. Females reach 50% maturity at 4.4 years in the GOA and 4.9 years in the eastern Bering Sea (Stark, 2007). Total body length at 50% maturity is significantly smaller (503 mm) in the GOA than in the eastern Bering Sea (580 mm). Similarly, Pacific cod females grow significantly faster in the Bering Sea than in the GOA. Males reach a smaller maximum length in the GOA than females; in contrast, Bering Sea males reach a similar maximum length to females.

Cod are demersal and concentrate on the shelf edge and upper slope (100-250 m) in the winter and move to shallower waters (<100 m) in the summer. Cod prey on clams, worms, crabs, shrimp, and juvenile fish. In turn, they are eaten by halibut and marine mammals.

Pacific cod is managed under two FMPs: one for the Bering Sea/Aleutian Islands region (assessed as two separate stocks – the Eastern Bering Sea stock and the Aleutian Islands stock) and the other for the GOA region.

Walleye Pollock

Walleye pollock (*Gadus chalcogrammus*) is a key species in the Alaska groundfish complex and a target species for one of the world's largest fisheries. Walleye pollock produce the largest catch of any single species inhabiting the 200-mile U.S. EEZ. Alaska pollock is incorporated into many products, including ’fish-sticks’, fast-food fish sandwiches, and imitation crab.

Pollock is a semi-pelagic schooling fish widely distributed in the North Pacific Ocean with the largest concentrations found in the eastern Bering Sea. Pollock are considered a relatively fast growing and short-lived species. Research suggests pollock spawn in primarily two pulses of 4 to 6 weeks, beginning in late February and in mid-April.

Pollock in Alaska is managed as four distinct stocks independent of each other, although some level of interaction between them is likely (NPFMC 2014a). These are the GOA stock, the Eastern Bering Sea Shelf stock, the Aleutian Islands near-shore stock, and the Bogoslof Island stock. The Bogoslof Island stock is considered part of a larger Aleutian Basin stock that also includes fish which inhabit the “donut hole” (international waters in the central Bering Sea between the Russian EEZ and U.S. EEZ). After heavy fishing in the 1980’s, declines in donut hole catch rates prompted a moratorium on fishing there known as the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (CCBSP). As a result, minimal fishing is permitted on the Bogoslof island stock.

Sablefish

Sablefish (*Anoplopoma fimbria*) is a member of the Anoplopomatidae family that includes sablefish and skillfish which occur only in the North Pacific Ocean, the Bering Sea, and adjacent waters from Hokkaido, Japan to Baja, California, with the greatest abundance in the GOA. Adult sablefish occur along the continental slope, shelf gullies, and in deep fjords commonly in depths between 366 m to 914 m, although they have been found in depths of less than 183 m to over 1829 m. Data from an extensive tag-recapture program indicates sablefish have high mobility resulting, in part, on sablefish being the only stock in the Alaska that are managed as a single stock throughout their entire Alaskan range.

Flatfish

Arrowtooth flounder

Arrowtooth flounder (*Atheresthes stomias*) is a relatively large flatfish that ranges from central California to the eastern Bering Sea and currently are the most abundant fish in the GOA. In Alaska waters, arrowtooth flounder are distributed over the continental shelf through age 4 and then at older ages disperse to occupy both the continental shelf and the slope. A huge increase in biomass observed in the 1990s resulted from strong year-classes produced in the 1980s. Because of their abundance, arrowtooth flounder are of substantial ecological importance at higher trophic levels in the GOA food web. Arrowtooth flounder are also known to be voracious predators of juvenile walleye pollock.

Rock sole

Two species of rock sole in Alaska were distinguished in 2000, the northern and southern rock soles (*Lepidopsetta polyxystra and L. bilineata*). Adults of the northern rock sole are found from Puget Sound through the Bering Sea and Aleutian Islands to the Kuril Islands, while the southern rock sole is known from the southeast Bering Sea to Baja California. Their distributions overlap from the far eastern Aleutian Islands and extreme south-eastern Bering Sea to Puget Sound. The northern rock sole spawns in midwinter and spring, and the southern rock sole spawns in summer.

Rock soles grow to approximately 60 cm and can live in excess of 20 years. In the GOA, the northern rock sole reaches 50% maturity at 328 millimeters (mm) total length at an average of 7 years. In the GOA, the southern rock sole reaches 50% maturity at 347 mm total length at an average of 9 years. Adhesive eggs are laid on the bottom and hatch in 6-25 days, depending upon temperature. The larvae develop in the upper water column consuming small zooplankton. Small juveniles can be very abundant in shallow, near-shore waters where they consume polychaetes and small crustaceans.

Yellowfin sole

Yellowfin sole *(Limanda aspera*) is one of the most abundant flatfish species in the eastern Bering Sea and is the target of the largest flatfish fishery in the United States. They inhabit benthic portions of the EBS shelf and are considered one stock. Abundance in the Aleutian Islands region is negligible. Yellowfin sole are distributed in North American waters from off British Columbia, Canada to the Chukchi Sea and south along the Asian coast to about lat. 35 degrees North latitude off the South Korean coast in the Sea of Japan.

Yellowfin sole are a relatively slow growing and long-lived fish species. Adults concentrate on the outer shelf in the winter, and move to the very shallow waters (<30 m) of the inner shelf in April or early May to spawn and feed. Prey includes benthic infauna and epifauna, euphausiids, and fish. Females reach 50% maturity at 30 cm (about 10.5 years old) and are highly fecund, producing one to three million eggs. Annual natural mortality of adults has been estimated to be about 10% (M = 0.12).

Yellowfin sole begin to recruit to trawl fisheries at age 6, but are not fully recruited to all gear types until about age 13. Maximum age for this species is 31 years. The stock has recently been at high population levels due to good recruitment in the early 1970's and low exploitation. Biomass is projected to decline slowly in coming years. The directed fishery typically occurs from spring through December. Yellowfin sole is managed as part of the shallow-water flatfish complex in the GOA.

Rockfish

Dusky rockfish

Dusky rockfish (*Sebastes variabilis*) ranges from southern British Columbia north to the Bering Sea and west to Hokkaido Island, Japan, but appear to be abundant only in the GOA. Adult dusky rockfishes are concentrated on offshore banks and near gullies on the outer continental shelf at depths of 100 to 200 m. Like many rockfishes in Alaska, dusky rockfishes are long-lived and have been aged as old as 76 years.

Northern rockfish

Northern rockfish (*Sebastes polyspinis)* has one of the most northerly distributions among the 60+ species of *Sebastes* in the North Pacific Ocean. It ranges from Southeast Alaska around the northern Pacific Rim to eastern Kamchatka and the northern Kurile Islands and also north into the eastern Bering Sea. GOA northern rockfishes grow significantly faster and reach a larger maximum length than Aleutian Islands northern rockfishes.

Little is known about the life history of northern rockfish. Like other species of Sebastes they have internal fertilization of eggs and bear live young. Parturition (larval release) occurs in the spring and is completed by summer. They attain a maximum age of about 70 years. The preferred habitat of adult northern rockfish in the GOA is relatively shallow rises or banks on the outer continental shelf at depths of approximately 75-150 m. The highest concentrations of northern rockfishes appear to be associated with relatively rough (variously defined as hard, steep, rocky, or uneven) bottom on these banks. Older juveniles (>20 cm) are found on the continental shelf, generally at locations inshore of the adult habitat. Northern rockfishes are generally planktivorous and eat mainly euphausiids and calanoid copepods. Predators of northern rockfish are not well documented, but likely include larger fish, such as Pacific halibut, that are known to prey on other rockfish species.

Pacific ocean perch

Pacific ocean perch (*Sebastes alutus*) has a wide distribution in the North Pacific from southern California around the Pacific rim to northern Honshu, Japan, including the Bering Sea. Pacific ocean perch appears to be most abundant in northern British Columbia, the GOA, and the Aleutian Islands. Adults are found primarily offshore on the outer continental shelf and the upper continental slope in depths 150-420 m. Seasonal differences in depth distribution have been noted by many investigators. In the summer, adults inhabit shallower depths, especially those between 150 and 300 m. In the fall, adults apparently migrate farther offshore to depths of approximately 300-420 m. They reside in these deeper depths until about May, when they return to their shallower summer distribution.

Their seasonal distribution pattern is probably related to summer feeding and winter spawning. Although small numbers of Pacific ocean perch are dispersed throughout their preferred depth range on the continental shelf and slope, most of the population occurs in patchy, localized aggregations. Pacific ocean perch are generally considered to be semi-demersal, but there can be a significant pelagic component to their distribution. Pacific ocean perch often move off-bottom at night to feed, apparently following diel euphausiid migrations.

Rougheye and blackspotted rockfish

Rougheye rockfish (*Sebastes aleutianus*) and blackspotted rockfish (*Sebastres melanostictus*) are managed as a single stock complex. They were once considered the same speices but genetic analysis (Orr and Hawkins 2007) has determined that they are separate species. Rougheye rockfishes are found along the continental slope from the eastern Aleutian Islands to southern Oregon. Blackspotted rockfish is distributed along the continental slope from slope from Japan, through the Aleutian Islands and to Southern California

In the GOA, as adults they inhabit a narrow band along the upper continental slope at depths of 200-500 m; outside of this depth interval, abundance decreases considerably. Adults average around 40 cm in length and are likely the longest lived fish with a reported maximum age of 200 years.

Rougheye and blackspotted rockfish often co-occur with shortraker rockfish (*Sebastes borealis*) in trawl or longline hauls. Rougheye and blackspotted rockfish grow slowly and have a late age-at-maturity. Like other rockfish, they are ovoviviparous, where fertilization and incubation of eggs is internal and embryos receive at least some maternal nourishment. Studies on maturity and fecundity of rougheye and blackspotted rockfish in Alaska are ongoing. One study on their reproductive biology indicated that they had protracted reproductive periods, and that parturition (larval release) may take place in December through April. Adults are known to inhabit particularly steep, rocky areas of the continental slope, with highest catch rates generally at depths of 300 to 400 m in longline surveys and at depths of 300 to 500 m in bottom trawl surveys and in the commercial trawl fishery. Food habit studies in Alaska indicate that the diet of rougheye and blackspotted rockfish is primarily shrimp (especially pandalids) and that various fish species such as myctophids are also consumed.

Shortraker rockfish

Shortraker rockfish (*Sebastes borealis*) ranges from southeastern Kamchatka, north into the Bering Sea, through the Aleutian Islands and GOA, and south to southern California. The center of abundance appears to be Alaskan waters. Shortraker rockfish attains the largest size of all *Sebastes*, with a maximum reported total length of 120 cm. Little is known about the life history of shortraker rockfish. Genetic techniques have been used recently to identify a few post-larval shortraker rockfishes from samples collected in surface waters far offshore in the GOA, which is the only documentation of habitat preference for this life stage. Few specimens of juvenile shortraker rockfish <35 cm fork length have ever been caught in the GOA, so information on this life stage is virtually unknown. Adults are concentrated in a narrow band along the 300-500 m depth interval of the continental slope. Much of this habitat is steep and difficult to trawl in the GOA, and observations from a manned submersible also indicate that shortraker rockfishes seem to prefer steep slopes with frequent boulders. Shortraker rockfish is believed to be one of the longest-lived of all fish in the northeast Pacific, and some individuals may reach a maximum age >120 years.

<u>Sculpins</u>

Sculpins belong to the superfamily *Cottoidea* in the order *Scorpaeniformes*, and are found in both freshwater and marine habitats. Sculpins are distributed throughout the BSAI and GOA and they occupy all benthic habitats and depths. They are relatively small, benthic-dwelling teleost fish with modified pectoral fins that allow them to grip the substrate, and they lack swim bladders (NPFMC 2014a). Sculpins are generally not targeted by commercial or recreational fisheries in Alaska

<u>Skates</u>

The family *Rajidae*, commonly known as skates and rays, includes about 280 species of primarily benthic fishes found throughout the world's oceans from tropical to cold temperate latitudes. At least 14 species of skates are known to occur in the GOA, AI and EBS from 8 m to depths of over 1500 m. Many of these species are widely distributed, with ranges extending south along the coast of North America as well as into the western North Pacific, Sea of Okhotsk, and Sea of Japan.

Alaska's skate fauna includes representatives of several genera, the most important of which are *Raja* and *Bathyraja*. The genus *Raja*, commonly known as the "stiff-snout" skates because they have a robust rostral cartilage, includes approximately 30 species worldwide and a North Pacific assemblage of 6 species ranging from the Gulf of California to the Bering Sea and into the western North Pacific. There are two *Raja* species common in the GOARA and occasionally found in the BSAIRA: longnose skate, *Raja rhina*, and big skate, *Beringraja binoculata* (formerly *Raja binoculata*). Big skate and longnose skate are commonly caught in AFSC research.

The genus *Bathyraja*, also known as the "soft-snout" skates due to their flexible rostral cartilage, includes over 40 species distributed throughout the world's oceans. *Bathyraja* is the most broadly distributed and most diverse of all the skate genera, and the greatest diversity of *Bathyraja* occurs in the North Pacific. Most of Alaska's skate species are included in this genus. Skates are generally not targeted by commercial or recreational fisheries in Alaska but are often retained, especially larger specimens.

The skate community varies substantially among regions and depth zones. In the GOARA, big and longnose skates are the most abundant species and occur mainly on the shelf, while *Bathyraja* species dominate on the slope. In the BSAIRA, the EBS shelf is dominated by a large population of a single species, Alaska skate, *Bathyraja parmifera*. Skate diversity is much higher on the EBS slope and in the AI, and big and longnose skates are rare in the BSAI.

Sharks

There are three species of sharks that are abundant in Alaska waters: Pacific sleeper shark (*Somniosus pacificus*), salmon shark (*Lamna ditropis*), and spiny dogfish (*Squalus suckleyi*). Currently there is no directed commercial fishing for these species, but they are caught incidentally in other fisheries and as recreation in Prince William Sound. Little is known about these sharks' life histories in Alaska, but research on their ages, natural mortality, movements, diets, and maturity is ongoing.

Pacific sleeper shark

Pacific sleeper sharks are the largest of the shark species encountered in the GOA and Bering Sea, with maximum size estimated between 4.3 and 7 m. This species ranges as far north as the Arctic Circle in the Chukchi Sea, west off the Asian coast and the western Bering Sea, and south to California. The species feeds mostly on fish, cephalopods, and sometimes marine mammals, and although they were once thought to be bottom dwelling, it is now known that they use much of the water column. This species has proven very difficult to age and due to the large size they are difficult to sample. Thus, their growth, longevity, the age at which they become mature, and the length of gestation are all unknown.

Salmon shark

Salmon sharks range from Japan through the Bering Sea and GOA and south to Baja, Mexico. Tagging studies show that some animals may migrate thousands of kilometers south while others may over winter in Alaskan waters. Salmon shark tend to congregate during the summer in areas with dense salmon runs, especially Prince William Sound, Alaska, but they also feed on squid, sablefish, rockfish, eulachon, spiny dogfish, arrowtooth flounder, and Pacific cod.

Spiny dogfish

Spiny dogfish (*Squalus suckleyi*) in the North Pacific Ocean were until recently considered the same species as those spiny dogfish (*S. acanthias*) found on the U.S. east coast and other oceans of the world but were redefined as a separate species in 2010. They range from the Bering Sea to the Baja Peninsula with the center of abundance believed to be in the waters around Washington State and British Columbia (Canada). Spiny dogfish are among the longest lived and slowest growing of all shark species studied, living to 100 years or more and females do not reach maturity until they are 36 years old. This species bears live young, with females bearing on average nine pups after a roughly two year gestation. Data suggests potential for skipped spawning occurrences. Diet studies have shown that spiny dogfish do not target specific prey. Instead, they are opportunistic, feeding on whatever is available. Tagging studies are showing that spiny dogfish can undertake large scale migrations, moving from Canadian waters to Japan or Mexico, and they may inhabit areas previously unknown, such as pelagic waters far from shore.

3.2.1.4 Other Species in the GOARA and BSAIRA

Hundreds of fish species have been caught during the course of AFSC research that may not be subject to formal stock assessments or belong to one of the categories above. Table 3.2-4 displays a list of these species that have an average catch of over 1 mt per year during AFSC surveys in the BSAIRA or GOARA during 2009-2013.

Table 3.2-4 Other Species in the GOARA and BSAIRA with Greater than 1000 kg Average Annual Research Catch

Species are listed in alphabetical order. Only species with average total catch greater than one metric ton (1 mt = 1000 kilograms) are listed.

Species	Scientific Name	Research Area Where Average Take is Greater than 1mt
Arctic cod	*Boreogadus saida*	BSAIRA
Lingcod	*Ophiodon elongatus*	GOARA
Saffron cod	*Eleginus gracilis*	BSAIRA
Spotted ratfish	*Hydrolagus colliei*	GOARA
Western eelpout	*Bothrocara zestum*	BSAIRA

3.2.1.5 Fish Species in the Chukchi Sea and Beaufort Sea

The Alaska portion of the Chukchi and western Beaufort seas support at least 107 fish species, representing 25 families (Mecklenburg et al. 2002, Logerwell and Rand 2010, Love 2005, Harris 1993, Johnson et al. 2010). Families and sub-families include lampreys, sleeper sharks, dogfish sharks, herrings, smelts, whitefish, trout and salmon, lanternfish, cods, sticklebacks, greenlings, sculpins, sailfin sculpins, fathead sculpins, poachers, lumpsuckers, snailfish, eelpouts, pricklebacks, gunnels, wolffish, sand lances, and righteye flounders. Forty-nine known species are common to the Beaufort and Chukchi seas.

Compared to the Bering Sea or GOA, little is known about the ecology and life-histories of offshore marine fishes of the Chukchi or Beaufort Seas. A significant amount of information about fish populations in the region as of 2009 can be found in NPFMC (2009a). However, developing oil and gas prospects in Alaskan Arctic waters and climate change concerns have stimulated increased research effort in the area, especially recently.

Many fish species have been found to occur in both the Beaufort and Chukchi Seas. Frost and Lowry (1984) concluded that Arctic cod may be the most important secondary consumer in the Arctic, in addition to providing the bulk of the diet of ringed seals, several species of seabirds, and to some extent beluga whales. Mecklenburg et al. (2002) indicate the Alaska plaice is fairly abundant in the Chukchi Sea based on UAF surveys conducted in 1990 and 1991, and may occur in the Beaufort Sea. Starry flounder are abundant in the Bering Sea, and present in the Chukchi and Beaufort Seas. Logerwell and Rand (2010) includes a comparison of species presence in recent Bering, Chukchi, and Beaufort Sea surveys and notes that Bering flounder, walleye pollock, and multiple species of snailfish, sculpin and eelpout are found in all of them.

During a 2008 Beaufort Sea survey, Logerwell and Rand (2010) identified four fish species that represented extensions of then known ranges. Fish assemblages and populations in other marine ecosystems of Alaska (e.g., GOA, Bering Sea) have undergone observable shifts in diversity, distribution, and abundance during the last 20 to 30 years, and these recent findings suggest that a similar trend is occurring in the Arctic, indicating it is likely that much existing research no longer accurately and precisely reflects the current distribution, abundance, and habitat-use patterns of fish resources in the Chukchi and Beaufort seas. It is also reasonable to suggest that because of the sparseness of data from limited surveys in the past, previously undocumented species or behaviors observed in recent studies may simply be the result of differential sample locations.

An Arctic FMP was approved in August of 2009 by the NPFMC to address Arctic fisheries issues. The NPFMC's policy as articulated in the plan is to "prohibit commercial harvest of all fish resources of the Arctic Management Area until sufficient information is available to support the sustainable management of a commercial fishery" (NPFMC 2009a). No timeline has been set for such a decision to be made but the Arctic FMP does outline several target and ecosystem component species groups based on information available during its development. Species that had an average annual research catch of over ten kilograms (2009-2013) within the CSBSRA are shown in Table 3.2-5, along with the Arctic management group they belong to.

Table 3.2-5 All Species in the CSBSRA with Greater than 10 kg Average Research Catch

Species are listed in alphabetical order of management group. Only species with average catch greater than 10 kilograms per year (in years when surveys are conducted) are listed.

Arctic Management Group	Arctic FMP Stock Status	Species	Scientific Name
Arctic cod	Not overfished	Arctic cod	*Boreogadus saida*
Ecosystem Component Species	Overfishing unknown	Alaska Plaice	*Pleuronectes quadrituberculatus*
		Arctic staghorn sculpin	*Gymnocanthus tricuspis*
		Bering flounder	*Hippoglossoides robustus*
		Capelin	*Mallotus villosus*
		Pacific sand lance	*Ammodytes hexapterus*
		Polar eelpout	*Lycodes turneri*
		Rainbow smelt	*Osmerus mordax*
		Slender eelblenny	*Lumpenus fabricii*
		Starry flounder	*Platichthys stellatus*
		Variegated snailfish	*Liparis gibbus*
		Warty sculpin	*Myoxocephalus verrucosus*
		Yellowfin sole	*Limanda aspera*
Saffron cod	Not overfished	Saffron cod	*Eleginus gracilis*

Chukchi Sea

Fish surveys in the Chukchi region have been deployed occasionally (see Frost and Lowry 1983, Barber et al. 1997), but have increased in recent years due to increased interest in oil and gas exploration and climate change (e.g., multiple studies related to the Chukchi Sea Environmental Studies Program (CSESP 2015, the Arctic Ecosystem Integrated Survey)). Thedinga et al. (2013) sampled nearshore areas from 2007 to 2009 using beach seines and small bottom trawls. They found that nearshore areas are used by several species of fish, with high capelin and Pacific sand lance catches in beach seines, and that Arctic cod were predominant in deeper water trawls. Capelin appear to be rare in offshore Chukchi surveys and, as noted in Thedinga et al. (2013), there may be a seasonal component to their distribution.

The CSESP is a multi-year study of the oceanography of the Chukchi Sea meant to support environmental baselines for oil and gas exploration. Under CSESP, Goodman et al. (2012) deployed pelagic and benthic trawl tows in select areas within the Hanna Shoal area northwest of Barrow. The overall density of individuals in pelagic catches was very low but dominated by jellyfish, Pacific sandlance, and Arctic cod. Bottom trawl catches were dominated by brittle stars, snow crab, hermit crab, and Arctic cod.

Gallaway and Norcross (2011) analyzed available data collected within an offshore oil lease area (Lease Sale 193) and found that gadidae, cottidae and stichaeidae (pricklebacks) were the most prevalent fish families, with Arctic cod dominating the gadids with sculpins and pricklebacks being more diverse.

Beaufort Sea

Fish surveys in the Beaufort Sea have been deployed occasionally since the mid 1970's (e.g., see Pirtle and Mueter 2011; Frost and Lowry 1983; Moulton and Tarbox 1987, and the current Arctic Coastal Ecosystem Surveys) and also have been increasing in frequency in recent years due to expanded interest in oil and gas development and climatic change. In 1988, 1990, and 1991, Jarvela and Thorsteinson (1999) sampled the nearshore waters of the central Beaufort Sea from the Colville Delta eastward to the region east of Barter Island. Arctic cod, capelin, and liparids were the most common offshore or marine fishes collected by purse seine and surface tow net; amphidromous Arctic cisco were also collected. Sampling gear focused on juvenile fishes, with age 0 cod and capelin abundance fluctuating, presumably because of oceanographic conditions. Johnson et al. (2010) sampled nearshore areas of Cooper Island farther west several years later and concluded that there was some continuity of fish species composition in the nearshore environment.

A major species of finfish in offshore portions of the Beaufort Sea is the Arctic cod (*Boreogadus saida*), a gadid that can be seasonally abundant but may not occur in commercially exploitable quantities in Alaska waters; data are not yet available to assess the stock dynamics of Arctic cod in the Arctic offshore of Alaska. Arctic cod are distributed throughout the circumpolar north, and may be found throughout the Beaufort and Chukchi Seas. Andriyashev (1964) noted that the species (called polar cod at the time) was widespread not only in the marginal seas of the Arctic Ocean but throughout the ocean to the extreme north.

The benthic offshore community includes Arctic cod, saffron cod, eelpouts and sculpins (Frost and Lowry 1983; Moulton and Tarbox 1987; Barber et al. 1997; Jarvela and Thorsteinson 1999). Arctic cod is a particularly important component of the food web of the Beaufort Sea because they are prey for seals, seabirds and beluga whales (Bradstreet et al. 1986). Smelt are thought to be one of the most common pelagic marine fish in the Beaufort Sea and are prey for beluga whales, arctic cod and marine birds (Norton and Weller 1984). Large winter aggregations of Arctic cod have been recently discovered hydroacoustically under sea ice cover in Franklin Bay, SE Canadian Beaufort Sea (Benoit et al., 2008). The estimated total biomass of cod would amply satisfy the requirements of predators, mostly seals. Thus, "dense accumulations of Arctic cod in embayments in winter likely play an important role in structuring the ecosystem of the Beaufort Sea" (Benoit et al., 2008).

Logerwell and Rand (2010) conducted a study in the western Beaufort Sea as part of a joint effort with NMFS, the University of Washington, and the University of Alaska Fairbanks. Researchers surveyed offshore marine fish and invertebrates and the physical and biological oceanography in the area between Cape Simpson to Cape Halkett. Both demersal and pelagic fish were most common along the outer edge of the continental shelf, particularly in the northwest portion of the Beaufort Sea. Range extensions were increased for four fish species based on data from this study. Thirty-eight species of fish were identified, with Arctic cod making up 80 percent of the total weight and several species of eelpouts accounting for 13 percent. Arctic cod occurred at all bottom trawl stations and were also the dominant catch in the mid-water hauls by weight and numbers. The second most prevalent species in the mid-water hauls were jellyfish (*Chrysaora* sp., *Cyanea* sp., and unidentified).

3.2.2 Marine Mammals

The marine mammal species listed in Table 3.2-6 occur in the GOARA, BSAIRA, and CSBSRA. The USFWS has jurisdiction over Pacific walrus, sea otters and polar bears. The remaining marine mammal species are under the jurisdiction of NMFS. All marine mammals are federally protected under the U.S. MMPA. In addition, eight species of whales and one pinniped species occurring in the AFSC research areas are listed as endangered under the ESA. One pinniped, the northern sea otter (Southwest Alaska DPS), and the polar bear are listed as threatened under the ESA. The Pacific walrus is a candidate species for listing (Table 3.2-6). By default, all species listed under the ESA as threatened or endangered are also considered depleted under the MMPA. Species may be considered depleted without being ESA listed, as is the case for the AT1 transient stock of killer whales and the Eastern Pacific stock of northern fur seals. The survey areas also encompass designated critical habitat for several species. Threatened and endangered species occurring in the AFSC survey areas are described in Section 3.2.2.2. Additionally, threatened and endangered species and critical habitats under NMFS jurisdiction are described and evaluated in the Biological Assessment (NMFS 2017a) and Biological Opinion (NMFS 2019). Non-ESA listed marine mammals that have historically been taken during AFSC fisheries research activities and those not historically taken but for which takes are requested by AFSC in the LOA Application are described in Section 3.2.2.3. Information provided here summarizes data on stock status, abundance, density, distribution and habitat, and auditory capabilities, as available in published literature and reports, including marine mammal stock assessments.

Table 3.2-6 Marine Mammal Species and Stocks Occurring in the GOARA, BSAIRA, and CSBSRA

Species		GOARA	BSAIRA	CSBSRA	Federal ESA/MMPA Status[1]
Common Name	Scientific Name				
CETACEANS					
Beluga whale	*Delphinapterus leucas*				-
Beaufort Sea stock			X	X	-
Eastern Chukchi Sea stock			X	X	-
Eastern Bering Sea stock			X		-
Bristol Bay stock			X		-
Cook Inlet stock		X			Endangered
Killer whale	*Orcinus orca*				-
Eastern North Pacific Alaska Resident stock		X	X		-
Eastern North Pacific Northern Resident stock		X			-
Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient stock		X	X	X	-
AT1 Transient stock		X			Depleted
West Coast Transient stock		X			-
Eastern North Pacific Offshore Stock		X	X		-
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*	X	X		-

Species		GOARA	BSAIRA	CSBSRA	Federal ESA/MMPA Status[1]
Common Name	**Scientific Name**				
Harbor porpoise	*Phocoena phocoena*				-
Southeast Alaska stock		X			Strategic
Gulf of Alaska stock		X			Strategic
Bering Sea stock			X	X	Strategic
Dall's porpoise	*Phocoenoides dalli*	X	X		-
Sperm whale	*Physeter macrocephalus*	X	X		Endangered
Baird's beaked whale	*Berardius bairdii*	X	X		-
Cuvier's beaked whale	*Ziphius cavirostris*	X	X		-
Stejneger's beaked whale	*Mesoplodon stejnegeri*	X	X		-
Gray whale	*Eschrichtius robustus*				
Eastern North Pacific stock		X	X	X	Delisted[2]
Western North Pacific stock [3]		X	X		Endangered
Humpback whale	*Megaptera novaeangliae*				
Western North Pacific stock		X	X	X	Endangered
Central North Pacific stock		X	X		Endangered
Blue whale	*Balaenoptera musculus*	X	X		Endangered
Fin whale	*Balaenoptera physalus*	X	X	X	Endangered
Sei whale	*Balaenoptera borealis*	X	X		Endangered
Minke whale	*Balaenoptera acutorostrata*	X	X	X	-
North Pacific right whale	*Eubalaena japonica*	X	X		Endangered
Bowhead whale	*Balaena mysticetus*		X	X	Endangered
PINNIPEDS					
Steller sea lion	*Eumetopias jubatus*				
Eastern DPS		X			Delisted [4]
Western DPS		X	X		Endangered
Northern fur seal	*Callorhinus ursinus*	X	X		Depleted [5]
California sea lion	*Zalophus californianus*	X	X		-
Harbor seal	*Phoca vitulina richardii*				-
Aleutian Islands stock			X		-
Pribilof Islands stock			X		-
Bristol Bay stock			X		-
North Kodiak stock		X			-
South Kodiak stock		X			-
Prince William Sound stock		X			-

Species		GOARA	BSAIRA	CSBSRA	Federal ESA/MMPA Status[1]
Common Name	**Scientific Name**				
Cook Inlet/Shelikof stock		X			-
Glacier Bay/Icy Strait stock		X			-
Lynn Canal/Stephens stock		X			-
Sitka/Chatham stock		X			-
Dixon/Cape Decision stock		X			-
Clarence Strait stock		X			-
Spotted Seal	*Phoca largha*		X	X	-
Bearded seal [6]	*Erignathus barbatus*		X	X	Strategic
Ringed seal	*Phoca hispida*		X	X	Threatened
Ribbon seal	*Histriophoca fasciata*		X	X	-
Northern elephant seal	*Mirounga angustirostris*	X	X		-
Pacific walrus [7]	*Odobenus rosmarus*		X	X	Candidate
MUSTELID					
Northern sea otter[7]	*Enhydra lutris kenyoni*	X	X	X	Threatened[8]
URSID					
Polar bear [7]	*Ursus maritimus*		X	X	Threatened

1. Denotes ESA listing as either endangered or threatened, or MMPA listing as depleted or strategic. All ESA-listed species or stocks are considered depleted and strategic. Depleted species or stocks are not necessarily ESA-listed, but are considered strategic. Stocks may be considered strategic without being ESA-listed or designated depleted under the MMPA.
2. The eastern North Pacific stock of gray whales was removed from the list of threatened and endangered species in 1994; the western North Pacific stock remains endangered.
3. The western North Pacific (WNP) stock of gray whales feeds in summer and fall in the Okhotsk Sea, Russia. Historically, wintering areas included waters off Korea, Japan, and China. Recent tagging, photo-identification, and genetics studies suggest that some WNP gray whales migrate to the eastern North Pacific (ENP) in winter, including off Canada, the U.S., and Mexico (Lang et al. 2011, Mate et al. 2011, Weller et al. 2012, Urbán et al. 2013). Recent tagging data of a female that traveled roundtrip between Sakhalin Island and Baja California, Mexico suggests that some presumed WNP gray whales may actually be ENP gray whales (Mate et al. 2015).
4. In November 2013, NMFS issued a final rule to remove the eastern distinct population segment (DPS) of Steller sea lions from the List of Endangered and Threatened Wildlife (78 FR 66140, November 4, 2013).
5. Eastern Pacific stock
6. The U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB) in July 2014. The decision vacated NMFS' listing of the Beringia DPS of bearded seals as a threatened species. In September 2014, the Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision.
7. Under the jurisdiction of the U.S. Fish and Wildlife Service
8. Only the Southwest Alaska DPS is listed under the ESA.

3.2.2.1 Marine Mammal Acoustics and Hearing

Since the potential effects of sound on marine mammal species present in the Research Action Areas involves analysis of the manner in which sound interacts with the physiology of marine mammals and the potential responses of those animals to sound[9], general information about sound and marine mammal hearing is provided in this section and potential effects of sound on marine mammal species is provided in Chapter 4, Section 4.2.4.

Understanding the frequency ranges marine mammals are able to hear described in this section is essential to the consideration of the effects of ecosystem research activities and the IPHC fishery-independent research activities to marine mammals specified in AFSCs LOA Application and explained in regulations to be issued under the MMPA. The exposure estimates associated with the activities specified in the LOA Application (see Appendix C) and the proposed rule (available at https://www.federalregister.gov/documents/2019/02/27/2019-02738/taking-and-importing-marine-mammals-taking-marine-mammals-incidental-to-southeast-fisheries-science) were considered in addition to other factors that may affect the impacts of those exposures on marine mammals.

Overview of Sound and Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals because they rely on sound to obtain detailed information about their surroundings, communicate, navigate, reproduce, socialize and avoid predators. Thus, the surrounding soundscape is a key component of marine mammal habitat and can be considered their acoustic habitat (Clark et al. 2009). Underwater sound comes from numerous natural sources (biological and physical processes) and anthropogenic sources. Biological sounds include marine life (marine mammals, fish, snapping shrimp). Physical sounds include wind and wave activity, rain, cracking sea ice, undersea earthquakes and volcano eruptions. Anthropogenic sound includes shipping and other vessel traffic, military activity, marine construction, oil and gas exploration and more. Some of these natural and anthropogenic sounds are present more or less everywhere in the ocean all of the time, therefore, background sound in the ocean is commonly referred to as “ambient noise” (DOSITS 2019).

Sound travels in waves, the basic components of which make up frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the “loudness” of a sound and is typically described using the relative unit of the dB. When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources). The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones. The sum of various natural and anthropogenic sound sources that comprise ambient noise at any given location and time depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on numerous varying factors, ambient noise levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 dB from day to day (Richardson et al. 1995). The result is that, depending on the source type and its intensity,

[9] For example, predicting how many marine mammals could be harassed required potential effects to be evaluated within the context of applicable laws and regulations. Both the MMPA and ESA require all anticipated responses to sound resulting from the proposed research activities be considered relative to their potential impact on animal growth, survivability and reproduction. Although a variety of effects may result from an acoustic exposure, not all effects will impact survivability or reproduction (e.g., short-term changes in respiration rate would have no effect on survivability or reproduction).

sound from a specified activity may be a negligible addition to the local soundscape or could form a distinctive signal that may affect marine mammals.

The sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can be an important component of total sound at frequencies above 500 Hz and possibly down to 100 Hz during quiet times. Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. In deep water, low-frequency ambient sound from 1-10 Hz mainly comprises turbulent pressure fluctuations from surface waves and the motion of water at the air-water interface. At these frequencies, sound levels depend only slightly on wind speed. Between 20-300 Hz, distant ships transiting dominates wind-related sounds. Above 300 Hz, the ambient sound level depends on weather conditions, with wind- and wave-related effects mostly dominating the soundscape. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly.

In the Research Action Area, existing anthropogenic sources includes shipping and other vessel traffic, pile driving for various activities, geophysical surveys for research and other purposes, fisheries, and military activity.

For frequency ranges marine mammals are able to hear, current data indicates not all marine mammal species have equal hearing capabilities (e.g., Richardson et al. 1995; Wartzok and Ketten 1999; Au and Hastings 2008). To reflect this, Southall et al. (2007, 2019) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (i.e., low-frequency cetaceans). Subsequently, NMFS described generalized hearing ranges for these marine mammal hearing groups in their revision to the technical guidance for assessing effects of anthropogenic sound published in April 2018[10] (NMFS 2018). Generalized hearing ranges were chosen based on the approximately 65 decibel (dB) threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall et al. (2007) retained. Marine mammal hearing groups and their associated hearing ranges are depicted in Table 3.2-7 below.

Table 3.2-7 Hearing Groups of Marine Mammals

Hearing Group	Generalized Hearing Range[1]
Low Frequency Cetaceans *(Mysticetes–Baleen whales)*	7 Hz to 35 kHz
Mid- Frequency Cetaceans *(Odontocetes—Toothed whales)*	150 Hz to 160 kHz
High-frequency Cetaceans *(Odontocetes)*	275 Hz to 160 kHz

[10] NMFS headquarters and AFSC personnel carefully reviewed the analysis in this FPEA and the AFSC 2017 LOA application and determined AFSCs approach to and results of the analysis of impacts to marine mammals described in this FPEA or and their 2017 LOA application did not change as a result of the updated technical guidance.

Hearing Group	Generalized Hearing Range[1]
Phocid pinnipeds *(true seals)*	50 Hz to 86 kHz
Otariid pinnipeds *(sea lions and fur seals)*	60 Hz to 39 kHz

Sources: NMFS 2018.

1 Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation)

3.2.2.2 Threatened and Endangered Marine Mammals

Species included in this section are only those listed as threatened or endangered under the ESA. Table 3.2-6, however, lists all marine mammal species encountered in the AFSC GOARA, BSAIRA, and CSBSRA.

Beluga Whale: Cook Inlet Stock

Status and trends: There are five stocks of beluga whales recognized in U.S. waters. All are in Alaska: the Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and Cook Inlet stocks (Allen and Angliss 2012). Several of these stocks are migratory, with distribution varying seasonally, and across research areas. The Beaufort Sea and eastern Chukchi Sea stocks occur in the CSBSRA and BSAIRA; the eastern Bering Sea and Bristol Bay stocks are in the BSAIRA; the Cook Inlet stock occurs in the GOARA. The Cook Inlet stock of beluga whales is the only one listed under the ESA and, therefore, the only stock considered in this section.

NMFS conducted aerial surveys of Cook Inlet beluga whales annually from 1993 to 2012; biennial surveys began in 2014 (Shelden et al. 2015). Population estimates, derived from aerial surveys corrected for sightability of whales, showed the Cook Inlet beluga population declined nearly 50 percent between 1994 and 1998. Estimates ranged from a high of 653 belugas in 1994 to a low of 278 in 2005. The estimated abundance of 340 belugas in 2014 is within the range of estimates from the previous ten survey years (312–375). Despite an increase since the low in 2005, the population still shows a declining trend. The 10-year (2004-2014) population trend is -0.4 percent and the overall trend since management of the hunt began in 1999 is -1.3 percent (Shelden et al. 2015). Despite restrictions on Alaskan Native subsistence harvest of Cook Inlet belugas, the population is not recovering (Hobbs and Shelden 2008).

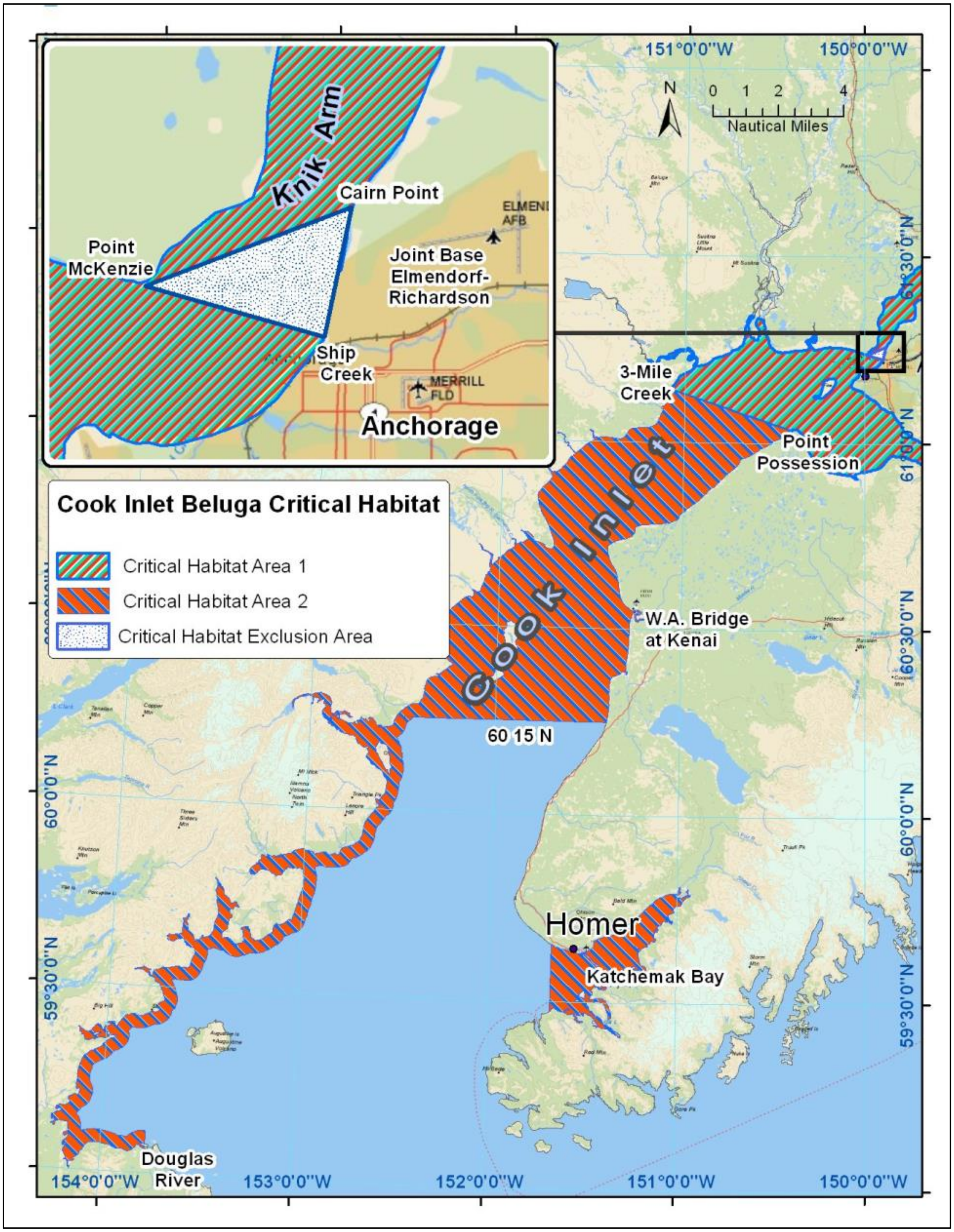
With low abundance relative to historic estimates and a population that does not appear to be increasing, despite low known levels of human caused mortality since 1999, this stock does not meet assumptions inherent to the use of PBR. NMFS cannot determine a maximum number that may be removed while allowing the population to achieve OSP, leaving PBR undetermined for this stock (Muto and Angliss 2015). The estimated minimum rate of mortality incidental to commercial fisheries is unknown due to lack of observer coverage since 2000. It is, however, likely to be low since the only known reported mortality in more than ten years was of a juvenile beluga whale entangled in a salmon net used during a special use subsistence fishery in 2012. The necropsy revealed the animal was in poor health prior to entanglement. Based on this entanglement, the average annual mortality and serious injury (M&SI) rate due to subsistence fisheries from 2009 to 2013 is 0.2 beluga whales. Since the population remains less than 350 whales, subsistence harvest is not allowed for the following five years (Muto and Angliss 2015).

The Cook Inlet beluga population was listed as depleted under the MMPA in 2000 and listed as endangered under the ESA in October 2008 (73 FR 62919, October 22, 2008). The Cook Inlet beluga whale stock is, therefore, considered a strategic stock. A draft recovery plan was released in May 2015 (80 FR 27925, May 15, 2015; NMFS 2015d).

Distribution and habitat preferences: Beluga whales occur in Cook Inlet year-round, but locations and movements vary seasonally. Most available information on seasonal movements is based on 14 whales outfitted with satellite transmitters in upper Cook Inlet in the summers of 2000-2002 (Hobbs et al. 2005). Feeding strategies and food availability influence the movements of belugas. In general, belugas concentrate in river mouths or bays during summer and early fall, particularly in areas characterized by mudflats and very shallow, low-salinity, relatively warm water at the outflow of major rivers in the upper inlet (Goetz et al. 2007, Moore et al. 2000a). Whales disperse into the middle inlet in late autumn and early winter after seasonal salmon runs at river mouths end. They pursue prey in mid- or bottom-waters while they are more dispersed and located farther offshore during winter (Hobbs et al. 2005).

NMFS issued a final rule designating critical habitat for Cook Inlet beluga whales in April 2011 (76 FR 20180, April 11, 2011). The critical habitat encompasses 3,016 square miles (7800 square km) of marine and estuarine environments considered to be essential for the survival of Cook Inlet beluga whales (Figure 3.2-1). Critical Habitat Area 1 encompasses important calving and foraging habitat where belugas concentrate from spring through fall. Critical Habitat Area 2 includes areas subject to less concentrated use in spring and summer, but known fall and winter use by Cook Inlet belugas.

Behavior and life history: Females become sexually mature at 9-12 years of age, gestation is about 14 months, and a single calf is born in late spring-early summer (O'Corry-Crowe 2009). Beluga whales feed on both invertebrate and vertebrate benthic and pelagic prey; when in nearshore waters they feed on seasonally abundant prey such as salmon, herring, capelin, smelt, and saffron cod (O'Corry-Crowe 2009). Beluga whales regularly dive to depths of 300-600 m to the sea floor and in deep water they may dive in excess of 1000 m and remain submerged for up to 25 minutes (Martin et al. 1998; O'Corry-Crowe 2009).



Source: http://alaskafisheries.noaa.gov/newsreleases/images/cibelugachmap.jpg

Figure 3.2-1 Cook Inlet Beluga Whale Critical Habitat

Sperm Whale

Status and trends: Sperm whales are divided into several stocks in U.S. waters. The North Pacific stock (also known as the Alaska stock) regularly inhabits Alaskan waters, including the GOARA and BSAIRA.

Sperm whales are listed as endangered under the ESA and, consequently, the Alaska stock is automatically considered as a depleted and strategic stock under the MMPA. Current and historical abundance estimates are unreliable and the number of sperm whales occurring in Alaska waters is unknown (Muto and Angliss 2015). A reliable minimum population estimate, PBR for this stock, and information on trends in abundance are lacking. Between 2009 and 2013, four serious injuries were reported in the GOA sablefish longline fishery, for an average annual M&SI rate of 0.8 sperm whales during that five year period. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero M&SI rate is unknown (Muto and Angliss 2015).

Distribution and habitat preferences: Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer with the northernmost boundary extending from Cape Navarin (62^{o} N) to the Pribilof Islands; the majority are thought to be south of 40^{o} N in winter. As summarized in Muto and Angliss (2015, and citations therein) females and young sperm whales usually remain in tropical and temperate waters year-round, while males are thought to move north in the summer to feed in the GOA, Bering Sea, and waters around the Aleutian Islands. Sperm whales inhabit deeper pelagic waters as well as the broad continental shelf of the eastern Bering Sea, and nearshore environs in the eastern Aleutian Islands, GOA, and southeast Alaska (Rice 1989). Sperm whales were the most frequently sighted large cetacean in the coastal waters around the central and western Aleutian Islands during surveys conducted by the National Marine Mammal Laboratory in the summers of 2001 to 2010 (Muto and Angliss 2015). Sperm whales were acoustically detected year-round in the GOA, but appeared more common in summer than in winter (Mellinger et al. 2004).

Behavior and life history: Females reach sexual maturity at about age 9 when roughly 9 m long and they give birth about every 5 years; gestation is 14-16 months (Whitehead 2009). Males are larger during the first 10 years and continue to grow well into their 30s, reaching physical maturity at about 16 m (Whitehead 2009). Sperm whale prey includes numerous varieties of deep water fish and cephalopods. Sperm whales forage during deep dives that routinely exceed 400 m depths and 30 minute durations (Watkins et al. 2002). They are capable of diving to depths of over 2,000 m with durations of over 60 minutes. Males do not spend extensive periods of time at the surface. In contrast, females spend prolonged periods of time at the surface (1 to 5 hours daily) without foraging (Whitehead 2009).

Humpback Whale

Status and trends: The three stocks of humpback whales in the North Pacific are: 1) the California/Oregon/Washington stock, which winters in coastal waters of Central America and Mexico and migrates to the coast of California to southern British Columbia in summer/fall; 2) the Central North Pacific stock, which primarily migrates between the Hawaiian Islands and northern British Columbia/Southeast Alaska, the GOA, and the Bering Sea/Aleutian Islands; and 3) the Western North Pacific stock, which migrates between Asia and Russia and the Bering Sea/Aleutian Islands (Allen and Angliss 2015). It is uncertain whether humpbacks seen in the Chukchi Sea are from the Central or Western North Pacific stock, although the latter may be more likely, given its known geographic range. Humpback whales from the Western and Central North Pacific stocks mix somewhat on summer feeding grounds from British Columbia through the central GOA and into the Bering Sea (Allen and Angliss 2015, and citations therein). These are the two stocks considered here.

The recent abundance estimate for the entire North Pacific of 19,594 humpbacks (Calambokidis et al. 2008) was revised to 21,063 by Barlow et al. (2011) using capture-recapture methods and simulation models to estimate biases. The estimated abundance for the Aleutian Islands, Bering Sea, and GOA combined is approximately 9,800 whales (Muto and Angliss 2015). Due to range overlap, these estimates likely include whales from both the Western and Central North Pacific stocks.

Abundance estimates for the Central North Pacific stock is based on mark-recapture data from Hawaii. The best available estimate for Hawaii is 10,252, with a conservative minimum population estimate of 9,896 whales (Muto and Angliss 2015). The population is growing at about 5-6 percent per year (Calambokidis et al. 2008). The PBR is calculated as 173.2 whales. Although the Southeast Alaska/northern British Columbia feeding aggregation is not formally considered a stock, the calculated PBR for this area (50.9), based on a minimum population size of 4,846, is useful for information purposes. The calculated PBR for the Aleutian Islands and Bering Sea is 101.8 (minimum population estimate of 7,250), and is 18.6 for the GOA, based on a minimum estimate of 1,773 (Muto and Angliss 2015).

The estimated annual average mortality rate incidental to U.S. commercial, recreational, or other fisheries, 2009-2013, is 7.3 whales per year (0.6 in observed Bering Sea/Aleutian Islands fisheries, 5.5 in state-managed Southeast Alaska salmon driftnet fishery, 0.2 in Hawaiian observed fisheries, 0.2 from strandings and reports in Alaska where a fishery is confirmed, and 0.8 from strandings and reports in Hawaii where a fishery is confirmed). Since the observed takes in the Bering Sea/Aleutian Islands fisheries occurred where the Western and Central North Pacific stocks overlap and stock identification is unknown, these mortalities and serious injuries are included in both stock assessments. Total average annual human caused M&SI for this stock is 21 (4.43 from vessel collisions in Alaska and Hawaii, 2.6 from entanglement in unknown marine debris/gear, and 7.3 in commercial fisheries, and 7 due to unknown fisheries). Estimated annual take is less than the calculated PBR, and the take in commercial fisheries (7.3) is less than 10 percent of PBR (17) and, therefore, can be considered insignificant and approaching a zero M&SI rate (Muto and Angliss 2015).

The best fitting model provided an abundance estimate of 893 humpback whales in the Western North Pacific stock in Asia (Ogasawara Islands, Okinawa, and the Philippines). The estimated minimum population size is 836 (Muto and Angliss 2015). The population appears to be growing at about 6-7 percent per year (Calambokidis et al. 2008). The PBR for this stock is calculated as 2.9 whales (Muto and Angliss 2015). The estimated annual average mortality rate incidental to U.S. commercial fisheries, 2009-2013, is 0.8 whales per year (0.6 in observed fisheries and 0.2 based on stranding database records). This is a minimum estimate as there are no data from Japanese, Russian, or international waters. Since the observed takes occurred where the Western and Central North Pacific stocks overlap and stock identification is unknown, these mortalities and serious injuries are included in both stock assessments. Total average annual human caused M&SI for this stock is 2.2 (1.2 from fishery-related interactions, 0.2 ship strikes, 0.8 from entanglement in unknown debris or gear). Estimated annual take is less than the calculated PBR, however, the take in observed commercial fisheries (0.6) exceeds 10 percent of PBR and cannot be considered insignificant and approaching a zero mortality rate (Muto and Angliss 2015).

Humpback whales are listed as endangered under the ESA and designated as depleted under the MMPA. The Central North Pacific and Western Pacific stocks are both considered strategic stocks (Muto and Angliss 2015). In April 2015, the NMFS finished a status review of humpback whales and announced a proposal to revise the listing status by splitting the endangered species into 14 DPSs and replacing the current species-level listing with listings by DPS, defined by breeding population (80 FR 22304, April 21, 2015). The result would be two listed as endangered (Cape Verde Islands/Northwest Africa and Arabian Seas DPSs), two as threatened (Western North Pacific and Central America DPSs), and ten not proposed for listing (the West Indies, Hawaii, Mexico, Brazil, Gabon/Southwest Africa, Southeast Africa/Madagascar, West Australia, East Australia, Oceania, and Southeastern Pacific DPSs). The Central North Pacific stock would fall within the Hawaii and Mexico DPSs and the Western North Pacific stock would become the Western North Pacific DPS and be listed as threatened (80 FR 22304, April 21, 2015).

Distribution and habitat preferences: Humpback whales live in all major ocean basins from equatorial to subpolar latitudes, migrating from tropical breeding areas to polar or subpolar feeding areas (Jefferson et al. 1993). Humpbacks in the Pacific are generally found during the summer on high-latitude feeding grounds in a nearly continuous band from southern California to the GOA, Aleutian Islands, Kamchatka Peninsula, and the Bering and Chukchi seas.

The northern Bering Sea, Bering Strait, and southern Chukchi Sea were considered the northern extreme of the humpback's range. Historical whaling data show catches of humpback whales in the Bering Strait and Chukchi Sea from August-October (Allen and Angliss 2011). Humpback whales have recently been observed in the Chukchi and Beaufort seas. The only confirmed sighting in the Beaufort Sea was of a mother-calf pair approximately 87 km (54.1 mi) east of Barrow in August 2007 (Hashagen et al. 2009). Small numbers of humpbacks whales have been sighted during shipboard and aerial surveys of the northeastern Chukchi Sea since 2007 (Brueggeman 2010, Clarke et al. 2011, Ireland et al. 2008). In September 2012, an unprecedented number (24) of humpback whales were sighted during a single aerial survey off Point Hope in the southern Chukchi Sea (Clarke et al. 2013). This may be a recent phenomenon as no humpback whales were sighted during the previous aerial surveys of the Chukchi Sea from 1982-1991 (Clarke et al. 2011).

Humpbacks primarily occur near the edge of the continental slope and deep submarine canyons, where upwelling concentrates zooplankton near the surface for feeding. They often feed in shipping lanes which makes them susceptible to mortality or injury from large ship strikes (Douglas et al. 2008).

Behavior and life history: Humpback whales are known for their spectacular aerial behaviors and complex songs of males, the latter of which is presumably to attract females. They breed in warm tropical waters after an 11 month gestation period; calves feed independently after about 6 months. Humpback whales feed on euphausiids and various schooling fishes, including herring, capelin, sand lance, and mackerel (Clapham 2009).

Blue Whale

Status and trends: The IWC formally recognizes only one management stock of blue whales in the North Pacific (Donovan 1991, Best 1993), but research suggests there may be several populations, including two that occur in AFSC research areas: the central North Pacific stock (formerly the western North Pacific stock) and the eastern North Pacific stock (Carretta et al. 2014). This distinction is partly based on call types. The northeastern call predominates in the GOA to the eastern tropical Pacific. The northwestern call predominates from south of the Aleutian Islands to the Kamchatka Peninsula in Russia. There is some overlap of calls in the GOA (Stafford et al. 2001, Stafford 2003).

Based on locations of whales killed during commercial whaling (1924-1965), blue whales were once relatively common across the GOA and the south side of the Aleutian Islands (Rankin et al. 2006). Sightings of blue whales in Alaskan waters are currently rare (Calambokidis et al. 2009, Forney and Brownell 1996). One of three blue whales photographically identified in the northern GOA in 2004 was identified previously off California, indicating that the whales were part of the eastern North Pacific population (Calambokidis et al. 2009). None of the three blue whales identified south of the Aleutian Islands during the same survey matched images from California. Acoustics data further suggest these whales were from the central North Pacific population (Rankin et al. 2006).

There are no reliable population estimates for the central North Pacific stock or for blue whales in the south Bering Sea/Aleutian Islands or in the GOA (Carretta et al. 2011). A 2010 survey of the Hawaiian Islands resulted in an estimate of 81 blue whales during summer/fall, although most central North Pacific blue whales were likely at higher latitude feeding grounds at that time of the year. This serves as a minimum estimate for the Hawaiian Islands only. Based on a minimum estimate of 38 blue whales for the Hawaiian Islands, the calculated PBR for this stock is 0.1 whales per year. Data are insufficient to determine population trends and there have been no reported humans-caused mortalities or serious injuries (Carretta et al. 2015b).

Population estimates are only available for the U.S. west coast portion of the eastern North Pacific stock. The best abundance estimate for the feeding stock of blue whales off the U.S. West Coast is 1,647, based on photographic mark-recapture for the period 2005 to 2011. The minimum estimate is 1,551. The calculated PBR 9.3, but since that stock spends approximately three quarters of its time outside the U.S. EEZ, the PBR allocation for U.S. waters is one-quarter of this total, or 2.3 whales per year (Carretta et al. 2015b).

The potential for human-caused mortality (from ship strikes and interactions with fisheries) exists in Alaskan waters, but none have been reported. The average annual incidental M&SI rate from ship strikes along the U.S. west coast (0.9/year for 2009-2013) is less than the calculated PBR for this stock. This rate, however, does not include unidentified large whales struck by ships, so the actual number may exceed PBR. There have been no reported blue whale mortalities associated with commercial fisheries and the total fishery M&SI rate is approaching zero (Carretta et al. 2015b).

Blue whales are listed as endangered under the ESA, and a recovery plan was finalized in 1998 (NMFS 1998). As an endangered species, the blue whale is automatically classified as a depleted and strategic stock under the MMPA.

Distribution and habitat preferences: The blue whale has a worldwide distribution in circumpolar and temperate waters. Blue whale distribution is presumably governed largely by food requirements (Fiedler et al. 1998, Croll et al. 1998) and populations are seasonally migratory. The eastern North Pacific stock of blue whales ranges from the northern GOA to the Eastern Tropical Pacific (Carretta et al. 2011). Most of this stock is believed to migrate south to spend the winter and spring in high productivity areas off Baja California, in the Gulf of California, and on the Costa Rica Dome.

Blue whale calls have been detected in Alaskan waters during all seasons, with most calls in the GOA during fall and winter (Watkins et al. 2000). Except for rare occurrences in the far southeastern corner of the Bering Sea, blue whales in the Bering Sea/Aleutian Islands area do not range north of the Aleutian Islands (Rice 1998).

Behavior and life history: Blue whales reach sexual maturity at 5-15 years of age; length at sexual maturity in the Northern Hemisphere is 21-23 m for females and 20-21 m for males (Sears and Perrin 2009). Females give birth about every 2-3 years in winter after a 10-12 month gestation; longevity is thought to be at least 80-90 years (Sears and Perrin 2009). Blue whales occur primarily in offshore deep waters and feed almost exclusively on euphausiids. Croll et al. (2001) determined that blue whales dived to an average of 141 m and for 7.8 minutes when foraging and to 68 m and for 4.9 minutes when not foraging. Dives of approximately 300 m depth have been recorded (Calambokidis et al. 2003).

Fin Whale

Status and trends: The IWC recognizes one stock of fin whales in the North Pacific, but NMFS recognizes three stocks in U.S. Pacific waters for management purposes: Alaska (Northeast Pacific); California/Oregon/Washington; and Hawaii. Stock structure of fin whales is, however, uncertain (NMFS 2010a, Allen and Angliss 2014). The Northeast Pacific stock is the only one that occurs in the AFSC research areas.

There are currently no reliable abundance estimates for the entire Northeast Pacific stock of fin whales. Surveys in the eastern Bering Sea and coastal waters from south central Alaska to the central Aleutian Islands provide the only data from which partial estimates could be derived. Visual surveys on the eastern Bering Sea shelf in 2002, 2008, and 2010 provide provisional abundance estimates of 419, 1,368, and 1,061 fin whales, respectively (Friday et al. 2013). Surveys conducted in 2001 to 2003 in coastal waters off western Alaska and the eastern and central Aleutian Islands recorded fin whales from Kodiak Island to

Samalga Pass, with a resulting estimate of 1,652 whales for that area (Zerbini et al. 2006). These estimates cannot be applied to the entire Northeast Pacific stock, since they are based on surveys in only part of the stock's range (Allen and Angliss 2015). The largest of the minimum estimates from the 2008-2010 surveys (1,368) is considered the best provisional estimate for fin whale abundance west of the Kenai Peninsula and a minimum estimate for this portion of the stock's range; a minimum abundance for the entire stock in unknown (Muto and Angliss 2015). Data are insufficient to estimate population trends for the entire stock. Zerbini et al. (2006) estimated an annual rate of increase of 4.8 percent from 1987-2003 for fin whales in coastal waters south of the Alaska Peninsula. The PBR level for the Northeast Pacific stock of fin whales is undetermined since a minimum abundance estimate for the stock is not available (Muto and Angliss 2015).

Incidental take in commercial fisheries is rare. There was one observed incidental mortality of a fin whale due to entanglement in ground tackle of a commercial mechanical jig fishing vessel in 2012. This is the only known fisheries-related mortality in Alaska between 2009 and 2013, for an average of 0.2 takes per year (Muto and Allen 2015). There are no records of fin whale entanglement in fishing gear. Two ship strikes occurred in Alaska waters between 2008 and 2012, for a mean annual mortality of 0.4 whales. Total estimated annual human-caused M&SI for this stock is 0.6 fin whales (Muto and Angliss 2015).

Fin whales are endangered under the ESA, and consequently considered depleted and strategic under the MMPA. A final Recovery Plan was published in 2010 (NMFS 2010a).

Distribution and habitat preferences: Fin whales occur throughout the North Pacific from Central Baja California, Mexico to the Chukchi Sea (Mizroch et al. 2009, Nasu 1974, Rice 1974). Occurrence in Alaskan waters in summer and fall has been documented primarily in the GOA and eastern Bering Sea (Mizroch et al. 2009). There are no reports of fin whales in the Beaufort Sea. In 2010, fin whales were commonly detected acoustically in the Chukchi Sea during August and September (Crance et al. 2011, Hannay et al. 2011). Visual observations in the Chukchi Sea are uncommon. One fin whale was observed north of Cape Lisburne during aerial surveys and two sightings of four whales were recorded during seismic surveys in the Chukchi Sea in 2008 (Clarke et al. 2011, Funk et al. 2010). Several fin whales, including feeding whales and calves, were sighted during an aerial survey west and south of Point Hope in the southern Chukchi Sea in September 2012 (Clarke et al. 2013). Little is known of their migratory movements. There is evidence of whales year-round in high latitude regions, and they may occur at several different latitudes during any one season (Mizroch et al. 2009, NMFS 2010a, Stafford et al. 2007). In the northern North Pacific and Bering Sea, fin whales generally occur along frontal zones or mixing zones, corresponding with the 200 m (656 ft) isobath (Nasu 1974).

Behavior and life history: Fin whales become sexually mature between six to ten years of age, depending on density-dependent factors. Mating occurs primarily in the winter. Gestation lasts about 11 months and nursing occurs for 6 to 11 months (Aguillar 2009). Fin whale dives likely coincide with the diel migration of krill. In general, fin whales in the North Pacific prey on euphausiids (krill) and large copepods, as well as schooling fish such as herring, walleye pollock, and capelin (Nemoto 1970, Kawamura 1982).

<u>Sei Whale</u>

Status and trends: The population structure and status of most stocks of sei whales are not well known. Population structure is assumed to be discrete by ocean basin (NMFS 2011). Sei whales in the eastern North Pacific (east of 180° W longitude) are considered a separate stock (Carretta et al. 2014).

There are no direct estimates of abundance for either the entire North Pacific or for the eastern North Pacific Ocean and stock assessments for this stock have not been revised since 2010. A minimum population estimate of 83 was calculated for sei whales along the U.S. west coast based on line-transect surveys in 2005 and 2008 (Carretta et al. 2014). Sei whales are not often encountered in Alaskan waters and there are no estimates of abundance for sei whales in that region.

Human-caused mortalities (i.e., incidental to commercial fishing operations or from ship strikes) are rare. There have been no reported takes of sei whales incidental to U.S. commercial fisheries and only one reported ship strike off the Washington coast in 2003 (Carretta et al. 2014). There are no reports of human caused injury or mortality off Alaska.

Sei whales are listed as endangered under the ESA and, consequently, the eastern North Pacific stock is automatically considered a depleted and strategic stock under the MMPA. A final recovery plan for sei whales was published in 2011 (NMFS 2011).

Distribution and habitat preferences: Sei whales have a worldwide distribution, but are found primarily in cold temperate to subpolar latitudes (Horwood 2009). They occur across the North Pacific north of 40°N latitude. Sei whales feed during summer in higher latitudes and return to lower latitudes to calve in the winter. The summer range in the North Pacific extends from southern California to the GOA and across the North Pacific south of the Aleutian Islands, extending into the Bering Sea only in the deep southwestern Aleutian Basin (Gambell 1985, Rice 1998). They appear to prefer regions of steep bathymetric relief, such as the continental shelf break, canyons, or basins situated between banks and ledges. On feeding grounds, the distribution is largely associated with oceanic frontal systems (Horwood 2009).

Behavior and life history: Sei whales mature at about 10 years of age for both sexes. Prey includes calanoid copepods, krill, fish, and squid. The dominant food for sei whales off California during June through August is the northern anchovy, while in September and October they eat mainly krill. There are no reported diving depths or durations for sei whales (Horwood 2009).

North Pacific Right Whale

Status and trends: The North Pacific right whale is critically endangered due to heavy exploitation from 19th century commercial whaling and illegal Soviet whaling in the 1960s. The species is currently quite rare and could represent the world's smallest population of whales for which a population estimate exists (Wade et al. 2011a). Using photo-identification and genetics mark-recapture techniques, 31 and 28 individuals, respectively, were estimated to occur in the Bering Sea and Aleutian Islands. Although this may represent a Bering Sea sub-population, available data indicate that the entire eastern North Pacific population is likely not much larger (Wade et al. 2011a).

Illegal Soviet whaling also occurred in the GOA in the 1960s. Sightings in this region are now exceedingly rare, with only two sightings between 1966 and 2003 and four from 2004 to 2006. The two photo-identified whales from the GOA did not match those photographed in the eastern Bering Sea (Wade et al. 2011b).

The minimum population estimate for North Pacific right whales is 25.7 whales (Muto and Angliss 2015). Estimated trends in abundance are not available. Based on a minimum estimate of 25.7, the calculated PBR for this stock is 0.05 whales, or the equivalent of one take every 20 years. There are no records of mortality or serious injury of North Pacific right whales in any U.S. fishery. The estimated annual rate of human-caused M&SI is considered to be insignificant and approaching a zero M&SI rate (Muto and Angliss 2015).

The right whale is listed as endangered under the ESA, and therefore designated as depleted under the MMPA and considered a strategic stock. In 2008, NMFS relisted northern right whales as two separate endangered species: the North Pacific right whale (*E. japonica*) and the North Atlantic right whale (*E. glacialis*) (73 FR 12024). The North Pacific right whale is arguably the most endangered large whale in the world (Allen and Angliss 2012). Recent genetic analyses show lack of genetic diversity, an extremely low effective population size and an apparent isolation of eastern and western Pacific populations, indicating that right whales are in serious danger of immediate extirpation from the eastern North Pacific (LeDuc et al. 2012).

Distribution and habitat preferences: Right whales historically occurred in Alaskan waters, mostly between 50°N and 60°N from April to September, with a peak in sightings in coastal waters in June and July (Maury 1852, Townsend 1935, Omura 1958, Klumov 1962, Omura et al. 1969). Important historical concentration areas in Alaska included the GOA, especially south of Kodiak Island (Shelden et al. 2005), and in the eastern Aleutian Islands and southern Bering Sea shelf waters (Braham and Rice 1984, Scarff 1986). Migration and winter distribution patterns are largely unknown. However, matches were recently made between an individual photographed off Maui in April 1996 and a whale photographed in the Bering Sea in July 1996, 2000, and 2008-2010 (Kennedy et al. 2011).

Vessel and aerial surveys conducted during July (1997-2000) reported lone animals or small groups of right whales in western Bristol Bay (Perryman et al. 1999, Moore et al. 2000b, LeDuc et al. 2001). More recent sightings, satellite telemetry, and acoustic detections confirm the importance of the southeastern Bering Sea for right whales from late spring to late fall (Shelden et al. 2005, Munger et al. 2008, Clapham et al. 2012, Baumgartner et al. 2013, Zerbini et al. 2015). Right whales are occasionally seen and acoustically detected elsewhere, yet the southeast Bering Sea is the only area where they have been seen consistently since the 1980s (Shelden et al. 2005). Long-term monitoring of calls show right whales intermittently occur on the southeast Bering Sea middle shelf between May and December; frequency and duration of occurrence are greatest in July–October. Right whales may also occur occasionally over the Bering Sea slope (Munger et al. 2008). All sightings in the Bering Sea since 1996 have been on the southeastern Bering Sea shelf (Wade et al. 2011a). The availability of their primary prey, the copepod *Calanus marshallae*, on the southeastern Bering Sea shelf during the summer, is the main reason North Pacific right whales annually return to this area (Baumgartner et al. 2013). The only area in the GOA where right whales have been seen repeatedly over the last 40 years is Barnabus Trough/Albatross Bank south of Kodiak Island (Wade et al. 2011b).

In July 2006, NMFS published a final rule designating critical habitat for the northern right whale in the GOA and the southeastern Bering Sea, which comprises approximately 95,200 square km of marine habitat (71 FR 38277, July 6, 2006) (Figure 3.2-2). When the North Pacific right whale was listed as a separate, endangered species in 2008, the two areas previously designated as critical habitat for the northern right whale were re-designated as critical habitat for the North Pacific right whale (73 FR 19000, April 8, 2008). Recent satellite telemetry studies show tagged whales remained within the Bering Sea critical habitat corroborating the importance of this region to right whales during the feeding season (Zerbini et al. 2015). Analysis of sonobuoy recordings during the summers of 2008-2011 also revealed strong site fidelity in the northeastern part of the critical habitat area. Long-term acoustic recorders across the Bering Sea shelf further elucidate this site fidelity within the northeastern portion of the critical habitat area, with seasonal presence extending from July through January (Clapham et al. 2012).

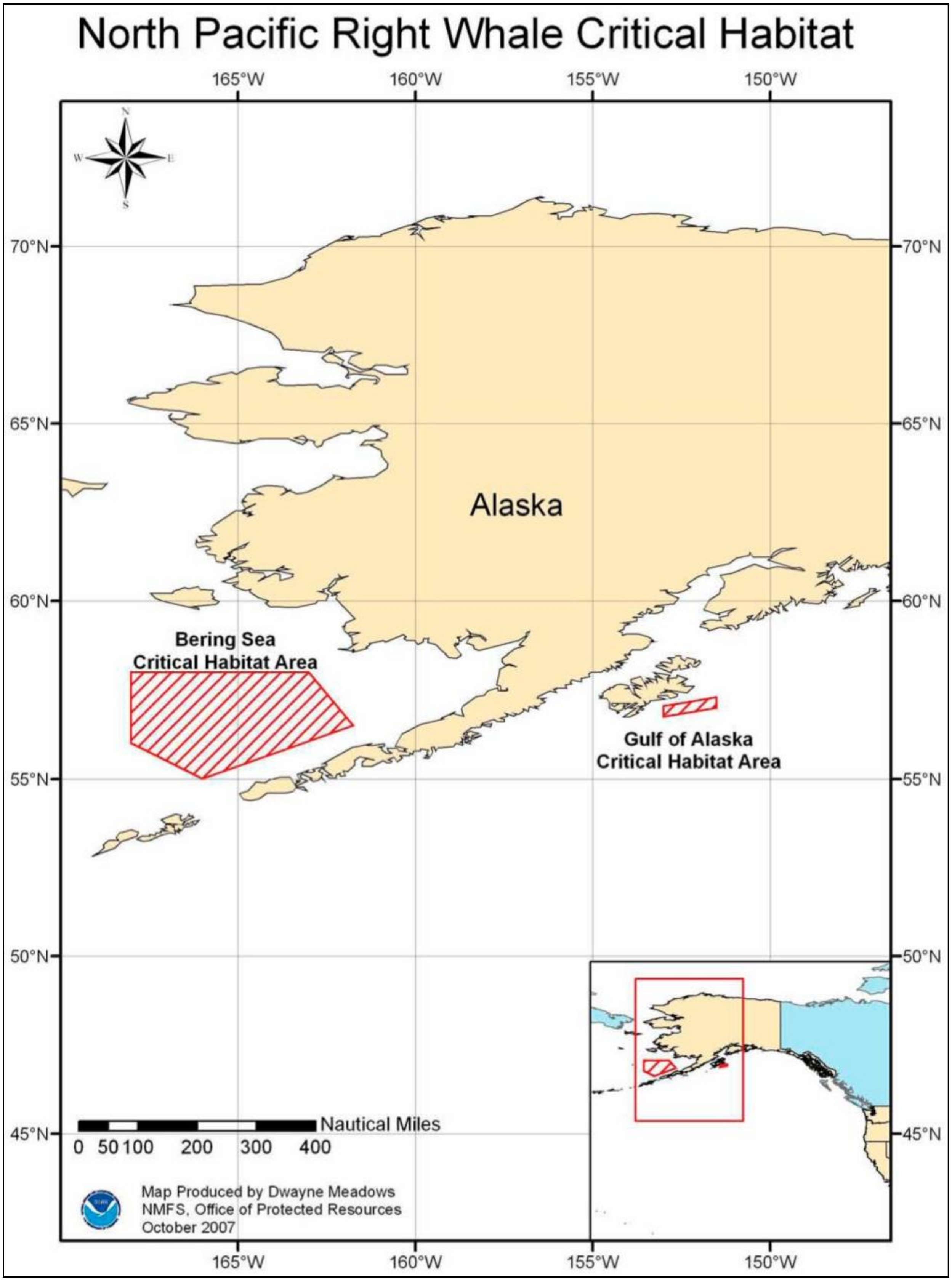


Figure 3.2-2 North Pacific Right Whale Critical Habitat Areas

Behavior and life history: Breeding, mating, and calving of North Atlantic right whales occur during winter, typically in shallow coastal regions or bays; calving may take place at geographically distant sites from mating (Kenney 2009). However, the location of calving and breeding grounds for the North Pacific right whale is unknown. Right whales are 'skimmers' and feed with the mouth agape straining their prey through the baleen; feeding occurs at the surface and at depth particularly on calanoid copepods (Kenney 2009).

<u>Bowhead Whale</u>

Status and trends: The IWC historically recognized five bowhead whale stocks for management purposes: the Spitsbergen stock; Davis Strait stock; Hudson Bay stock; Okhotsk Sea stock; and the Western Arctic (Bering-Chukchi-Beaufort Seas) stock. The Davis Strait and Hudson Bay bowhead whales may comprise a single Eastern Arctic stock (IWC 2011). The Western Arctic stock is the largest remnant population and the only stock within U.S. waters (Allen and Angliss 2012) and in the AFSC research areas (CSBSRA and BSAIRA). Bowhead whales are not found in the GOARA.

The most recent population estimate for the Western Arctic stock, derived from an ice-based census in 2011 was 16,892 bowhead whales in the Western Arctic stock (Givens et al. 2013). This is a substantial increase over the previous estimate of 10,470 bowhead whales from the 2001 ice-based census (George et al. 2004), which was subsequently revised to 10,545 bowhead whales (Zeh and Punt 2004). The estimated annual rate of increase from 1978 to 2001 was 3.4 percent, during which time abundance doubled from approximately 5,000 to approximately 10,000 whales (George et al. 2004). The estimated rate of increase from 1978 to 2011 is 3.7 percent (Givens et al. 2013). Capture-recapture analysis based on aerial photographs of individually identified bowhead whales from 2003-2005 provided an estimate of 12,631 whales, excluding calves, which is consistent with expected abundance and trend estimates from ice-based surveys (Koski et al. 2010). The minimum population estimate is 16,091 and the PBR is 161 whales per year (Muto and Angliss 2015).

Calculating PBR is required by the MMPA, but the subsistence harvest quota is managed under the authority of the IWC and takes precedence over PBR for the purpose of managing the Alaska Native subsistence harvest from the Western Arctic bowhead stock. The subsistence harvest by Alaska Natives is the single greatest source of human-caused mortality of this stock of bowhead whales. The subsistence take has been regulated by a quota system under the IWC since 1977. For 2013-2018, a block quota of 306 landed bowheads is allotted, of which 67 can be taken annually (Muto and Angliss 2015). Alaska Natives struck 57 and landed 46 bowhead whales during the 2013 subsistence hunt, which is higher than the ten-year (2003-2012) average of 40.5 landed whales (Suydam et al. 2014). The average annual combined take by subsistence hunters in Alaska, Russia, and Canada was 44 from 2009 through 2013 (Muto and Angliss 2015). Incidental mortality or serious injury from entanglement in commercial fishing gear is known to occur, although there are no observer records of mortality incidental to commercial fisheries (Muto and Angliss 2015). Scarring attributed to ropes or entanglements have been observed on approximately 10 percent of whales harvested from 1988 to 2008 (Reeves et al. 2012). A dead bowhead whale found floating in Kotzebue Sound in July 2010 was entangled in crab pot gear similar to that used in the Bering Sea crab fishery (Suydam et al. 2011). The estimated average annual commercial fisheries-related M&SI for 2009-2013 is 0.2 whales, although the actual rate is not known (Muto and Angliss 2015). Incidence of injury caused by vessel collisions appears to be low. Two to three percent of harvested whales examined between 1988 and 2007 had ship or propeller injuries (Reeves et al. 2012). The total annual level of human-caused M&SI (of 44.2 whales) does not exceed PBR and fisheries-related mortality (0.2 whales) is less than 10 percent of PBR (Muto and Angliss 2015).

The Western Arctic stock of bowhead whales may be approaching carrying capacity (Brandon and Wade 2006), but remains listed as endangered under the ESA and is considered depleted and strategic under the MMPA.

Distribution and habitat preferences: Western Arctic bowhead whales are distributed in seasonally ice-covered waters north of 60°N latitude and south of 75°N latitude in the western Arctic Basin (Braham 1984, Moore and Reeves 1993). They closely associate with ice for most of the year. Six primary high-use areas and periods of peak use were identified based on satellite telemetry data collected between 2006 and 2012: 1) Cape Bathurst polyna in the Canadian Beaufort Sea (May-July); 2) Waters off the Tuktoyaktuk Peninsula, Canada (July-September); 3) near Point Barrow, Alaska (August-November); 4) northern shore of Chukotka, Russia (late October-early January); 5) Anadyr Strait in the Bering Sea (November-April); and 6) Gulf of Anadyr (December-April) (Citta et al. 2014). During winter, the Western Arctic stock is in the central and western Bering Sea associated with the marginal ice front and polynyas near St. Matthew and St. Lawrence Islands and the Gulf of Anadyr (Moore and Reeves 1993, NMFS 2008a, Quakenbush et al. 2010). The spring migration (April-June) follows leads in the sea ice through the Bering Strait to the Chukchi Sea and past Barrow and into the Beaufort Sea where most of the population feeds through the summer (Quakenbush et al. 2010). The area off of Barrow appears to be important for feeding during summer and fall (Ashjian et al. 2010). Few bowheads are found in the northeastern Chukchi Sea in summer (Ireland et al. 2008, Clarke et al. 2011). In autumn, bowheads migrate across the Beaufort Sea to the Chukchi Sea and, by late-October and November, are found in the Chukchi Sea, along the Chukotka coast, and into the northern Bering Sea (Quakenbush et al. 2010).

Behavior and life history: Bowhead whales live in areas often covered in thick ice and are able to break through ice up to 60 cm thick to create breathing holes. They feed throughout the water column; the most prevalent prey are copepods, euphausiids, mysids, and gammarid amphipods. They may stay submerged for over an hour (Lee et al. 2005, Rugh and Shelden 2009). Bowheads likely mate in late winter or early spring, although mating behavior has been observed at other times of the year. Gestation is about 13-14 months, and calves are usually born between April and June, during the spring migration. The calving interval is about three to four years. Juvenile growth is relatively slow. Bowheads reach sexual maturity at about 15 years of age (12-14 m [39-46 ft] long) (Nerini et al. 1984). Growth for both sexes slows markedly at about 40–50 years of age; bowheads are exceedingly long-lived and may live to greater than 100-150 years of age (George et al. 1999).

Steller Sea Lion: Western DPS (Stock)

Status and trends: Two DPSs of Steller sea lions are recognized in U.S. waters: an Eastern DPS, which ranges from California to Prince William Sound, Alaska (east of Cape Suckling at 144° W), and a Western DPS, which includes animals at and west of Cape Suckling (Loughlin 1997). The former includes the GOARA and the latter, the GOARA and BSAIRA. Frequent movement by juveniles of both populations occurs across the boundary at Cape Suckling (Raum-Suryan et al. 2002). Genetic evidence suggests that the western population consists of two distinct sub-populations: the central population, from 144°W through the Aleutian Islands and the Commander Islands (Russia); and the Asian population, which includes all animals that breed on the Kamchatka Peninsula, Kuril Islands, and the Sea of Okhotsk (Baker et al. 2005). A recent paper proposed that the two DPSs be formally designated as two subspecies: the eastern subspecies (*Eumetopias jubatus monteriensis*) and the western subspecies (*E. j. jubatus*) (Phillips et al. 2009). For the purposes of this FPEA, the term DPS is retained.

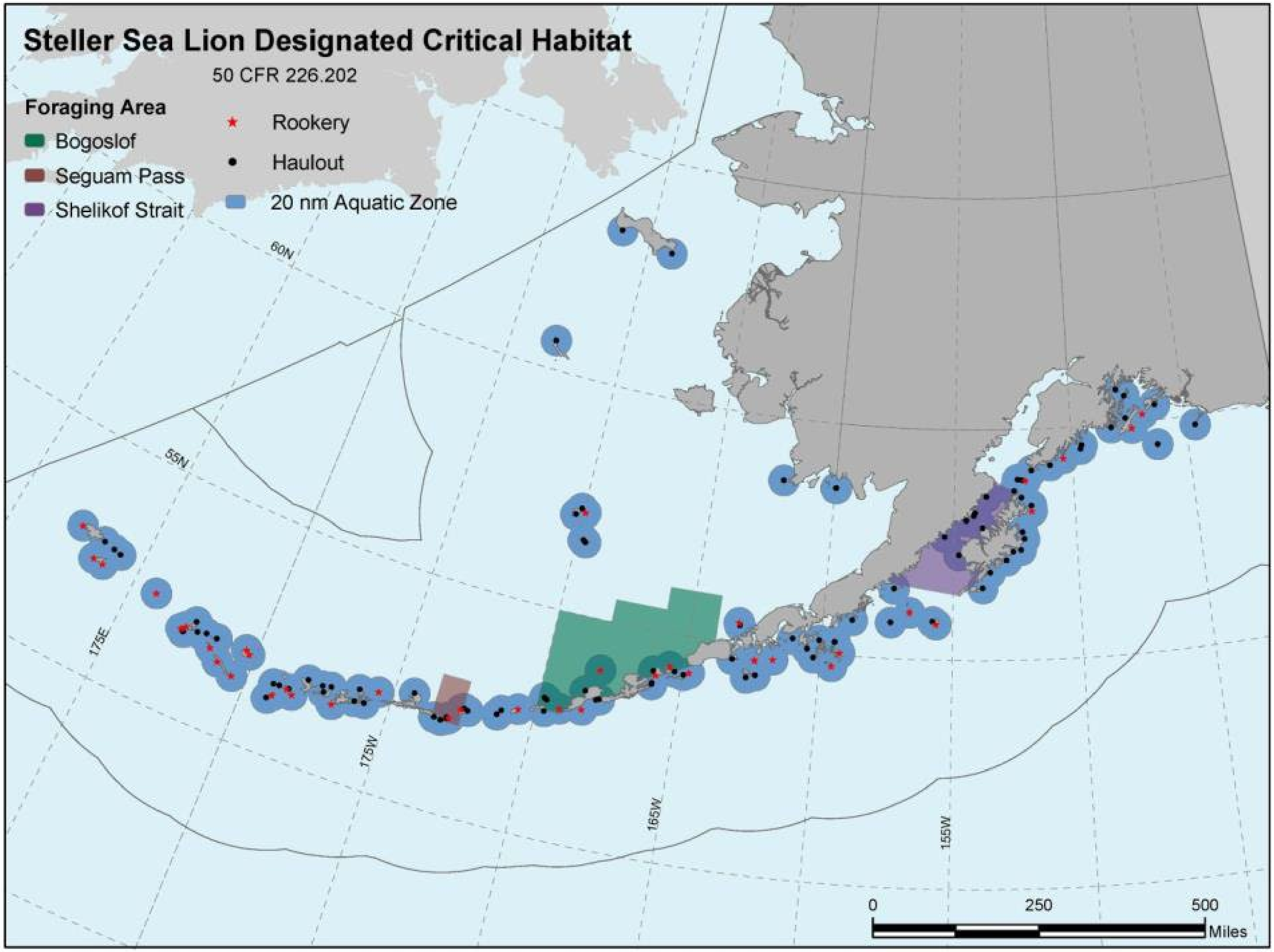
In November 1990, NMFS listed Steller sea lions as threatened under the ESA (55 FR 49204). In 1997, the two stocks were formally recognized (Loughlin 1997) and the western population was listed as endangered (62 FR 24345, June 1997), while the eastern stock retained a threatened classification. In 2013, NOAA delisted the eastern stock, by removing it from the ESA list of threatened and endangered species. The endangered status for the western stock remains unchanged (78 FR 66140, November 4, 2013). The western stock, or DPS, is discussed in this section.

Western Steller sea lion pup and non-pup counts in Alaska in 2014 were 12,189 and 37,308, respectively. Due to uncertainty regarding the use of the pup multiplier to calculate abundance from these counts, best estimates of the total counts were used as the minimum population estimate. The sum of 2014 pup and non-pup counts (49,497) is, therefore, considered the minimum population estimate for this stock in U.S. waters and the calculated PBR is 297 animals (Muto and Angliss 2015). Commercial fisheries involved in M&SI of western Steller sea lions in U.S. waters include the Bering Sea/Aleutian Islands Atka mackerel, flatfish, Pacific cod, and pollock trawl fisheries, the GOA Pacific cod longline, Pacific cod trawl, and sablefish longline fisheries, and the Prince William Sound salmon driftnet fishery. The current (2009-2013) annual level of mortality incidental to observed U.S. commercial fisheries (31) exceeds 10 percent of the PBR and, therefore, cannot be considered insignificant and approaching a zero M&SI rate. Additional sources of M&SI include 1.2 sea lions per year in unknown fisheries and marine debris, 199 per year in subsistence takes, and 2.2 per year via other human interactions, for an estimated annual level of total human-caused mortality of 233 sea lions. This is less than PBR (Muto and Angliss 2015). In addition to being listed as endangered under the ESA, the Western DPS of Steller sea lions is considered depleted and strategic under the MMPA.

Distribution and habitat preferences: Steller sea lions occur throughout the North Pacific Ocean rim from Japan to southern California. The Western DPS breeds on rookeries from the Russian Far East, across the Aleutian chain to the GOA. Seal Rocks in Prince William Sound, Alaska is the northernmost (60^{o} 09' N) rookery (Loughlin et al. 1987, Loughlin 2009). Steller sea lions occur year round in Alaska, with peak numbers in late summer, fall, and winter (Allen and Angliss 2015).

Steller sea lions prefer isolated offshore rocks and islands to breed and rest. Rookeries and haul out sites occur principally on exposed rocky shorelines and wave-cut platforms. Steller sea lions tend to return to their birth island as adults to breed. They range widely during their first few years and during the non-breeding season; some yearlings have been seen over 1,000 km from their birth rookery (Loughlin 2009).

Critical habitat for Steller sea lions was designated in 1993 (58 FR 45269, August 27, 1993). In the range of the western population, the aquatic zone includes areas within 20 nm (37 km) of designated rookeries and haulouts and key foraging areas in the Bogoslof district, Seguam Pass, and Shelikof Strait. Terrestrial critical habitat consists of areas landward within 3,000 feet (0.9 km) of designated rookeries and haulouts and the air zone extends 3,000 feet (0.9 km) above the terrestrial zone, measured vertically from sea level (Figure 3.2-3). In the final rule delisting the Eastern DPS of Steller sea lions, NMFS stated that ‘‘NMFS will undertake a separate rulemaking to consider amendment to the existing critical habitat designation that takes into account any new and pertinent sources of information since the 1993 designation, including amending the critical habitat designation as appropriate to reflect the delisting of the Eastern DPS.’’ NMFS solicited public comment in 2014 and is currently conducting a review to determine if revision of the existing critical habitat is warranted.



Source: http://alaskafisheries.noaa.gov/protectedresources/stellers/maps/criticalhabitat_map.pdf

Figure 3.2-3 Designated Critical Habitat for the Western DPS of Steller Sea Lion

Behavior and life history: Steller sea lions breed from late May to early July. One pup is born annually after a 9 month gestation, following a 3 month period of delayed implantation. Pups are weaned prior to the breeding season, but some may remain with their mothers for 2-3 years (Loughlin 2009). They are opportunistic predators, feeding primarily on a wide variety of fishes and cephalopods. Some of the more important prey species include Pacific whiting, walleye pollock, Atka mackerel, Pacific herring, capelin, Pacific sand lance, Pacific cod, and salmon (Loughlin 2009). Steller sea lions have been known to prey infrequently on harbor seal, fur seal, ringed seal, and possibly sea otter pups.

Compared to other pinnipeds, Steller sea lions tend to make relatively shallow dives, with few dives recorded to depths greater than 250 m. Maximum depths recorded for individual adult females in summer are in the range from 100 to 250 m; maximum depth in winter is greater than 250 m. The maximum depth measured for yearlings in winter was 72 m and average depths are near 18 m and in shallow near-shore waters (Loughlin et al. 2003).

Bearded Seal

Status and trends: The subspecies of bearded seals that occurs in the Pacific (*E. b. nauticus*) is further divided into an Okhotsk DPS and a Beringia DPS (Heptner et al. 1976a, Ognev 1935). The Beringia DPS includes bearded seals in the Bering, Chukchi, Beaufort, and East Siberian seas (Cameron et al. 2010) and is the DPS of interest in this FPEA.

Accurately assessing bearded seal abundance and trends is hindered by their broad distribution, sea-ice habitat, logistical challenges, and cross-political boundaries (Cameron et al. 2010). A reliable population estimate for the entire stock is not available, but research programs have recently developed new survey methods and partial, but useful, abundance estimates. In spring of 2012 and 2013, U.S. and Russian researchers conducted aerial abundance and distribution surveys of the entire Bering Sea and Sea of Okhotsk (Moreland et al. 2013). The data from these image-based surveys are still being analyzed, but Conn et al. (2014), using a very limited sub-sample of the data collected from the U.S. portion of the Bering Sea in 2012, calculated an abundance estimate of approximately 299,174 bearded seals in those waters. These data do not include bearded seals in the Chukchi and Beaufort Seas. A partial minimum estimate and PBR from these data are 273,676 and 8,210, respectively, for bearded seals that overwinter and breed in the U.S. portion of the Bering Sea. There is not, however, a reliable minimum estimate or PBR available for the entire stock (including the Chukchi and Beaufort Seas) (Muto and Angliss 2015).

Sources of human-caused mortality include subsistence hunting and fisheries interactions. Between 2009 and 2013, there was an estimated annual average M&SI rate of 1.2 bearded seals in the Bering Sea/Aleutian Islands pollock, flatfish, and Pacific cod trawl fisheries (Muto and Angliss 2015). Bearded seals have been an important subsistence species for Alaska Natives for thousands of years and continue to be so today. Only 11 of the 64 coastal communities known to harvest bearded seals have been surveyed over the last five years (2009-2013), so statewide harvest estimates are not available. Based on these limited data, a minimum estimate of the average annual bearded seal harvest for 2009-2013 is 379 seals per year (Muto and Angliss 2015).

On December 10, 2010, NMFS announced a 12-month finding on a petition to list the bearded seal as a threatened or endangered species (75 FR 77496). NMFS determined the Beringia DPS and the Okhotsk DPS are likely to become endangered throughout all or a significant portion of their ranges in the foreseeable future, and issued the proposed rule to list them as threatened species. The basis for the determination was the likelihood of current and future sea-ice habitat modification due to climate change and marine habitat modification due to ocean acidification. On December 28, 2012, NMFS issued a final determination to list the Beringia and Okhotsk DPSs of bearded seals as threatened under the ESA, with the final rule taking effect on February 26, 2013 (77 FR 76740). Because of its threatened status under the ESA, this stock was designated as “depleted” under the MMPA and so is classified as a strategic stock. On July 25, 2014, the U.S. District Court for the District of Alaska issued a memorandum decision in a lawsuit challenging the listing of bearded seals under the ESA (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). The decision vacated NMFS' listing of the Beringia DPS of bearded seals as a threatened species. On September 25, 2014, the Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. While the appeal process is in progress, the Beringia DPS of bearded seals will retain consideration as an ESA-listed species in the FPEA, despite current removal from the list.

Distribution and habitat preferences: Bearded seal distribution is circumpolar (Burns 1967, Burns and Frost 1979, Kelly 1988) and extends from the Arctic Ocean (85°N) to Sakhalin Island (45°N) in the Pacific (Allen 1880, Ognev 1935). Distribution and seasonal movements are closely associated with seasonal changes in sea ice. Sea ice provides an important platform on which bearded seals haul out to give birth, nurse pups, rest, and molt. Bearded seals prefer ice in constant motion, with natural openings and areas of open water, such as leads, fractures, and polynyas (Heptner et al. 1976a). It is unusual for bearded seals in the Bering, Beaufort and Chukchi seas to haul out on land.

Most adult bearded seals move north from the Bering Sea into the Bering Strait and Beaufort and Chukchi seas as the ice retreats in spring (late April through June). From summer to early fall, they occur along the southern edge of the Chukchi and Beaufort Sea pack ice (Heptner et al. 1976a). Highest densities of bearded seals in the eastern Chukchi Sea during May and June were in the offshore pack ice where benthic productivity is high (Bengtson et al. 2005). During late winter and early spring, bearded seals are widely distributed in the broken, drifting pack ice from the Chukchi Sea to the ice front in the Bering Sea (Cameron et al. 2010). Pregnant females generally overwinter on drifting ice in the Bering Sea where they whelp and wean before migrating north. Wintering and whelping bearded seals are also found in coastal leads of the Bering and Chukchi Seas, including Bristol and Kuskokwim Bays, Norton and Kotzebue Sounds, the Gulf of Karaginskiy, the Gulf of Anadyr, and near Point Hope (Coffing et al. 1998, Georgette et al. 1998).

Behavior and life history: Bearded seals are largely solitary but they do haul out in small groups along ice leads and at holes in the ice. Peak breeding occurs from March to mid-May, depending on location (Kovacs 2009). Bearded seals prey on benthic organisms, such as epifaunal and infaunal invertebrates and demersal fishes. Crabs, shrimp, and clams are major prey in the Bering, Chukchi, and Beaufort Seas. Tanner crabs are important in the southern Bering Sea, and spider crabs are important in the northern Bering, Chukchi, and Beaufort Seas. Sculpins, arctic cod, polar cod, or saffron cod can also be important prey (Allen 1880, Antonelis et al. 1994, Dehn et al. 2007, Finley and Evans 1983, Heptner et al. 1976a, Kenyon 1962, Lowry et al. 1980, Ognev 1935, Wilke 1954).

<u>Ringed Seal</u>

Status and trends: The five recognized subspecies of ringed seals are the Arctic ringed seal (*Phoca hispida hispida*), the Baltic ringed seal (*P. h. botnica*), the Okhotsk ringed seal (*P. h. ochotensis*), the Ladoga ringed seal (*P. h. ladogensis*), and the Saimaa ringed seal (*P. h. saimensis*). The Arctic ringed seal is further subdivided by geographical region: Greenland Sea and Baffin Bay; Hudson Bay; Beaufort and Chukchi Seas; and the White, Barents and Kara Seas (Allen and Angliss 2011). Arctic ringed seals of the Beaufort and Chukchi Seas are the only ones anticipated to occur in the AFSC research areas.

Several factors, including the seals' distribution and ecology, make population assessments difficult. Estimates based on recent survey data of at least 300,000 ringed seals in the Alaskan Beaufort and Chukchi seas likely underestimate the true population size (Bengtson et al. 2005, Frost et al. 2004). The total population of ringed seals in the Beaufort and Chukchi seas was estimated at 1 million when accounting for seals inhabiting pack ice and the eastern Beaufort and Amundson Gulf areas (Bengtson et al. 2005, Frost et al. 2004). Reliable abundance and minimum population estimates for U.S. waters are forthcoming, pending further analysis of data collected in comprehensive and synoptic aerial surveys of ice-associated seals in the Bering and Okhotsk Seas in 2012 and 2013 (Allen and Angliss 2015).

In the absence of reliable estimates of minimum population size, PBR cannot be determined. Interactions between U.S. commercial fisheries and ringed seals in the Bering Sea/Aleutian Islands flatfish, pollock, and Pacific cod trawl and Pacific cod longline fisheries from 2009 to 2013 resulted in an annual average of rate of M&SI in U.S. commercial fisheries of 4.1 seals. Ringed seals are an important subsistence resource for Alaska Native communities. Only 11 of the 64 coastal communities known to harvest ringed seals have been surveyed over the last five years (2009-2013), so statewide harvest estimates are not available. Based on these limited data, a minimum estimate of the average annual ringed seal harvest for 2009-2013 is 1,040 seals per year (Muto and Angliss 2015).

On December 10, 2010, NMFS announced a proposed rule and a 12-month finding on a petition to list the ringed seal as a threatened species under the ESA after determining that all of the subspecies, except for the Saimaa ringed seal, are likely to become endangered throughout all or a significant portion of their range in the foreseeable future (75 FR 77476). The basis for the determination was the likelihood of sea-ice habitat modification due to climate change and marine habitat modification due to ocean acidification.

NMFS listed the Arctic subspecies of ringed seals and the Beringia DPS of bearded seals as threatened under the ESA on December 28, 2012 (77 FR 76706 and 77 FR 76740 respectively). In two separate decisions, the U.S. District Court for the District of Alaska vacated the Beringia DPS bearded seal listing and the Arctic subspecies of ringed seal listing (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB; Alaska Oil and Gas Association v. NMFS, Case No. 4:14-cv-00029-RRB). NMFS appealed both decisions to the Ninth Circuit. On October 24, 2016, the Ninth Circuit reversed the district court's decision with regard to the bearded seal listing. On May 12, 2017, the court ruled to reinstate bearded seals as threatened under the ESA. On February 12, 2018 the Ninth Circuit Court ruled that ringed seals would receive threatened species protection. The Biological Assessment (NMFS 2017a) and Biological Opinion (NMFS 2019) include both ringed and bearded seals so that the action agency has the benefit of the analysis of the consequences of the proposed action on these species.

Distribution and habitat preferences: Ringed seals are circumpolar and occur in all seasonally ice-covered seas of the northern hemisphere (King 1983). They are strongly ice-associated, and the seasonality of ice cover dictates movements, feeding, and reproductive behavior (Kelly et al. 2010b). The Arctic subspecies typically hauls out exclusively on sea ice for resting, pupping, and molting (Kelly and Quakenbush 1990, Kelly et al. 2010b).

Ringed seals are found throughout the Beaufort, Chukchi, and Bering Seas, including as far south as Bristol Bay in years of extensive ice coverage. During late April through June, ringed seals are distributed from the southern ice edge northward. They prefer large ice floes and often occur in the ice pack where sea ice coverage is greater than 90 percent (summarized in Allen and Angliss 2011). Ringed seals are common in May and June in the eastern Chukchi Sea, with highest densities in coastal waters south of Kivalina and near Kotzebue Sound, and associated with nearshore fast ice and pack ice (Bengston et al. 2005). In the Alaskan Beaufort Sea, the density of ringed seals in May-June is higher to the east than to the west of Flaxman Island. Highest densities occur at depths of 5-35 m (16-144 ft) and on relatively flat ice near the fast ice edge (Frost et al. 2004).

Ringed seals are able to remain in areas of dense ice cover throughout the fall, winter, and spring by maintaining breathing holes in the ice. They excavate lairs in the snow (subnivean space) over their breathing holes as pupping season approaches (Helle et al. 1984).

Behavior and life history: Ringed seals reach sexual maturity at 4-6 years of age for both sexes. Females give birth to a single pup in a subnivean lair during March-April. Weaning occurs about 40 days later, with mating following soon thereafter (Hammill 2009). Ringed seals typically prey on small schooling fish and crustaceans (Kovacs 2007). Known prey in the Chukchi Seas include Arctic cod, polar cod, saffron cod, sculpins, shrimp, amphipods, euphausiids, and mysids (Kelly et al. 2010b, Quakenbush and Sheffield 2007).

Pacific Walrus

Status and trends: The three modern subspecies of walruses are the Atlantic walrus (*O. r. rosmarus*), the Pacific walrus (*O. r. divergens*), and the Laptev walrus (*O. r. laptevi*) (ITIS 2010). The Pacific walrus, the only subspecies occurring in AFSC fisheries research areas, consists of a single population that inhabits continental shelf waters of the Bering and Chukchi Seas (Fay 1982).

Total population size is not known. Part of the spring range in the Bering Sea pack ice was surveyed in 2006 using a combination of thermal imaging and satellite transmitters, resulting in an estimated 129,000 walruses in the area (Garlich-Miller et al. 2011, Speckman et al. 2011). This represents a partial population estimate, since only about half of the potential walrus habitat was surveyed (Speckman et al. 2011). It is, however, the best estimate of minimum population size. The calculated PBR is 2,580 walrus (USFWS 2014a).

The estimated incidental M&SI due to commercial fisheries (2.0 per year in the Bering Sea/Aleutian Island flatfish trawl fishery, 2006-2010) is less than 10 percent of the calculated PBR, so can be considered insignificant and approaching a zero M&SI rate. Total human-caused mortality, including removals through subsistence harvests in the U.S. and Russia (4,852 per year, 2006-2010), the two fisheries takes, and 19 due to other human activities exceed estimated PBR. The Pacific walrus stock is, therefore, classified as strategic (USFWS 2014a).

In 2011, the USFWS published a notice of a 12-month finding on a petition to list the Pacific walrus as threatened or endangered under the ESA (76 FR 7634, February 10, 2011). Listing was considered warranted, but precluded by higher priority actions to list other species. Factors considered primary threats to Pacific walrus in the foreseeable future and the reason for the determination are impacts of sea ice loss in summer and fall and the subsistence harvest. Upon publication of the notice, the Pacific walrus was added to the USFWS list of candidate species.

Distribution and habitat preferences: Pacific walrus range across continental shelf waters of the northern Bering Sea and Chukchi Sea. Walruses congregate in the Bering Sea pack-ice adjacent to areas with open water during the breeding season from January to March (Fay et al. 1984). Breeding aggregations are common southwest of St. Lawrence Island, south of Nunivak Island and south of the Chukotka Peninsula in the Gulf of Anadyr (Speckman et al. 2011). Adult males remain in the Bering Sea to forage from coastal haul outs during the ice free season. Most of the remaining population migrates through the Bering Strait to summer feeding areas over the continental shelf in the Chukchi Sea as ice in the Bering Sea breaks up in spring (Garlich-Miller et al. 2011). Summer distribution in the Chukchi Sea depends on sea ice distribution and extent. Walrus concentrate in loose pack ice off the northwest coast of Alaska between Icy Cape and Point Barrow and along the coast of Chukotka, Russia, to Wrangel Island (Belikov et al. 1996, Gilbert et al. 1992). Walrus return to the Bering Sea wintering areas in September and October in advance of sea ice formation in the Chukchi Sea. Large herds may gather to rest during migration at haul outs in the southern Chukchi Sea (Belikov et al. 1996).

Sea ice provides a platform for resting, breeding, calving, and care of dependent young (Fay et al. 1984, Kelly 2001). Walrus may haul out on land when sea ice is not available (Fischbach et al. 2009). In 2007, 2009, and 2010, the pack-ice retreated beyond the continental shelf and large numbers of walruses hauled out on land at several locations between Point Barrow and Cape Lisburne (Clarke et al. 2011, Thomas et al. 2009).

Behavior and life history: Walrus are polygynous, with dominant males having the majority of mating opportunities. Mating occurs in the water during January to April and a single calf is born in April to early June (Kastelein 2009). Females reach sexual maturity at about 5-7 years of age and males at about 7–10 years of age, although males are not physically and socially mature enough to mate until about age 15 (Kastelein 2009). Calves are weaned after about 3 years. Walruses prefer shallow water over continental shelves up to a depth of about 80 m. The diet consists mainly of bivalve invertebrates, mostly mollusks (Kastelein 2009).

Northern Sea Otter: Southwest Alaska DPS

Status and trends: Three genetically and geographically distinctive population segments (DPSs) of sea otters are recognized in Alaska: the Southwest Alaska DPS, which extends from the Bering Sea, Aleutian Islands, and Alaska Peninsula to the western shore of Cook Inlet; the Southcentral Alaska DPS, which extends from Cook Inlet east to Cape Yakataga, including Kachemak Bay, the Kenai Peninsula coast, and PWS; and the Southeast Alaska DPS, which extends from Cape Yakataga to the southern boundary of Alaska (Gorbics and Bodkin 2001). The latter two DPSs occur entirely within the GOARA; the former spans both the GOARA and BSAIRA. Only the Southwest Alaska DPS will be considered here, as it is the only DPS in Alaska listed under the ESA.

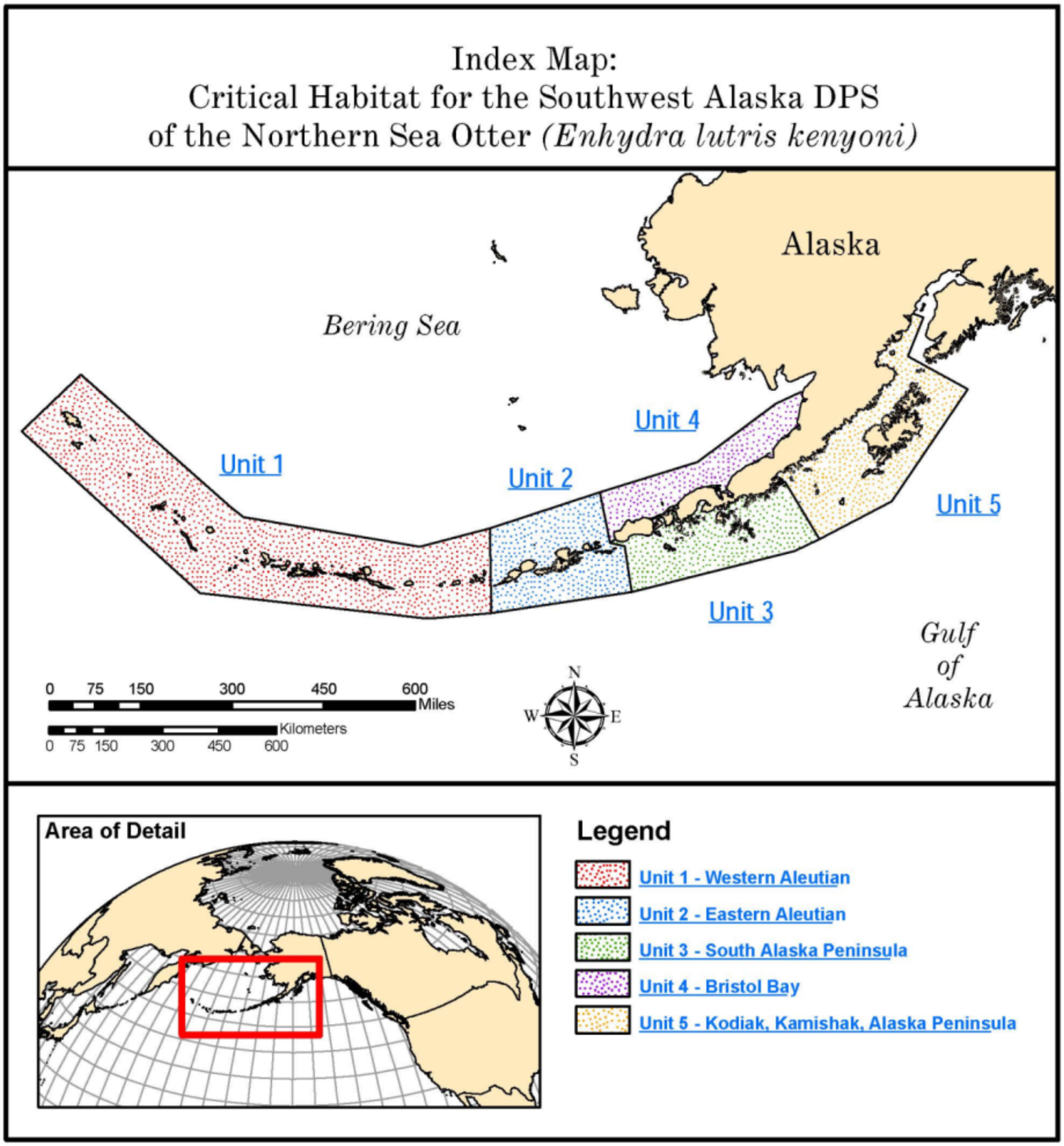
In spring 2000, USFWS repeated an aerial survey that was previously conducted in 1992 and observed widespread declines throughout the Aleutian Islands, particularly in the central Aleutians. Uncorrected counts indicated that sea otter populations had declined by 70 percent since 1992. The population declined overall by at least 55–67 percent since the mid-1980s and, in some areas within southwest Alaska, by over 90 percent during this time period. As a result, the Southwest Alaska DPS was listed as threatened under the ESA in 2001 (70 FR 46366, August 9, 2005).

The most recent adjusted abundance estimate for the southwest Alaska sea otter population, based on surveys across the range in 2000-2008, and Katmai in 2009, is 54,771 (USFWS 2014b). The most recent calculated PBR, based on a minimum estimate of 45,064, is 450 sea otters per year (USFWS 2014b).

Current estimates of sea otter bycatch in commercial fisheries are not available. Observer coverage in fisheries within the range of this stock is lacking or low for most fisheries, including those known to interact with sea otters, such as set and drift gillnet fisheries (USFWS 2014b). Other human-caused sources of mortality for this stock include a subsistence hunt. The annual average subsistence take during 2006 to 2010 was 76 otters, 83 percent of which were from the Kodiak Archipelago (USFWS 2014b).

Distribution and habitat preferences: The Southwest Alaska DPS ranges from Attu Island at the western end of the Aleutian Islands to Kamishak Bay on the west side of Cook Inlet. Included are the coastal waters of the Aleutian Islands, the Alaska Peninsula, the Kodiak archipelago, and the Barren Islands (70 FR 46366, August 9, 2005). Habitat is generally shallow (less than 34 m) nearshore marine waters with sandy or rocky bottoms supporting substantial populations of benthic invertebrates. Sea otters occasionally occur offshore. Large aggregations have been observed more than 30 km north of Unimak Island in the Bering Sea (Kenyon 1969).

The USFWS published the final rule designating critical habitat for the Southwest Alaska DPS in 2009 (74 FR 51988, October 8, 2009). Primary defining features of critical habitat are: shallow, rocky areas where marine predators are not likely to forage; nearshore waters within 100 m (328.1 ft) of the mean high tide line that may provide protection from marine predators; kelp forests that provide marine predator protection; and adequate prey availability and quality. The five management units designated as critical habitat are: Western Aleutian Unit; Eastern Aleutian Unit; South Alaska Peninsula Unit; Bristol Bay Unit; and Kodiak, Kamishak, Alaska Peninsula Unit (Figure 3.2-4).



For detailed maps of critical habitat within each of the five management units, refer to http://alaska.fws.gov/fisheries/mmm/seaotters/pdf/SeaOtterCriticalHabitatMaps.pdf.

Figure 3.2-4 Critical Habitat for the Southwest Alaska DPS of the Northern Sea Otter

Behavior and life history: Reproduction occurs throughout the range. Sea otters pup in late winter and early spring, and the pups are weaned in late summer and early fall. Post weaning mortality is higher for males than females and increases as resources become limited (Estes et al. 2009). They forage on a variety of marine invertebrates, including sea urchins (Estes et al. 2009). Otters will typically dive up to 60 feet while foraging and will bring their prey to the surface to crack open and consume (Estes et al.

2009). Feeding occurs both at day and night. Sea otters are preyed upon by white sharks, killer whales, and, infrequently, Steller sea lions.

Polar Bear

Status and trends: The two stocks of polar bears in Alaska are the Chukchi/Bering Seas stock and the Southern Beaufort Sea stock. The former ranges across the CSBSRA and northern BSAIRA and the latter across the CSBSRA. Ranges overlap in the northeastern Chukchi Sea. Low population densities, inaccessible habitat, cross-boundary politics and budget constraints have made estimating abundance of Alaskan populations difficult (Lentfer and Galster 1987).

There is currently no reliable population estimate for the Chukchi/Bering seas stock. The IUCN Polar Bear Specialist Group estimated a population of approximately 2,000 animals by extrapolating multiple years of aerial den survey data. However, the estimate is imprecise and not useful for evaluating status and trends (Lunn et al. 2002). Reliable estimates of minimum population, PBR level, and human-caused mortality or serious injury in Chukotka are currently unavailable. The average annual Alaska subsistence harvest from this stock was 37 for 2003-2007. There is no incidental mortality or serious injury of polar bears in any U.S. commercial fishery (Allen and Angliss 2012).

The most current and valid population estimate for the Southern Beaufort Sea stock (1,526 bears) was based on data collected from 2001-2006. The area to which this applies extends from Point Barrow east to the Baillie Islands in Canada (Regehr et al. 2006). The overall population growth rate declined by approximately 0.3 percent per year for the years 2001 to 2006 (Hunter et al. 2007). The minimum population estimate is 1,397 bears, with a calculated PBR of 22 bears per year (Allen and Angliss 2012). The combined average annual subsistence harvest in Alaska and Canada was 53.6 bears per year for 2003-2007. Polar bear stocks in Alaska have no direct interaction with commercial fisheries activities; the total fishery M&SI rate for this stock is zero (Allen and Angliss 2012).

A determination of threatened species status for the polar bear throughout its range was published by the USFWS in 2008 (73 FR 28212, May 15, 2008). This determination was based on declining sea ice habitat throughout the species range and the anticipated continued decline in the foreseeable future. Loss of sea ice habitat was considered a sufficient threat that polar bears were considered likely to become an endangered species in the foreseeable future throughout their range. The Chukchi/Bering seas and South Beaufort Sea stocks are, therefore, also classified as depleted under the MMPA and designated as strategic stocks (Allen and Angliss 2012).

On December 7, 2010, the USFWS published a Final Rule (75 FR 76086) designating critical habitat for U.S. populations of polar bears. The area encompassed 484,734 km^2 (187,157 mi^2) and included sea-ice habitat, terrestrial denning habitat, and barrier island habitat in Alaska and adjacent territorial and U.S. waters. On January 10, 2013 The U.S. District Court for the District of Alaska issued an order vacating and remanding to the USFWS this 2010 Final Rule. The USFWS appealed the ruling and on February 29, 2016, the 9th Circuit Court of Appeals ruled that the USFWS had acted properly in designating critical habitat for polar bears (http://www.adn.com/article/20160229/appeals-court-upholds-designation-polar-bear-habitat). It is not clear if further legal proceedings will affect the polar bear critical habitat designations as defined in the final rule.

Distribution and habitat preferences: Polar bears are distributed across ice-covered waters of the circumpolar Arctic. Sea ice is their primary habitat upon which they depend for most life functions. Pack ice is the primary summer habitat for Alaska polar bears that use it for traveling and feeding, as well as for denning in fall and winter. Shorefast ice is important in the spring for preying on seal pups, traveling, and occasional denning. Leads that open and close between the active pack ice and shore-fast ice are important during winter and spring for feeding and travel (Schliebe et al. 2006, Stirling and Derocher 1993). Distribution and movements are intricately tied to seasonal sea ice dynamics and the polar bears range is limited to areas covered in sea ice for much of the year (Stirling et al. 1999).

The Chukchi/Bering seas stock is widely distributed on pack ice in the Chukchi Sea, northern Bering Sea, and adjacent coastal areas in Alaska and Russia. The range extends to the northeast near the Colville Delta in the central Beaufort Sea and to the west near Chauniskaya Bay in the Eastern Siberian Sea. The southern boundary is determined by the annual extent of pack ice (Amstrup et al. 2005, Garner et al. 1990).

The Southern Beaufort Sea stock ranges east to south of Banks Island and east of the Baillie Islands, Canada (Amstrup et al. 2000). The western boundary is near Point Hope. Adult female polar bears from this stock occasionally move into an area that overlaps with the range of the Chukchi/Bering stock between Point Hope and Colville Delta, centered near Point Lay (Amstrup et al. 2000, Garner et al. 1990, Garner et al. 1994).

Behavior and life history: Breeding occurs in late March to early June with on average two cubs are born in November/December. Most maternal denning takes place in snow drifts in coastal areas. In the western Beaufort Sea a large portion of adult females used to den 200 km or more offshore (Stirling 2009). The percentage denning on sea ice dropped dramatically in recent years (to 37 percent, 1998-2004) in response to thinning sea ice (Fischbach et al. 2007). Polar bear movements are extensive and individual activity areas are enormous. Their preferred prey is ringed seals with bearded, hooded, and harp seals also consumed.

3.2.2.3 Non-ESA Listed Marine Mammals that could be Taken during the course of AFSC Fisheries Research Activities

Species included in this section are non-ESA listed species that could be taken by mortality/serious injury or 'Level A' harassment during the course of AFSC fisheries research over the next five years. This includes species that have historically (2004-2014) been taken, those with vulnerabilities similar to those previously taken and could, therefore, be taken in the future, and species that have been taken by commercial fisheries using gear analogous to that used during fisheries research. Species historically taken include Dall's porpoises, one northern fur seal, and one northern sea otter (Southeast Alaska DPS). Detailed species descriptions and take determinations are available in the LOA Application (Appendix C).

<u>Beluga Whale: Beaufort Sea and East Chukchi Sea stocks</u>

As noted above, there are five stocks of beluga whales recognized in U.S. waters: Cook Inlet; Bristol Bay; eastern Bering Sea; eastern Chukchi Sea; and Beaufort Sea stocks. The Cook Inlet stock is described in Section 3.2.2.2. The LOA application (Appendix C) includes take requests for the eastern Chukchi Sea and Beaufort Sea stocks. Neither stock is listed as depleted under the MMPA or threatened or endangered under the ESA.

Opportunistic and systematic observations have been used to estimate abundance for belugas from these two stocks off northern Alaska and western Canada. Based on the most recent aerial surveys in 1992 and correction factors to account for availability bias, the best available abundance estimate for the Beaufort Sea stock is 39,258 (Allen and Angliss 2015). Telemetry data from 1993 and 1995 showed belugas ranging well beyond the aerial survey area, suggesting the 1992 abundance may have been greatly underestimated (Richard et al. 2001). The minimum estimate of 32,453 whales is greater than eight years old, which is generally deemed too unreliable for calculating PBR. Recent trend data from Harwood and Kingsley (2013) indicating that the population is stable or increasing prompted the Alaska Scientific Review Group to recommend retaining this minimum estimate. Based on this, the PBR for this stock is 649 belugas per year (Allen and Angliss 2015). There are no reports of mortality incidental to commercial fisheries and total fishery-related M&SI is estimated to be zero. The Beaufort Sea stock of beluga whales are harvested for subsistence purposes in both Alaska and Canada. The mean annual number landed by Alaska Natives is 65.6 (2008-2012) and is 100 in Canada (2005-2009) for a total average annual subsistence take of 166 from this stock (Allen and Angliss 2015).

Survey data are also outdated for the eastern Chukchi stock of beluga whale. It was not possible to estimate abundance from the most recent survey in 1998, but, in 2012, efforts to estimate abundance of this stock took place. Data are currently being analyzed. The most reliable estimate continues to be 3,710 whales derived from 1989-91 survey counts corrected for animals diving and not visible at the surface and for newborns and yearlings missed due to their small size and dark coloring. There is currently no evidence that the eastern Chukchi Sea stock of beluga whales is declining, but the current trend is unknown. Due to the age of the most recent estimate, neither a minimum estimate nor PBR could be determined (Allen and Angliss 2015). There have been no reported mortalities incidental to commercial fisheries. The average annual subsistence harvest by Alaska Natives was 57.4 belugas for the years 2008 to 2012 (Allen and Angliss 2015).

Beluga whales closely associate with open leads and polynyas in ice-covered regions throughout Arctic and sub-Arctic waters of the Northern Hemisphere. Distribution varies seasonally. Whales from both the Beaufort Sea and eastern Chukchi Sea stocks overwinter in the Bering Sea. In the spring, belugas migrate north to coastal estuaries, bays, and rivers. Annual migrations may cover thousands of kilometers. Belugas of the eastern Chukchi Sea stock congregate in nearshore waters of Kotzebue Sound and Kasegaluk Lagoon (near Point Lay) in June and July (Frost et al. 1993, Huntington et al. 1999). Movement patterns between July and September vary by age and/or sex classes. Beaufort Sea belugas migrate westward in September, both on and off the continental shelf (Richard et al. 2001). In fall, most belugas migrate back to the Bering Sea. The diet of beluga whales appears to be quite varied. Fish, including Arctic cod and saffron cod, and invertebrates, such as cephalopods and shrimp, seem to be important in the diet of belugas along the Alaskan Chukchi Sea coast (Seaman et al. 1982). Belugas in the eastern Beaufort Sea appear to feed predominantly on Arctic cod (Loseto et al. 2009).

Killer Whale (Alaska Resident Stock)

Killer whales belong to the Order Cetacea, Suborder Odontoceti, and Family Delphinidae. There are three recognized ecotypes in the North Pacific Ocean: residents, transients, and offshores (Krahn et al. 2004). Resident killer whales forage primarily for fish in relatively large groups in coastal areas. Transient killer whales primarily hunt marine mammals (Herman et al. 2005, Krahn et al. 2004, Baird et al. 1992). Transient pods are usually fewer in number than resident pods, and they typically have different dorsal fin shapes and saddle patch pigmentation than resident pods. Less is known about offshore killer whales, but their groupings are large, they range from Mexico to Alaska, and their prey includes fish, particularly sharks (Ford et al. 2000, Krahn et al. 2004, Ford et al. 2014).

Alaskan resident whales are found from southeastern Alaska to the Aleutian Islands and Bering Sea. Intermixing of Alaska residents have been documented among areas (Allen and Angliss 2015, and citation therein). Recent studies have shown the Alaska Resident stock differs from the Northern Resident stock based on acoustic and genetic data; the Northern Resident stock is found in summer primarily in central and northern British Columbia. Members of the Northern Resident population have been documented in southeastern Alaska; however, they have not been seen to intermix with Alaskan residents. Combining counts of known ‘resident’ whales gives a minimum number of 2,347 (Southeast Alaska + Prince William Sound + Western Alaska; 121 + 751 + 1,475) killer whales belonging to the Alaska Resident stock (ibid); this count of individual killer whales also represents to minimum population estimate (2,347 whales). The trend in population abundance is equivocal and the calculated PBR is 23.4 killer whales (Allen and Angliss 2015).

The minimum abundance estimate for the Alaska Resident stock is likely underestimated because researchers continue to encounter new whales in the Gulf of Alaska and western Alaskan waters. Based on currently available data, the estimated minimum annual average U.S. commercial fishery-related mortality level (0.9) is less than 10 percent of the PBR and is therefore considered to be insignificant and approaching zero M&SI rate. Commercial fisheries with reported takes from 2007- 2011 include the Bering Sea-Aleutian Islands flatfish and rockfish trawl fisheries and the Greenland turbot longline fishery.

The estimated annual level of human-caused M&SI (0.9 animals per year) is not known to exceed the PBR. Therefore, the eastern North Pacific Alaska Resident stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its OSP is currently unknown (Allen and Angliss 2015).

Pacific White-sided Dolphin

Pacific white-sided dolphin stock structure is poorly understood. Despite this, management issues support a two stock designation: 1) the California/Oregon/Washington stock, and 2) the North Pacific stock (Allen and Angliss 2015). The latter is considered here. The most comprehensive range-wide abundance estimate of 931,000 animals was derived from marine mammal surveys in the central North Pacific in 1987 to 1990. The portion of this estimate from sightings north of 45° N in the GOA (26,880 dolphins) could serve as an estimate for this area. These data are, however, older than eight years, so neither a minimum estimate nor PBR can be determined for this stock (Muto and Angliss 2015). There were no reported mortalities or serious injuries of this stock of Pacific white-sided dolphins in observed commercial fisheries between 2009 and 2013. Several gillnet fisheries known to interact with this stock lacked observer coverage; any mortality, if it occurred, has not been reported. The stock size is sufficiently large that unreported mortalities would not likely be significant (Muto and Angliss 2015).

Pacific white-sided dolphins are endemic to temperate waters of the North Pacific Ocean, where they occur on the high seas and along continental margins, as well as in some inland waters. In the eastern North Pacific, the species ranges from the southern Gulf of California to the GOA, and west to Amchitka in the Aleutian Islands. They are rare in the southern Bering Sea. (Allen and Angliss 2015 and citations therein).

Harbor Porpoise

Three harbor porpoise stocks are currently recognized in Alaska, based primarily on geography and perceived areas of low porpoise density: the Southeast Alaska stock (British Columbia to Cape Suckling, Alaska); the GOA stock (Cape Suckling to Unimak Pass); and the Bering Sea stock (Aleutian Islands and all waters north of Unimak Pass). The validity of these stock designations has not been analyzed (Muto and Angliss 2015).

The most recent comprehensive abundance estimate of 11,146 harbor porpoise in the coastal and inside waters of Southeast Alaska is from 1997 (Hobbs and Waite 2010). A more recent (2010-2012) estimate of 975 porpoises only includes the inland waters of Southeast Alaska, so is not an accurate estimate of overall or minimum abundance for the entire Southeast Alaska harbor porpoise stock. PBR for this stock is undetermined, due to the unreliability of the outdated abundance estimate. A minimum estimate (463) and PBR (4.6) were calculated for the Wrangell and Zarembo Islands areas of Southeast Alaska to provide context with which to assess takes of harbor porpoise in the salmon gillnet fishery that occurs in the area. The estimated annual U.S. commercial fisheries-related M&SI level for the Southeast Alaska stock in 2009-2013 is 34.2 porpoises (34 from observed fisheries, 0.2 from stranding data) (Muto and Angliss 2015).

The most recently available abundance estimate of 31,046 porpoises for the GOA stock is based on surveys conducted in 1998 (Hobbs and Waite 2010). Therefore, the minimum population estimate is considered unknown and the PBR undeterminable. Average annual mortality in state-managed observed fisheries (1990-2005) is 72 harbor porpoises. All takes were in drift or set gillnets (Muto and Angliss 2015).

The population estimate for the Bering Sea stock of 48,215 is similarly outdated. This was based on surveys of the Bristol Bay area in 1997 through 1999 (Hobbs and Waite 2010). There is no reliable information on trends in abundance for this stock and, due to the age of the data, a minimum estimate is unknown and PBR cannot be determined. There were no mortalities of Bering Sea harbor porpoise reported in observed commercial fisheries during 2009 to 2013. One harbor porpoise mortality due to entanglement in a commercial salmon gillnet in Kotzebue was reported in 2013, for a minimum average annual M&SI rate of 0.2 Bering Sea harbor porpoise in commercial fisheries in 2009-2013. One harbor porpoise was reportedly entangled in a subsistence gillnet in 2012, for a mean annual mortality of 0.2 porpoise due to subsistence fishery interactions. Total mean annual M&SI is 0.4 porpoises (Muto and Angliss 2015).

Harbor porpoise are not listed as "depleted" under the MMPA or listed as threatened or endangered under the ESA. At present, U.S. commercial fishery-related annual mortality levels (i.e., <10 percent of PBR) can be considered insignificant and approaching zero M&SI rate. However, because the abundance estimates are 12 years old and information on incidental harbor porpoise mortality in commercial fisheries is not well understood, all three harbor porpoise stocks in Alaska are classified as strategic stocks. Population trends and status of all these stocks relative to OSP are currently unknown (Muto and Angliss 2015).

Harbor porpoises in the eastern North Pacific range from Point Barrow and along the west coast of North America from Alaska to Point Conception, California (Gaskin 1984). They are primarily coastal and most commonly occur in waters less than 100 m (328 ft) deep (Hobbs and Waite 2010). Harbor porpoises often feed on bottom-dwelling fishes and small pelagic schooling fishes with high lipid content, such as herring and anchovy (Bjørge and Tolley 2009, Leatherwood et al. 1982).

Dall's Porpoise

Stock structure of eastern North Pacific Dall's porpoise populations is not well understood. The Alaska stock is currently the only stock recognized in Alaska waters where it occurs in the GOA, Bering Sea and Aleutian Islands areas. A corrected abundance estimate for the Alaska stock was 83,400 porpoises for 1987-1991 (Muto and Angliss 2015). Minimum population size and PBR are considered unknown because the abundance estimate is based on data older than 8 years. By regulation, abundance estimates older than 8 years should not be used to calculate a PBR level (Muto and Angliss 2015).

Dall's porpoise are not listed as depleted under the MMPA or as threatened or endangered under the ESA. The estimated level of human-caused M&SI from 2009 to 2013 is 38 per year from observed Bering Sea/Aleutian Islands pollock trawl (0.2) and Pacific cod longline (0.3) fisheries, the Southeast Alaska salmon drift gillnet fishery (9), and Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery (28). Because the PBR is undetermined, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero M&SI rate is unknown. The Alaska stock of Dall's porpoise is not classified as a strategic stock (Muto and Angliss 2015).

The species is found only in temperate waters of the North Pacific and adjacent seas and is probably the most widely distributed cetacean in temperate and subarctic regions of the North Pacific and Bering Sea. This is an oceanic species found along the continental shelf and in inland and coastal waters of the GOA and Bering Sea/Aleutian Islands areas. There are seasonal inshore-offshore and north-south movements, but these movements are poorly understood (Jefferson 2009).

Steller Sea Lion: Eastern DPS (Stock)

The ESA-listed Western DPS of Steller sea lion is described above in Section 3.2.2.2. The Eastern DPS, delisted in 2013, is included here. The recent status review (NMFS 2013a) shows the population met recovery criteria outlined in the recovery plan developed by NOAA fisheries in 1992 and revised in 2008. Therefore in November 2013, NOAA delisted the eastern stock, by removing it from the ESA list of threatened and endangered species (78 FR 66140, November 4, 2013). Although no longer listed under the ESA, eastern Steller sea lions are considered depleted and, as a result, classified as a strategic stock.

Based on extrapolations from non-pup and pup surveys, 2009-2013, the total population of the eastern stock of Steller sea lion is estimated to range from 60,131 to 74,448 with a minimum population estimate of 59,968 for the entire stock and 36,551 for the U.S. portion only. Counts of adults and juvenile Steller sea lions observed at rookeries and haulouts in Southeast Alaska in 2013 totaled 18,595 animals (Allen and Angliss 2015). The calculated PBR for the U.S. portion of the stock is either 1,645 or 2,193, depending on the recovery factor used and whether or not the DPS is considered depleted. Total average annual human-caused M&SI for this DPS is 92.3 sea lions (17.0 in observed commercial fisheries, 34.6 in commercial and recreational fisheries based on opportunistic observations and strandings, 11.3 subsistence takes, and 29.4 from other sources). The observed commercial fisheries takes were all from south of 49° N latitude; between 2008 and 2012, there were no serious injuries and mortalities observed in the federally regulated and monitored commercial fisheries in Alaska (Allen and Angliss 2015).

The eastern stock of Steller sea lions ranges from California to Prince William Sound, Alaska (east of Cape Suckling at 144° W) (Loughlin 1997). Steller sea lions prefer isolated offshore rocks and islands to breed and rest. Rookeries and major haulouts for the Eastern DPS extend from Cape Fairweather (58.8° N) to Año Nuevo Island (37.1° N) (NMFS 2013a). Steller sea lions tend to return to their birth island as adults to breed. They range widely during their first few years and during the non-breeding season; some yearlings have been seen over 1,000 km from their birth rookery (Loughlin 2009). Delisting the eastern stock of Steller sea lions did not remove or modify Steller sea lion critical habitat, designated in 1993 (58 FR 45269, August 27, 1993). Existing critical habitat designation will remain in place until NMFS undertakes a separate rulemaking to consider amending designation (78 FR 66140, November 4, 2013).

Northern Fur Seal

Northern fur seals consist of two stocks in U.S. waters: Eastern Pacific stock (Pribilof Islands and Bogoslof Island) and California stock. The Eastern Pacific stock is the most prevalent stock in AFSC fisheries research areas. Northern fur seals do not occur in the CSBSRA.

Population estimates are based on pup counts multiplied by expansion factors to account for other age classes. Most pups in this stock are born on St. Paul and St. George Islands where surveys occur biennially. Additional counts are periodically made at Sea Lion Rocks and Bogoslof Island. The most recent estimate, based on counts between 2008 and 2012, is 648,534 fur seals. The minimum estimate is 548,919 and the PBR is 11,802 fur seals per year (Muto and Angliss 2015). The total estimated annual human-caused M&SI for this stock for 2009-2013 was 439 animals (1.1 from commercial fisheries, 1.8 in unknown fisheries, 432 from Alaska Native harvest, 0.6 from research activities, 2.6 in marine debris, and 0.2 by power plant entrainment) (Muto and Angliss 2015). This is well below total and 10 percent of PBR.

This northern fur seal population was designated as depleted pursuant to the MMPA in 1988 (53 FR 17888, 18 May 1988) because it declined to less than 50 percent of levels observed in the late 1950s and there was no compelling evidence that the northern fur seal carrying capacity of the Bering Sea had changed substantially since then (NMFS 2007a). The Eastern Pacific stock is, therefore, also classified as a strategic stock. It is not listed under the ESA.

As summarized in NMFS (2007a), northern fur seals are endemic to the North Pacific Ocean. During the winter, the southern limit of their range extends across the Pacific Ocean from southern California to the Okhotsk Sea and Honshu Island, Japan. In the spring most northern fur seals migrate north to breeding colonies in the Bering Sea, primarily on the Pribilof Islands. The largest breeding colonies on St. Paul and St. George Islands in the Pribilof Islands (Bering Sea) comprise approximately 74 percent of the worldwide fur seal population. Other breeding colonies are located in the Commander Islands (Russia) in the western Bering Sea and on Robben Island (Russia) in the Okhotsk Sea (approximately 15 and 9 percent of the population, respectively). Small breeding colonies are also located on the Kuril Islands in the western North Pacific, Bogoslof Island in the central Aleutian Islands, and on San Miguel Island off the southern California coast. While at sea, fur seals feed primarily along the subpolar continental shelf and shelf break from the Bering Sea to California, with highest densities associated with major oceanographic frontal features, including sea mounts, valleys, and canyons (NMFS 2007a and citations therein).

Northern fur seals prey primarily on schooling fish and gonatid squid, although the species consumed vary with location and season (Sinclair et al. 1996). Prey most commonly consumed by sub-adult males and adult females at St. Paul Island include walleye pollock, Pacific salmon, Pacific herring, and cephalopods (Call and Ream 2012).

Harbor Seal

In 2010, the NMFS and the Alaska Native Harbor Seal Commission defined 12 separate stocks of harbor seals in Alaska based largely on their genetic structure, along with population trends, movements, and traditional Alaska Native use areas. This is a substantial increase over the three previously recognized stocks (Bering Sea, GOA, and Southeast Alaska). The 12 stocks are: the Aleutian Islands stock, the Pribilof Islands stock, the Bristol Bay stock, the North Kodiak stock, the South Kodiak stock, the Prince William Sound stock, the Cook Inlet/Shelikof Strait stock, the Glacier Bay/Icy Strait stock, the Lynn Canal/Stephens Passage stock, the Sitka/Chatham Strait stock, the Dixon/Cape Decision stock, and the Clarence Strait stock (Muto and Angliss 2015). The Aleutian Islands, Pribilof Islands, and Bristol Bay stocks are within the BSAIRA. The rest are in the GOARA.

The most recent abundance estimates are based on aerial survey data collected from 1998 to 2011. The current statewide estimate (all stocks combined) is 205,090 harbor seals (Muto and Angliss 2015). Table 3.2-8 includes best and minimum abundance estimates, PBR, and human-caused M&SI for each of the twelve harbor seal stocks in Alaska.

Table 3.2-8 Stocks of Harbor Seals in the AFSC Research Areas

Stock	Best Abundance Estimate	Minimum Abundance Estimate	PBR	Average Annual Human-Caused Mortality & Serious Injury			
				Commercial Fisheries (2009-2013)	Subsistence Harvest (2004-2008)[1]	Stranding Data (2009-2013)	Total
Aleutian Islands	6,431	5,772	173	0	90	0	90
Pribilof Islands	232	232	7	0	0	0	0
Bristol Bay	32,350	28,146	1,182	0.6	141	0	142
N. Kodiak	8,321	7,096	298	0	37	0	37
S. Kodiak	19,199	17,479	314	1.9	126	0	128
Prince William Sound	29,889	27,936	838	24[2]	255	0.4	279
Cook Inlet/Shelikof Strait	27,386	25,651	770	0.4	233	0.2	234
Glacier Bay/Icy Strait	7,210	5,647	169	0	104	0	104

Stock	Best Abundance Estimate	Minimum Abundance Estimate	PBR	Average Annual Human-Caused Mortality & Serious Injury			
				Commercial Fisheries (2009-2013)	Subsistence Harvest (2004-2008)[1]	Stranding Data (2009-2013)	Total
Lynn Canal/Stephens Passage	9,478	8,605	155	0	50	0	50
Sitka/Chatham Strait	14,855	13,212	555	0	77	0	77
Dixon/Cape Decision	18,105	16,727	703	0	69	0	69
Clarence Strait	31,634	29,093	1,222	0	40	0.8	41

1. The most recent community harvest data available for several stocks is from 2004-2008. Data shown for Kodiak Island, Prince William Sound, and Southeast Alaska are from 2011 and 2012 (Muto and Angliss 2015).

2. The Prince William Sound salmon gillnet fishery is known to interact with harbor seals, yet observer data is only available for 1990 and 1991. At that time, the average annual mortality of harbor seals in this fishery was 24. That number is assigned to commercial fisheries takes for the Prince William Sound harbor seal stock (Muto and Angliss 2015).

None of the harbor seal stocks in Alaska is considered a strategic stock. Although a reliable estimate of commercial fisheries mortality is unavailable for all stocks, the current estimates are less than 10 percent of PBR for all 12 stocks and, therefore, considered insignificant and approaching a zero M&SI rate. Total human-caused M&SI is less than PBR for all stocks (Muto and Angliss 2015).

Harbor seals are the most widespread of any pinniped, distributed in nearshore temperate and arctic waters of the northern hemisphere of both the Atlantic and Pacific Oceans. Harbor seals haulout along the coast and inland waters, including intertidal sand bars and mudflats in estuaries, intertidal rocks and reefs, floating glacial ice, sandy, cobble, and rocky beaches, islands, log-booms, docks, and floats in all marine areas of the state. Group sizes typically range from small numbers of animals on some intertidal rocks to several thousand animals found seasonally in coastal estuaries (Burns 2009).

Harbor seals feed opportunistically on a wide variety of fish and invertebrates (Iverson et al. 1997). Their diet varies seasonally, regionally, and most likely, annually. Common prey items include herring, pollock, salmon, cod, squid, and crustaceans (Jemison 2001, Iverson et al. 1997).

Spotted Seal

The spotted seal population includes three DPSs based on genetics, geography and breeding groups: the Bering DPS; the Okhotsk DPS; and the Southern DPS (Boveng et al. 2009). Only the Bering DPS occurs in U.S. waters and, for the purposes of stock assessments, is considered the Alaska stock of spotted seals (Allen and Angliss 2015).

The most recent aerial surveys of spotted seals during April to May 2012 and 2013 covered the vast majority of the spotted seal breeding area in U.S. waters. Analysis of data from April 2012 resulted in a mean estimate of 460,268 spotted seals and a minimum estimate of 391,000 seals. The calculated PBR for this stock is 11,730 (Allen and Angliss 2015). Incidental take of spotted seals was reported in the Bering Sea/Aleutian Islands flatfish trawl and Pollock trawl fisheries and in the Bering Sea/Aleutian Islands cod longline fishery between 2008 and 2012 for a minimum average mortality of 1.5 seals per year (Allen and Angliss 2015). This value is well below 10 percent of PBR. Spotted seals are an important subsistence resource, yet there are currently no efforts to quantify the total statewide harvest of this species and complete harvest and struck and lost data are not available for 2008-2012. As of August 2000, the statewide harvest estimate was 5,265 spotted seals per year (Allen and Angliss 2015). The combined estimated annual human-caused M&SI does not exceed PBR for this stock (Allen and Angliss 2015).

Spotted seals are widely distributed on continental shelf areas of the Beaufort, Chukchi, southeastern East Siberian, Bering, and Okhotsk Seas, and south through the Sea of Japan and the northern Yellow Sea. Habitat use and distribution are closely linked to seasonal sea ice from November/December to March in the Bering Sea. The seals haul out on ice during the whelping, nursing, breeding, and molting periods (Heptner et al. 1976b). Spotted seals congregate on ice floes as the ice begins to disappear in late spring, during which time adults molt and pups are weaned. Adult spotted seals in the Bering Sea molt from late April or early May to mid-July (Boveng et al. 2009). In summer, seals move north toward ice-free coastal waters (Heptner et al. 1976). Spotted seals in the eastern Bering Sea use coastal haul-out sites from Kuskokwim Bay to the Bering Strait from May to July (Quakenbush 1988).

Spotted seals are generalists and eat a varied array of fish, crustaceans, and cephalopods (Dehn et al. 2007). The fish commonly consumed are Pacific herring, smelt, Arctic cod, and saffron cod (Quakenbush et al. 2009).

Ribbon Seal

The two main breeding areas for ribbon seals are in the Sea of Okhotsk and the Bering Sea. There is no strong evidence to warrant division into multiple stocks (Boveng et al. 2008). Only the Alaska stock is recognized in U.S. Waters (Muto and Angliss 2015).

A reliable population estimate for the entire stock of Ribbon seals is not available. However, recently developed new survey methods provide partial, but useful, abundance estimates. During the spring of 2012 and 2013, U.S. and Russian researchers conducted aerial abundance and distribution surveys of the entire Bering Sea and Sea of Okhotsk (Moreland et al. 2013). These data are still being analyzed, but Conn et al. (2014) used a very limited sub-sample of the data collected from the U.S. portion of the Bering Sea in 2012 to calculate an abundance estimate of approximately 184,000 ribbon seals in those waters. Although this is only a preliminary estimate, it is considered a reasonable estimate for the entire U.S. population of ribbon seals since few ribbon seals are expected to be north of the Bering Strait in the spring when these surveys were conducted. When the final analyses for both the Bering and Okhotsk Seas are complete they should provide the first range-wide estimates of ribbon seal abundance (Muto and Angliss 2015). Using the Bering Sea abundance estimate of Conn et al. (2014), a minimum estimate is 163,086 seals and the calculated PBR is 9,785 (Muto and Angliss 2015).

Mortalities of ribbon seals were reported in the Bering Sea/Aleutian Islands flatfish, Atka mackerel, and pollock trawl fisheries between 2009 and 2013, for an estimated mean annual mortality of 0.6 seals. Alaska Native subsistence hunters primarily harvest ribbon seals from villages along the Bering Strait and, to a lesser degree, the Chukchi Sea coast. Only 11 of the 64 coastal communities known to harvest ribbon seals have been surveyed over the last five years (2009-2013), so statewide harvest estimates are not available. Based on these limited data, a minimum estimate of the average annual ribbon seal harvest for 2009-2013 is 3.2 seals per year (Muto and Angliss 2015).

NMFS received a petition to list ribbon seals under the ESA in December 2007 due to loss of sea ice habitat caused by climate change in the Arctic. NMFS published a notice in the *Federal Register* on March 28, 2008 (73 FR 16617) indicating that there were sufficient data to warrant a status review of the species (Boveng et al. 2008). Status reviews in 2008 (73 FR 79822, December 30, 2008) and in 2013 (78 FR 41371, July 10, 2013) determined that listing the ribbon seal as threatened or endangered under the ESA was not warranted. Ribbon seals are not designated as depleted under the MMPA and the Alaska stock is not considered strategic.

Ribbon seals occur in the northern North Pacific Ocean and adjoining sub-Arctic and Arctic seas, primarily the Bering Sea and the Sea of Okhotsk, and are strongly associated with sea ice during whelping, mating, and molting from mid-March through June (Burns 1970). The rest of the year is primarily spent at sea. In Alaska, ribbon seals are found in the open sea, on pack ice, and only rarely on shorefast ice. They range from the western Beaufort Sea to the Chukchi Sea and Bristol Bay in the Bering Sea. From late March to early May, they inhabit the Bering Sea ice front (Braham et al. 1984, Burns 1970). During May and June, ribbon seals haul out on ice floes where weaned pups become self–sufficient and adults molt. Satellite tag data from 2005 and 2007 indicated that ribbon seals disperse widely into the Bering Strait, Chukchi Sea, or Arctic Basin as ice retreated northward and remained there for at least part of the summer and autumn. Most of the seals tagged in the central Bering Sea did not travel north of the Bering Strait (Boveng et al. 2008).

Ribbon seals primarily consume pelagic and benthic prey, including demersal fishes and cephalopods. Arctic cod have been identified as an important prey item in the northern Bering Sea (Ziel et al. 2008).

Northern Elephant Seal

Populations of northern elephant seals breed in the U.S. and Mexico; the California breeding population, considered here, is demographically isolated from the Baja California population. Elephant seal population size is typically estimated by counting the number of pups produced and multiplying by the inverse of the expected ratio of pups to total animals. Based on counts in 2010, the estimated size of the California stock was approximately 179,000. The minimum population estimate is 81,368 elephant seals and PBR is 4,882 (Carretta et al. 2015a). Total average annual human caused M&SI was ≥8.8 for 2008-2012. This includes ≥4.0 in commercial fisheries and 4.8 from other sources, none of which were in Alaska waters (Carretta et al. 2015a). Northern elephant seals are not listed as either threatened or endangered under the ESA nor designated as depleted under the MMPA.

After the breeding season, immature and adult male northern elephant seals move northward to feed from Baja California to northern Vancouver Island and far offshore of the GOA and Aleutian Islands; adult females typically feed in the western North Pacific (Carretta et al. 2015a). Northern elephant seals breed on the mainland and on islands off the California coast from the Farallon Islands, CA, south to islands off Mexico during winter. When not on the islands to breed or molt they occur in deep offshore waters from central California north to the Aleutian Islands and west to Japan. Females tend to go farther northwest and males farther north (Hindell and Perrin 2009). Elephant seals prey on deep water and bottom dwelling organisms, including fish, squid, crab, and octopus. They are extraordinary divers with some dive depths exceeding 1500 m and 120 minutes (Hindell and Perrin 2009).

3.2.3 Birds

Over 70 species of seabirds occur over waters off Alaska and could potentially be affected by direct and indirect interactions with the AFSC fisheries research activities described in Chapter 2. Thirty-eight of these species regularly breed in Alaska and waters of the EEZ (NMFS 2004). More than 1,800 seabird colonies have been documented, ranging in size from a few pairs to 5.75 million birds (USFWS 2012a). Breeding populations of seabirds are estimated at approximately 48 million birds and non-breeding migrant birds probably account for an additional 30 million birds (USFWS 2012a).

This section describes the bird species that are most likely to have interactions with the AFSC fisheries research activities described in Chapter 2. These accounts provide a baseline description for the analysis of environmental effects in Chapter 4. All of these seabirds are protected by the MBTA under the jurisdiction of the USFWS. Some species have additional protections under the ESA.

3.2.3.1 Threatened and Endangered Species

Three bird species in Alaska marine waters are listed as threatened or endangered under the ESA: short-tailed albatross, spectacled eider, and Steller's eider. The black-footed albatross was petitioned for listing but the USFWS determined that listing was not warranted (USFWS 2011a). The ESA allows the USFWS to list bird species as endangered or threatened regardless of which country the species lives in. Although greater legal protections are given to ESA-listed species within the U.S. EEZ, the law also protects listed species wherever they occur from potentially adverse interactions with people and entities subject to U.S. jurisdiction, such as the AFSC and its researchers. Table 3.2-9 lists these species and their presence or absence in the three research areas. These species are all under the jurisdiction of the USFWS. The following accounts describe each species' distribution within the three research areas, a summary of the basic life history, population trends, any USFWS Section 7 consultation history, and the estimated bycatch of these species in commercial fisheries. Additionally, ESA-listed short-tailed albatross are described and evaluated in the Biological Opinion (USWFS 2018).

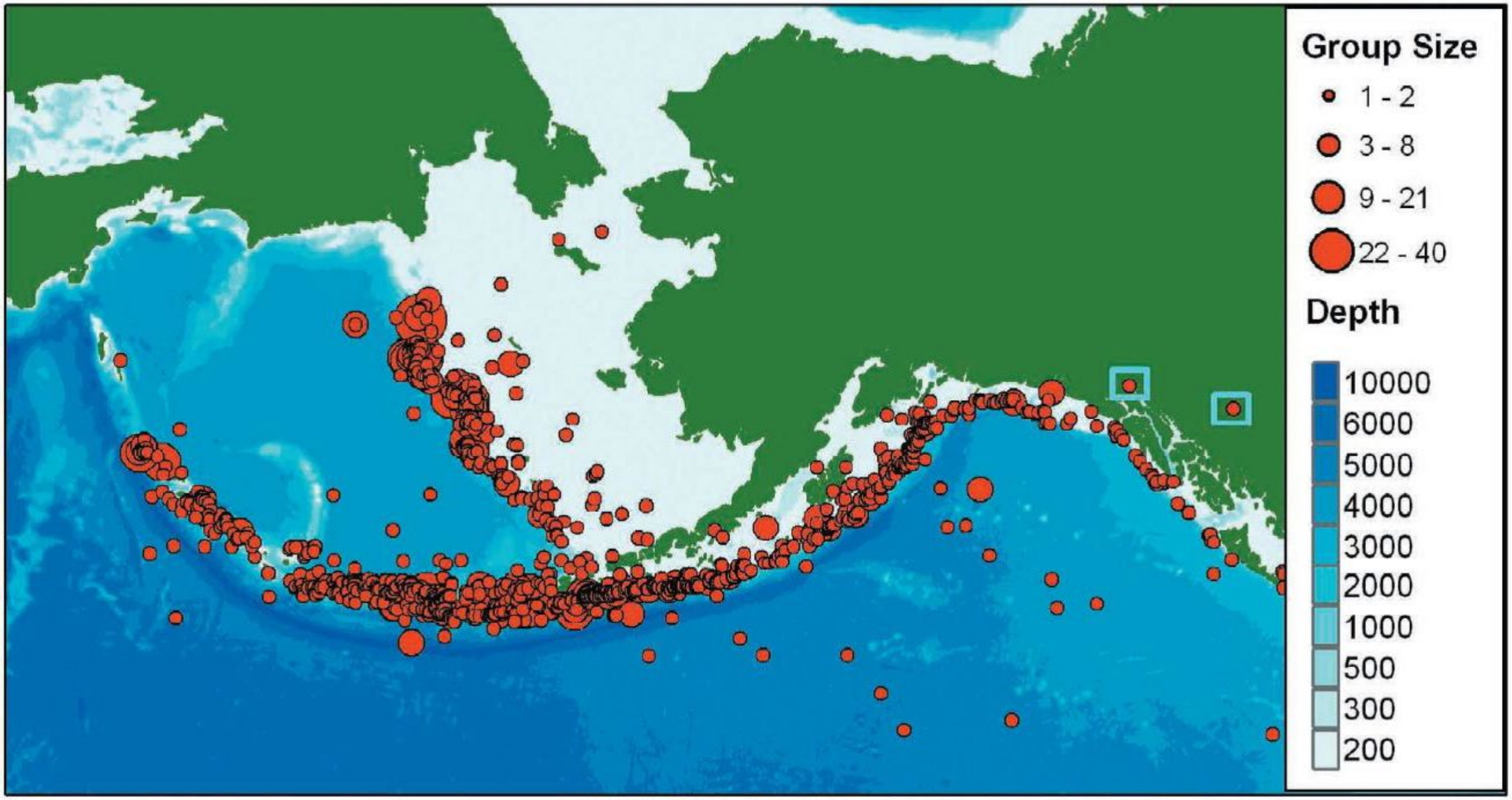
Table 3.2-9 ESA-listed Birds Occurring in the AFSC Research Areas

Common Name and Federal ESA Status	Scientific Name	GOARA	BSAIRA	CSBSRA
Short-tailed Albatross (Endangered)	*Phoebastria albatrus*	Yes	Yes	No[1]
Steller's Eider (Threatened)	*Polysticta stelleri*	Yes	Yes, and Critical Habitat	Yes
Spectacled Eider (Threatened)	*Somateria fischeri*	No	Yes, and Critical Habitat	Yes, and Critical Habitat

1 One short-tailed albatross was documented in the Chukchi Sea in 2012 (Day et al. 2013) but its occurrence is likely extremely rare.

<u>Short-tailed albatross</u>

Short-tailed albatross are found in the GOA and BSAIRAs. Breeding is known from only four locations in the world. The majority of birds nest on Torishima Island and most of the rest nest on Senkakus Island near Japan. A small number of birds also nest on and Midway Island and Kure Island in the northwestern Hawaiian Islands. Regular sightings of short-tailed albatross off Alaska have occurred along the Aleutian Island coastline, GOA, and the edge of the continental shelf between Alaska and Russia (Figure 3.2-5).



Source: NMFS 2008b

Figure 3.2-5 Sightings of Short-tailed Albatross off the Coast of Alaska from 1940 to 2004

The short-tailed albatross is a very large seabird with narrow, 7-foot-long wings adapted for soaring low over the ocean. Short-tailed albatross mate for life, returning to the same nest sites in the breeding colony for many years. Single eggs are laid in October or November, chicks hatch in December through February, and the young fledge from May to July. Immature birds wander across the North Pacific until they begin breeding at 6 to 9 years old (USFWS 2008a).The North Pacific Ocean and Bering Sea once supported millions of short-tailed albatross but they were decimated by commercial hunters in the early 1900s. By 1949, there were no short-tailed albatross breeding at any of the 15 historically known breeding sites and the species was reported to be extinct. Fortunately, this report was premature and several birds returned from the sea in 1950 to nest on Torishima. Japan designated the albatross a protected species in 1958, prohibiting hunting and limiting access to the breeding colonies. These protection measures and extensive habitat enhancement work on Torishima has allowed the species to increase steadily (Fadely 1999).

The USFWS released a Recovery Plan for short-tailed albatross in 2008 that contains extensive information on the species life history, demographics, and population status (USFWS 2008a). No critical habitat has been designated because it was determined that it would not be beneficial to the species' recovery (USFWS 2000 and 2008a). The world population of the endangered short-tailed albatross is currently estimated at almost 5,000 individuals and is growing at an average annual rate of 7.5 percent (USFWS 2014c).

The USFWS has issued several BiOps during ESA Section 7 consultation with NMFS regarding commercial fisheries in Alaska. USFWS has concurred with NMFS determination that the short-tailed albatross is adversely affected by hook-and-line groundfish fisheries off Alaska due to incidental hooking of birds. USFWS (2018) agreed with earlier BiOps and concluded that the GOA and BSAI fisheries are not likely to jeopardize the continued existence of the short-tailed albatross. These BiOps established incidental take limits for the longline and trawl fisheries and specified several conditions that have led to improved data gathering and seabird avoidance measures for different types of fishing gear to minimize the chances of incidental takes of short-tailed albatross (USFWS 1999, 2003, 2015, 2018).

Since 1983, there have been 19 documented incidental takes of short-tailed albatross in commercial fisheries in the North Pacific (USFWS 2015a). Thirteen of these takes occurred in U.S. waters off of Alaska, primarily in the Bering Sea, four occurred in Russian waters, one occurred in Japanese waters, and one occurred off of the coast of Oregon. Since mandatory seabird mitigation measures were implemented for the commercial longline fleet operating in the U.S. EEZ offshore of Alaska in 2003, six short-tailed albatross have been incidentally killed in the BSAI: one in August 2010, one in September 2010, one in October 2011, two in September 2014, and one in December 2014 (USFWS 2015a). All of the takes occurred along the edge of the continental shelf where upwellings concentrate fish, fishing effort, and birds. In the 2014 incident, large flocks of short-tailed albatross (as many as 70) were reported near the vessel, prompting NMFS to encourage vessel operators to consider not deploying gear amidst such a congregation of endangered birds, to instead move to a location where there are none (NMFS 2014a).

<u>Spectacled eider</u>

Spectacled eiders (*Somateria fischeri*) are large, diving sea ducks that spend most of the year in marine waters of the Bering Sea, Chukchi Sea, and Beaufort Sea and nest in coastal tundra. Spectacled eiders historically nested along much of the coast of Alaska, from the Nushagak Peninsula in the southwest, north to Barrow, and east nearly to the Canadian border. Today, three primary nesting grounds remain; the central coast of the Yukon-Kuskokwim Delta, the arctic coastal plain of Alaska, and the arctic coastal plain of Russia. A few pairs nest on St. Lawrence Island as well.

The North American Waterfowl Breeding Pairs Survey indicates that the numbers of spectacled eiders breeding on the Yukon-Kuskokwim Delta dropped from about 48,000 pairs in the 1970s to less than

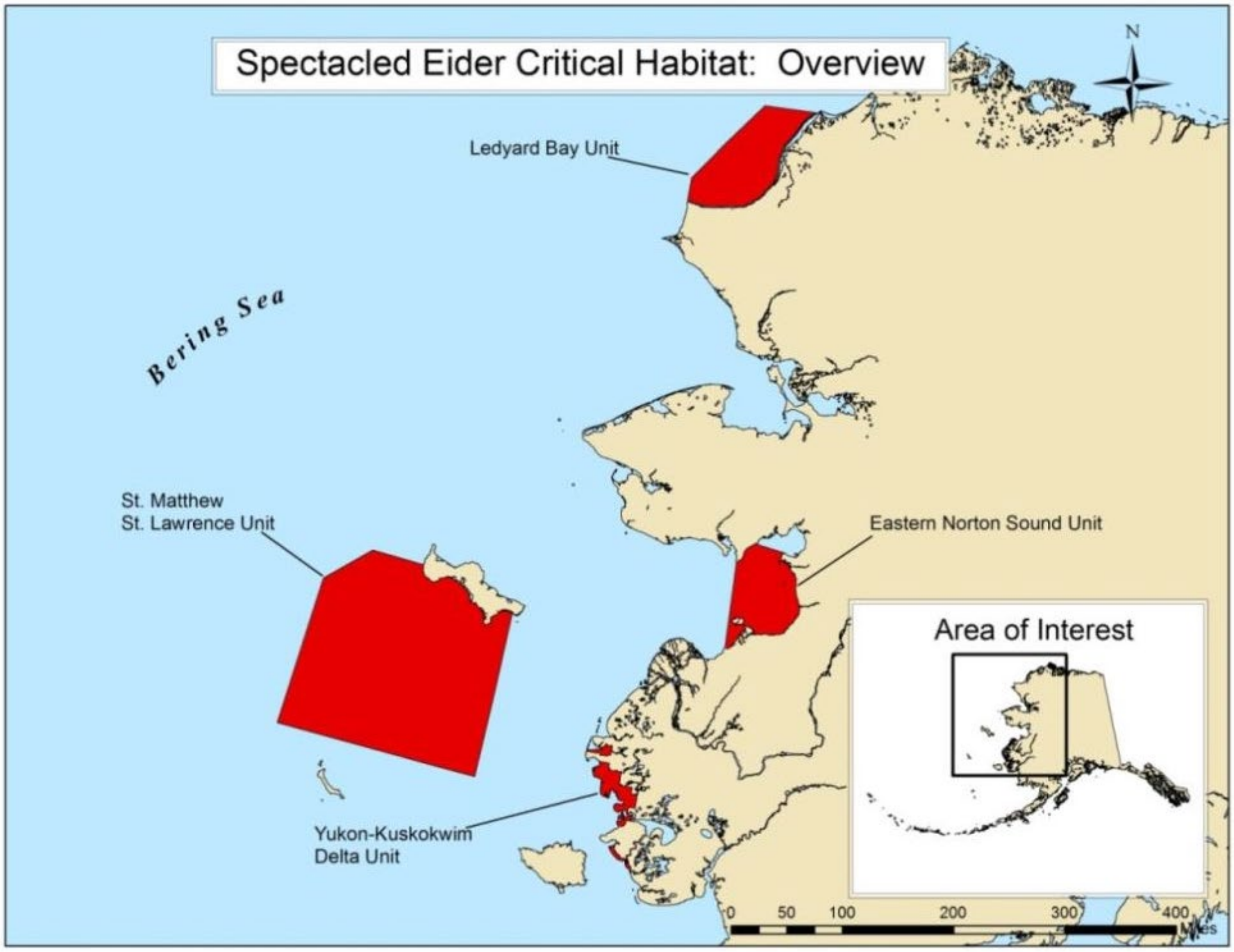
2,500 pairs by 1992, a 95 percent decline (Stehn et al. 1993). Subsequent surveys suggest the Yukon-Kuskokwim Delta population has declined by about 9 percent per year for the last 20 years (USGS 2010). Biologists estimate that about 9,000 pairs currently nest on Alaska's arctic coastal plain and at least 40,000 pairs nest in arctic Russia.

All three nesting populations of spectacled eiders migrate to the Bering Sea in October and November and overwinter in openings in the pack ice (polynyas) between St. Lawrence and St. Matthew islands, where they remain until March or April (USFWS 2015a). Because nearly all individuals of this species may spend each winter occupying an area of ocean less than 50 km (31 miles) in diameter, they may be particularly vulnerable to chance events during this time (USFWS 2001). The latest abundance estimate for spectacled eiders was about 370,000, including non-breeding birds, based on aerial surveys of these wintering concentrations in the Bering Sea in 2010 (Larned et al. 2012).

In the spring, spectacled eiders likely rely on open leads in the pack ice to move north toward nesting areas in May and June (USFWS 2015a). Because few eiders are observed in marine areas along the Beaufort coast in spring, it is believed that a majority may migrate to the nesting areas overland from the Chukchi Sea (MMS 2002). Nesting pairs arrive on the breeding grounds together each spring, but the males leave after egg incubation begins. Females incubate the eggs for 25-28 days before hatching. After breeding, the adults travel to protected marine waters where they undergo a complete molt of their flight feathers. Important late summer and fall molting areas have been identified in eastern Norton Sound and Ledyard Bay in Alaska, and in Mechigmenskiy Bay and an area offshore between the Kolyma and Indigirka river deltas in Russia (USFWS 2001).

Spectacled eiders were listed as threatened under the ESA in 1993 primarily due to the rapid decline in their breeding population on the Yukon-Kuskokwim Delta. The causes of the decline are not known but are thought to include factors affecting adult survival such as poisoning from lead shot, overharvest, and collisions with structures as well as habitat loss and increased nest predation (USFWS 1996). The USFWS designated critical habitat in 2001 (66 FR 9146, Figure 3.2-6), and published a Recovery Plan in 1996 (USFWS 1996). The critical habitat includes nesting grounds on the Yukon-Kuskokwim Delta and marine areas in Norton Sound, Ledyard Bay, and the wintering area in the Bering Sea between St. Lawrence and St. Matthew Islands (Figure 3.2-6).

Designated critical habitat for spectacled eiders is well outside the normal spatial/temporal distribution of most commercial fisheries and AFSC fisheries and ecosystem research activities in the Bering and Chukchi seas. The USFWS conducted several ESA Section 7 consultations on the federal fisheries in Alaska and determined that the fisheries were not likely to adversely affect spectacled eiders based primarily on the lack of spatial/temporal overlap between the marine ranges of the eiders and the groundfish harvest (USFWS 1999, 2003). There are no records of spectacled eiders being taken in the latest estimate of seabird bycatch by groundfish fisheries (NMFS 2014b) and no spectacled eiders have been taken during AFSC fisheries research.



Source: USFWS 2012b

Figure 3.2-6 Spectacled Eider Critical Habitat

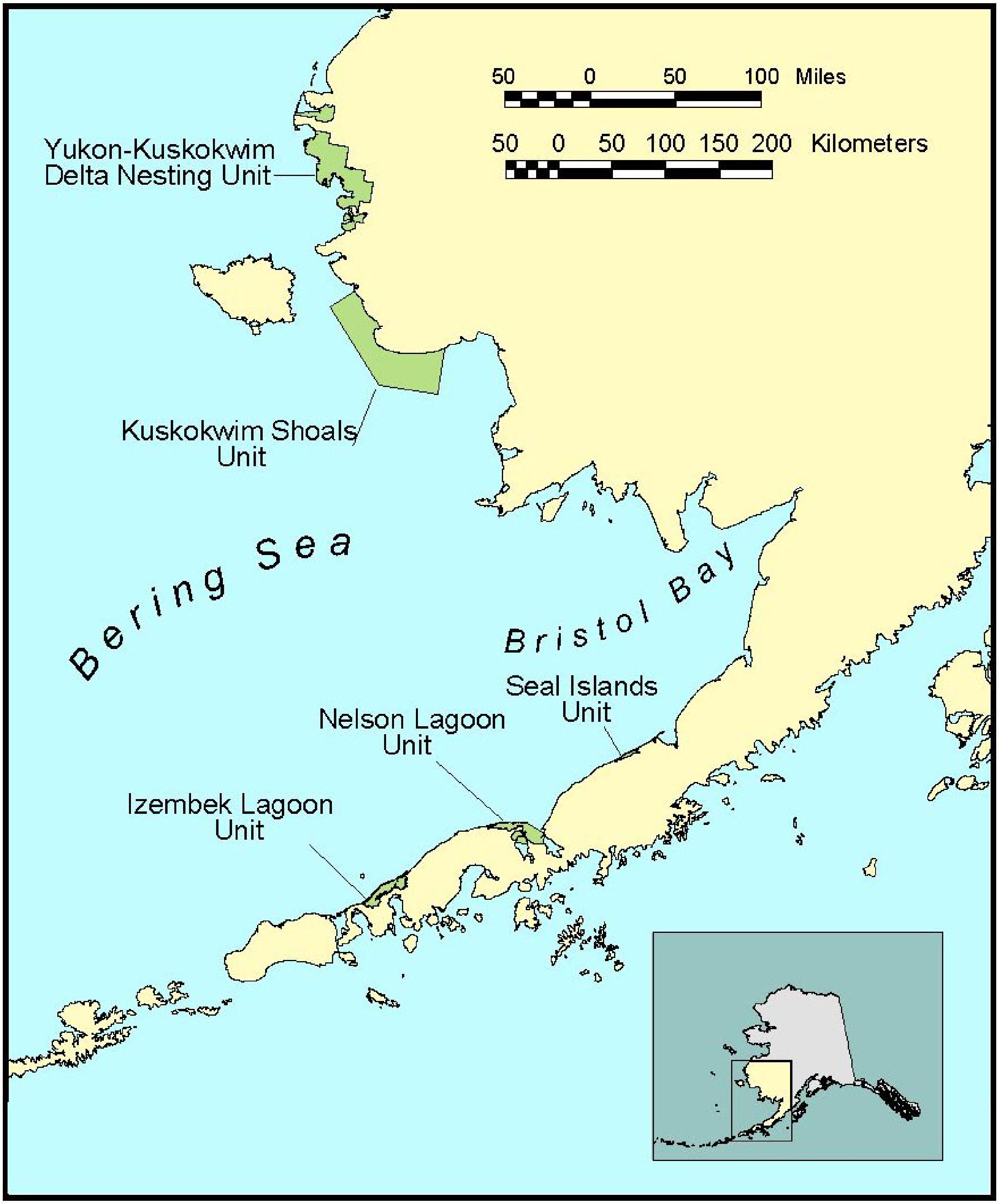
Steller's eider

Steller's eiders (*Polysticta stelleri*) are small diving ducks with circumpolar distribution that spend most of the year in shallow, near-shore marine waters. Steller's eiders are divided into Atlantic and Pacific populations; the Pacific population is further subdivided into the Russia-breeding and Alaska-breeding populations. Population estimates are imprecise due to the remoteness of breeding sites and the difficulty of detecting birds during aerial surveys. It is believed the Russian Pacific breeding population is 50,000 to 100,000 birds and the Alaska breeding population is only about 500 birds (USFWS 2011b). Steller's eiders from both Russia-breeding and Alaska-breeding populations spend the winter in the same areas of protected marine waters along the Aleutians, Alaska Peninsula, and east to Cook Inlet. The Alaska-breeding population of Steller's eiders was listed as threatened on July 11, 1997 (62 FR 31748) due to substantial contraction of their Alaska breeding range on the arctic coastal plain and the Yukon-Kuskokwim Delta.

Current primary nesting range in Alaska consists of a portion of the central arctic coastal plain between Wainwright and Prudhoe Bay, primarily near Barrow. Historically they were common nesters on the Yukon-Kuskokwim Delta but are now thought to be rare nesters in that area (USFWS 2011b). Most of the Pacific population of Steller's eiders from both Alaska and Russia migrate south after breeding to molt and spend the winter along the coast of Alaska from Nunivak Island to Cold Bay, primarily in Izembek Lagoon, Nelson Lagoon, and near the Seal Islands. During their northward spring migration from wintering areas in Alaska, Steller's eiders can be found in large flocks close to shore from northern Bristol Bay to Hooper Bay.

The USFWS designated critical habitat in 2001 (66 FR 8849, Figure 3.2-7) and published a Recovery Plan in 2002 (USFWS 2002). The critical habitat includes nesting grounds on the Yukon-Kuskokwim Delta and four units in marine waters of southwest Alaska; Kuskokwim Shoals in northern Kuskokwim Bay, and Seal Islands, Nelson Lagoon (including Nelson Lagoon and portions of Port Holler and Herendeen Bay), and Izembek Lagoon on the north side of the Alaska Peninsula (Figure 3.2-7). The three areas on the north side of the Alaska Peninsula are used for molting in the fall, wintering, and staging during spring migration.

The USFWS conducted several ESA Section 7 consultations on the federal fisheries in Alaska and determined that the BSAI and GOA commercial groundfish fisheries are not likely to adversely affect Steller's eiders or destroy or adversely modify their critical habitat based on the species' behavior and distribution relative to fishing activities in the BSAI and GOA (USFWS 2003a, 2015). There are no records of any eider species being taken in the latest estimate of seabird bycatch by groundfish fisheries (NMFS 2014b). There is one record of a Steller's eider colliding with a commercial fishing vessel in 2014 (S. Fitzgerald, pers. comm.). No Steller's eiders have been taken in AFSC fisheries research gear or are known to have collided with AFSC research vessels.



Source: USFWS 2012c

Figure 3.2-7 Steller's Eider Critical Habitat

3.2.3.2 Birds of Conservation Concern

The USFWS (2008b) designated Birds of Conservation Concern to identify the species (beyond those already designated as federally threatened or endangered) that represent their highest conservation priorities. The designation means that without additional conservation actions, these birds may become candidates for listing under the ESA. The seabird species in Alaska that may interact with AFSC fisheries and ecosystem research activities include black-footed albatross, Laysan albatross, red-legged kittiwake, Kittlitz's murrelet, and yellow-billed loon. Table 3.2-10 includes information on the abundance and distribution of seabirds that regularly occur in the three AFSC research areas and their main prey items, including ESA-listed species, birds of conservation concern, and other seabirds in Alaska.

<u>Black-footed Albatross</u>

Black-footed albatrosses (*Phoebastria nigripes*) occur in the GOA and BSAIRAs, but are most abundant in the GOA and along the Aleutian Islands; a few have been reported near Nunivak Island in the Bering Sea (USFWS 2006).

Nearly the entire world population of black-footed albatross nests on the Hawaiian Islands National Wildlife Refuge, principally Laysan and Midway Islands. There is also a colony on Torishima Island in Japan, nesting among short-tailed albatross. Breeding begins in early November, chicks begin to hatch in mid-January, and fledging occurs in June and July. Black-footed albatross spend the summer (approximately May through September) in Alaskan waters, although some non-breeding birds may be encountered at any time. Black-footed albatross are most abundant over the outer continental shelf, especially at the shelf break, in areas with strong, persistent upwelling.

Over the past century, black-footed albatross and Laysan albatross (*Phoebastria immutabilis*) have been subjected to high rates of mortality and disturbance at their breeding colonies and at sea (Arata et al. 2009). Commercial feather hunting greatly reduced or destroyed many colonies in the early 1900s. Military occupation of several breeding islands during World War II destroyed nesting birds and habitat and led to population declines. Conservation efforts to clean up and reclaim many of these military sites, and the transfer of key Hawaiian islands to the National Wildlife Refuge System, has greatly improved nesting success. Thousands of Laysan and black-footed albatrosses were also killed each year in high-seas driftnet fisheries, especially from 1978 until the fisheries were banned in 1992. There was also a growing awareness of the large numbers of albatrosses that were being killed in longline fisheries. The development of effective mitigation measures for longline gears (Melvin et al. 2001, Melvin and Wainstein 2006), and the implementation of new regulations requiring use of those mitigation measures in many longline fisheries in Alaska and elsewhere in the North Pacific, have greatly reduced mortality of albatross in longline fisheries (Arata et al. 2009). Predation of nests and adults by non-native mammals, ingestion of plastics at sea, and exposure to other contaminants has also been documented to reduce productivity or increase mortality (VanderWerf 2012). Conservation measures have addressed most of these problems to some extent and allowed the populations of black-footed and Laysan albatross to recover (Arata et al. 2009). However, because many albatross nesting sites are on low-lying remote islands, loss of nesting habitat due to rising sea levels and greater storm surges as a result of climate change is thought to pose a long-term threat to the populations of both black-footed and Laysan albatross (VanderWerf 2012, Birdlife International 2016)

The USFWS received a petition to list the black-footed albatross under the ESA in 2004 but concluded that listing is not warranted (76 FR 62504, 7 Oct. 2011). The black-footed albatross population currently appears to be stable or increasing based on standardized surveys in the Hawaiian Islands during nesting season.

The latest estimates of seabird bycatch in the Alaska groundfish fisheries indicates an annual average of 168 black-footed albatross were caught from 2007 to 2013, with a range of 48 to 314 birds caught per year (NMFS 2014b). Thirty-four black-footed albatross have also been incidentally caught during AFSC fisheries research from 2004 through 2015, all in the Alaska Longline Survey and all in the GOA. Section 4.2.5 presents information on birds caught during AFSC research, the mitigation measures that were in place during that research, and an assessment of impacts.

Laysan Albatross

Laysan albatross occur throughout the North Pacific from the southern Bering Sea to the Hawaiian Islands. More than 99 percent of Laysan albatross nest in the northwest Hawaiian Islands. Laysan albatross spend the summer (approximately May through September) in Alaskan waters, although some non-breeding birds may be encountered at any time. In 1989 and 1999, satellite telemetry studies indicated that Laysan albatross nesting in the northwestern Hawaiian Islands mixed short foraging trips near their nesting island with much longer trips primarily to the north, frequently reaching the Aleutian Islands and GOA. Thus, based on satellite telemetry data, breeding Laysan albatross are known to forage in waters off Alaska (Anderson et al. 2000, Hyrenbach et al. 2002). Non-breeding birds, which are not tied to the colony, also occur there in substantial numbers. Since the 1970s, the Laysan albatross has greatly expanded its presence in the southeastern Bering Sea. At present, Laysan albatross are most abundant in the western Aleutian Islands but are increasingly encountered in and north of the passes through the Aleutian Islands, over the shelf north of the Alaska Peninsula, and in the Bering Sea along the shelf break as far north as St. Matthew Island (Kuletz et al. 2014).

Only one egg is laid per year beginning around mid-November, and incubation lasts about 65 days. Both parents share in incubation duties although females usually leave for a few weeks after egg-laying. Chicks hatch during late January to mid-February. Both parents will feed the chick by regurgitation and will often leave them for several days while they obtain food out at sea. Fledging occurs 5 to 6 months after hatching (mid-June through late July). Parents will often leave before the chicks have reached their full juvenile plumage. Sub-adults return to their natal nesting colony after spending 3 to 5 years at sea. Mating and first nesting usually occurs by age 6 to 8 years old. Breeding pairs of Laysan albatross have different rates of attempting to breed, where some pairs attempt annually, others do so every other year, and other pairs are more sporadic. During periods of low prey availability due to poor ocean conditions, many pairs will simply not attempt to breed at all, regardless of their cycle. This preserves their energy for molting and survival (Arata et al. 2009).

Population estimates are difficult to make for albatross because of their long life spans, large and variable numbers of non-breeding birds that remain at sea for years, and inconsistent breeding cycles for mature adults. No systematic population estimates were made until the USFWS began to make population estimates in 1992. The 2005 world estimate of the number of breeding pairs of Laysan albatross was 590,683 (Flint 2005). Since the number of sub-adult (i.e., non-breeding) albatross may be 5 to 6 times the number of breeding pairs (Pradel 1996), the total world population of Laysan albatross was estimated at approximately 3.4 million birds (Arata et al. 2009). Given the relative abundance of this species compared to other albatross species, its status is generally considered to be relatively secure.

The latest estimates of seabird bycatch in the Alaska groundfish fisheries indicates an annual average of 164 Laysan albatross were caught from 2007 to 2013, with a range of 17 to 233 birds caught per year (NMFS 2014b). Two Laysan albatross have been incidentally caught during AFSC fisheries research from 2004 through 2014, both in the Alaska Longline Survey. One was caught in the GOARA and the other in the BSAIRA. Section 4.2.5 presents information on birds caught during AFSC research, the mitigation measures that were in place during that research, and an assessment of impacts.

Red-legged Kittiwake

The red-legged kittiwake (*Rissa brevirostris*) is a small gull that breeds at only five or six locations in the world, all in the Bering Sea. The Alaskan breeding population is estimated at 209,000 birds (USFWS 2006). In Alaska, they nest on St. George, St. Paul, and the Otter islands in the Pribilof Islands, and on

Bogoslof and Buldir islands in the Aleutian Island chain. The St. George colony in Alaska contains over 80% of the world's population. Current surveys indicate that population indices have increased at St. George (+1.1% per annum) and Buldir (+7.5% per annum) from 2005 through 2014 but were slightly decreasing at St. Paul (-0.3% per annum) (Dragoo et al. 2015). Productivity varies substantially between years due to fluctuations in food availability, which is tied to changing oceanic conditions (USFWS 2006).

There are a few records of red-legged kittiwakes being taken in Alaskan federal groundfish fisheries but it is a rare event (NMFS 2014b). No kittiwakes have been incidentally taken during AFSC fisheries research.

Kittlitz's Murrelet

Kittlitz's murrelets (*Brachyramphus brevirostris)* occur in all three research areas, but the majority are found in the GOA. The entire North American population and most of the world's population inhabit Alaskan coastal waters discontinuously from Point Lay south to northern portions of Southeast Alaska and are concentrated in the belt of glaciated fjords in the northern GOA from Glacier Bay to Cook Inlet.

The marine habitats in which Kittlitz's murrelets are most often associated during summer are characterized by close proximity to tidewater glaciers, and waters offshore of remnant high elevation glaciers and deglaciated coastal mountains. Their eggs are typically laid on bare ground in unvegetated scree fields, coastal cliffs, rock ledges, and talus above timberline in coastal mountains. During winter, Kittlitz's murrelets have been observed around Prince William Sound, Kenai Fjords, Kachemak Bay, Kodiak Island, Sitka Sound, and in the northern GOA along the Alaska Coastal Current and mid-shelf regions. They have also been observed in the Sireniki polynya (areas of open water in sea ice covered regions) of southern Chukotka in Russia and in the polynyas south of St. Lawrence Island (USFWS 2011c).

The USFWS was petitioned to list Kittlitz's murrelet under the ESA in 2001 and determined that it should be listed as a candidate species in 2004 (69 FR 24876, 4 May 2004). However, additional research indicated that the species was not declining as previously thought and the USFWS determined that it did not warrant being listed under the ESA (78 FR 61764, 3 Oct. 2013).

There are no records of any murrelets being taken in the latest estimate of seabird bycatch by Alaska groundfish fisheries (NMFS 2014b). No Kittlitz's murrelets have been taken in gear used for AFSC fisheries research.

Yellow-billed Loon

Yellow-billed loons (*Gavia adamsii*) occur in all three AFSC research areas but in Alaska are known to breed only along the arctic coastal plain, primarily within the National Petroleum Reserve-Alaska (Earnst et al. 2005) and to a lesser extent around Kotzebue Sound. Additional nesting areas occur in Canada and Russia. Yellow-billed loons nest in coastal tundra in association with large, fish-bearing lakes greater than 2 m deep. They are believed to be long-lived and dependent upon high annual adult survival to maintain current population size. The total Alaska breeding population is estimated at between 3,000 and 4,000 birds while the global breeding population is estimated in the range of 16,000 to 32,000 birds (74 FR 12932, 25 March 2009). A study of the Alaska arctic coastal plain population indicated that no population trend is discernable since 1986 (Earnst et al. 2005).

Much of the Alaska breeding habitat of the yellow-billed loon is available for oil and gas leasing and development. Conservation concerns for yellow-billed loons include disturbance or destruction of habitat by development and climate change, nest predators, and contaminants from development. Human disturbance up to 1 mile away can cause behavioral changes in yellow-billed loons such as leaving eggs or chicks unattended (USFWS 2007).

The USFWS was petitioned to list yellow-billed loons under the ESA in 2004 and determined that such listing was warranted but precluded by higher priorities (74 FR 12932, 25 March 2009). However, additional research indicated that the species viability was stronger than previously thought (USFWS 2014d) and the USFWS determined that it did not warrant being listed under the ESA (79 FR 59195, 1 Oct. 2014).

There are no records of any loon species being taken in the latest estimate of seabird bycatch by Alaska groundfish fisheries (NMFS 2014b) and none have been caught in gear during AFSC fisheries research.

Table 3.2-10 Common Seabirds in the AFSC Research Areas

Species	Population [1,2]			Diet [3]
	GOA	BSAI	CS/BS	
TUBENOSES				
Black-footed albatross [4] (*Diomedea nigripes*)	Common	Uncommon	-	Q,M,F,I,D
Laysan albatross [4] (*Diomedea immutabilis*)	Common	Common	-	Q,M,F,I
Short-tailed albatross [4] (*Diomedea albatrus*)	Uncommon	Uncommon	Accidental	Q,F,I
Sooty shearwater [4] (*Puffinus griseus*)	Abundant	Common	-	M,C,S,A,Q,S,F,Z,I
Short-tailed shearwater [4] (*Puffinus tenuirostris*)	Common	Abundant	Common	Z,I, C,Q, F,S
Northern fulmar (*Fulmarus glacialis*)	600,000	1.500,000	Rare	Q,M,P, S,F,Z,I,C
Fork-tailed storm-petrel (*Oceanodroma furcata*)	1,200,000	4,500,000	-	Q,I,Z,C,P,F
Leach's storm-petrel (*Oceanodroma leucorrhoa*)	1,500,000	4,500,000	-	Z,Q,F,I
CORMORANTS				
Double-crested cormorant (*Phalacrocorax auritis*) [5]	8,000	9,000	-	F,I
Pelagic cormorant (*Phalacrocorax pelagicus*)	70,000	80,000	Rare	S,C,P,H,F,I
Red-faced cormorant (*Phalacrocorax urile*)	40,000	90,000	-	C,S,H,F,I
JAEGERS, GULLS, AND TERNS				
Pomarine jaeger (*Stercorarius pomarinus*)	Uncommon	Uncommon-Rare	Common	C,S,F
Parasitic jaeger (*Stercorarius parasiticus*)	Uncommon	Uncommon	Common	C,S,F
Long-tailed jaeger (*Stercorarius longicaudus*)	Rare	Uncommon	Common	C,S,F
Bonaparte's gull (*Larus philadelphia*)	Uncommon	Rare	-	Z,I,F
Mew gull (*Larus canus*) [5]	40,000	700	Rare	C,S,I,D,Z
Herring gull (*Larus argentatus*) [5]	Common	Uncommon	Rare	C,S,H,F,I,D
Glaucous-winged gull (*Larus glaucescens*)	300,000	150,000	-	C,S,H,F,I,D
Glaucous gull (*Larus hyperboreus*) [5]	2,000	30,000	Common	C,S,H,I,D
Sabine's gull (*Xema sabini*)	Uncommon	Uncommon	Common	F,Q,Z
Ivory gull (*Pagophila eburnean*)	-	Uncommon	Uncommon	M,P,R,I,F,Q
Black-legged kittiwake (*Rissa tridactyla*)	1,000,000	800,000	Common	C,S,H,P,F,M,Z

Species	Population [1,2]			Diet [3]
	GOA	BSAI	CS/BS	
Red-legged kittiwake (*Rissa brevirostris*)	-	150,000	-	M,C,S,Z,P,F
Arctic tern (*Sterna paradisaea*) [5]	20,000	7,000	Uncommon	C,S,Z,F,H
Aleutian tern (*Sterna aleutica*)	25,000	9,000	Rare	C,S,Z,F
ALCIDS				
Common murre (*Uria aalge*)	2,000,000	3,000,000	Common	C,S,H,G,F,Z
Thick-billed murre (*Uria lomvia*)	200,000	5,000,000	Common	C,S,P,Q,Z,M,F,I
Black guillemot (*Cepphus grylle*)	-	Rare	Uncommon	S,F,I
Pigeon guillemot (*Cepphus columba*)	100,000	100,000	Uncommon	S,C,F,H,P,I,G,Q
Marbled murrelet (*Brachyramphus marmoratus*)	Common	Uncommon	-	C,S,H,P,F,G,Z,I
Kittlitz's murrelet (*Brachyramphus brevirostris*)	Uncommon	Uncommon	Rare	S,C,H,Z,I,P,F
Ancient murrelet (*Synthliboramphus antiquus*)	600,000	200,000	-	Z,F,C,S,P,I
Cassin's auklet (*Ptychoramphus aleuticus*)	750,000	250,000	-	Z,Q,I,S,F
Parakeet auklet (*Cyclorrhynchus psittacula*)	150,000	800,000	Uncommon	F,I,S,P,Z,C,H
Least auklet (*Aethia pusilla*)	50	9,000,000	Common	Z
Whiskered auklet (*Aethia pygmaea*)	-	30,000	-	Z
Crested auklet (*Aethia cristatella*)	50,000	3,000,000	Common	Z,I
Rhinoceros auklet (*Cerorhinca monocerata*)	200,000	50	-	C,S,H,A,F
Horned puffin (*Fratercula corniculata*)	1,500,000	500,000	Uncommon	C,S,P,H, F,Q,Z,I
Tufted puffin (*Fratercula cirrhata*)	1,500,000	2,500,000	Uncommon	C,S,P,H,F,Q,Z,I

1 Source of population data for colonial seabirds that breed in coastal colonies: modified from USFWS 1998. Estimates are minima, especially for storm-petrels, auklets, and puffins. Relative abundance for Chukchi Sea/Beaufort Sea derived from Denlinger (2006), Divocky (1987), and Gall and Day (2009). Estimates of abundance are seasonal and are primarily for the open-water period in the arctic and northern Bering Sea.

2 Numerical estimates are not available for species that do not breed in coastal colonies. Approximate numbers: abundant > 10^6; common = 10^5-10^6; uncommon = 10^3-10^5; rare < 10^3.

3 Abbreviations of diet components: M, Myctophid; P, walleye pollock; G, other gadids; C, capelin; S, sandlance; H, herring; A, Pacific saury; F, other fish; Q, squid; Z, zooplankton; I, other invertebrates; D, detritus; ?: no information for Alaska. Diet components are listed in approximate order of importance; see species accounts in seabird section of NPFMC (2000) for sources of diet data. However, diets depend on availability and usually are dominated by one or a few items (see NPFMC 2000).

4 Species does not breed in Alaska

5 Species breeds both coastally and inland; population estimate is only for coastal colonies.

3.2.3.3 Other Marine Bird Species

Table 3.2-11 lists other species of birds that regularly occur in the AFSC research areas and spend at least part of the year in marine waters. This list does not include many species of waterfowl, shorebirds, and passerines that use marine coastal habitats but do not spend significant time on marine waters, although many of them migrate over marine waters. These species primarily use nearshore areas where AFSC fisheries research efforts are minimal and are thus unlikely to interact directly with ADFG fisheries research activities. Additional information on the status and natural history of these species can be found in several standard and on-line references (Denlinger 2006, the Sea Duck Joint Venture website; http://seaduckjv.org/meet-the-sea-ducks/, and the ADFG on-line wildlife notebook series;

http://www.adfg.alaska.gov/index.cfm?adfg=educators.notebookseries). Additional natural history information on these marine species and their interactions with commercial fishing in Alaska is provided in the Alaska Groundfish Fisheries Programmatic EIS (NMFS 2004, and 2007 updates), which are incorporated by reference.

Table 3.2-11 Other Marine Birds Regularly Occurring in the AFSC Research Areas

Common Name	Scientific Name	Common Name	Scientific Name
Red-throated loon	*Gavia stellate*	**Surf scoter**	*Melanitta perspicillata*
Pacific loon	*Gavia pacifica*	**White-winged scoter**	*Melanitta fusca*
Common loon	*Gavia immer*	**Black scoter**	*Melanitta americana*
Yellow-billed loon	*Gavia adamsii*	**Common goldeneye**	*Bucephala clangula*
Red-necked grebe	*Podiceps grisegena*	**Barrow's goldeneye**	*Bucephala islandica*
Horned grebe	*Podiceps auritus*	**Bufflehead**	*Bucephala albeola*
Brant	*Branta bernicla*	**Common merganser**	*Mergus merganser*
Emporor goose	*Chen canagica*	**Red-breasted merganser**	*Mergus serrator*
Lesser scaup	*Aythya affinis*	**Red-necked phalarope**	*Phalaropus lobatus*
Greater scaup	*Aythya marila*	**Red phalarope**	*Phalaropus fulicarius*
Canvasback	*Aythya valisineria*	**Surf scoter**	*Melanitta perspicillata*
Redhead	*Aythya americana*	**White-winged scoter**	*Melanitta fusca*
Harlequin duck	*Histrionicus histrionicus*	**Black scoter**	*Melanitta americana*
Long-tailed duck	*Clangula hyemalis*	**Common goldeneye**	*Bucephala clangula*
King eider	*Somataria spectabilis*	**Barrow's goldeneye**	*Bucephala islandica*
Common eider	*Somataria mollissima*	**Bufflehead**	*Bucephala albeola*

3.2.4 Sea Turtles

Sea turtles are protected under the Inter-American Convention for the Protection and Conservation of Sea Turtles and the ESA. NMFS and the USFWS share responsibilities at the federal level for the research, management, and recovery of Pacific sea turtle populations under U.S. jurisdiction. Free-swimming turtles, or turtles caught in fishing gear, fall under the jurisdiction of NMFS, whereas turtles on beaches fall under the jurisdiction of the USFWS.

Four species of sea turtles have been documented in Alaska waters; leatherback, green, olive ridley, and loggerhead (Table 3.2-12). These species are uncommon to rare visitors to Alaska; their use of the area is limited to foraging during the late summer/early fall. Bruce Wing at NOAA's Auke Bay Laboratory maintained a database of incidental sea turtle observations in Alaska for several decades (Hodge and Wing 2000 as cited in ADFG 2008). Since he retired in 2011, database updates have ceased. Because the Hodge and Wing (2000) data includes incidental observations only (individuals either found dead on the shore or observed by fishermen), it is likely that it represents a small percentage of the sea turtles that actually occur in Alaska waters (Ream 2015).

The cold waters of Alaska are beyond the typical northern limits for sea turtles, but leatherbacks have a mammal-like ability to maintain a high body temperature (about 80° F), independent of the temperature of the surrounding water (ADFG 2008). This may account for its relatively common occurrence in cold northern waters where jellyfish are seasonally abundant. In contrast to the leatherbacks, the hard shell turtles (green, olive ridley, and loggerhead) are considered warm water species, which rarely stray into cold Alaskan waters.

However, under certain oceanographic conditions (e.g.,

warmer currents), all four species could occur (ADFG 2008). Hodge and Wing (2000) described an "Alaska Turtle Season" as July through October, with 75% of occurrences reported during this period. Both green sea turtles and leatherback sea turtles probably reach Alaska by way of the warm Japan Current and North Pacific Current, which reach Alaska's Alexander archipelago, arc northwestward across the GOA, and then flow southwestward along the Aleutian chain (ADFG 2008). As water temperatures drop, all sea turtles except the leatherback can become cold stressed and strand on the beaches with no way to survive the return to warmer waters.

The following sea turtle sightings have been recorded in Alaska since 1960 (ADFG 2011a):

- 19 reports of leatherback sea turtles (2 dead, 17 alive)
- 20 reports of green sea turtles (15 dead, 5 alive)
- 4 reports of olive ridley sea turtles (2 dead, 2 alive)
- 2 reports of loggerhead sea turtles (1 dead, 1 alive)
- 3 unidentified sea turtles (all alive)

Six of the 19 leatherback sea turtles were found entangled in fishing gear (Hodge and Wing 2000 as cited in ANHP 2012). Currently, all four species are listed as threatened or endangered under the ESA. Table 3.6-12 shows the status and distribution of the four species within the three research areas. The GOA is at the edge of the habitat range for leatherback and green sea turtles. Leatherbacks have also been seen in the Bering Sea. Sea turtles have not been recorded in the Chukchi Sea/Beaufort Sea Research Area.

Prior to 1993, Alaska sea turtle sightings were mostly of live leatherback sea turtles; since then most observations have been of green sea turtle carcasses. At present, it is not possible to determine if this change is related to changes in oceanographic conditions, perhaps as the result of climate change, or to changes in the overall population size and distribution of these species (ADFG 2008).

Table 3.2-12 Sea Turtles Occurring in the AFSC Research Areas

Common Name	Scientific Name	Federal Status in Alaska	GOARA	BSAIRA	CSBSRA
Leatherback	*Dermochelys coriacea*	Endangered	Yes	Yes	No
Green	*Chelonia mydas*	Threatened	Yes	No	No
Olive Ridley	*Lepidochelys olivacea*	Threatened	Rare	No	No
Loggerhead	*Caretta caretta*	Threatened	Rare	No	No

3.2.4.1 Threatened and Endangered Species

All of the sea turtles found in the area of the AFSC research activities are listed as threatened or endangered under the ESA. The information presented in the following species accounts is primarily from the NOAA Fisheries OPR website, available online at: http://www.nmfs.noaa.gov/pr/species/turtles/. Additionally, threatened and endangered species and critical habitats under NMFS jurisdiction are described and evaluated in the Biological Assessment (NMFS 2017a) and Biological Opinion (NMFS 2019).

Leatherback Sea Turtles

Leatherback sea turtles are uncommon in the GOARA, rare in the Bering Sea research area, and do not occur in the Chukchi Sea/Beaufort Sea Research Area. They are the most frequently reported sea turtles in Alaska prior to 1983, with at least 19 records occurring between 1960 and 1998 from Southeast Alaska to the Alaska Peninsula, with peak numbers being reported in August in the 1970s and 1980s (MacDonald 2003). They have also been reported at Cape Navarin, Russia, 280 miles northwest of Saint Mathew Island in the Bering Sea. They feed primarily on jellyfish, which are abundant in the GOA during late summer and fall (Macdonald 2003).

The leatherback sea turtle is the largest living turtle and ranges farther than any other sea turtle species, exhibiting broad thermal tolerances that allow it to forage into the colder waters. Leatherback sea turtles are widely distributed throughout the oceans of the world and are found in waters of the Atlantic, Pacific, Caribbean, and the Gulf of Mexico. The leatherback turtle was listed as endangered under the ESA in June of 1970. In 2012, NMFS designated critical habitat for the leatherback sea turtle off the coast of Washington and Oregon. Recent estimates of global nesting populations are that 26,000 to 43,000 females nest annually, which is a dramatic decline from the 115,000 estimated in 1980 (Wallace et al. 2013a). Because adult female leatherbacks frequently nest on different beaches, nesting population estimates and trends are especially difficult to monitor. However, it is estimated that the global population has declined an estimated 40% over the past three generations (Wallace et al. 2013a).

The population of leatherback sea turtles in the Pacific Ocean is smaller than that of the Atlantic Ocean, and appears to be in a critical state of decline. Unlike populations of Atlantic leatherbacks, Pacific leatherback populations have plummeted in recent decades: Western Pacific leatherbacks have declined more than 80 percent and Eastern Pacific leatherbacks have declined by more than 97 percent.

Declines in the leatherback population have resulted from fishery interactions as well as exploitation of the eggs. A significant factor impacting leatherback populations worldwide is incidental capture in artisanal and commercial fisheries (reviewed by Eckert et al. 2012; Lewison et al. 2004, 2013; Wallace et al. 2010, 2013b). Globally, over 85,000 sea turtles (all species combined) are estimated to be bycaught in fisheries deploying gillnets, longlines and trawls (Wallace et al. 2010). Pelagic longlines were estimated to take more than 50,000 leatherbacks worldwide in 2000 (Lewison et al. 2004).

Green Sea Turtle

Green sea turtles are uncommon in the GOARA. Sightings have occurred from the Alexander Archipelago north and west to near Cordova, and near Seldovia, and Homer in Kachemak Bay (MacDonald 2003). Green sea turtles have not been recorded in the Bering Sea or Arctic research area.

Green sea turtles are distributed circumglobally. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south. In the central Pacific, green turtles occur around most tropical islands, including the Hawaiian Islands. Adult green turtles that feed throughout the main Hawaiian Islands undergo a long migration to French Frigate Shoals in the Northwest Hawaiian Islands, where the majority of nesting and mating occurs (NMFS and USFWS 1998).

Impacts to the green sea turtle population are similar to those discussed above for leatherback turtles. Fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of mortality. Incidental take of green sea turtles has been recorded in the pelagic driftnet, pelagic longline, sea scallop dredge, southeast shrimp trawl, and summer flounder bottom trawl fisheries.

Olive Ridley Sea Turtle

Olive ridley sea turtles are rare in the GOARA and do not occur in the Bering Sea or Chukchi Sea/Beaufort Sea Research Areas. This species has been documented in southeast Alaska four times, including a carcass found near Yakutat in January 1986, and another south of Ketchikan in June 1991 (MacDonald 2003). Steiner and Walder (2005) suggest that the turtles may have died or been injured elsewhere and been carried out of their normal range.

The olive ridley sea turtle is mainly a "pelagic" sea turtle, but has been known to inhabit coastal areas, including bays and estuaries. Olive ridley sea turtles mostly breed annually and have an annual migration from pelagic foraging, to coastal breeding and nesting grounds, then back to pelagic foraging. Observers on trans-pacific ships have seen olive ridley sea turtles over 2,400 miles (4,000 km) from shore. Olive ridley sea turtles are globally distributed in the tropical regions of the South Atlantic, Pacific, and Indian oceans. In the Eastern Pacific, they occur from Southern California to Northern Chile where, arribadas (massive synchronized nesting events) occur from June through December on certain beaches on the coasts of Mexico, Nicaragua, and Costa Rica and on a single beach in Panama.

Degradation of nesting beaches, ongoing directed harvest, and bycatch in fisheries have all contributed to the decline of the species. Incidental bycatch of olive ridley sea turtles occurs worldwide in trawl fisheries, longline fisheries, purse seines, gill net and other net fisheries and hook and line fisheries (Frazier et al. 2007).

Loggerhead Sea Turtle

Loggerhead sea turtles are rare in the GOARA and do not occur in the Bering Sea or Chukchi Sea/Beaufort Sea Research Areas. Two sightings have occurred in Alaska, a carcass found on Shuyak Island north of Kodiak in December 1991, and a sighting near Cape Georgena on Kruzof Island northwest of Sitka in July 1993 (MacDonald 2003).

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Pacific, Atlantic, and Indian oceans in a wide range of habitats. These include open ocean, continental shelves, bays, lagoons, and estuaries (NMFS and USFWS 1998; Witherington et al. 2006). Loggerhead sea turtles are primarily benthic feeders, opportunistically foraging on crustaceans and mollusks (Witherington et al. 2006). Under certain conditions, they may also scavenge fish (NMFS and USFWS 1998).

Loggerheads face threats on both nesting beaches and in the marine environment. The greatest cause of decline and the continuing primary threat to loggerhead turtle populations worldwide is incidental capture in fishing gear, primarily in longlines and gillnets, but also in trawls, traps and pots, and dredges. Directed harvest for loggerheads still occurs in many places (e.g., the Bahamas, Cuba, and Mexico) and is a serious and continuing threat to loggerhead recovery.

3.2.5 Invertebrates

There is tremendous diversity among the marine invertebrates which inhabit the three AFSC research areas. Marine invertebrates inhabit the water column and benthic habitats, and can be found in offshore environments (including the continental shelf and slope, and underwater canyons) and in nearshore environments, such as kelp forests, and salt marshes. Marine invertebrates are an important part of the ecosystem, as prey for fish, marine mammals, birds, and land mammals both offshore and in bays and estuaries. Many invertebrates found in the research areas are highly valuable to commercial, recreational, and subsistence fisheries. Invertebrates found within the AFSC research areas include numerous species of cnidarians (particularly corals and anemones), crustaceans (such as crabs and shrimp), mollusks (including clams and snails), echinoderms (sea stars and sea urchins), sponges, and tunicates. There are currently no invertebrate species found within the AFSC region listed as threatened or endangered under the ESA and thus will not be discussed further. However, there is concern over coral species so these are discussed separately from other species. The succeeding sections discuss managed species, non-managed species, and deep-sea corals.

3.2.5.1 Managed Species

There are many invertebrate species in AFSC research areas that have valuable fisheries associated with them. Some are primarily in State waters and managed solely by the ADFG, such as sea urchins, shrimp, sea cucumbers, clams, and some crab species. There are no specific retention regulations for these species aside from those published by ADFG. Other species, including some species of king crab, Tanner crab, and scallops, are managed jointly by ADFG and NMFS and retention of these species by federal commercial groundfish fisheries is generally prohibited with some exceptions. Octopuses and squids are managed by NMFS in federal waters and by ADFG in state waters. Due to these management agreements, many of these species are targeted by AFSC surveys for stock assessment purposes and may be caught in large numbers. Table 3.2-13 displays a list of the most commercially important species, as well as their primary management jurisdiction.

Table 3.2-13 Commercial and Prohibited Invertebrate Species in the AFSC Research Areas

Species	Scientific Name	Fishery Management Agency	Primary Research Areas Fished In
Alaskan pink shrimp	*Pandalus eous*	ADFG	GOARA, BSAIRA
Blue king crab	*Paralithodes platypus*	ADFG/NMFS - BSAIRA ADFG - GOARA	GOARA, BSAIRA
Coonstripe shrimp	*Pandalus hypsinotis*	ADFG	GOARA, BSAIRA
Dungeness crab	*Cancer magister*	ADFG	GOARA, BSAIRA
Geoduck clam	*Panopea generosa*	ADFG	GOARA
Giant octopus	*Enteroctopus dofleini*	ADFG/NMFS	GOARA, BSAIRA
Golden king crab	*Lithodes aequispinus*	ADFG/NMFS - BSAIRA ADFG - GOARA	BSAIRA
Green sea urchin	*Strongylocentrotus droebachiensis*	ADFG	GOARA, BSAIRA
Grooved Tanner crab	*Chionoecetes tanneri*	ADFG	BSAIRA
Littleneck clam	*Protothaca stamineais*	ADFG	GOARA, BSAIRA
Magistrate armhook squid	*Berryteuthis magister*	ADFG/NMFS	GOARA, BSAIRA
Razor clam	*Siliqua patula*	ADFG	GOARA, BSAIRA
Red king crab	*Paralithodes camtschaticus*	ADFG/NMFS - BSAIRA ADFG - GOARA	GOARA, BSAIRA
Red sea cucumber	*Parastichopus californicus*	ADFG	GOARA, BSAIRA
Red sea urchin	*Strongylocentrotus franciscanus*	ADFG	GOARA, BSAIRA
Scarlet king crab	*Lithodes cousei*	ADFG	GOARA, BSAIRA
Sidestriped shrimp	*Pandalopsis dispar*	ADFG	GOARA, BSAIRA
Snow crab	*Chionoecetes opilio*	ADFG/NMFS	BSAIRA
Spot shrimp	*Pandalus platyceros*	ADFG	GOARA, BSAIRA

Species	Scientific Name	Fishery Management Agency	Primary Research Areas Fished In
Southern Tanner crab	*Chionoecetes bairdi*	ADFG/NMFS	GOARA, BSAIRA
Tanner crab unidentified[1]	*Chionoecetes sp.*	ADFG	GOARA, BSAIRA
Triangle Tanner crab	*Chionoecetes angulatus*	ADFG	GOARA, BSAIRA
Weathervane scallop	*Patinopecten caurinus*	ADFG/NMFS	GOARA, BSAIRA

1 Tanner crab unidentified is not a managed species group. It is included in this list to reflect that some research catch is identified to this level and not to the species level.

The subsequent paragraphs provide descriptions of the biology and distributions of those species most frequently caught in recent AFSC surveys (2009-2013). The information is primarily from species reports on the ADFG website (online at http://www.adfg.alaska.gov/index.cfm?adfg=animals.main) and on the AFSC website at http://www.afsc.noaa.gov/. Additional species life history information can be found in the SAFE Reports for the crab, groundfish, and weathervane scallop fisheries of Alaska, available online at http://www.npfmc.org/safe-stock-assessment-and-fishery-evaluation-reports/.

King Crabs

King crabs, also called stone crabs, are a family of decapod crustaceans mainly found in cold seas. There are approximately 40 known species of king crabs. In Alaska, there are only three commercially harvested species: the red king crab, the blue king crab and the golden king crab. There is a fourth species of king crab found in Alaska, the scarlet king crab, though its low abundance and comparatively-small size make it commercially undesirable. Red, blue and golden king crabs seldom co-exist, although their depth ranges and habitat often overlap.

Food eaten by king crabs varies by species, size, and depth inhabited. King crabs are known to eat a wide assortment of marine life including worms, clams, mussels, snails, brittle stars, sea stars, sea urchins, sand dollars, barnacles, crabs, other crustaceans, fish parts, sponges, and algae. King crabs are eaten by a wide variety of organisms including but not limited to fishes (Pacific cod, sculpins, halibut, yellowfin sole), octopuses, king crabs (they can be cannibalistic), sea otters, and several new species of nemertean worms, which have been found to eat king crab embryos.

Red king crab

Red king crab (*Paralithodes camtschaticus*) are the predominant king crab in commercial harvests, with the largest harvests coming from Bristol Bay and smaller harvests coming from Southeast Alaska, Norton Sound, and the Adak area. Living in waters less than 90 feet deep, they can grow very large with the record female and male weighing 10.5 and 24 pounds, respectively.

Red king crab exhibit annual migrations from near shore to offshore (or shallow to deep) and back. Adult male red king crabs in the Kodiak area have been known to migrate up to 100 miles round-trip annually, moving at times as fast as a mile per day. Adult crabs tend to segregate by sex off the mating-molting grounds. Adult females and some adult males molt and mate before they start their offshore feeding migration to deeper waters. Adult females brood thousands of embryos underneath their tail flap for about a year's time. When the embryos are fully developed they hatch as swimming larvae, but they are still susceptible to the movements of tides and currents. After feeding on plant and animal plankton for several months and undergoing several body changes with each molt, the larvae settle to the ocean bottom and molt into nonswimmers, red king crabs settle in waters less than 90 feet deep.

Blue king crab

Blue king crab (*Paralithodes platypus*) are similar in size and appearance to red king crab, with the most obvious difference being color. They typically live in waters less than 210 feet deep and are distributed from Japan to the Siberian coast and into the Bering Strait. In Alaska, they are found in discrete populations off St. Matthew Island, St. Lawerence Island, the Pribilof Islands, and in fjord-like bays of Southeast Alaska.

Blue king crab exhibit annual nearshore to offshore (or shallow to deep) migrations. They move to shallow water in late winter, with embryos hatching in spring. Adult molting and mating then occur before migrations begin to deeper water feeding grounds. Similar to red king crab, blue king crab tend to separate by sex away from mating grounds. Female blue king crab reach sexual maturity at about five years of age and males reach maturity at about six.

The primary blue king crab commercial fisheries have been around St. Matthew Island and the Pribilof Islands. The Pribilof Islands blue king crab stock is currently considered overfished.

Golden king crab

Golden king crab (*Lithodes aequispinus*) are found in deep waters often exceeding 300 fathoms (1,800 ft; 550 m) and are found from British Columbia to the Aleutian Islands and Japan. Although golden king crab are primarily fished in the waters surrounding the Aleutian Islands, significant populations occur in pockets off the Pribilof and Shumagin Islands, Shelikof Strait, Prince William Sound and at least as far south as lower Chatham Strait in Southeast Alaska, where an annual commercial fishery exists. Golden king crabs average 5–8 lb and tend to avoid open sand substrates and prefer steep-sided ocean bottoms. Juveniles are cryptic and rely on structure-forming sessile invertebrates growing on the sea floor, such as corals, sponges and sea-whips, to provide habitat. Golden king crab eat a wide assortment of marine life including worms, clams, mussels, snails, brittle stars, sea stars, sea urchins, sand dollars, barnacles, crabs, other crustaceans, fish parts, sponges, and algae.

Mature golden king crabs have a very set migration pattern - they come into shallow water to mate in late winter; by spring, when the embryos hatch and set off on their own, they migrate back to their deep-water feeding grounds. Adult crabs tend to segregate by sex once off the mating/molting grounds. When the embryos are fully developed, they hatch as swimming larvae, but they are still susceptible to the movements of tides and currents. Larvae feed on plant and animal plankton for several months, undergoing several body changes with each molt. Eventually, the larvae settle to the ocean bottom and molt into non-swimmers. Juveniles molt many times in their first few years, then less frequently until they reach sexual maturity in four or five years. Adult females must molt in order to mate but males do not. Adult males often skip a molt and keep the same shell for one or two years.

Tanner crabs

Tanner crabs are two of the four species of the genus *Chionoecetes* occurring in the eastern North Pacific Ocean, Bering, Chukchi, and Beaufort Seas. They form the basis of a thriving fishery from southeastern Alaska north through the Bering Sea. These crabs are also marketed under their trade names: snow crab (*C. opilio*) and southern Tanner crab (*C. bairdi*). Although *C. opilio* and *C. bairdi* are discreet species, they are able to crossbreed. In fact, there are specific regions in the Bering Sea that contain high numbers of Tanner crab hybrids. The hybrid individuals display a mix of physical traits that are typically attributed to either of the two discreet species. Males of commercial size usually range from 7 to 11 years of age and vary in weight from 1 to 2 pounds for *C. opilio* and 2 to 4 pounds for *C. bairdi*. Tanner crabs feed on a wide assortment of marine life including worms, clams, mussels, snails, crabs, other crustaceans, and fish parts. They are fed upon by bottomfish, pelagic fish, and humans.

Migration patterns are not well understood; however, it is known that the sexes are separated during much of the year and move into the same areas during the reproductive season. Female Tanner crab mate with adult males for the first time during their last molt (maturity molt) and may deposit 85,000 to 424,000 eggs in a clutch. Fertilization is internal, and the eggs are usually ovulated (extruded) within 48 hours onto the female's abdominal flap where they incubate for a year. Hatching occurs late the following winter and spring with the peak hatching period usually during April to June. The young, free-swimming larvae molt many times and grow through several distinct stages lasting about 63 to 66 days, after which the larvae lose their swimming ability and settle to the ocean bottom. After numerous molts and several years of growth, females mature at approximately 5 years of age while males mature at about 6 years. Tanners may live to an estimated maximum age of 14 years.

Shrimp

Trawl caught shrimp were a major component of shellfish harvests in the GOA through the early 1980s. The primarily Kodiak-based fishery declined following a climate-induced regime shift accompanied by an increase in Pacific cod, a major shrimp predator. Small trawl fisheries continue in Southeast Alaska and Prince William Sound and the Kodiak area, and a large pot fishery for spot prawns occurs in southeast Alaska.

Alaskan pink shrimp

Alaskan pink shrimp (*Pandalus eous),* also known as Northern or pink shrimp, are the primary shrimp species found in AFSC surveys. In the Pacific Ocean, northern shrimp are found from the Bering Sea south to Oregon in the east, and south to Japan and Korea in the west. Alaskan pink shrimp may live for a maximum of at least 5 or 6 years in the GOA. Northern shrimp are typically found over soft mud or silt bottoms in 50-100 m of water, but have been found at depths of up to 1,380 m (4,500 ft). They have been found in waters as warm as 12 °C (54 °F) but generally prefer waters in the range 3 to 6 °C (32 to 41 °F). Alaskan pink shrimp migrate into the water column each night to feed on small crustaceans and other zooplankton. When targeting plankton, the shrimp filter feed, capturing their prey by trapping it among their legs. During the day however, they typically forage in the bottom sediments on worms, small crustaceans, algae, and detritus. Shrimp are preyed upon by sablefish, arrowtooth flounder, Pacific cod, walleye pollock, rockfish, halibut, salmon, spiny dogfish, common murres and other seabirds.

Alaskan pink shrimp move up in the water column at night to feed, except that females carrying eggs remain near the bottom. There may also be some seasonal movements to shallower or deeper water. Alaskan pink shrimp breed in the fall, after the females molt and become ready for breeding. Females carry fertilized eggs, which develop over the winter and hatch the following spring. Females may hatch up to 4,000 eggs, but the average is about half that. Larvae swim throughout the water column for most of the first summer, after which they settle to the bottom and begin the juvenile phase. During the second summer, they molt again and become sexually mature, typically as males. After breeding at least one or two times as a male, they gradually transform permanently into females. A very small proportion of northern shrimp start out as females and stay female throughout life.

Alaskan pink shrimp abundance remains low over the western and central GOA, and the historically important trawl fisheries for northern shrimp remain closed. The primary factors that can threaten northern shrimp populations are ocean regime shifts caused by climate cycles, ocean acidification, and overfishing. Although overfishing may have occurred in the past in some areas, northern shrimp are now taken mostly as bycatch in small amounts that are unlikely to result in overfishing.

Green sea urchin

Two sea urchins species are commercially harvested in Alaska. The red sea urchin (*Strongylocentrotus franciscanus*) is the larger, longer-spined species and is the target in the state's largest urchin fishery in

Southeast Alaska. The green sea urchin (*S. droebachiensis*) is a smaller species with shorter spines taken in a small commercial fishery principally in the Kodiak area. The green sea urchin is circumpolar in the northern hemisphere, occurring in the Eastern Pacific from Washington State to the Arctic Ocean. Green sea urchins are found in a wide variety of habitats, and especially in more protected waters and embayments and feed on kelps and other algae. Highest concentrations occur from the intertidal to depths of 30 feet.

Giant Pacific octopus

Giant Pacific octopus (*Enteroctopus dofleini*) is the largest species of octopus in the world. It is found in the northern Pacific Ocean from the northwest coast of the continental U.S. to Japan, including waters off Alaska. Octopus are not generally targeted by fishermen in Alaska, and they are occasionally captured in nets and fishing gear as bycatch, where they are often retained. For management purposes, all octopus species are grouped into a single species complex, however data indicate that giant Pacific octopus comprise are the most abundant in shelf waters and make up the largest proportion found in commercial catches. They are found most often in pots used to fish for Pacific cod, where they often weigh more than 50 pounds. There is little information available about the migration and movements of giant octopus in Alaska waters. Samples collected during research in the Bering Sea indicate that they are reproductively active in the fall with peak spawning occurring in the winter to early spring months. Like most species of octopods, giant octopus are terminal spawners, dying after mating (males) and the hatching of eggs (females). Fecundity for this species in the GOA ranges from 40,000 to 240,000 eggs per female with an average fecundity of 106,800 eggs per female.

Squid

Squid (class Cephalopoda) are marine mollusks. They have 10 appendages which surround the mouth and they have lateral fins that extend from the rear of the mantle. More than 15 species of squids are found in Alaska. The most abundant species of squid in Alaska is the magistrate armhook squid (*Berryteuthis magister*).

Squid are managed under the GOA FMP and under the BSAI FMP as separate aggregations of species, each of which amounts to a stock complex. There are currently no directed fisheries for squid in Alaska waters, however some targeting of squid occurred by foreign vessels prior to 1990 and multiple targeted squid fisheries occur around the world. Squid are frequently taken as bycatch in Alaska fisheries, amounting to less than 2% of target fisheries. In 2003, bycatch rates increased to 5% in GOA groundfish fisheries and periodic increases have occurred since then.

Weathervane scallops

Weathervane scallops (*Patinopecten caurinus)*, the largest of the world's commercial species, are distributed from California to the Bering Sea and as far west as the Aleutian Islands. Scallop beds in Alaska are located on mud, sand or gravel substrate in depths of 120 to 390 feet. Adult scallops assemble in dense "beds" with a characteristic oblong shape that parallels the direction of the prevailing current. They become commercially harvestable at about four inches shell height and age four to six years. Scallops reach a maximum age of approximately 28 years in Alaska.

Weathervane scallops sexually mature around age 3 or 4 years. They spawn annually during summer and are about 100 mm in shell height when they are sexually mature. Scallops are broadcast spawners that reproduce by assembling and releasing clouds of gametes which are fertilized in the water column. The signal for scallop spawning is thought to be increasing water temperature, which occurs in May and June in Alaska. Fertilized eggs settle to the bottom where they develop after a few days into a tiny transparent-shelled veliger larvae. Veliger larvae swim in the water column and feed on microplankton (small free-floating plants) for a period of about three weeks before settling to the bottom to begin life as a benthic filter feeder.

3.2.5.2 Non-managed Species

Hundreds of invertebrate species have been caught during the course of AFSC research that are not subject to formal stock assessments or management regimes. Some surveys only identify these animals to family, order or genus, and some identify these animals to species. There are many reasons why different surveys identify invertebrate catch to different levels including time constraints in sorting and identifying large volumes of catch, research priorities, and difficulty in identifying species with very similar characteristics (for example, see Wing and Barnard 2004). To account for these limitations, the RACE's Species Code database has over 2500 species codes for various invertebrate species and species groups (AFSC 2015), which are used by survey personnel to report invertebrate catches. Table 3.2-14 displays a list of reported species or species groups that have an average catch from AFSC surveys of over 1 mt per year over the 2009-2013 period in all research areas. It is these non-managed species and species groups that are discussed in the analysis of effects in Chapter 4. Also indicated in the table is the research area with average catches greater than 1000 kg (in the case of BSAIRA and GOARA) or greater than 500 kg (in the case of CSBSRA).

Table 3.2-14 Non-managed Invertebrate Species with Greater than 1000 kg Average Annual Research Catch

Taxa	Species Name Reported	Scientific Name	Research Area with Highest Average Catches per Year
Class Anthozoa (corals and anemones)	Gigantic anemone	*Metridium farcimen*	GOARA, BSAIRA
	Sea anemone unidentified	NA	GOARA
	Tentacle-shedding anemone	*Liponema brevicorne*	BSAIRA
Class Ascidiacea (tunicates)	NA	*Boltenia ovifera*	BSAIRA
	Sea blob	*Synoicum sp.*	BSAIRA
	Sea glob	*Aplidium sp. A (Clark 2006)*	BSAIRA
	Sea peach	*Halocynthia aurantium*	BSAIRA
	Sea peach unidentified.	*Halocynthia sp.*	BSAIRA
	Sea potato	*Styela rustica*	BSAIRA
Class Asteroidea (sea stars)	Basketstar	*Gorgonocephalus eucnemis*	BSAIRA
	Blackspined sea star	*Lethasterias nanimensis*	BSAIRA
	Common mud star	*Ctenodiscus crispatus*	BSAIRA
	NA	*Leptasterias polaris*	BSAIRA, CSBSRA
	Purple-orange sea star	*Asterias amurensis*	BSAIRA, CSBSRA
	Sunflower sea star	*Pycnopodia helianthoides*	GOARA
Class Gastropoda (snails)	Empty gastropod shells	NA	BSAIRA
	Fat whelk	*Neptunea ventricosa*	BSAIRA
	Lyre whelk	*Neptunea lyrata*	BSAIRA
	NA	*Neptunea heros*	BSAIRA, CSBSRA
	Oregon triton	*Ophiolebes sp. B (Clark 2006)*	BSAIRA
	Pribilof whelk	*Neptunea pribiloffensis*	BSAIRA

Taxa	Species Name Reported	Scientific Name	Research Area with Highest Average Catches per Year
Class Holothuroidea (sea cucumber)	Brownscaled sea cucumber	*Psolus fabricii*	CSBSRA
	Deep sea papillate cucumber	*Pannychia moseleyi*	BSAIRA
Class Malacostraca (crabs)	Aleutian hermit	*Pagurus aleuticus*	BSAIRA
	Circumboreal toad crab	*Hyas coarctatus*	BSAIRA
	Fuzzy hermit crab	*Pagurus trigonocheirus*	BSAIRA, CSBSRA
	Hairy hermit crab	*Pagurus capillatus*	BSAIRA
	Hermit crab unident.	NA	GOARA
	Sponge hermit	*Pagurus brandti*	BSAIRA
Class Ophiuroidea (basketstars and brittlestars)	NA	*Gorgonocephalus sp. cf. arcticus*	BSAIRA, CSBSRA
	notched brittlestar	*Ophiura sarsi*	BSAIRA
	NA	*Ophiacantha normani*	BSAIRA
Class Scyphozoa (jellies)	Jellyfish unident.	NA	GOARA
	Sea nettle	*Chrysaora fuscescens*	BSAIRA, CSBSRA
	NA	*Chrysaora melanaster*	BSAIRA
	NA	*Cyanea sp.*	GOARA
Phylum Porifera (sponges)	Barrel sponge	*Halichondria panicea*	BSAIRA
	Clay pipe sponge	*Aphrocallistes vastus*	BSAIRA
	Sponge, unidentified	NA	BSAIRA
Class Echinoidea (sea urchins and sand dollars)	NA	*Strongylocentrotus sp.*	BSAIRA

3.2.5.3 Deep-Sea Corals

The following section contains information found online at http://www.afsc.noaa.gov/ABL/MESA/mesa_me_cor.php.

Deep-sea corals are widespread throughout Alaska, including the continental shelf and upper slope of the GOA, Aleutian Islands, the eastern Bering Sea, and extending as far north as the Beaufort Sea. Coral distribution, abundance, and species assemblages differ among geographic regions. Gorgonians and black corals are most common in the GOA while gorgonians and hydrocorals are the most common corals in the Aleutian Islands. True soft corals are common on Bering Sea shelf habitats. Overall, the Aleutian Islands have the highest diversity of deep-sea corals in Alaska, and possibly in the North Pacific Ocean, including representatives of six major taxonomic groups and at least 50 species or subspecies of deep-sea corals that may be endemic to that region. In the Aleutian Islands, corals form high density "coral gardens" that are similar in structural complexity to shallow tropical reefs and are characterized by a rigid framework, high topographic relief and high taxonomic diversity.

Many of the commercial fish and crab species currently harvested in Alaska spend all or part of their life cycle in deep habitat where corals are potentially found. As the world population continues to grow and the demand for seafood increases in the future, conservation of Alaska's deep coral resources will be a major challenge for managers striving to maintain sustainable fisheries. In recognition of the value of both shallow and deep coral habitat conservation, NOAA has listed corals as one of nine programs within the Ecosystems goal in its Strategic Plan, the only taxa explicitly listed in the Strategic Plan, and the MSA mandates continued research, mapping, and protection of deep coral communities.

Coral communities in Alaskan waters are highly diverse and include six major taxonomic groups (Table 3.2-15): true or stony corals (*Order Scleractinia*), black corals (*Order Antipatharia*), true soft corals (*Order Alcyonacea*) including the stoloniferans (*Suborder Stolonifera*), sea fans (*Order Gorgonacea*), sea pens (*Order Pennatulacea*), and hydrocorals (*Order Anthoathecatae*). One hundred and forty one unique coral taxa have been documented from Alaska waters and include 11 species of stony corals, 14 species of black corals, 15 species of true soft corals (including six species of stoloniferans), 63 species of gorgonians, 10 species of sea pens, and 28 species of hydrocorals. All corals found in Alaska are azooxanthellate and satisfy all their nutritional requirements by the direct intake of food. They are ahermatypic, or non-reef building corals, but many are structure forming. The degree to which they provide structure depends on their maximum size, growth form, intraspecific fine-scale distribution, and interaction with other structure-forming invertebrates.

Table 3.2-15 Coral Taxa Found in AFSC Research Areas

Taxa	Number of Species Known in AFSC Research Areas	Depth Range (meters)
Scleractinia	11	24-4620
Antipatharia	14	401-4784
Alcyonacea	9	10-3209
Stolonifera	6	11-591
Gorgonacea	63	6-4784
Pennatulacea	10	3-2947
Anthothecatae	28	11-2130

Source: http://www.afsc.noaa.gov/ABL/MESA/mesa_me_cor_cm.htm

In Alaska, many commercially valuable fish and crab species and other non-commercial species are associated with deep corals. Most associations are believed to be facultative rather than obligatory. Fish and crabs, particularly juveniles, use coral habitat as refuge and as focal sites of high prey abundance. Some shelter-seeking fishes such as rockfish may use coral habitat as spawning and breeding sites.

All known threats to deep-sea coral communities in Alaska are directly or indirectly the result of human activities. While activities such as coastal development, point-source pollution, and mineral mining have the potential to affect nearshore habitats, the effects of these activities are geographically limited and occur (or are likely to occur) in areas with minimal coral habitat. Fishing activities, on the other hand, occur over vast areas of the seafloor and often in areas containing sensitive deep coral habitat. Human activities that may indirectly affect deep coral habitat include the introduction of invasive species and changes to the physical and chemical properties of the oceans due to climate change and the emission of greenhouse gases.

3.3 SOCIAL AND ECONOMIC ENVIRONMENT

Activities associated with AFSC fisheries and ecosystem research have several implications for the social and economic environment. These include providing guidance for federally managed commercial, recreational, and subsistence fisheries, and direct and indirect expenditures on goods and services associated with fisheries research.

The AFSC conducts field and laboratory research to help conserve and manage the living marine resources in Alaska and the North Pacific in compliance with the MSA, the MMPA, and the ESA.

AFSC research is used for stock assessments that provide the NPFMC and NMFS with the scientific information needed to implement the MSA requirement for ACLs that prevent overfishing, rebuild overfished stocks, and obtain optimum yield from the fisheries. The goal is to achieve fish harvests that provide the greatest overall benefit to the nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems and sustained participation from marine resource dependent communities.

The 1996 amendments to the MSA require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2009a). National Standard 8 of the MSA states:

> *Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.*

The NMFS Economic and Social Sciences Research Program conducts community studies and develops statistical methodologies and economic models for identifying and describing communities substantially engaged in fishing. This information is ultimately utilized by fishery managers, whose decisions balance the needs of a variety of fishing communities and users.

AFSC fisheries and ecosystem research activities occur both inside and outside the U.S. EEZ and span across multiple ecological, physical, and political boundaries. NMFS Alaska Regional Office oversees sustainable fisheries that produce about half the fish caught in US waters, with responsibilities covering 842,000 square nm off Alaska (NMFS 2015e).

As discussed in Chapter 1, NOAA participates in the LME approach to marine resources management. Sixty-four LME's have been identified around the world's coastal margins. The AFSC's research activities occur in five research areas that correspond to LME's. These areas include the GOA, East Bering Sea, West Bering Sea, Chukchi Sea, and Beaufort Sea. Briefs have been developed about each LME that typify the regions (Sherman and Hempel 2009).

3.3.1 Fishing Communities

Over half of communities in Alaska have a substantial reliance on commercial, recreational, and/or subsistence fisheries in Alaska (Himes-Cornell et al. 2013). Commercially important communities occur adjacent to the GOA and along Bristol Bay and the Bering Sea. Recreational fishing has become economically important in Southeast and Southcentral Alaska. Many remote Alaska communities are dependent on subsistence fisheries and the harvest of marine mammals by Alaska Natives. Most of Alaska's fishing communities are reached only by sea or air; few roads connect them to other communities (NMFS 2009b).

In 2011, the AFSC compiled baseline socioeconomic information about Alaskan fishing communities in Community Profiles for North Pacific Fisheries - Alaska (Himes-Cornell et al. 2011). In terms of size, some of these fishing communities are large municipalities that serve as regional economic hubs, such as Anchorage, while other communities are relatively isolated and only have a few dozen inhabitants. Commercial fishing communities with shoreside processing plants tend to have a higher proportion of males in the population than the state. For example, Akutan (77 percent male), Dutch Harbor/Unalaska (68 percent male), and Sand Point (63 percent male) all have higher proportions of males in 2010 than the state as a whole (52 percent). Communities that are heavily involved in processing as well as commercial harvesting activities attract large temporary populations of workers, including many Asians and Hispanics, from outside the region. In these communities, temporary workers sometimes outnumber permanent residents. Community leaders reported that an estimated 1,500 people come to Sand Point (resident population of 976 in 2010) each year as seasonal workers or transients, primarily to work in the cannery or on fishing boats. In some places, temporary workers are housed in group quarters during the fishing season, for example, Akutan (91 percent of residents) and Sand Point (36 percent of residents).

3.3.2 Commercial Fisheries

State fisheries include species harvested within three nm of shore and in Alaska's network of rivers and lakes. Federal fisheries in Alaska are those where harvesting occurs beyond three nm, in federal waters out to the 200-mile limit (NEI 2009a). Federal fisheries include some of the nation's largest, such as pollock, cod, and crab. The Alaska Region has six catch share programs including a community development quota (CDQ) program. The Western Alaska CDQ Program apportions a percentage of the total allowable catch (TAC) for groundfish, bycatch species, halibut, and crab to 65 eligible communities in western Alaska that are organized into six CDQ groups. The purpose of the CDQ program is to provide coastal native villages with the opportunity to participate and invest in fisheries in the Bering Sea and Aleutian Islands Management Area and support economic development in western Alaska (NMFS 2014c). All of these fisheries, both federal and state, contribute to the economic and social well-being of Alaska's coastal communities, its urban cities, and the state as a whole (NEI 2009a).

Fisheries Economics of the U.S. 2015 analyzed data for the North Pacific Region for 2006 through 2015 (NMFS 2017c). Key species, representing approximately 98-99 percent of revenue, included Atka mackerel, Pacific herring, Pacific cod, rockfish, crab, sablefish, flatfish, salmon, Pacific halibut, and walleye pollock. North Pacific fishers earned over $1.7 billion from their commercial harvest (about 6 billion pounds) in 2015. Landings revenue was dominated by walleye pollock ($509 million), salmon ($413 million), crab ($284 million), and Pacific cod ($174 million). Walleye pollock contributed the most to landings in 2015, accounting for 54 percent of total landings (3.2 billion pounds) and 29 percent of landings revenue, with an average price of $0.16 per pound (NMFS 2017c). Table 3.3-1 shows top species landings and revenue data for 2011 to 2015 for the North Pacific Region (Alaska).

Alaska's seafood industry generated $4.4 billion in sales impacts, $1.9 billion in income impacts, and 53,400 jobs in 2015. Seafood processing and dealer operations contributed 25 percent to in-state sales for Alaskan businesses, with over $1.1 billion generated in 2015. The commercial harvester sector of the seafood industry generated more impacts than any other sector with approximately 70 percent of total impacts. The importer sector consisted of less than one percent of the total impacts for the state (NMFS 2017c).

In 2015, 9,660 Alaska residents held commercial fishing permits in Alaska. In the same year residents of Washington State, Oregon, and California held 1,984, 418, and 280 commercial fishing permits in Alaska respectively. Alaskan commercial fishing permits were held by 882 residents of other states and countries. Estimated gross earnings by permit holder residence were: Alaska ($602 million), Washington ($904 million), Oregon ($126 million), California ($27 million) and other states and countries ($155 million) (ACFEC 2017).

The State of Alaska levies a Fisheries Business Tax ("raw fish tax") on fisheries businesses and persons who process fisheries resources in, or export unprocessed fisheries resources from Alaska. The tax is based on the price paid to commercial fishers and is collected primarily from licensed processors and persons who export fish from Alaska. Alaska also levies a Fishery Resource Landing Tax on fishery resources processed outside of the State's 3-mile limit and first landed in Alaska, or any processed fishery resource subject to Section 210(f) of the American Fisheries Act. The Fishery Resource Landing Tax is based on the unprocessed value of the resource and is collected primarily from factory trawlers and floating processors outside the state's 3-mile limit who bring products into Alaska for transshipment elsewhere. In FY2013, the state collected over $44.2 million in the Fisheries Business Tax, and nearly $13.4 million in the Fishery Resource Landing Tax. Half of the revenue collected in the Fisheries Business Tax and Fishery Resource Landing Tax is shared with communities and boroughs (UFA 2015).

Table 3.3-1 Commercial Landings, Revenue, and Top Species (by Weight) for Alaska 2009-2013

All Species			Top Species				Top Species Percent of All Species (Pounds)	Top Species Percent of All Species (Revenue)
Year	Pounds (thousands)	Revenue (thousands)	Pounds (thousands)	Revenue (thousands)	Price per Pound	Top Species		
2011	5,354,950	$1,930,551	2,810,728	$564,788	$0.14	Pollock, Walleye	52%	21%
2012	5,345,454	$1,839,324	2,872,187	$453,172	$0.16	Pollock, Walleye	54%	25%
2013	5,791,752	1,926,853	3,003,183	$679,528	$0.15	Pollock, Walleye	52%	23%
2014	5,671,323	1,730,807	3,145,639	$546,022	$0.13	Pollock, Walleye	55%	24%
2015	6,038,170	1,732,545	3,262,568	$508,560	$0.16	Pollock, Walleye	54%	29%

Source: NMFS 2017c

Alaska ports collecting the most revenue for fish and shellfish from 2009 to 2013 were Dutch Harbor/Unalaska and Kodiak. Dutch Harbor/Unalaska is the top port in Alaska in pounds landed and revenues (NMFS 2015f). The community is located at the center of one of the richest marine ecosystems on earth and it lies along West Coast and Pacific Rim shipping routes (Himes-Cornell et al. 2013). Table 3.3-2 shows landings data for Alaska's top ports.

Table 3.3-2 Top Landings Locations in Alaska by Weight and Revenue for 2000 and 2013

Year	By Weight			By Revenue		
	Rank	Port	Millions of Pounds	Rank	Port	Millions of Dollars
2000	1	Dutch Harbor/Unalaska	790.6	1	Dutch Harbor/Unalaska	$174.5
	2	Akutan	454.1	2	Kodiak	$96.7
	3	Kodiak	285.4	3	Akutan	$71.8

Year	By Weight			By Revenue		
	Rank	Port	Millions of Pounds	Rank	Port	Millions of Dollars
2013	1	Dutch Harbor/Unalaska	887.8	1	Dutch Harbor/Unalaska	$243.4
	2	Akutan	473.8	2	Kodiak	$163.2
	3	Kodiak	429.6	3	Akutan	$111.3

Source: NMFS 2015f

3.3.3 Recreational Fisheries

Recreational saltwater anglers spent approximately 975,000 angler-days fishing in Alaska in 2015. These anglers numbered over 309,000, with 59 percent of them non-residents. Pacific halibut was the most caught species or species group, with approximately 691,000 harvested or released in 2015. Rockfish and coho salmon were also caught in large numbers, with 475,000 and 578,000 caught, respectively. Together, these three species accounted for 74 percent of total catch by saltwater anglers (NMFS 2017c).

NMFS estimates recreational fishing data annually, based on a variety of sources. For Alaska, data is partially derived from mail and phone surveys, with contacts sampled from saltwater and freshwater fishing licenses. NMFS uses an input-output economic model to estimate patterns in direct, indirect, and induced effects. The estimated economic effects of marine recreational fishing in Alaska are shown in Table 3.3-3 (Lovell et al. 2013).

Table 3.3-3 Total Economic Impacts Generated from Marine Recreational Fishing in 2011

State	Expense ($1,000)	Economic Contribution				Taxes ($1,000)
		Employment (Jobs)	Income ($1,000)	Value Added ($1,000)	Output ($1,000)	
Alaska	$387,359	4,250	$191,109	$299,190	$482,728	$80,261

Source: Lovell et al. 2013

Note: Value Added is the contribution made to Alaska's gross domestic product from marine recreational fishing. Output is the gross value of sales by businesses in Alaska affected by marine recreational fishing. Tax impacts include federal, state, and local taxes.

3.3.4 Subsistence

The Alaska National Interest Land Conservation Act (ANILCA) defines subsistence as:

> *The customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of nonedible byproducts of fish and wildlife resources taken for personal or family consumption; for barter or sharing for personal or family consumption; and for customary trade (16 U.S.C 3113).*

Almost all rural Alaska communities participate in a blended subsistence and cash economy. Fishing and hunting provide an important economic contribution to families and communities, and is an important traditional and cultural practice for many Alaska Natives. The subsistence food harvest by Alaska residents (about 36.2 million pounds excluding wild plants) represents about 1.1 percent of the fish and game harvested annually in Alaska. If one assumes a value of $4.00 to $8.00 per pound, the replacement value of wild food harvests in Alaska would be an estimated $201-$402 million annually (ADFG 2014a).

The regulations governing the harvest of subsistence resources in Alaska are complex and changing. Currently, the federal government manages the harvest of subsistence resources on federally owned lands and waters while the state manages its own lands and waters. Under federal management, residents of non-rural areas are ineligible to harvest subsistence resources on federal lands and waters. Residents of non-rural areas, however, are eligible to harvest subsistence resources on lands and waters of the State of Alaska. Although state law allows any Alaska resident to participate in subsistence activities, the state has identified several urban areas as nonsubsistence areas where subsistence hunting and fishing is not allowed. This includes areas in and around Anchorage, Wasilla, Fairbanks, Valdez, Juneau, the Kenai Peninsula, and Ketchikan (Himes-Cornell et al. 2013).

Subsistence uses of fish and land mammals are given a priority over commercial fishing and recreational hunting and fishing in state and federal law. This means that when the harvestable portion of a fish or wildlife population is not sufficient for all public uses, subsistence uses are restricted last by regulation. This is sometimes referred to as the "subsistence priority" (ADFG 2014a).

Subsistence hunting and fishing on federal lands and waters is regulated by the Federal Subsistence Board, whose membership is comprised of leaders from five federal agencies in Alaska and an appointee of the Secretary of the Interior. The Alaska Board of Fisheries and the Alaska Board of Game, whose members are appointed by the governor and approved by the legislature, create regulations for state subsistence fisheries or hunts (Himes-Cornell et al. 2013). The harvest of waterfowl and other migratory birds is co-managed by the USFWS and Alaska Native groups under the MBTA. Subsistence fishing for halibut is managed by NMFS (see https://alaskafisheries.noaa.gov/ram/subsistence/halibut.htm). Subsistence hunting for sea otters, polar bears, and walrus is co-managed by the USFWS and Alaska Native groups. Subsistence hunting for seals, sea lions, and some whales is co-managed by NMFS and Alaska Native groups. Under the MMPA, Alaska Natives may harvest marine mammals for subsistence purposes. The MMPA defines subsistence as:

> *…the use of marine mammals taken by Alaskan Natives for food, clothing, shelter, heating, transportation, and other uses necessary to maintain the life of the taker or those who depend upon the taker to provide them with such subsistence (50 CFR Part 216.3).*

See Chapter 6 for more information about applicable laws and policies regarding subsistence.

Table 3.3-4 shows subsistence harvests by fishing community, in general correspondence with the AFSC research areas. This information is contained in the Alaska Department of Fish and Game's Community Subsistence Information System (ADFG 2012a). Not all communities have been surveyed, as shown. ADFG designates the years of data which are most representative in terms of completeness among species. While the statistical limitations of this data should be considered, it does provide a broad estimate of levels of subsistence activity. The fishing communities shown in the table are primarily coastal, although many inland communities also rely on subsistence harvests, and among marine species, there is a pronounced reliance on salmon. Fisheries management at sea for migratory species is equally important for inland communities. Recent low runs of salmon, especially king salmon, have spurred research as to the causes, whether it may be environmental, or bycatch of salmon by large commercial trawl fisheries in marine waters (ADFG 2015c).

Figure 3.3-1 shows compiled harvest statistics in order to demonstrate that proportions of subsistence harvests by major species group vary by region. Availability of resources varies widely by region, according to species' residence or migration, and the presence of major rivers, such as the Yukon or Kuskokwim. Marine mammals make up a larger proportion of the Chukchi and Beaufort Sea harvests than the other AFSC research areas, and salmon harvests are more minor. A subsistence reliance on salmon is evident in all areas, and especially in the Yukon-Koyukuk area. Marine invertebrate harvests increase in the more southern areas.

ADFG estimated that average annual subsistence harvest was about 295 pounds of food per person per year for rural residents and 22 pounds per person per year for urban residents (ADFG 2014a). Table 3.3-4 shows a range of per capita harvests; the highest is Akiachak at 1,328 pounds per capita. The higher rate is due to traditional and cultural hunting and fishing practices, as well as the expense of importing food into remote communities.

Table 3.3-4 Subsistence Harvest Estimates in Alaska Fishing Communities

Communities by Census Area and AFSC Research Area	All Resources, Pounds per Capita	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Invertebrates (lbs.)	Marine Mammals (lbs.)	Large Land Mammals (lbs.)	Most Recent Representative Study Year
GULF OF ALASKA							
Ketchikan Gateway Borough							
Ketchikan	*	*	*	*	*	*	*
Skagway – Hoonah – Angoon							
Angoon	216.2	47,590	27,640	17,480	5,239	2,811	1996
Elfin Cove	262.53	4,820	3,511	1,413	**	4,326	1987
Gustavus	240.8	8,409	12,415	4,336	**	9,746	1987
Hoonah	384.89	100,791	59,553	51,956	2,008	71,824	1996
Pelican	355.13	14,442	28,490	11,153	1,730	26,558	1987
Skagway[1]	48.11	10,291	9,029	5,224	**	2,123	1987
Tenakee Springs	329.93	4,671	7,752	4,065	721	12,826	1987
Wrangell – Petersburg							
Kake	162.84	32,602	31,100	16,381	7,712	38,871	1996
Petersburg	197.67	169,365	166,203	144,008	1,605	213,943	1987
Port Alexander	311.71	7,452	7,457	3,316	**	11,556	1987
Wrangell	155.2	85,760	122,119	107,144	18,538	90,648	1987
Prince of Wales-Hyder							
Craig	230.66	113,989	110,299	50,446	17,824	81,444	1977
Edna Bay	383.25	2,863	9,744	864	**	4,698	1998
Hydaburg	384.11	47,134	43,990	40,694	1,228	13,973	1997
Klawock	320.36	88,745	65,924	31,587	18,069	45,290	1997
Metlakatla (Indian Reservation)	70.14	31,556	27,016	22,934	1,298	16,736	1987
Point Baker	288.56	3,915	4,209	2,756	**	2,254	1996

Communities by Census Area and AFSC Research Area	All Resources, Pounds per Capita	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Invertebrates (lbs.)	Marine Mammals (lbs.)	Large Land Mammals (lbs.)	Most Recent Representative Study Year
Port Protection	450.86	5,743	10,865	13,604	840	9,866	1996
Thorne Bay	179.22	32,303	18,998	13,692	5,776	18,694	1998
Whale Pass	184.96	1,550	1,979	3,092	**	2,773	1998
Sitka City and Borough							
Sitka	205.01	493,542	459,665	234,496	2,358	434,225	1996
Juneau City and Borough							
Juneau – Douglas	*	*	*	*	*	*	*
Haines Borough							
Haines	195.81	125,619	173,947	22,599	263	62,481	1996
Valdez-Cordova							
Cordova	176.37	142,767	220,090	13,448	**	117,757	1988
Valdez	79.47	165,929	120,471	34,822	226	70,422	1991
Whittier	79.93	9,453	2,494	2,494	**	2,994	1990
Yakutat City and Borough							
Yakutat	385.51	92,329	55,238	34,447	21,991	21,033	2000
Kenai Peninsula Borough							
Anchor Point	*	*	*	*	*	*	*
Clam Gulch	*	*	*	*	*	*	*
Fritz Creek	*	13,576	12,953	3,269	**	12,765	1998
Halibut Cove	*	*	*	*	*	*	*
Homer	93.83	111,961	166,913	94,467	**	132,279	1982
Kasilof	*	*	*	*	*	*	*
Kenai	83.82	246,787	103,939	32,375	**	106,416	1993
Nikiski	*	*	*	*	*	*	*
Nikolaevsk	132.95	15,724	7,835	893	**	5,267	1998

Communities by Census Area and AFSC Research Area	All Resources, Pounds per Capita	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Invertebrates (lbs.)	Marine Mammals (lbs.)	Large Land Mammals (lbs.)	Most Recent Representative Study Year
Ninilchik	163.81	45,560	41,113	11,837	**	70,474	1998
Port Graham	466.34	41,325	23,498	1,875	1,580	5	2003
Seldovia	183.55	27,678	18,788	14,627	**	10,077	1993
Seward	*	*	*	*	*	*	*
Soldotna	*	*	*	*	*	*	*
Sterling	*	*	*	*	*	*	*
Anchorage							
Anchorage Eagle River/Chugiak/Girdwood	*	*	*	*	*	*	*
Kodiak Island Borough							
Akhiok	123.2	6,825	1,678	1,794	**	1,532	2003
Karluk	268.71	13,307	2,078	299	**	1,918	1991
Kodiak	151.05	289,229	363,265	57,595	**	137,012	2003
Larsen Bay	157.4	11,444	3,612	3,199	**	1,178	2003
Old Harbor	162.5	33,514	12,257	4,699	9,319	8,657	2003
Ouzinkie	142.4	27,730	23,533	2,967	2,500	3,999	2003
Port Lions	159.2	37,280	15,059	7,149	**	12,845	1993
Lake and Peninsula Borough							
Chignik Bay	321.09	10,956	9,050	3,595	5	2,390	2003
Chignik Lagoon	388.7	13,959	3,394	4,420	**	4,950	2003
Chignik Lake	255.54	16,140	2,934	1,780	2,003	7,071	2003
Egegik	384.34	9,128	153	1,326	578	23,587	1984
Igiugig	542	8,447	2,445	**	1,203	8,352	2004
Iliamna	469.4	26,935	2,477	**	473	2,335	2004
Kokhonak	679.6	81,222	5,752	**	**	14,956	2004

Communities by Census Area and AFSC Research Area	All Resources, Pounds per Capita	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Invertebrates (lbs.)	Marine Mammals (lbs.)	Large Land Mammals (lbs.)	Most Recent Representative Study Year
Levelok	526.7	51,710	7,279	**	894	27,742	1992
Newhalen	691.5	62,889	3,980	**	555	12,692	2004
Pedro Bay	305.5	17,232	1,053	**	**	2,065	2004
Perryville	517.96	28,269	7,030	4,602	3,119	17,844	2004
Pilot Point	338.71	6,133	1,004	401	296	15,342	1987
Port Alsworth	132.8	9,712	1,314	115	110	2,547	2004
Port Heiden	407.62	8,766	1,205	1,824	1,543	25,740	1987
Matanuska-Susitna Borough							
Palmer	*	*	*	*	*	*	*
Skwentna	*	*	*	*	*	*	*
Wasilla	*	*	*	*	*	*	*
Willow	*	*	*	*	*	*	*
BERING SEA AND ALEUTIAN ISLANDS							
Aleutians East Borough							
Akutan	*	12,339	14,581	2,866	10,767	10,767	1990
False Pass	*	13,385	4,188	1,610	1,753	5,115	1988
King Cove	*	76,647	23,921	9,700	**	10,744	1992
Sand Point	*	83,320	32,734	10,796	2,848	14,005	1992
Aleutians West							
Adak	*	*	*	*	*	*	*
Atka	439.28	8,051	7,100	444	12,797	**	1994
Dutch Harbor/Unalaska	194.54	98,192	147,684	50,138	17,536	7,412	1994
St George	63.24	569	4,875	193	63,507	**	1994
Saint Paul	267.47	1,506	57,754	26,198	18	**	1994
Scammon Bay	*	*	*	*	*	*	*

Communities by Census Area and AFSC Research Area	All Resources, Pounds per Capita	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Invertebrates (lbs.)	Marine Mammals (lbs.)	Large Land Mammals (lbs.)	Most Recent Representative Study Year
Bethel							
Bethel	*	*	*	*	*	*	*
Chefornak	*	*	*	*	*	*	*
Akiachak	1328.28	339,495	129,826	**	16,057	127,884	1998
Eek	550.4	*	*	*	*	*	*
Goodnews Bay	*	*	*	*	*	*	*
Kipnuk	*	*	*	*	*	*	*
Kwigillingok	*	*	*	*	*	*	*
Mekoryuk	*	*	*	*	*	*	*
Napakiak	*	*	*	*	*	*	*
Nelson Lagoon	52	5,703	299	1,060	262	8,640	1987
Nightmute	*	*	*	*	*	*	*
Platinum	*	*	*	*	*	*	*
Toksook Bay	*	*	*	*	*	*	*
Bristol Bay Borough							
King Salmon	313.04	62,919	1,054	970	521	8,495	2007
Naknek	264.16	85,333	8,730	2,207	6,227	15,401	2007
South Naknek	267.48	10,443	420	186	1,098	371	2007
Quinhagak	767.92	162,125	70,815	**	58,964	49,000	1982
Tuntutiliak	1266.2	*	*	*	*	*	*
Tununak	1092.58	*	*	*	*	*	*
Dillingham							
Clark's Point	181.01	9,911	1,927	48	772	40	1989
Dillingham	67.1	288,651	35,649	2,488	6,067	117,878	1984
Aleknagik	129.4	13,556	8,749	450	2,171	21,619	1989

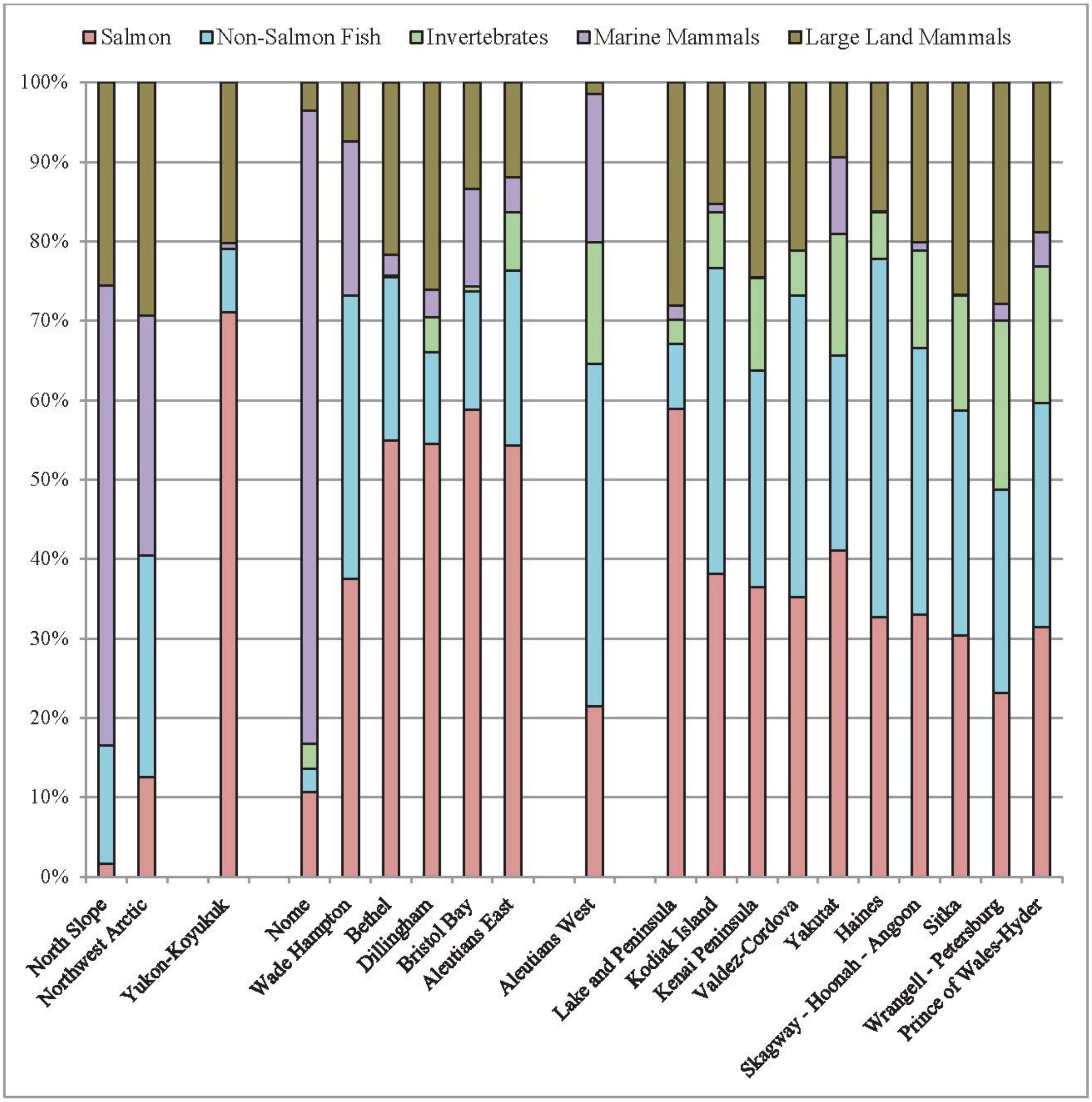
Communities by Census Area and AFSC Research Area	All Resources, Pounds per Capita	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Invertebrates (lbs.)	Marine Mammals (lbs.)	Large Land Mammals (lbs.)	Most Recent Representative Study Year
Ekwok	122.44	48,827	7,340	**	**	20,524	1987
Koliganek	898.5	84,699	13,563	**	**	26,685	2005
Manokotak	64.49	46,353	14,740	1,163	11,027	44,811	1999
New Stuyahok	170.68	79,316	11,812	**	**	5,881	2005
Togiak	36.96	45,040	32,577	45,040	19,649	53,139	1999
Twin Hills	24.09	11,867	6,966	290	753	9,948	1999
Nome							
Elim	*	*	*	*	*	*	*
Nome	*	*	*	*	*	*	*
Shaktoolik	*	*	*	*	*	*	*
Unalakleet	147.44	*	*	*	*	*	*
Wales[1]	744.14	11,869	3,173	3,546	88,431	3,848	1993
Wade Hampton							
Emmonak	612.2	101,716	91,400	0	42,533	17,875	1980
Hooper Bay	*	*	*	*	*	*	*
Kotlik	502.6	54,176	56,840	**	37,920	13,040	1980
Marshall	*	*	*	*	*	*	*
Pilot Station	*	*	*	*	*	*	*
Saint Mary's	*	*	*	*	*	*	*
Scammon Bay	*	*	*	*	*	*	*
CHUKCHI AND BEAUFORT SEAS							
Northwest Arctic Borough							
Deering	672.19	27,000	6,680	*	32,603	27,768	1994
Kivalina	593.7	3,445	75,334	*	125,257	38,733	2007
Kotzebue	592.84	274,202	593,152	*	575,419	644,967	1991

Communities by Census Area and AFSC Research Area	All Resources, Pounds per Capita	Salmon (lbs.)	Non-Salmon Fish (lbs.)	Invertebrates (lbs.)	Marine Mammals (lbs.)	Large Land Mammals (lbs.)	Most Recent Representative Study Year
North Slope Borough							
Barrow	289.16	12,244	106,226	**	508,181	214,676	1989
Kaktovik	18.6	2,702	22,847	**	115,645	28,705	1992
Nuiqsut	741.75	3,540	89,481	**	85,216	87,306	1993
Point Hope	*	*	*	*	*	*	*
Wainwright	751.24	**	10,035	**	179,573	60,686	1989
Point Lay	890.11	*	*	*	*	*	*

Source: ADFG 2012a

Notes: * = Not available in ADFG CSIS

** = Negligible



Source: ADFG 2012b

Note: Nome Census Area data represented by Wales, a whaling community.

Figure 3.3-1 Proportions of Major Subsistence Species Groups Harvested in Alaska Communities, by Census District and Pounds

3.3.5 Fisheries Research and Management

The primary species of fish, shellfish, and marine mammals harvested varies across the three AFSC research areas. Particular regions are often dependent on a few species. For example, Bristol Bay is highly dependent on commercial harvests of sockeye salmon, while Dutch Harbor/Unalaska is highly dependent on the commercial pollock and crab fisheries. Tax revenues are derived from commercial landings and sales, which benefit communities. Subsistence harvests, depending heavily on salmon in more southern areas and marine mammals in more northern areas, are of extreme importance in remote communities. Residents of many communities with non-diversified economies participate in both commercial and subsistence harvesting for their livelihood, especially in the Bristol Bay and Lake and Peninsula areas. Unemployment (as measured for a cash economy) runs very high in some communities. Subsistence activity runs very high in many of the same places (Table 3.3-4). Recreational fishing is more centered along the GOA coast because of easier transportation options for non-Alaska residents.

Ecological changes in the AFSC research areas occur in varying magnitudes, and affect fisheries and communities in different ways. Changes in sea ice cover, ocean temperatures, land snow cover, and coastal erosion have changed subsistence and commercial opportunities and practices. There have been substantial shifts in native hunting practices, subsistence activities, and the consumption of marine products on the Chukchi Peninsula during the last decade (Sherman and Hempel 2009). Climate change is having and is expected to have a profound influence on the socioeconomics of natural resources, goods, and services throughout Alaska (Sherman and Hempel 2009). The abundance and distribution of fish, marine mammals, and land mammals as well as reduced or altered access to these food resources due to changing ice and weather conditions are all critical factors in assessing future consequences for communities.

Changes that have typically occurred in the past have included (Knapp et al. 1998):

- harvest levels, and seasonal opportunity;
- regulations, and closures;
- fishing and processing employment, income, and profits;
- harvesting and processing costs, prices, and market share;
- fishing-related cash income, and availability of subsistence foods;
- boat, gear, permit and individual fishing quota (IFQ) values; and
- fisheries participation.

3.3.6 AFSC Operations

The AFSC's operations have a direct economic impact on the communities and ports in which they operate (see Section 1.2 for a description of AFSC research facilities in Alaska, Washington, and Oregon). Research-related spending directly generates jobs and income, and benefits businesses in the private economy by expenditures on research-related equipment, supplies, and services. The AFSC routinely charters research vessels, commercial fishing vessels, and NOAA vessels (so called white boats) to conduct various types of fisheries research, with fieldwork continuing throughout the year.

The AFSC's annual spending fluctuates, but federal funding was about $62.18M in fiscal year 2015 (AFSC Operations Management and Information Staff pers. comm. 2015). In addition, the AFSC periodically receives funding from other federal agencies and institutions to address special fisheries and ecosystem issues as needs arise. These funds support many research costs, including operational support of NOAA vessels and chartered vessels (fuel, supplies, services), operational costs of research support facilities (utilities, supplies, services), charter fees and operating costs for all vessels, salaries for federal and contractual staff participating in fisheries research, travel, and other incidental expenses. This does not include capital costs of vessels and facilities.

4.1 INTRODUCTION AND ANALYSIS METHODOLOGY

This chapter presents an analysis of the potential direct and indirect effects of the alternatives on the physical, biological, and social environments consistent with Section 1502.16 of the CEQ NEPA regulations (40 CFR Part 1500) and NAO 216-6A (Environmental Review Procedures for Implementing the National Environmental Policy Act). Four alternatives have been brought forward for detailed analysis (see Chapter 2):

- The No Action/Status Quo Alternative, where fisheries and ecosystem research programs conducted and funded by the AFSC would be performed as they were at the end of 2015. This is considered the No Action Alternative for ongoing programs under NEPA.
- The Preferred Alternative, where the AFSC would conduct some new research activities and implement new protocols intended to mitigate impacts to protected species in addition to those described under the Status Quo Alternative.
- The Modified Research Alternative, where the AFSC would conduct fisheries and ecosystem research with scope and protocols modified to minimize risks to protected species.
- The No Research Alternative, where the AFSC would no longer conduct or fund fieldwork in marine waters for the fisheries and ecosystem research considered in the scope of this FPEA.

In addition to a suite of fisheries and ecological research conducted or funded by the AFSC as the primary federal action, the second and third alternatives would also include promulgation of regulations and subsequent issuance of LOAs under Section 101(a)(5)(A) of the MMPA for the incidental, but not intentional, taking of marine mammals as the secondary federal action.

As was discussed in Chapter 1 of this FPEA, the NMFS is fundamentally a science-based agency, its primary mission being the stewardship of living marine resources through science-based management. The first three alternatives evaluated in this FPEA would enable the AFSC to collect additional scientific information that otherwise would not be fully replaced by other sources, while the fourth alternative (The No Research Alternative) would not enable the collection of such information. In NMFS view, the inability to acquire scientific information essential to managing fisheries on a sustainable basis and rebuilding overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and restore the nation's fishery resources. Similar concerns apply to the conservation and management of protected species, their habitats, and other marine ecosystem components. However, there are several plausible scenarios (such as federal budget cuts, legal actions against NMFS, or natural disasters affecting AFSC facilities) where the research activities of the AFSC could be severely curtailed or eliminated for a period of time. The No Research Alternative therefore allows NMFS to examine the effects on the human environment of discontinuing federally funded fisheries research in the AFSC research areas.

4.1.1 Impact Assessment Methodology

The authors of the sections in this chapter are subject matter experts. They developed a discussion of the effects on each resource component based on their best professional judgment; relying on the collective knowledge of other specialists in their respective fields and the body of accepted literature.

The impact assessment methodology consists of the following steps:

1. Review and understand the proposed action and alternatives (Chapter 2).
2. Identify and describe:

a. Direct effects that would be "caused by the action and occur at the same time and place" (40 CFR § 1508.8(a)), and

b. Indirect effects that would be "caused by the action and (would occur) later in time or farther removed in distance, but are still reasonably foreseeable" (40 CFR § 1508.8(b)).

c. Compare the impacts to the baseline conditions described in Chapter 3 and rate them as major, moderate, or minor. In order to help consistently assess impacts and support the conclusions reached, the authors developed a criteria table that defines impact ratings for the resource components (Table 4.1-1). The criteria provide guidance for the authors to place the impacts of the alternatives in an appropriate context, determine their level of intensity, and assess the likelihood that they would occur. Although some evaluation criteria have been designated based on legal or regulatory limits or requirements (see description of criteria for marine mammals below), others are based on best professional judgment and best management practices. The evaluation criteria include both quantitative and qualitative analyses, as appropriate to each resource. The authors then determine an overall rating of impacts to a given resource by combining the assessment of the impact components.

In developing this FPEA, NMFS adhered to the procedural requirements of NEPA; the Council on Environmental Quality (CEQ) regulations for implementing NEPA (40 Code of Federal Regulations (CFR) 1500-1508), and NOAA's procedures for implementing NEPA[11].

The following definitions will be used to characterize the nature of the various impacts evaluated with this FPEA:

- *Short-term or long-term impacts.* These characteristics are determined on a case-by-case basis and do not refer to any rigid time period. In general, short-term impacts are those that would occur only with respect to a particular activity or for a finite period. Long-term impacts are those that are more likely to be persistent and chronic.
- *Direct or indirect impacts.* A direct impact is caused by a proposed action and occurs contemporaneously at or near the location of the action. An indirect impact is caused by a proposed action and might occur later in time or be farther removed in distance but still be a reasonably foreseeable outcome of the action. For example, a direct impact of erosion on a stream might include sediment-laden waters in the vicinity of the action, whereas an indirect impact of the same erosion might lead to lack of spawning and result in lowered reproduction rates of indigenous fish downstream.
- *Minor, moderate, or major impacts.* These relative terms are used to characterize the magnitude of an impact. Minor impacts are generally those that might be perceptible but, in their context, are not amenable to measurement because of their relatively minor character. Moderate impacts are those that are more perceptible and, typically, more amenable to quantification or measurement. Major impacts are those that, in their context and due to their intensity (severity), have the potential to meet the thresholds for significance set forth in CEQ regulations (40 CFR 1508.27) and, thus, warrant heightened attention and examination for potential means for mitigation to fulfill the requirements of NEPA.
- *Adverse or beneficial impacts.* An adverse impact is one having adverse, unfavorable, or undesirable outcomes on the man-made or natural environment. A beneficial impact is one having positive outcomes on the man-made or natural environment. A single act might result in adverse impacts on one environmental resource and beneficial impacts on another resource.

[11] NOAA Administrative Order (NAO) NAO 216-6 A and the Companion Manual for NAO 216-6A.

- *Cumulative impacts.* CEQ regulations implementing NEPA define cumulative impacts as the "impacts on the environment which result from the incremental impact of the action when added to other past, present, and RFFAs regardless of what agency (federal or non-federal) or person undertakes such other actions." (40 CFR 1508.7) Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time within a geographic area.

The proposed AFSC research activities are not reasonably expected to result in the spread or introduction of non-indigenous species. The research involves movement of vessels between water bodies. However, ballast water management and other discharge processes for NOAA and charter vessel operations are bound by federal laws, regulations and EOs that are in place in order to prevent or minimize the potential for spread or introduction of non-indigenous species, including the Clean Water Act, National Invasive Species Act, Nonindigenous Aquatic Nuisance Prevention and Control Act, and EO13112. The AFSC has consulted the State Historic Preservation Office in order to identify fisheries research activities that may have a nexus with historic sites or archaeological resources. Based on the results of this consultation, the proposed activities are not expected to result in any impacts to underwater historical or archaeological resources within the U.S. EEZ. In addition, the proposed AFSC research activities are not expected to result in impacts to public health or safety. These issues are not considered further in this assessment.

If no significant impacts are discovered, NMFS can document its decision on the proposed action with a FONSI. The assessment methodology described in this section is consistent with NAO 216-6A, which provides guidance on how the agency should make determinations of significance in NEPA documents.

Table 4.1-1 Criteria for Determining Effect Levels

Resource Components	Assessment Factor	Effect Level		
		Major	**Moderate**	**Minor**
Physical Environment	**Magnitude or intensity**	Large, acute, or obvious changes that are easily quantified	Small but measurable changes	No measurable changes
	Geographic extent	> 10% of project area (widespread)	5-10% of project area (limited)	0-5% of project area (localized)
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible
Biological Environment	**Magnitude or intensity**	Measurably affects population trend For marine mammals, M&SI greater than or equal to 50% of PBR[1]	Population level effects may be measurable For marine mammals, M&SI between 10% and 50% of PBR	No measurable population change For marine mammals, M&SI less than or equal to 10% of PBR
	Geographic extent	Distributed across range of a population	Distributed across several areas identified to support vital life phase(s) of a population	Localized to one area identified to support vital life phase(s) of a population or non-vital areas
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible

Resource Components	Assessment Factor	Effect Level		
		Major	Moderate	Minor
Social and Economic Environment	Magnitude or intensity	Substantial contribution to changes in economic status of region or fishing communities	Small but measurable contribution to changes in economic status of region or fishing communities	No measurable contribution to changes in economic status of region or fishing communities
	Geographic extent	Affects region (multiple states)	Affects state	Affects local area
	Frequency and duration	Chronic or constant and lasting up to several months or years (long-term)	Periodic or intermittent and lasting from several weeks to months (intermediate)	Occasional or rare and lasting less than a few weeks (short-term)
	Likelihood	Certain	Probable	Possible

1. Potential Biological Removal (PBR).

4.1.2 Impact Criteria for Marine Mammals

The impact criteria for the magnitude of effects on marine mammals have been developed in the context of two important factors derived from the MMPA. The first factor is the calculation of PBR for each marine mammal stock. The MMPA defined PBR at 16 U.S.C. § 1362(20) as, "the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its OSP." PBR was intended to serve as an upper limit guideline for anthropogenic mortality for each species. Calculations of PBR are stock-specific and include estimates of the minimum population size, reproductive potential of the species, and a recovery factor related to the conservation status of the stock (e.g., whether the stock is listed under the ESA or depleted under the MMPA). NMFS and USFWS are required to calculate PBR (if possible) for each stock of marine mammals they have jurisdiction over and to report PBR in the annual marine mammal stock assessment reports (SARs) mandated by the MMPA. The PBR metric has been used extensively to assess human impacts on marine mammals in many commercial fisheries involving M&SI and is a recognized and acceptable metric used by NMFS OPR in the evaluation of commercial fisheries incidental takes of marine mammals in U.S. waters as well as for other sources of mortality such as ship strikes.

The second factor is the categorization of commercial fisheries with respect to their adverse interactions with marine mammals. Under Section 118 of the MMPA, NMFS must classify all U.S. commercial fisheries into one of three categories based on the level of marine mammal M&SI that occurs incidental to each fishery, which it does in the List of Fisheries (LOF) published annually. Category III fisheries are considered to have a remote likelihood of or no known incidental M&SI of marine mammals. Category II fisheries are those that have occasional incidental M&SI of marine mammals. Category I fisheries are those that have frequent incidental M&SI of marine mammals. A two-tiered classification system is used to develop the LOF, with different thresholds of incidental M&SI compared to the PBR of a given marine mammal stock.

However, the LOF criteria is primarily used for managing commercial fisheries based on their actual levels of marine mammal M&SI and is not necessarily designed to assess impacts of projected takes on a given marine mammal stock. Because the analysis of direct impacts of AFSC fisheries research on marine mammals in this FPEA is based on projected takes rather than actual takes, we use a similar but not identical model to the LOF criteria.

In spite of some fundamental differences between most AFSC fisheries research activities and commercial fishing practices, it is appropriate under NEPA to assess the impacts of incidental takes due to research in a manner similar to what is done for commercial fisheries for two reasons:

- AFSC fisheries research activities are similar to many commercial fisheries in the fishing gear and types of vessels used, and
- AFSC fisheries research plays a key role in supporting commercial fisheries.

As part of the NEPA impact assessment criteria (Table 4.1-1), if the estimated annual average M&SI of a marine mammal stock from all AFSC fisheries research activities is less than or equal to 10 percent of PBR for that stock, the effect would be considered minor in magnitude for the marine mammal stock, similar to the LOF's Category III fisheries that have a remote likelihood of M&SI with marine mammals with no measurable population change. Projected annual M&SI from AFSC fisheries research activities between 10 and 50 percent of PBR for that stock would be moderate in magnitude for the marine mammal stock, similar to the LOF's Category II fisheries that have occasional M&SI with marine mammals where population effects may be measurable. Projected annual M&SI from AFSC fisheries research activities greater than or equal to 50 percent of PBR would be major in magnitude for the marine mammal stock, similar to the LOF's Category I fisheries that have frequent M&SI with marine mammals which measurably affect a marine mammal stock's population trend. Note that NEPA requires several other components to be considered for impact assessments (see Table 4.1-1); the magnitude of impact is not necessarily the same as the overall impact assessment in a NEPA context.

In the MMPA LOA application, AFSC estimated takes for each marine mammal stock are grouped by gear type (i.e., trawl gear and longline gear) with the resulting take request not apportioned by individual research activities (e.g., by survey). This precludes impact analysis at the individual activity or project level within the FPEA.

NMFS recognizes that more than one of its regional Fisheries Science Centers may interact with the same stock of marine mammals in the Pacific, namely the Northwest Fisheries Science Center (NWFSC), Southwest Fisheries Science Center (SWFSC),and Pacific Islands Fisheries Science Center (PIFSC), and that the collective impact from all of these FSCs on marine mammal stocks should be considered. The SWFSC and NWFSC have completed their own NEPA and MMPA compliance processes while the PIFSC are currently working on their own NEPA and MMPA compliance processes. Historical data on incidental takes from the other FSCs and their estimated takes from their LOA applications will be considered along with the contribution of the AFSC in the Cumulative Effects section of this FPEA (Chapter 5). NMFS does not anticipate incidental takes from other Pacific FSC research activities to substantially increase the aggregate impacts on marine mammal stocks shared with the AFSC.

The contribution of AFSC research activities to overall impacts on marine mammals will be aggregated with past, present, and reasonably foreseeable future impacts on marine mammals from commercial fisheries and other factors external to AFSC research activities in the Cumulative Effects analysis in Chapter 5. NMFS will report all sources of M&SI in the annual marine mammal SARs, including any incidental M&SI takes that may occur from any of the FSCs. The cumulative effects analysis will use the same impact assessment criteria and thresholds as described in Table 4.1-1, only they will be applied to collective sources of M&SI and other types of impacts on marine mammals.

4.2 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 1 – NO ACTION/STATUS QUO ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 1 – the No Action/Status Quo Alternative on the physical, biological, and social environment. Under this Alternative, fisheries research programs conducted and funded by the AFSC would be performed as they have been over the previous five years. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 1 is presented below in Table 4.2-1.

Table 4.2-1 Alternative 1 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
SECTION #	**4.2.1**	**4.2.2**	**4.2.3**	**4.2.4**	**4.2.5**	**4.2.6**	**4.2.7**	**4.2.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.2.1 Effects on the Physical Environment

The AFSC conducts research in three distinct areas, the Gulf of Alaska Research Area (GOARA), Bering Sea- Aleutian Islands Research Area (BSAIRA), and the Chukchi Sea-Beaufort Sea Research Area (CSBSRA). This section describes effects on the physical environment that would result from SWFSC research activities in these three areas under Alternative 1. These potential effects would generally include:

- Physical damage to benthic (seafloor) habitat
- Changes in water quality

Refer to Appendix A for a detailed description of the AFSC research vessels and survey gear specifications.

4.2.1.1 Physical Damage to Benthic (Seafloor) Habitat

The primary mechanism for physical impacts to seafloor habitat from AFSC research proposed under the Status Quo Alternative involves bottom-contact gear associated with surveys in each of the three research areas. Fishing gear that is towed across the seafloor, such as bottom trawls and dredges, are primarily responsible for impacts to seafloor habitat, although stationary gear such as pot gear and bottom longlines can also have impacts (Barnette 2001). All of these gear types have historically been used in AFSC research, however, trawls compose the vast majority of bottom-contact research effort (Table 2.2-1).

Physical damage from bottom trawls can result in smooth-centered furrows on the seafloor (Schwinghamer et al. 1998, Kaiser et al. 2002). The displacement of rocks and boulders can also occur (Malik and Mayer 2007), and such damage can increase with multiple contacts in the same area (NRC 2002). Further, the effects of bottom contact gear differ in each type of benthic environment. In sandy habitats with “high energy” water movement for example, the furrows created by mobile bottom contact gear quickly begin to erode because lighter weight sand at the edges of furrows can be easily moved by water back towards the center of the furrow (NRC 2002). Duration of effects in these environments therefore tend to be very short because the terrain and associated organisms are accustomed to natural disturbance. By contrast, the physical features of more stable hard bottom habitats are less susceptible to disturbance, but once damaged or removed by fishing gear, the organisms that grow on gravel, cobbles, and boulders can take years to recover, especially in deeper water where there is less natural disturbance (NRC 2002). This is discussed further in Section 4.2.7, the Effects on Invertebrates.

Physical damage to the seafloor caused by fishing gear can last for months or even years. Furrows created by trawl doors are up to 10 cm deep in mud, with berms 10-20 cm along the edges, and 2 cm deep with a 5.5 cm berm in sand (Stevenson et al. 2004). Door tracks can last for months or for more than a year in muddy habitats or in deeper sandy habitats, but only for days in shallow sandy areas. Trawls and dredges also smooth out rough bottom, removing high habitat features and filling in depressions. Studies have shown that recovery of seafloor topography can take six months to a year depending on sediment type and the degree of natural disturbance (Stevenson et al. 2004). Physical features in sandy and muddy habitats generally recover more quickly in shallower, more dynamic environments than in deeper, less disturbed areas (NRC 2002). Recovery times in gravel and more complex rocky habitats do not vary as much with depth because the substrate is more stable and less affected by natural disturbance. In areas that are rarely trawled or dredged - such as areas that have been closed to commercial fishing with bottom contact gear for years – the impacts of even a single tow can be pronounced, but limited to the immediate area swept by the gear. By contrast, commercial trawling grounds, where much larger areas may be towed repeatedly are susceptible to more acute and prolonged impacts because there is limited opportunity for habitat features to recover (NRC 2002).

Seafloor composition is highly variable both within and between the AFSC research areas. Silt, sand, clay, and gravel are abundant at particular sites within each research area. With the exception of rock and boulder displacement, any physical impacts to benthic habitat resulting from AFSC survey activities would be expected to recover within 18 months. Bottom-contact trawl gear can also increase turbidity and alter the chemical composition of water near the seafloor. However, these effects would be short-term, minor in magnitude, and limited in regional extent, as the resuspended material responsible for increases in turbidity and changes in the chemical composition of the water near the sea floor would settle out of solution over timescales of hours following the disturbance by bottom contact equipment.

Estimating impacts to the physical environment is difficult. As discussed above, some terrain recovers more quickly, while other terrain recovers more slowly. Annual bottom trawl effort under the Status Quo Alternative varies from year to year, depending on what schedule a survey is on (annual, biennial, etc.); not all surveys are deployed every year. Individual survey variables such as tow time, tow speed and footrope width (from Table 2.2-1) can be used to estimate the area affected by bottom-contact parts of the net, although the actual areas of trawl door spreads and deployed net configuration varies somewhat with environmental conditions. The subsequent discussion take a maximum-impact approach by assuming that all bottom trawl surveys occur each year and that the maximum number of intended trawls are actually conducted; both assumptions overestimate likely impacts in any given year. A summary of impacts is discussed below and shown in Table 4.2-2.

Under the Status Quo Alternative, surveys in the GOARA using bottom trawl gear that would potentially impact benthic habitat include Acoustic Assessment of Snakehead Bank, Acoustic Trawl Rockfish Study, ADFG Large-mesh Trawl Survey of Gulf of Alaska and Eastern Aleutian Islands, ADFG Small-mesh Shrimp and Forage Fish Survey, Conservation Engineering experimental surveys, EcoFOCI/ EMA Age-1 Walleye Pollock Assessment Survey and Ecosystem Observations, Gulf of Alaska Biennial Shelf and Slope bottom Trawl Groundfish Survey, summer and winter Pollock Acoustic Trawl surveys, Rockfish Habitat Studies/Reproduction of Groundfish, Rockfish Reproduction Charters, and Sablefish Maturity Study. The maximum total area of benthic habitat potentially affected by AFSC survey activities in the GOARA in a single year under the Status Quo Alternative would be up to 37.68 square miles, representing less than 0.01 percent of the total research area.

Within the BSAIRA, a number of research surveys would involve bottom trawl equipment that could potentially impact seafloor habitat. These include the Aleutian Islands Biennial Shelf and Slope Bottom Trawl Groundfish Survey, Aleutian Islands Bottom Trawl Survey Atka Mackerel Tag Movement and Abundance in the Aleutian Islands, Bering Sea Shelf Bottom Trawl Survey, Conservation Engineering surveys, Eastern Bering Sea Upper Continental Slope Trawl Survey Summer, EcoFOCI/ EMA Age-1 Walleye Pollock Assessment Survey, and the summer and winter Pollock Acoustic Trawl surveys. Some of these surveys are only deployed every few years, but the maximum total area of benthic habitat potentially affected by AFSC survey activities in the BSAIRA in any one year would be up to 73.73 square miles, representing less than 0.01 percent of the total research area.

In the CSBSRA, AFSC would conduct bottom trawl operations associated with the Arctic Coastal Ecosystem Surveys (ACES) and the Chukchi Sea Bottom Trawl Survey. ACES are conducted annually in both the Chukchi Sea and Beaufort Sea and would result in approximately .03 square miles of bottom disturbance. The Chukchi Sea Bottom Trawl Survey, although not deployed every year, would result in the disturbance of approximately 2.69 square miles of benthic habitat within the Chukchi Sea in any single year. Thus, if all bottom-contact trawl surveys in the CSBSRA were deployed ever year, they would impact approximately 2.72 square miles of bottom habitat, representing about 0.001 percent of the total size of the CSBSRA.

Table 4.2-2 Area of Seafloor Affected by AFSC Bottom Trawls by Research Area

Values represent data from all bottom trawl surveys presented in Table 2.2-1. Not all surveys occur every year but for a maximum-impact analysis, the values represent a given year in which all surveys are deployed at maximum levels.

Research Area	Maximum Number of Bottom Trawls	Estimated Total Area Affected by Bottom Trawls (mi^2)	Total Size of Research Area (mi^2)	Percent of Research Area Affected
GOARA	1691	37.68	461,387	0.008%
BSAIRA	1279	73.73	860,184	0.009%
CSBSRA	207	2.72	197,724	0.001%
Totals	**3177**	**114.08**	**1,519,295**	**0.008%**

As discussed above, impacts to all research areas resulting from individual gear deployment events would be localized and limited to the small areas where research equipment contacts the sea floor. These small areas of impact would be scattered through large parts of each research area (precluding impacts related to multiple deployments in close proximity or in the same area from different surveys). Thus, the magnitude and geographic extent of physical impacts to benthic habitats may be considered minor according to the impact assessment criteria shown in Table 4.1-1. In most instances, the duration of impacts would be considered short-term, as the condition of the resource would be expected to return to the pre-activity condition within several months after the completion of bottom-contact survey activity at a given location.

Under the Status Quo Alternative, the overall area of benthic habitat affected by AFSC research each year would be a very small fraction (less than 0.01 percent) of the total of all research areas. Direct and indirect effects would be localized, short-term in duration, and result in minor changes to seafloor habitat. Considering the small area affected and the limited magnitude of the physical effects, the overall effects of surveys on benthic habitat in the AFSC research areas would be minor adverse.

4.2.1.2 Changes in Water Quality

Fishing gear that contacts the seafloor could increase the turbidity of the water by resuspending fine sediments and benthic algae from the seafloor. Resuspension of fine sediments and turnover of sediment could also result in localized increases in the concentrations of dissolved organic material, nutrients, and trace metals in seawater near the seafloor (Stevenson et al. 2004). As discussed above, the direct impacts resulting from bottom-contact survey activities in the AFSC research areas would be short-term, minor in magnitude, and limited in geographic extent, as the resuspended material responsible for increases in turbidity and changes in the composition of the water near the sea floor would settle out of solution over timescales of hours following the disturbance by bottom contact equipment.

In addition, potentially adverse effects resulting from discharge of contaminants from vessels used during research surveys are possible, but unlikely. If such effects were to occur, they would be infrequent, temporary, and localized. All NOAA and ocean going vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010a). MARPOL includes six Annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (International Maritime Organization IMO 2010). Adherence to these regulations minimizes or eliminates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). NOAA vessels and vessels contracted for the performance of AFSC fisheries and ecosystem research activities are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills and increase the chance that they will be managed and contained quickly. Oil spill prevention training and equipment may be more variable on small boats and contracted fishing vessels used in research, although all vessels are required to comply with USCG regulations on spills. Potential effects on the physical environment resulting from discharged or spilled materials are not gear type dependent and would be negligible to minor throughout the AFSC research areas.

4.2.1.3 Conclusion

The effects of the Status Quo Alternative on the physical environment include potential changes to benthic habitat and changes in water quality near the seafloor. The geographic extent of any physical impacts to benthic habitats caused by AFSC fisheries research activities would be limited to much less than 0.01 percent of the total area of each of the research areas. Effects would persist to some degree but in general, physical damage to the seafloor would recover within several months. Adverse effects on water quality through accidental contamination from research activities are possible, but unlikely. If such effects were to occur, their intensity, extent, duration, and frequency would be minor. Other effects on water quality could result from the temporary resuspension of sediments and benthic algae; such impacts would be minor in magnitude, temporary in duration, and would be limited to areas near the seafloor. The overall impacts of AFSC fisheries and ecosystem research activities on the physical environment under the Status Quo Alternative would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.2.2 Effects on Special Resource Areas and EFH

Section 3.1.2 describes the special resource areas that occur in the same geographic areas as AFSC fishery research activities. This section describes the general types of effects that AFSC fishery research activities may have on the following categories of special resource areas:

- EFH and Habitat Areas of Particular Concern (HAPC)
- Closed Areas

- Marine Protected Areas (MPAs)

4.2.2.1 EFH and HAPC

Section 3.1.2.1 describes the areas designated as EFH and HAPC within AFSC research areas. EFH applies to federally managed marine species in both state and federal jurisdictional waters throughout the range of the species within U.S. waters. Where a species' range extends beyond U.S. waters, EFH stops at the boundary. EFH includes hard bottom structures underlying the waters and associated biological communities. These biological communities include algae, corals, and other sessile invertebrates. Effects on these biological communities under the Status Quo Alternative are evaluated in Section 4.2.7. HAPC are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. The NPFMC has designated several HAPC in the GOARA and BSAIRA; none have been designated in the CSBSRA (see Section 3.1.2.2). HAPC include HCA, areas where fishing restrictions are implemented for the purposes of habitat conservation, Habitat Protection Areas, and Habitat Conservation Zones. Figure 3.1-7, Figure 3.1-8 and Table 3.1-2 summarize the EFH and HAPC designations within each research area.

Overlapping EFH for numerous federally-managed species covers almost all areas where AFSC research occurs. EFH is designated for over 30 groundfish species or species groups within the GOARA, BSAIRA, and CSBSRA (NPFMC 2015a, 2014a, 2009); all five salmon species in the EEZ off Alaska (NPFMC 2012); king and Tanner crab in the BSAI and snow crab in the Arctic (NPFMC 2011, 2009); and scallop in the GOA and BSAI (NPFMC 2014b).

Bottom contact fishing gear can disrupt bottom-dwelling organisms, alter physical characteristics of the seafloor, increase turbidity, and alter the geochemistry in the water column around the trawl. These effects can occur in any location or environment where bottom fishing occurs and impacts to EFH and HAPC are therefore substantially similar to impacts to the overall physical environment (Section 4.2.1). The information presented in the following analysis is consequently related to that discussion.

The analyses below evaluate the impact on EFH and HAPC by assessing the total affected area of bottom-contact fishing gear within each research area and designated EFH. NMFS is in the process of developing a model to allow for a more thorough and detailed assessment of impacts to EFH which includes modeling effects based on sediment type, habitat features, and recovery and impact dynamics. The model may be applied to AFSC fisheries research efforts in the future when its development is completed.

<u>Gulf of Alaska Research Area</u>

The types of effects on EFH and HAPC resulting from AFSC research in the GOARA primarily involve impacts to benthic habitat and the removal of fish and invertebrates during a number of research surveys that include bottom trawling. These include Acoustic Assessment of Snakehead Bank; Acoustic Trawl Rockfish Study; ADFG Large-mesh Trawl Survey of Gulf of Alaska and Eastern Aleutian Islands; ADFG Small-mesh Shrimp and Forage Fish Survey; Ecosystems & Fisheries-Oceanography Coordinated Investigations / Ecosystem Monitoring and Assessment Program (EcoFOCI/EMA) Age-1 Walleye Pollock Assessment Survey and Ecosystem Observations; Gulf of Alaska Biennial Shelf and Slope bottom Trawl Groundfish Survey; Pollock Summer and Winter Acoustic trawl surveys (Shelikof Strait, Shumagin/Sanak Islands); Rockfish Habitat Studies/Reproduction of Groundfish; Rockfish Reproduction Charters; Sablefish Maturity Study; Seasonal Distribution and Habitat Use of Managed Fish Species in Upper Cook Inlet; and the Conservation Engineering experimental surveys. Not all of these surveys occur every year but for a maximum-impact analysis, the values discussed below presume all are deployed at maximum levels (as shown in Table 2.2-1) during a given year. Table 4.2-3 provides a summary of major survey efforts with the total bottom area affected in the GOARA.

Table 4.2-3 Maximum Annual Area of EFH Bottom Affected by AFSC Bottom Trawl Surveys Conducted in the GOARA

Survey	Maximum Number of Tows Per Survey Season	Tow Speed (knots)	Tow Duration (mins)	Footrope Length (ft)	Estimated Bottom Area Affected (mi^2)
Acoustic Assessment of Snakehead Bank	6	3	15	81.6	0.08
Acoustic Trawl Rockfish Study	59	3	10	81.6	0.52
Gulf of Alaska Biennial Shelf and Slope bottom Trawl Groundfish Survey	884	3	15	81.6	11.79
ADFG Large-mesh Survey	380	2.6	25	40	3.58
ADFG Small-mesh Survey	150	2	30	61	1.99
EcoFOCI/ EMA Age-1 Walleye Pollock Assessment Survey and Ecosystem Observations	50	5	20	81.6	1.48
Pollock Acoustic Trawl Surveys	40	3	20	81.6	0.71
Rockfish Habitat Studies/Reproduction of Groundfish	8	3	10	81.6	0.07
Rockfish Reproduction Charters	8	3	45	81.6	0.32
Sablefish Maturity Study	41	3	30	122	1.64
Seasonal Distribution and Habitat of Fish in Cook Inlet	25	3	5	3.7	0.05
Conservation Engineering	40	3.5	405	75	15.45
Total Estimated Area Affected by Bottom Trawl Surveys (mi^2)					**37.68**
Total GOARA Area (mi^2)					**461,387**
% of GOARA Affected By AFSC Research Bottom Trawls					**0.008%**

Other surveys use a variety of techniques and gear. Near-surface and mid-water trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment, would result in temporary disturbance and displacement of pelagic species and habitats (i.e., lasting seconds or minutes). The magnitude of such impacts would be minor because the effects would not result in noticeable changes to the environment.

As discussed in Section 4.2.1.1, the effects of AFSC fisheries research bottom trawling are likely to be short-term and localized. Total area affected in a given year may be up to 37.7 square miles but is typically less because this analysis assumes that all surveys are conducted in a given year; that patterns of contact are consistent along the breadth of a given tow; and that recovery rates are consistent between different gear designs and different bottom types. Given the short duration and small swept area of AFSC research bottom trawls (less than 0.01 percent of the GOARA) and the small removals of fish and invertebrates of all surveys in the GOARA (Section 4.2.3 and Section 4.2.7), the impacts of AFSC research on EFH and HAPC are considered small in magnitude, temporary or short-term in duration, and widely dispersed over a large area within the GOARA. The overall effect of AFSC research on EFH and HAPC is therefore considered minor adverse under the Status Quo Alternative according to the impact criteria listed in Table 4.1-1.

Regulations require that effects on EFH from research or other activities associated with implementing FMPs should be considered identifiable, not more than minimal or temporary, and minimized to the extent practicable [50 CFR 600.815(a)(2)(ii)]. AFSC fisheries and ecosystem research fulfills these requirements, and its role as a stock and habitat assessment tool contributes to the capacity of resource managers to understand and monitor the status of EHF in the GOARA for various species and therefore has beneficial effects on EFH management decisions.

Bering Sea/Aleutian Islands Research Area

The types of effects on EFH and HAPC resulting from AFSC research in the BSAIRA primarily involve impacts to benthic habitat and the removal of fish and invertebrates during a number of research surveys that include bottom trawling. These include the Aleutian Islands Biennial Shelf and Slope, Bering Sea Shelf, and Eastern Bering Sea Upper Continental Slope groundfish trawl surveys; the Atka Mackerel Tag Movement and Abundance in the Aleutian Islands survey; the EcoFOCI/EMA Age-1 Walleye Pollock Assessment and Ecosystem Observations survey; the Pollock Summer and Winter acoustic trawl surveys; and the Conservation Engineering experimental surveys. Not all of these surveys occur every year but for a maximum-impact analysis, the values discussed below presume all are deployed at maximum levels (as shown in Table 2.2-1) during a given year. Table 4.2-4 provides a summary of major survey efforts with the total bottom area affected in the BSAIRA.

Table 4.2-4 Maximum Annual Area of EFH Bottom Affected by AFSC Bottom Trawl Surveys Conducted in the BSAIRA

Survey	Maximum Number of Tows Per Survey Season	Tow Speed (kts)	Tow Duration (mins)	Footrope Length (ft)	Estimated Bottom Area Affected (mi^2)
Aleutian Islands Biennial Shelf and Slope Bottom Trawl Groundfish	450	3	15	78.7	5.8
Bering Sea Shelf Bottom Trawl	376	3	30	112	13.77
Eastern Bering Sea Upper Continental Slope Trawl	200	2.5	30	100	5.45
Atka Mackerel Tag Movement and Abundance in the Aleutian Islands	88	3	90	130	11.22
EcoFOCI/EMA Age-1 Walleye Pollock Assessment and Ecosystem Observations	50	5	20	100	1.82
Pollock Acoustic Trawl Survey – Bering Sea	15	3	20	112	0.37
Pollock Acoustic Trawl Survey – Bogoslof Island	10	3	20	81.6	0.18
Conservation Engineering	90	3.5	390	78.7	35.12
TOTAL Estimated Area Affected by Bottom Trawl Surveys (mi^2)					**73.73**

Survey	Maximum Number of Tows Per Survey Season	Tow Speed (kts)	Tow Duration (mins)	Footrope Length (ft)	Estimated Bottom Area Affected (mi^2)
TOTAL BSAIRA Area (mi^2)					**860,184**
% of BSAIRA Affected By AFSC Research Bottom Trawls					**0.009%**

Other surveys use a variety of techniques and gear. Near-surface and mid-water trawl gear, as well as various plankton nets, water sampling devices, and acoustic survey equipment, would result in temporary disturbance and displacement of pelagic species and habitats (i.e., lasting seconds or minutes). The magnitude of such impacts would be minor because the effects would not result in noticeable changes to the environment.

As discussed in Section 4.2.1.1, the effects of bottom trawling are temporary or short-term and localized. Total area affected in a given year may be up to 73.7 square miles but is typically less because this analysis assumes all surveys are conducted in a given year. Given the short duration and small swept area of AFSC research bottom trawls (less than 0.01% of the BSAIRA), and the small removals of fish and invertebrates of all surveys in the BSAIRA (Section 4.2.3 and Section 4.2.7), the impacts of AFSC research on EFH and HAPC are considered small in magnitude, temporary or short-term in duration, and widely dispersed over a large area within the BSAI Research Area. The overall effect of AFSC research on EFH and HAPC is therefore considered minor adverse under the Status Quo Alternative according to the impact criteria listed in Table 4.1-1.

Regulations require that effects on EFH from research or other activities associated with implementing FMPs should be considered identifiable, not more than minimal or temporary, and minimized to the extent practicable [50 CFR 600.815(a)(2)(ii)]. AFSC fisheries and ecosystem research fulfills these requirements, and its role as a stock and habitat assessment tool contributes to the capacity of resource managers to understand and monitor the status of EHF in the BSAIRA for various species and therefore has beneficial effects on EFH management decisions.

Chukchi Sea/Beaufort Sea Research Area

The types of effects on EFH resulting from AFSC research in the CSBSRA primarily involve impacts to benthic habitat and the removal of fish and invertebrates while bottom trawling during the ACES and the Chukchi Sea Bottom Trawl Survey. Table 4.2-5 provides a summary of these efforts with the total bottom area affected in the CSBSRA.

Table 4.2-5 Maximum Annual Area of EFH Bottom Affected by AFSC Bottom Trawl Surveys Conducted in the CSBSRA

Survey	Maximum Number of Tows Per Survey Season	Tow Speed (kts)	Tow Duration (mins)	Footrope Length (ft)	Estimated Bottom Area Affected (mi^2)
Arctic Coastal Ecosystem Surveys (ACES)	24	3	30	4	0.03
Chukchi Sea Bottom Trawl Survey	143	3	15	112	2.62

Survey	Maximum Number of Tows Per Survey Season	Tow Speed (kts)	Tow Duration (mins)	Footrope Length (ft)	Estimated Bottom Area Affected (mi^2)
Chukchi Sea Bottom Trawl Survey	40	1.5	3	112	0.07
Total Estimated Area Affected by Bottom Trawl Surveys (mi^2)					**2.72**
Total CSBSRA Area (mi^2)					**197,724**
% of CSBSRA Affected By AFSC Research Bottom Trawls					**0.001%**

As discussed in the GOARA section, the effects of AFSC fisheries research bottom trawling in the CSBSRA are likely to be temporary or short-term and localized. Assuming both surveys occurred each year and deployed at maximum levels (based on Table 2.2-1), 2.72 square miles of bottom would be affected. Given the small number of surveys in the Chukchi Sea/Beaufort Sea Research Area, the short duration and small swept area of AFSC research bottom trawls, and the small removals of fish and invertebrates of all surveys in the CSBSRA (Section 4.2.3 and Section 4.2.7), the impacts of AFSC research are considered small in magnitude, temporary or short-term in duration, and widely dispersed over a large area within the CSBSRA. The overall effect of AFSC research on EFH and HAPC is therefore considered minor adverse under the Status Quo Alternative according to the impact criteria listed in Table 4.1-1 and EFH consultation requirements.

Regulations require that effects on EFH from research or other activities associated with implementing FMPs should be considered identifiable, not more than minimal or temporary, and minimized to the extent practicable [50 CFR 600.815(a)(2)(ii)]. AFSC fisheries and ecosystem research fulfills these requirements, and its role as a stock and habitat assessment tool contributes to the capacity of resource managers to understand and monitor the status of EHF in the CSBSRA for various species and therefore has beneficial effects on EFH management decisions.

<u>Conclusion for EFH and HAPC</u>

An analysis of commercial fishing in Alaska on EFH (NMFS 2005a) determined that, while disturbance to habitat exists, the (then) current level of commercial fishing was not enough to cause significant detriment to EFH. Additionally, the ability of EFH to protect populations of managed fish species would not be affected over the long term. A subsequent 5-year review (NPFMC 2012b) determined that, while updates to EFH descriptions were necessary for several species, no change in conclusions from NMFS 2005a was warranted). In order for AFSC research to not significantly affect EFH, effects on EFH from research activities should be not more than minimal or temporary in nature; be considered identifiable; and to have been minimized to the greatest extent practicable (50 CFR 600.815(a)(2)(ii). Based on these mandates and the above assessment of effects of Alaska commercial fisheries on EFH, AFSC research is not expected to significantly affect EFH.

When analyzing the potential impact of gear types, survey techniques, and mitigation measures described under the Status Quo Alternative, the overall effect of all survey activities on EFH and HAPC in AFSC research areas would be minor in magnitude, temporary or short-term in duration, and dispersed over huge geographical areas and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1. AFSC fisheries and ecosystem research would also have beneficial effects on EFH and HAPC through its contribution to knowledge about these resources in the three research areas.

4.2.2.2 Closed Areas

There are several areas closed to fishing, with some closures specific only to trawl gear (see Table 3.1-3 and Figure 3.1-9 in Section 3.1.2.3). Closed areas vary in the level and type of restrictions or regulations to fisheries management. Considering the wide range of fishery goals and varying degrees of management associated with individual closed areas in the AFSC Research Areas, assessing impacts of AFSC research activities is impractical on a case-by-case basis. Locations of randomized sampling sites vary from year to year, and impacts of research surveys within particular closed areas would vary substantially over space and time. In general, the impacts to each of the closed areas are a subset of the impacts to specific physical, biological, and socioeconomic resources that are addressed in the resource-specific sections of this FPEA. For all of these resources, overall impacts from AFSC research are considered minor adverse under the Status Quo Alternative and therefore also considered minor adverse for these subregions.

In addition to potentially minor adverse impacts on closed areas through capture of marine organisms, disturbance of benthic habitats, and potentially reduced utility as a reference area for comparisons with open areas, AFSC research activities have beneficial contributions to closed areas by providing ecological information related to the science-based management, conservation, and protection of living marine resources within these areas. The information developed from AFSC fisheries and ecosystem research activities is used to develop a broad array of fisheries, habitat, and ecosystem management actions taken by NMFS, as well as other federal and state authorities.

4.2.2.3 Marine Protected Areas

Section 3.1.2.4 describes MPAs within the AFSC research areas. There are 65 MPAs within the GOARA and BSAIRA, and none in the CSBSRA. MPAs encompass a large portion of the area where research surveys are conducted in the BSAI and GOA. They include state MPAs, National Wildlife Refuges, National Parks, National Estuarine Research Reserves, and NOAA Fisheries MPAs. There is one National Marine Reserve in Alaska, the Sitka Pinnacles Marine Reserve in Southeast Alaska, near Sitka, AK, within the GOARA. MPAs vary widely in the level and type of legal protection afforded to the site's natural and cultural resources and ecological processes. Considering the wide range of conservation goals and varying degrees of legal protection associated with individual MPAs in the AFSC Research Areas, assessing impacts of AFSC research activities is impractical on a case-by-case basis. Locations of randomized sampling sites vary from year to year, and impacts of research surveys within particular MPAs would vary substantially over space and time. In general, the impacts to each of the MPAs are a subset of the impacts to specific physical, biological, and socioeconomic resources that are addressed in the resource specific sections of this FPEA. For all of these resources, overall impacts from AFSC research are considered minor adverse under the Status Quo Alternative and therefore also considered minor adverse for these subregions.

In addition to potentially minor adverse impacts on MPAs through capture of marine organisms and disturbance of benthic habitats, AFSC research activities have beneficial contributions to MPAs by providing ecological information related to the science-based management, conservation, and protection of living marine resources within these areas. The information developed from AFSC research activities is used to develop a broad array of fisheries, habitat, and ecosystem management actions taken by NMFS, as well as other federal and state authorities.

4.2.2.4 Conclusion

Special resource areas within the AFSC research areas include EFH, HAPC, closed areas, and MPAs. Impacts from AFSC fisheries and ecosystem research under the Status Quo Alternative include effects on the physical environment as well as biological components. The analysis of effects on these general components (Section 4.2.1 for the physical environment and Sections 4.2.3-4.2.7 for the biological components) are reflected in the analysis for the special resource areas. The magnitude of effects on benthic habitats is relatively small and such effects would be temporary or short-term in duration. The removal of fish and invertebrates during research is also relatively small in magnitude and dispersed over time and space and unlikely to affect the populations of any species. The analysis of research impacts within the MPAs is consistent with the relatively small and temporary or short-term effects described in general. The overall effects on special resource areas under the Status Quo Alternative would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria listed in Table 4.1-1. In contrast to these adverse effects, the scientific data generated from AFSC research activities within special resource areas could contribute to beneficial effects on these areas and resources therein through their contribution to marine ecosystem knowledge and science-based conservation management practices.

4.2.3 Effects on Fish

This section describes the types of effects of the Status Quo Alternative on fish species in the AFSC research areas (Section 3.2.1). The potential effects of research vessels, survey gear, and other associated equipment on fish are generally similar among the three AFSC research areas, and include:

- Mortality from fisheries research activities
- Disturbance and changes in behavior
- Contamination from discharges

4.2.3.1 Mortality from Fisheries Research Activities

Direct mortality of fish occurs as a result of various AFSC fisheries research activities. Fish are caught in a variety of gear types, some of which involve experimental tests of fishing gear and equipment designed to reduce incidental catch of non-target species or protected species. These surveys provide important data to determine biomass estimates, reproductive potential, and distribution of fish stocks, which are necessary for fisheries managers to maintain healthy populations and rebuild overfished or depressed stocks. The AFSC also conducts surveys to provide indices of juvenile abundance that are used to identify and characterize the strength of year classes before fish are large enough to be harvested by commercial or recreational fisheries. Stock assessments based on accurate abundance and distribution data are essential to developing effective management strategies.

The majority of fish affected by AFSC research projects are caught and killed during these annual surveys:

- Bering Sea Shelf Bottom Trawl Survey (BSAIRA)
- Aleutian Islands Biennial Shelf and Slope Bottom Trawl Groundfish Survey (BSAIRA)
- Alaska Longline Survey (GOARA and BSAIRA)
- Gulf of Alaska Biennial Shelf and Slope Bottom Trawl Groundfish Survey (GOARA)
- ADFG Large-mesh Trawl Survey of Gulf of Alaska and Eastern Aleutian Islands (GOARA)
- Conservation Engineering (various research activities, BSAIRA)
- Eastern Bering Sea Upper Continental Slope Trawl Survey Summer (BSAIRA)
- Conservation Engineering (various research activities, GOARA)

The capture rate of fish species in research surveys varies substantially in space and time, with higher numbers in samples from some areas and very low or no individuals collected in other samples. This variability in catch is used to determine species abundance and distribution. Concentrations of biomass and species richness depend on topographic features, water temperature and salinity, prey availability, and other habitat characteristics. Consequently, the status of fish stocks varies over time and by fishery management region. Fisheries and ecosystem research projects funded by or otherwise affiliated with the AFSC (Table 2.2-1) have a wide variety of research objectives. The Conservation Engineering projects design and deploy modified fishing gear to test for effectiveness in reducing bycatch of particular species. Some projects, such as video camera projects and SCUBA surveys, have no catch of fish. For these surveys, mortality and effects on fish species is minimal.

The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. Measuring this relationship is difficult because there are many species which are not well understood, and total biomass estimates can have fairly large confidence intervals. However, the process used by NPFMC for determination of commercial fishing quotas attempts to account for these concerns and these quotas can be used to give context to AFSC research catch.

Scientists from various agencies collaborate to produce annual Stock Assessment and Fishery Evaluation (SAFE) reports for the NPFMC (e.g., NPFMC 2014d, 2014e). SAFE reports include calculations of several measures of population strength for determination of the amounts of fish that may be taken in directed or bycatch fisheries. These measures include Overfishing Limit (OFL), Acceptable Biological Catch (ABC), and Total Allowable Catch (TAC). OFL describes the amount of removal a stock can absorb prior to being considered overfished. ABC is an amount below OFL that allows for scientific uncertainty in the OFL, and is effectively similar to an Annual Catch Limit (ACL, a tool used nationally for prevention of overfishing). NPFMC annually publishes TACs, which are commercial quotas for each managed stock or species in the regional FMP. An allowance for research catch is also included in the quota determination process.

TACs are set for many species, which makes them a good tool for comparing research catch to overall population strength. For the purpose of assessing the magnitude of mortality effects in this FPEA, the amount of each fish species caught in AFSC research is compared to its TAC, if available. TACs are not required for all species and, for some species, estimates of the amount caught in commercial fisheries are available and can be used as a comparison metric instead.

Additionally, this FPEA does not attempt to analyze the effects of research mortality on each of the hundreds of species caught in the various surveys. Rather, to demonstrate the effects of research mortality on fish stocks, it analyzes only the effects on species that are caught most frequently in the surveys (average annual catch over one ton for the BSAIRA and GOARA).

Most research surveys are conducted during the spring and summer (Appendix B). Spatially, trawl and longline surveys that target managed fish species are focused fairly evenly in the GOARA and BSAIRA, although some research may be conducted in specific locations important to commercial fisheries or habitat conservation. In comparison to commercial fisheries-related mortality, mortality due to research activities occurs in small areas, research tow times are much shorter than commercial tows, and sampling is usually not repeated in the same area.

4.2.3.2 Disturbance and Changes in Behavior

There are several mechanisms by which fisheries research activities could potentially disturb fish and alter behavior, including turbidity relating to the physical movement of marine vessels and fishing gear through the water and displacement resulting from gear contact with the substrate. Operational sounds from engines, hydraulic gear, and acoustic devices used for navigation and research also potentially result in disturbances to fish and alter their behavior.

Deployment of fishing gear by the AFSC results in capture for many fish; some of these are retained on board and others are discarded either dead or alive. For the purposes of this FPEA, most fish brought on board are assumed to have died, and impact of this mortality on populations is the focus of the discussions on target and other species (Sections 4.2.3.6 and 4.2.3.7). However, many fish likely escape initial capture and this can be due to mesh size constraints, swimming ability, or tissue tears related to hooking; the sub-lethal effects on these fish are difficult to analyze because they remain free-swimming and therefore cannot be observed for long-term effects.

Wilson et al. (2014) performed a literature review to determine effects on species that either escape or are discarded and found that most of the available literature focuses on the mortality of fish after release, but few discuss the outcome of fish that do not die immediately, particularly escapees. Of the reviewed studies which address escapees, Ryer et al. (2004) experimentally found that sablefish which escaped after periods of trawling swam more slowly and were less likely to be resistant to predation. Other studies, such as those discussed in Suuronen (2005), have found similar outcomes related to escape from capture (e.g., effects due to changes in daylight, pressure, temperature, scale loss, collision, etc.), and some of these individually or in combination may ultimately result in mortality. Effects on species of fish that escape capture by AFSC surveys are therefore likely, and include sub-lethal and delayed mortality outcomes. However, AFSC surveys affect very small areas and numbers of fish, particularly in comparison to the overall size of each research area and to commercial fisheries. The magnitude of effects from AFSC research under the Status Quo Alternative would likely be geographically localized and small in magnitude; duration could be long term (in the case of mortality) or temporary depending on the type of effect. This combination of effects would be considered minor adverse for all fish species according to the impact criteria in Table 4.1-1.

Noise from active acoustic devices used on vessels conducting fisheries research could potentially affect fish. The LOA application (Appendix C, Section 6.2) describes the types of acoustic devices used on AFSC research vessels. Fish with a swim bladder (or air sac) that is near, or connected to, the auditory structures likely have the best hearing sensitivity among fish, with a presumed functional hearing range of approximately 50 hertz to 10 kHz (Popper and Fay 2011, Mann et al. 2001). Gulf menhaden (*Brevoortia patronus*) are in the order Clupeiformes and are in this category of fish, which are specialized to hear high frequency sounds that are within the range of acoustic devices used in research. These types of fish are likely to detect acoustic devices, but only if they are relatively near the source. Pacific herring, the most common Alaskan species in the order, by contrast have been shown to not have the same hearing levels (Mann et al. 2005) and are not likely to be affected by acoustic devices. Regarding other fish with potential to have ultrasound hearing, research vessels are usually moving while using acoustic gear and the source of potentially disturbing sounds would be localized and the behavioral response of fish would likely be limited to temporary avoidance behavior.

Globally, approximately 25,000 fish species have a swim bladder (or other air cavity) that is not near the ear (for example, salmonids). These species probably detect some pressure from large physical disturbances of the water or vessel traffic, but functional hearing is most likely in the 30 hertz to 500 hertz range (Popper and Fay 2011) and higher frequency acoustic devices used in research are unlikely to be audible. Any acoustical effect that is audible and that would cause avoidance disturbance, would be minor in intensity, occur over a local geographic extent, and the duration would be temporary.

Commercial vessel and fishing gear noise, and recreational vessel noise are common components of background (ambient) noise in the marine environment. At present, there are thousands of commercial fishing, transport vessels, and recreational vessels in the project area that contribute to background vessel noise.

Potential disturbance and acoustic masking effects from research vessel noise under the Status Quo Alternative would likely be geographically localized, minimal in magnitude, and temporary in duration; this type of effect would be considered minor adverse for all fish species according to the impact criteria in Table 4.1-1.

4.2.3.3 Contamination from Discharges

Discharge from vessels, whether accidental or intentional, include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to fish exposed to the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (DOE 2008, NOAA 2010b).

All NOAA vessels and AFSC chartered vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010a). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010). In addition, all NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they will be responded to and contained quickly.

Discharge of contaminants from AFSC vessels and AFSC chartered vessels is possible, but unlikely to occur in the near future. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to fish would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of fish would therefore be considered minor adverse.

As the potential effects of discharges, regulations governing discharges, and the likelihood of discharges are universal throughout the AFSC research areas, this type of potential effect on fish will not be discussed further in this analysis.

4.2.3.4 ESA-listed Species

There are several anadromous fish species with populations currently listed as threatened or endangered under the ESA that have not been shown to spawn in Alaska freshwaters but have the potential to show up in marine waters off Alaska where AFSC fisheries research takes place. The Southern DPS of Pacific eulachon is listed as threatened, and several species of threatened or endangered Pacific Northwest salmon ESUs and steelhead DPSs originate in freshwater habitat in Washington, Oregon, Idaho, and California. The NEPA context for impacts to threatened and endangered species is considered important due to their status as ESA-listed species. However, directed research on ESA-listed species requires permitting under section 10 of the ESA, which is subject to its own NEPA analysis, and is not covered under this FPEA. The ESA-listed Southern DPS of eulachon is not targeted by AFSC research and historically all eulachon caught in AFSC research appear to have originated from the Northern DPS (which spawn in Alaska waters), although this has not been examined closely. In considering the species for the NMFS Biological Opinion (2019) Southern DPS of eulachon were eliminated from consideration and are not reviewed in that document or further in this FPEA. The Southern DPS of green sturgeon however, were reviewed in the NMFS Biological Opinion (2019). Therefore, the following discussion focuses on effects on ESA-listed salmonid species and green sturgeon incidental to the purpose of AFSC funded or conducted fisheries research because some of these fish have been shown to appear in the AFSC research areas.

Mortality from Fisheries Research Activities

Salmonids

The potential effects of AFSC research on ESA-listed salmon focuses on the potential mortality of salmon from each listed ESU. The following discussion presents the approach to, and results of, the analysis of the potential effects of AFSC fisheries and ecological research on ESA-listed salmon as described in the BA (NMFS 2017a) and Biological Opinion (NMFS 2019). it is assumed that all interactions with fishery surveys and gear type result in a mortality to the listed salmon species. The following paragraphs provide a step-by-step description of how the number of salmon by ESU that might be taken by AFSC and ADFG during the Status Quo Alternative in all three research areas has been estimated. The actual number of salmon, by species, that were taken between 2011 and 2016 was used as the basis for estimating the average annual take by species and survey.

The analysis in NMFS (2017a) started with the total number of Pacific salmon (737,047) and steelhead trout (110) caught in research surveys conducted by the AFSC and ADFG from 2011 to 2016. The majority of this catch were pink salmon. Since there are no ESA-listed ESUs of pink salmon, the total number was reduced to 299,054 after subtracting all pink salmon from the total. Catch from the Auke Creek Weir and Research Hatchery was considered in NMFS (2017a) as well. The weir is in freshwater and it is unlikely that stray Pacific salmon rearing in other freshwater watersheds will be found at the weir (although it is possible; see Keefer and Caudill 2014). As a result, the total number of fish was reduced again to 124,231 fish after removing all fish that passed thru the Auke Creek Research Hatchery. Auke Creek Weir is the only research activity in the AFSC research areas that also catches steelhead. This research has never reported catch of ESA-listed salmonid species and the eggs from any ESA-listed steelhead that stray from its natal stream, then hatch in southeast Alaska, would not be considered part of the listed ESU. Therefore, steelhead from the Auke Bay research program would not be listed under the ESA. Therefore, they were also removed from consideration as a possible PNW ESA species caught in AFSC surveys, which left 124,221 total fish. Next, age-specific removals of fish were conducted based on the BASIS surveys, which recorded some of the catch by age, as well as by species and weight. Multiple studies have shown that immature salmon captured in the Bering Sea and GOA are likely fish that were spawned in Alaska streams and rivers due to timing and location of capture relative to age. For that reason any immature fish captured were removed from the total which left 104,364 fish. This number was reduced to 95,095 after taking into account genetic stock composition analysis of chum and Chinook salmon bycatch in the GOA trawl surveys (GOA Assessment, GOA Bottom Trawl and SECM Surveys) and Bering Sea trawl surveys (BS Bottom Trawl, Chukchi Sea Study, and BASIS surveys). This number was further reduced to 74,484 by subtracting out 90% of the coho and sockeye catch in the GOA Assessment Survey based on the likelihood of occurrence in the GOA as described in NMFS (2017a). Finally, the total was reduced after taking into account non-listed stock composition in SECM surveys. On average, approximately 3% of salmon in these surveys are from stocks other than Alaska stocks, possibly from PNW ESUs. This left approximately 20,353 total ESU fish that might be taken by AFSC and ADFG during fishery surveys.

To estimate annual catch per species from the above 20,353 total salmon, total catch per species was divided by the number of surveys that have been conducted during 2011-2016. This resulted in 238 Chinook, 1,951 chum, 341 coho, and 1,296 sockeye salmon per year (Table 4.2-6). This total is considered a proxy for the take that might occur to each PNW salmon ESU per year during AFSC fishery surveys.

A primary challenge in providing an impact analysis for ESA-listed salmonids in AFSC research areas is determining the origin of salmonids caught. In the NMFS (2017a) analysis, the annual catch of PNW salmon by ESU was estimated by assuming the take in research surveys was proportional to the juvenile abundance for each ESU. The results of this analysis are presented below in Table 4.2-6. In all cases the estimated number of PNW salmon (by ESU) caught in AFSC surveys is less than one percent of the juvenile population abundance, and approaches zero in most cases. Similarly, the worse-case scenario is still less than one percent of total juvenile abundance for each ESU.

The AFSC considers the adverse impacts of its various research activities on ESA-listed salmonids to be very small in magnitude, dispersed in time and geographic area, and likely to have minimal impact on all ESUs. In contrast to these minor adverse effects, AFSC research on Pacific salmon has beneficial impacts on both ESA-listed and non-listed ESUs through its contribution to sustainable fisheries management and monitoring changes in the marine environment important to the recovery of these species. Overall, the impact of AFSC research on ESA-listed salmonids under the Status Quo Alternative is considered minor adverse according to the impact criteria described in Table 4.1-1.

Table 4.2-6 Estimated Annual Catch of PNW Salmon by ESU under the Status Quo Alternative

ESA-Listed ESU	Juvenile Population	Estimated Annual AFSC Take	Estimated Percent Take Per ESU	Estimated Worst-case Scenario
Chinook Salmon – *Lower Columbia River*	49,679,018	150	<0.001	0.01
Chinook Salmon – *Puget Sound*	4,494,693	13	<0.001	
Chinook Salmon – *Snake River Fall*	7,427,592	22	<0.001	
Chinook Salmon – *Snake River (Spring-Summer)*	7,000,107	21	<0.001	
Chinook Salmon – *Upper Columbia River (Spring)*	1,981,042	7	<0.001	
Chinook Salmon – *Upper Willamette River*	7,862,859	25	<0.001	
Chum Salmon – *Hood Canal*	3,347,420	1,951	0.06	0.06
Coho Salmon – *Lower Columbia River*	9,776,242	341	<0.01	<0.01
Sockeye Salmon – *Snake River*	191,948	293	0.15	0.68
Sockeye Salmon – *Ozette Lake*	658,282	1,003	0.15	

Green Sturgeon

The green sturgeon is infrequently encountered at the extreme boundaries of its range (Colway and Stevenson 2007; Rosales-Casian and Almeda-Jauregui. 2009). In Alaska, green sturgeon are listed as a “nominee” species in the State of Alaska Wildlife Action Plan and designated as a “Species of Greatest Conservation Need” under the Aquatic Habitat Implementation Plan, which is part of the Comprehensive Wildlife Conservation Strategy (NMFS 2015i). The ADFG indicates that information about green sturgeon presence is limited to a few anecdotal reports of sightings and captures in State of Alaska waters, occurring mostly in southeastern Alaska (encompassing the mouths of the Stikine and Taku rivers). ADFG has received no reports of recurrent sightings of sturgeon.

Studies confirm that North American green sturgeon are rare in Alaskan waters (NMFS 2015i). Lindley et al. (2008) tagged 213 sub-adult and adult Northern and Southern DPS green sturgeon from Oregon, Washington, and California and observed only one tagged green sturgeon taken in a commercial gillnet fishery in southeast Alaska, further supporting the assumption that green sturgeon only rarely enter Alaskan waters. The tagged green sturgeon was later confirmed as belonging to the Southern DPS (NMFS 2015i).

The North Pacific Groundfish Observer Program, which observes federal groundfish fisheries off Alaska within the action area, has recorded rare encounters with green sturgeon in trawl fisheries in the Bering Sea for over three decades (1982:1; 1984:2; 2005:1; 2006:3; 2009:1; 2012:1; 2013:1; 2015:1l; reported in NMFS (2015i). It is unknown whether these green sturgeon belonged to the Northern DPS or the Southern DPS. However, it follows that given the reduced scale of the research surveys as compared to the commercial fisheries that encounters with sturgeon would be even less likely in the research program. In fact, during the same three-decade period there have been no takes of green sturgeon reported from any of the fishery surveys considered in the proposed action.

Although they have never been identified as a factor for decline or a threat preventing recovery, scientific research and monitoring activities have the potential to affect the species' survival and recovery by killing listed green sturgeon. For the year 2017, NMFS issued several section 10(a)(1)(A) and section 4(d) scientific research permits and authorizations allowing lethal and non-lethal take of listed green sturgeon. Actual take levels associated with these activities are very likely to be a good deal lower than the authorized levels. There are two reasons for this. First, most researchers do not handle or kill the full number of juveniles (or adults) they are allowed. Our research tracking system reveals that for the past five years researchers, on average, ended up taking approximately only 3 percent of the number of juvenile sturgeon and 2 percent of the adults they requested and the actual mortality was only 4 percent of requested for juveniles while no adults were killed. Second, the estimates of mortality for each proposed study are purposefully inflated to account for potential accidental deaths and it is therefore very likely that fewer fish - especially juveniles - would be killed during any given research project than the researchers are allotted, in some cases many fewer. In 2015 and 2016, NMFS consulted on the effects of fisheries research conducted and funded by the SWFSC and NWFSC, the issuance of a LOA under the MMPA for the incidental take of marine mammals pursuant to those research activities, and the issuance of scientific research permits under the ESA for directed take of ESA-listed salmonids (NMFS 2015j; NMFS 2016a). NMFS determined that the SWFSC and NWFSC fisheries research are not likely to jeopardize the continued existence of ESA-listed salmon, steelhead, or green sturgeon. NMFS expected that a total of 7 adult green sturgeon would be incidentally captured with no mortalities in SWFSC and NWFSC surveys.

The AFSC considers the adverse impacts of its various research activities on Southern DPS green sturgeon to be very small in magnitude, dispersed in time and geographic area, and likely to have minimal impact. The principal cause of decline and current threat to the Southern DPS of green sturgeon is the reduction of historically accessible spawning habitat, most notably by impoundments (NMFS 2019). Additional threats to green sturgeon include freshwater habitat alteration, impaired water quality, dredging and ship traffic, ocean energy development, incidental catch in recreational and commercial fisheries, poaching, scientific research, disease, predation, displacement by non-native invasive species, inadequacy of existing regulatory mechanisms, and entrainment of larvae and juveniles in water diversions (NMFS 2019). Overall, the impact of AFSC research on Southern DPS green sturgeon under the Status Quo Alternative is considered minor adverse.

4.2.3.5 Prohibited Species

Prohibited fish species (as defined in section 3.2.1.2) are those prohibited from catch and sale in commercial groundfish fisheries managed by NMFS and include Pacific halibut, Pacific herring, and, as discussed earlier, Pacific salmon. The effects of AFSC research catches of Pacific salmon are described in the ESA-listed species section above; Pacific halibut and Pacific herring are discussed here.

There are several difficulties with analyzing impacts of AFSC research upon halibut. Most AFSC surveys report halibut catch by weight, which is relatively straightforward because halibut quotas, published each year by the IPHC, are allocated by area and by weight. However, some surveys report catch by number. This makes the analysis of impact somewhat complicated because halibut range from just a few kg to over 200 kg. Longline surveys in particular (e.g., Alaska Longline Survey) track counts because catch is brought on board one individual at a time. Weight may also be tracked in these surveys, which can be done by weighing the animal, by visual estimation, or by estimation based on a scientifically accepted halibut length-weight relationship. For those surveys where only number of fish was available (and not weight), average weights were applied.

Variable mortality is also a complicating factor. The IPHC annually publishes expected halibut bycatch discard mortality rates in commercial groundfish fisheries based on gear type, fishery and area (e.g., Williams 2016). These rates vary significantly, with the highest being allotted to commercial trawl fisheries (greater than 80% for most fisheries) and the lowest to commercial longline fisheries (9-14%). Most halibut encountered by AFSC longline research are released alive (with apparently minor hooking injuries), but the published IPHC mortality rates indicate survival after release is not guaranteed. Despite the likely survival of many halibut caught and released in AFSC research, this FPEA analysis will take a precautionary approach to account for the maximum potential effect and will assume that all halibut caught in AFSC research have 100% mortality after discard.

Survey catch in the GOARA reported as weight amounts to approximately 71.86 mt per year. Those GOARA surveys that report halibut catch only by number combine for an average of 69 fish per year. Survey catches from these surveys have been reported to average about 10 kg per fish, equivalent to about 690 kg per year. The 2015 combined total quota for all commercial fishing sectors in the GOA is 7,892.64 mt. The precautionary estimate for AFSC fisheries research mortality is therefore about 0.92 percent of the annual commercial quota for the GOARA, which is accounted for when the commercial quota is determined, and actual mortality is likely much less.

Most AFSC surveys in the BSAIRA report Pacific halibut catch by weight. Total estimated AFSC fisheries research catch in the BSAIRA amounts to approximately 51.85 mt of halibut per year. The 2015 combined total quota (guided sport fishing, treaty, and commercial fishing) is 1,730.48 mt. In this comparison, the precautionary estimate for AFSC research mortality represents 3.0 percent of the area wide quota. Unguided sport fishing is allocated based on daily bag limits and not poundage quotas so they are not included in this analysis but additional fish caught by that sector would further decrease this percentage. Again, fisheries managers use estimates of research catch in their calculations of what the yearly quota should be.

Analysis difficulties arise for pacific herring as well. Most surveys report herring catch by weight but some report catch by number. In addition, ADFG herring management and quota allocations are complicated because herring have different markets based on what part of their life cycle is fished upon. Sac roe fisheries are prosecuted on individual stocks that come in to particular spawning areas while food and bait fisheries are prosecuted in areas and times where multiple stocks may intermix. Additionally, even though directed fishing is prosecuted in particular bays and other state waters where fish spawn, fish on the high seas may not be intercepted in the same region. For the purposes of this FPEA, only sac roe and spawn-on-kelp fishery quotas from 2013 (the year for which the most complete data are available, from http://www.adfg.alaska.gov/index.cfm?adfg=cfnews.main) are used for comparison. It is also presumed that, for example, fish bound for Togiak (in Bristol Bay) are only intercepted in the BSAIRA and not in the GOARA.

In the GOARA, AFSC fisheries surveys report Pacific herring by both number and weight. An average of 1.21 mt during the survey period (2009-2013) was reported by weight, with an additional count of 5666 fish per year. Applying an average weight (as reported in ADFG 2015d) of 0.166 kg per fish to those fish calculates to 0.94 mt per year. This equals a combined average survey weight of approximately 2.15 mt. The GOARA-wide commercial herring quota for 2013 was 20,336 mt. AFSC fisheries research catch of herring represents only 0.011 percent of this quota. Catch of Pacific herring in AFSC research in the BSAIRA amounts to an average of 6.48 mt per year. The total commercial herring quota in the BSAIRA equals 49,649 mt. AFSC fisheries research catch of herring represents only 0.013 percent of this quota. In the CSBSRA, the average AFSC research catch of 3.17 mt per year, which does not occur every year because surveys in the CSBSRA are not conducted on a regular basis, is just 2.12 percent of the quota for the Kotzebue commercial fishery, the only one in the Arctic. AFSC surveys that report numbers of fish caught in the CSBSRA account for an average of 91 fish per year, creating a small but not appreciable increase in this percentage.

The overall AFSC research capture rates for Pacific halibut and Pacific herring are relatively low considering biomass estimates and commercial and sport allocations, are accounted for by fisheries managers when quotas are determined, and therefore represent a low magnitude of impact on each species. Catch of these species in AFSC fisheries research surveys helps inform fishery managers as well as AFSC scientists of abundance in times and areas where directed stock assessment surveys for these species may not occur. Effects of AFSC research on Pacific halibut and Pacific herring are expected to occur on a regular basis, be dispersed over large areas, and result in no measurable population level effects. Therefore, effects are considered minor adverse under the Status Quo Alternative according to the criteria in Table 4.1-1.

4.2.3.6 Target and Other Fish Species in the GOARA and BSAIRA

Mortality from Fisheries Research Activities in the Gulf of Alaska Research Area

Table 4.2-7 shows the average annual catch (by weight) of the most frequently caught fish species in a recent five-year period (2009-2013) from AFSC fisheries and ecosystem research in the GOARA. These totals include research activities funded by the AFSC, at least in part, but conducted by cooperative research partners (i.e., ADFG) (Table 2.2-1). Some surveys only record number of each species of fish caught but not the weight of fish caught. For a rough estimate of caught weight from these surveys, average weights (the highest published average weight available) were derived from published documents (NPFMC 2010, NPFMC 2014d, and Mecklenburg et al. 2002), applied to average number reported, and added to totals from surveys where weight was recorded. Table 4.2-7 compares these average annual research catches to the average annual 2014 TAC for that species or species complex. These data indicate that for most target species the average amount of fish killed in AFSC fisheries and ecosystem research in the GOARA is much less than one percent of commercial quotas. For these species, the magnitude of research mortality is very small relative to the fisheries and even smaller relative to the estimated populations of these fish.

The most frequently caught species in AFSC research in the GOARA are walleye pollock and arrowtooth flounder, and survey catches comprise less than half of one percent of the annual TACs for each of these species (Table 4.2-7). Both species are considered to be healthy and not overfished. Walleye pollock is the largest single-species fishery in the GOARA. They have a relatively short time to maturity (50 percent maturity at 4.9 years of age, NPFMC 2014e), a wide overall population distribution, and high reproductive potential.

Sablefish has the next highest research catch rate, the bulk of which are caught during the Alaska Longline Survey, which targets sablefish and other groundfish for stock assessment purposes. About five percent of sablefish are tagged and released alive; the remainder of fish caught in the Alaska Longline Survey are retained and commercially processed, not just discarded. However, survivability of released fish is not guaranteed so for the purposes of this FPEA, 100 percent mortality is assumed to maintain a precautionary comparison. Using this metric, the maximum mortality rate represents less than 2.5 percent of the total TAC for this species in the GOARA, with actual mortality likely lower. As with other managed fish species, research catch is accounted for during the FMP TAC-setting process.

Grenadiers are the fourth most caught species group in the GOARA. They are considered an "ecosystem component species", for which an ABC is not required. However, Rodgveller and Hulson (2014) have estimates of ABC for this group. Between 2009 and 2013, AFSC surveys in the GOARA caught an average of 165.77 mt of giant grenadier and 1.46 mt of Pacific grenadier annually, for a total of 167.23 mt per year; additional species of grenadier made up 0.41 mt per year. This amount of grenadier survey catch per year equates to approximately 0.55 percent of the 30,691 mt estimate of ABC as reported in Rodgveller and Hulson (2014). Based on this comparison, AFSC survey catch of grenadier species is expected to have a minor magnitude impact on grenadier in the GOARA.

The rest of the fish with quota allocations caught in GOARA research have catch rates of less than 1.5 percent of TAC, with most being considerably lower than half of one percent.

Currently there are no overfished species in the GOARA. Research data is necessary for monitoring the status of stocks where overfishing is unknown and other stocks of conservation concern and to determine if management objectives are being met. Under the Status Quo Alternative, scientific research proposals for both long-term and short-term projects require SRPs or experimental fishing permits. The potential impacts of those proposed projects are assessed for each stock, including overfished stocks, before those permits are issued. Fisheries managers typically consider the estimated amount of research catch from all projects along with other sources of mortality (e.g., bycatch in other fisheries and predation) before setting commercial fishing limits to prevent overfishing of stocks or to help overfished stocks rebuild. This type of annual review of research proposals would continue to occur in the future under the Status Quo Alternative. Any future proposed projects targeting overfished stocks, or projects likely to have substantial bycatch of an overfished stock or other stock of conservation concern, would receive additional scrutiny on a stock by stock basis to ensure minimal impact on the stock before a research permit is issued. These permitting reviews would also determine whether the proposed projects were consistent with the NEPA analysis presented in the FPEA or whether additional NEPA analysis was required (see Section 2.3.5).

Table 4.2-7 indicates that, while mortality to fish species is a direct effect of AFSC fisheries and ecosystem research in the GOARA, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations of these species. For all target species in the GOARA, mortality from AFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

Table 4.2-7 Comparison of Estimated Fish Caught under the Status Quo Alternative Compared to Commercial TAC in the GOARA

Species are listed in descending order of total research catch by weight. Only survey species with average annual research catch greater than one metric ton (1 mt = 1000 kilograms) are shown.

Species Group	Stock Status[a]	Species	Average AFSC research catch per year (mt) (2009-2013)[b]	Average AFSC research catch per year (mt) for group (2009-2013)	2014 commercial GOA TAC (mt)[c]	Average AFSC research catch compared to GOA commercial TAC (percentage)
Walleye pollock	No overfishing, not overfished	Walleye pollock	288.71	288.71	193,809	0.15%
Arrowtooth flounder	No overfishing, not overfished	Arrowtooth flounder	268.37	268.37	61,519	0.44%
Sablefish	No overfishing, not overfished	Sablefish	237.78	237.94	9,554	2.49%
Grenadiers	Status unknown	Giant grenadier	165.77	167.23	NA[d]	NA
		Pacific grenadier	1.46			
Pacific cod	No overfishing, not overfished	Pacific cod	153.68	153.68	61,519	0.25%
Flathead sole	No overfishing, not overfished	Flathead sole	106.53	106.53	27,726	0.38%
Pacific ocean perch	No overfishing, not overfished	Pacific ocean perch	101.47	101.47	19,764	0.51%
Shallow-water flatfish	No overfishing, not overfished	Northern rock sole	39.18	86.95	32,027	0.27%
		Yellowfin sole	19.47			
		Southern rock sole	10.09			
		Starry flounder	6.9			
		Alaska plaice	5.75			
		Butter sole	3.54			
		English sole	2.02			
Longnose skate	No overfishing, overfished status unknown	Longnose skate	22.26	22.26	2,876	0.77%
Dusky rockfish	No overfishing, not overfished	Dusky rockfish	16.87	16.87	5,081	0.33%

Species Group	Stock Status[a]	Species	Average AFSC research catch per year (mt) (2009-2013)[b]	Average AFSC research catch per year (mt) for group (2009-2013)	2014 commercial GOA TAC (mt)[c]	Average AFSC research catch compared to GOA commercial TAC (percentage)
Thornyhead rockfish	No overfishing, overfished status unknown	Shortspine thornyhead	16.63	16.78	1,841	0.91%
		Longspine thornyhead	0.15			
Shortraker rockfish	No overfishing, overfished status unknown	Shortraker rockfish	14.13	14.13	1,323	1.07%
Northern rockfish	No overfishing, not overfished	Northern rockfish	13.58	13.58	5,010	0.27%
Rex sole	No overfishing, not overfished	Rex sole	12.56	12.56	9,155	0.14%
Rougheye and Blackspotted rockfish	No overfishing, not overfished	Rougheye rockfish	11.06	13.09	1,262	1.04%
		Blackspotted rockfish	2.03			
Atka mackerel	No overfishing, overfished status unknown	Atka mackerel	9.1	9.1	2,000	0.46%
Deep-water flatfish	No overfishing, not overfished	Dover sole	8.03	8.03	13,303	0.06%
Big skate	No overfishing, overfished status unknown	Big skate	7.66	7.66	3,762	0.20%
Forage fish species	Status unknown	Eulachon	5.59	5.59	262[e]	2.13%
Other skates	No overfishing, overfished status unknown	Aleutian skate	3.69	8.94	1,989	0.45%
		Bering skate	2.53			
		Skates unidentified	2.72			
Sharks	No overfishing, overfished status unknown	Pacific sleeper shark	3.04	14.36	5,989	0.24%
		Spiny dogfish	11.32			
Other rockfish	No overfishing, overfished status unknown	Silvergray rockfish	2.97	7.76	1,811	0.43%
		Redbanded rockfish	2.49			
		Harlequin rockfish	1.19			
		Sharpchin rockfish	1.11			

Species Group	Stock Status[a]	Species	Average AFSC research catch per year (mt) (2009-2013)[b]	Average AFSC research catch per year (mt) for group (2009-2013)	2014 commercial GOA TAC (mt)[c]	Average AFSC research catch compared to GOA commercial TAC (percentage)
Sculpins	No overfishing, overfished status unknown	Great sculpin	2.91	7.13	5,569	0.13%
		Yellow Irish lord	2.57			
		Plain sculpin	1.65			
Not allocated	Status unknown	Spotted ratfish	2.13	2.13	NA[d]	NA
Not allocated	Status unknown	Lingcod	1.77	1.77	NA[d]	NA
Demersal shelf rockfish	No overfishing, overfished status unknown	Yelloweye rockfish	1.04	1.04	274	0.38%

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Some surveys reported number only; estimates of weight were made and included in the total for that species.

c. Source: 2013-2014 Alaska Groundfish Harvest Specification. Available online: https://alaskafisheries.noaa.gov/sustainablefisheries/specs14_15/

d. Spotted ratfish and lingcod are not in the GOA FMP and are not required to have a TAC. Grenadier are considered an "ecosystem component species" in the GOA FMP and are not required to have a TAC because there is no directed commercial fishery.

e. Forage fish, including eulachon, are not required to have an ABC. For this species, the estimated biomass is unknown and the number presented here represents the 2014 estimated catch according to the Alaska Region (http://alaskafisheries.noaa.gov/sustainablefisheries/forage/2014catch.pdf).

Mortality from Fisheries Research Activities in the Bering Sea/Aleutian Islands Research Area

Table 4.2-7 shows the average annual catch (by weight) of the most frequently caught fish species in a recent five-year period (2009-2013) from AFSC fisheries and ecosystem research in the BSAIRA. These totals include research activities funded by the AFSC, at least in part, but conducted by cooperative research partners (i.e., ADFG) (Table 2.2-1). Some surveys only record the number of each species of fish caught and not the weight of fish caught. For a rough estimate of caught weight from these surveys, average weights were derived from published AFSC data where available, applied to average number reported, and added to totals from surveys where weight was recorded. Table 4.2-7 compares average annual research catches to the average annual 2014 TAC for that species or species complex. These data indicate that for most species the average amount of fish killed in AFSC fisheries and ecosystem research in the BSAIRA is much less than one percent of commercial quotas. For these species, the magnitude of research mortality is very small relative to the fisheries and even smaller relative to the estimated populations of these fish.

The most frequently caught species in the BSAIRA are walleye pollock and pacific ocean perch, comprising less than half of one percent of the annual TACs for these species as shown in Table 4.2-7. These species are considered to be healthy and not overfished and the amounts taken are considered to have minimal impacts on the overall health of these species.

Walleye pollock is the largest single-species fishery in the BSAIRA, frequently accounting annually for over half of the entire BSAIRA TAC. The vast majority of pollock quota is allocated to the Eastern Bering Sea stock, which is not considered overfished and has significant economic value to the region. A small TAC (19,000 mt in 2014) is allocated for the Aleutian Islands stock, and an even smaller amount of 75 mt in 2014 was allocated to the Bogoslof stock.

While the information in Table 4.2-7 takes into account all pollock in the BSAIRA as a whole, it is informative to also consider the potential impact on individual BSAI stocks. The Eastern Bering Sea stock had a 2014 TAC of 1,267,000 mt. Conservatively assuming all survey catch of pollock in the BSAIRA came from this stock, the total amount taken by surveys would be less than 0.03 percent of the TAC. Similarly, if all catch came from the Aleutian Islands stock, the impact on the population would still be just 1.63 percent of the total TAC, or 0.72 percent of the OFL for that stock (79 FR 12108, 4 March 2014). If all research catch of pollock came from the Bogoslof stock, only 2.31 percent of the 13,413 mt OFL would be taken annually. These values would be more than enough to insure overfishing does not occur due to unexpectedly high research catches.

Grenadiers are the third most caught species group in the BSAIRA. They are considered an "ecosystem component species" in the BSAI FMP, so an ABC is not required. However, Rodgveller and Hulson (2014) have estimates of ABC for this group. Between 2009 and 2013, AFSC surveys in the BSAIRA caught an average of 268.45 mt of giant grenadier and 11.89 mt of popeye grenadier annually, for a total of 280.34 mt per year; additional species of grenadier made up 0.81 mt per year. This amount of grenadier survey catch per year equates to approximately 0.37 percent of the 75,274 mt estimate of ABC as reported in Rodgveller and Hulson (2014). Based on this comparison, AFSC survey catch of grenadier species is expected to have a minor impact on grenadier populations in the BSAIRA.

For forage fish species, TACs are not set because they are considered essential to the ecosystem and a directed commercial fishery is prohibited. Thus it is difficult to gauge the impact of capelin and eulachon survey catches on overall population strengths. However, some metrics exist that can be used for comparison. Aydin et al. (2007) made biomass estimates of multiple species groups, including capelin and eulachon, based on food web models. Capelin biomass in the Eastern Bering Sea was estimated to be 613,714 mt, and eulachon in the Eastern Bering Sea was estimated to be 273,583 mt. Comparing these values to average AFSC survey catches of 1.5 to 2.5 mt per year indicates that AFSC research catches for these two species are likely minor in magnitude.

The rest of fish caught in BSAIRA research have catch rates less than 1.8 percent of TAC, with most being considerably lower than half of one percent.

In general, the type of programmatic analysis presented in this FPEA indicates that research activities have minimal impact on all populations and therefore pose little conservation concern. Currently there are no overfished species in the BSAIRA and the SRP system is expected to provide a safeguard against fisheries research catches inadvertently becoming a conservation concern for any species that may approach an overfished condition in the future. These ideas were presented earlier in this document during the discussion of mortality from fisheries research activities in the GOARA; refer to that section for further information.

Table 4.2-8 indicates that, while mortality to fish species is a direct effect of AFSC fisheries and ecosystem research in the BSAIRA, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations of these species. For all target species in the BSAIRA, mortality from AFSC research activities would be low in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

Table 4.2-8 Comparison of Estimated Fish Caught under the Status Quo Alternative Compared to Commercial TAC in the BSAIRA

Species are listed in descending order of total research catch by weight. Only survey species with average annual research catch greater than one metric ton (1 mt = 1000 kilograms) are shown.

Species complex	Stock Status[a]	Species	Average AFSC research catch per year (mt) (2019-2013)[b]	Average AFSC research catch per year (mt) for group (2009-2013)	2014 Commercial BSAI TAC (mt)[c]	Average AFSC research catch compared to commercial BSAI TAC (percentage)
Walleye pollock	No overfishing, not overfished[d]	Walleye pollock	309.62	309.62	1,286,075[e]	0.02%
Pacific ocean perch	No overfishing, not overfished	Pacific ocean perch	293.22	293.22	33,122	0.89%
Grenadiers	Status unknown	Giant grenadier	268.45	280.34	NA[f]	NA
		Popeye grenadier	11.89			
Atka mackerel	No overfishing, not overfished	Atka mackerel	101.15	101.15	32,322	0.31%
Pacific cod	No overfishing, not overfished	Pacific cod	107.74	107.74	246,897	0.04%
Northern rockfish	No overfishing, not overfished	Northern rockfish	46.14	46.14	2,594	1.78%
Arrowtooth flounder	No overfishing, not overfished	Arrowtooth flounder	114.28	114.28	25,000	0.46%
Yellowfin sole	No overfishing, not overfished	Yellowfin sole	104.01	104.01	184,000	0.06%
Flathead sole	No overfishing, not overfished	Flathead sole	99.02	99.02	24,500	0.40%
Rock Soles	No overfishing, not overfished	Northern rock sole	93.08	94.38	85,000	0.11%
		Southern rock sole	1.31			
Other flatfish	No overfishing, overfished status unknown	Rex sole	38.94	42.7	2,650	1.61%
		Starry flounder	3.76			
Alaska plaice	No overfishing, not overfished	Alaska plaice	38.27	38.27	24,500	0.16%
Skates	No overfishing, not overfished	Alaska skate	20.67	49.38	26,000	0.19%
		Whiteblotched skate	12.95			
		Aleutian skate	6.35			
		Commander skate	3.92			
		Leopard skate	1.81			
		Mud skate	1.49			

Species complex	Stock Status[a]	Species	Average AFSC research catch per year (mt) (2019-2013)[b]	Average AFSC research catch per year (mt) for group (2009-2013)	2014 Commercial BSAI TAC (mt)[c]	Average AFSC research catch compared to commercial BSAI TAC (percentage)
		Bering skate	1.14			
		Skates unidentified	1.05			
Sablefish	No overfishing, not overfished	Sablefish	19.18	19.18	3,150	0.61%
Kamchatka flounder	No overfishing, not overfished	Kamchatka flounder	14.28	14.28	7,100	0.20%
Other rockfish	No overfishing, overfished status unknown	Shortspine thornyhead	13.8	13.8	773	1.79%
Greenland turbot	No overfishing, not overfished	Greenland turbot	12.16	12.16	2,124	0.57%
Shortraker rockfish	Status unknown	Shortraker rockfish	5.31	5.31	370	1.44%
Sculpins	No overfishing, overfished status unknown	Yellow Irish lord	5.71	15.98	5,750	0.28%
		Bigmouth sculpin	2.13			
		Plain sculpin	2.88			
		Darkfin sculpin	1.52			
		Great sculpin	2.26			
		Warty sculpin	1.49			
Rougheye rockfish	No overfishing, not overfished	Blackspotted rockfish	3.33	5.75	416	1.38%
		Rougheye rockfish	2.43			
Non-allocated	Status unknown	Western eelpout	5.63	5.63	NA[f]	NA
Non-allocated	Status unknown	Saffron cod	2.94	2.94	NA[f]	NA
Forage Fish species	Status unknown	Eulachon	2.13	2.13	NA[f]	NA
Non-allocated	Status unknown	Arctic cod	1.9	1.9	NA[f]	NA
Forage fish species	Status unknown	Capelin	1.42	1.42	NA[f]	NA

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Some surveys reported number only; estimates of weight were made and included in the total for that species.

c. Source: 2014-2015 Alaska Groundfish Harvest Specification. Available online: https://alaskafisheries.noaa.gov/sustainablefisheries/specs14_15/

d. Walleye pollock is not considered overfished in the Eastern Bering Sea stock or in the Aleutian Islands stock. It is unknown whether the Bogoslof stock is overfished or not. Since survey data does not characterize which stock caught pollock are from, stock status represents fish from all walleye pollock stocks associated with the BSAIRA.

e. Since survey data does not characterize which stock caught pollock are from, this value represents a summation of all walleye pollock TACs associated with the BSAIRA.

f. Western eelpout, saffron cod, and Arctic cod are not in the BSAI FMP and are not required to have a TAC. Grenadier and forage fish, including capelin and eulachon, are considered "ecosystem component species" in the BSAI FMP but are not required to have a TAC because there are no directed commercial fisheries.

4.2.3.7 Fish Species in the Chukchi Sea and Beaufort Sea Research Area

Mortality from Fisheries Research Activities in the Chukchi Sea and Beaufort Sea Research Area

AFSC surveys are not deployed as regularly in the Alaskan Arctic as they are in the GOARA or BSAIRA – some surveys are only completed once every few years or even just a single time based on funding availability. However, it is important to consider the amount of potential mortality from such surveys to determine the potential impact on fish populations. For the purposes of this FPEA, the catch of fish species from all surveys in the CSBSRA during a recent five-year period (2009-2013) was combined to give an average amount of catch per year. The most frequently caught species are listed in Table 4.2-9.

Some AFSC fisheries and ecosystem research projects in the CSBSRA only record number of each species of fish caught and not weight. For a rough estimate of caught weight from these surveys, average weights were derived from published AFSC data where available, applied to average number reported, and added to totals from weight reporting surveys. Since commercial fishing is not allowed in the CSBSRA, ABCs are not assigned for any species. However, other metrics exist for assessing the impact of AFSC research surveys in the CSBSRA. Data from Arctic research cruises in the early 1990s were used to calculate biomass estimates for inclusion in the Arctic FMP (NPFMC 2009a). Species for which biomass estimates were computed represent those groups which were prevalent in the survey data or which likely represented important future target species (NPFMC 2009a). Comparison of these species with more recent survey data (shown in Table 4.2-9) can give clues to how the fish based biota of the Arctic has changed. These data indicate that for most target species the average amount of fish killed in AFSC fisheries and ecosystem research in the CSBSRA is much less than one percent relative to the estimated populations of these fish.

The most frequently caught species in recent AFSC research in the CSBSRA have been Arctic cod and saffron cod. For each of these species, survey catches amount to less than one percent of 2009 biomass estimates. Capelin, yellowfin sole, and prickleback catches have been much higher in comparison, 4.5 percent or more of 2009 biomass estimates. Many other fish caught in CSBSRA research also have catches which amount to less than one percent of 2009 biomass estimates. There are many potential explanations for the range of catch rates seen including incorrect initial biomass estimates (higher or lower than reality), or decreased population strength over time. Increased research data collection in the Arctic is necessary for monitoring the status of stocks in part because the moratorium prevents commercial fishing from contributing to knowledge about species distribution and abundance. In general, the type of programmatic analysis presented here indicates that research activities likely have minimal impact on Arctic populations and therefore pose little conservation concern. These ideas were presented earlier in this document during the discussion of mortality from fisheries research activities in the GOARA; refer to that section for further information.

Table 4.2-9 indicates that, while mortality to fish species is a direct effect of AFSC fisheries and ecosystem research in the CSBSRA, there are likely no measurable population changes occurring as a result of these research activities because they represent such a small percentage of the total population estimates for these species. For all target species in the CSBSRA, mortality from AFSC research activities would be minor in magnitude, dispersed over a wide geographic area, and therefore considered minor adverse for all target species under the Status Quo Alternative.

Table 4.2-9 Comparison of Estimated Fish Caught under the Status Quo Alternative Compared to Biomass Estimates in the CSBSRA

Species are listed in descending order of research catch for group by weight. Note that survey deployment from year to year is inconsistent and values only represent averages from recent surveys; future catch potential likely varies widely from what is shown in the table. Only survey species with average annual research catch greater than 10 kilograms are shown.

Stock	Stock Status[a]	Species	Average AFSC research catch per year (mt) (2009-2013)[b]	Average AFSC research catch per year (mt) for group (2009-2013)	2009 Biomass Estimate (mt)[c]	Average AFSC research catch compared to biomass estimate (percentage)
Arctic cod	Status unknown	Arctic cod	0.24	0.24	42339	<0.01%
Saffron cod	Status unknown	Saffron cod	0.15	0.15	4605	<0.01%
Miscellaneous fish species	status unknown	Pacific sandlance	0.08	0.14	265	0.054%
		Polar eelpout	0.01			
		Rainbow smelt	0.02			
		Starry flounder	0.04			
Capelin	Status unknown	Capelin	0.07	0.07	15	0.45%
Yellowfin sole	Status unknown	Yellowfin sole	0.05	0.05	17	0.30%
Pricklebacks	Status unknown	Slender eelblenny	0.03	0.03	132	0.02%
Warty sculpin	Status unknown	Warty sculpin	0.02	0.02	980	<0.01%
Bering flounder	Status unknown	Bering flounder	0.02	0.02	2224	<0.01%
Arctic staghorn sculpin	Status unknown	Arctic staghorn sculpin	0.01	0.01	844	<0.01%
Alaska plaice	Status unknown	Alaska plaice	0.01	0.01	56	0.02%
Snailfishes	Status unknown	Variegated snailfish	0.01	0.01	418	<0.01%

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Some surveys reported number only; estimates of weight were made and included in the total for that species.

c. Source: NPFMC 2009a

4.2.3.8 Conclusion

AFSC fisheries research conducted under the Status Quo Alternative could have effects on ESA-listed species, prohibited species, commercially targeted species, and non-managed fish species through mortality, disturbance, and changes in habitat.

For ESA-listed species, incidental capture of Pacific salmon from Washington and Oregon ESUs has occurred, and such incidental captures would likely continue to occur irregularly under the Status Quo Alternative but would be unlikely to have adverse effects on their populations due to small catches compared to large spawning populations and to take authorization caps. Overall effects of the Status Quo Alternative on ESA-listed fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration (for effects other than potential mortality) and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

For most species targeted by commercial fisheries and managed under FMPs, mortality due to research surveys and projects is accounted for during the FMP TAC-setting process and is much less than one percent of TACs (or other fishing metrics as available) and is considered to be minor in magnitude for all species. For a few species which do not have a large commercial market due to various market conditions, the research catch exceeds one percent of commercial catch but is still small relative to the population of each species and is considered minor in magnitude. Proposed research projects that target stocks that may approach an overfishing condition or other conservation concern in the future are reviewed annually before SRPs are issued to determine if they would conflict with rebuilding plans or present other conservation concerns. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities. Disturbance of fish and benthic habitats from research activities would be temporary and minor in magnitude for all species. The potential for accidental contamination of fish habitat from AFSC research vessels is considered minor in magnitude and temporary or short-term in duration. The overall effects of the Status Quo Alternative on non-ESA-listed fish would be minor in magnitude, distributed over a wide geographic area, and temporary or short-term in duration (for effects other than potential mortality) and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

In contrast to these adverse effects, AFSC research also provides long-term beneficial effects for managed fish species throughout the Alaska Region through its contribution to sustainable fisheries management. Data from AFSC fisheries and ecosystem research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by AFSC research programs effects are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data collected during fisheries research, provide the basis for monitoring changes to the marine environment important to fish populations.

4.2.4 Effects on Marine Mammals

Section 3.2.2 describes the marine mammals that are likely to overlap with fishery research activities in the three AFSC research areas. This section describes the potential effects of the AFSC research activities on marine mammals under the Status Quo Alternative, including measures that have been implemented in the past to mitigate those effects. Because the secondary federal action considered in this FPEA is NMFS, OPR consideration whether to issue regulations and a LOA to AFSC's application for promulgation of regulations and subsequent issuance of LOAs pursuant to under Section 101(a)(5)(A) of the MMPA, this section provides more information and analysis for effects on marine mammals than is presented for the analysis of effects on some other resources. Potential effects of fishery research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment on marine mammals include:

- Disturbance and behavioral changes due to acoustic equipment and the physical presence of researchers
- Injury or mortality due to ship strikes
- Injury or mortality due to entanglement or hooking in research gear
- Changes in food availability due to research removal of prey and discards
- Contamination from discharges

The first part of this section provides information on the mechanisms for these different types of effects. For those effects for which the mechanisms and levels of impact are similar for all species of marine mammals, the analysis is not repeated in the following research area and species subsections (4.2.4.1, 4.2.4.2, and 4.2.4.3).

The second part of the analysis provides information on the effects of the AFSC research activities on marine mammals and their habitat in each research area. An application for ITA under the MMPA (referred to in this document as the LOA application) must include estimates of the numbers of animals that may be taken by serious injury or mortality, harassment that has the potential to injure (Level A harassment takes), and harassment that has the potential to disturb (Level B harassment takes). The AFSC LOA application (Appendix C) only concerns the Preferred Alternative because that is the AFSC's proposed action. However, the analysis of takes in the LOA application is based on a similar scope of research activities as the Status Quo Alternative (a number of projects would not be continued and a few new projects would be added under the Preferred Alternative) and is therefore helpful in describing the potential effects of the Status Quo Alternative. For those research areas and marine mammal species where the effects of the Status Quo are considered the same or very similar to the Preferred Alternative, analysis provided in the LOA application is summarized and referenced in this section. Where the scope of activities differs between the Status Quo and Preferred Alternatives, the analysis of effects from the LOA application are summarized and referenced in the Preferred Alternative (Section 4.3.4). The following analysis focuses on the types of research gear most likely to have adverse interactions with marine mammals.

4.2.4.1 Disturbance and Behavioral Responses due to Acoustic Equipment

Several mechanisms exist by which research activities could potentially disturb marine mammals and alter behavior, including the physical presence of marine vessels and fishing gear combined with operational sounds from engines, hydraulic gear, and acoustical devices used for navigation and research. The impacts of anthropogenic noise on marine mammals have been summarized in numerous articles and reports including Richardson et al. (1995), NRC (2005), and Southall et al. (2007). Marine mammals use hearing and sound transmission to perform vital life functions. Sound (hearing and vocalization/ echolocation) serves four primary functions for marine mammals, including: 1) providing information about their environment, 2) communication, 3) prey detection, and 4) predator detection. Introducing sound into their environment could disrupt those behaviors. The distances to which anthropogenic sounds are audible depend upon source levels, frequency, ambient noise levels, the propagation characteristics of the environment, and sensitivity of the marine mammal (Richardson et al. 1995).

In assessing potential effects of noise, Richardson et al. (1995) suggested four criteria for defining zones of influence:

- Zone of audibility – the area within which the marine mammal might hear the sound. Marine mammals as a group have functional hearing ranges of 10 hertz to 180 kHz, with highest sensitivities to sounds near 40 kHz (Ketten 1998, Kastak et al. 2005, Southall et al. 2007). These data show reasonably consistent patterns of hearing sensitivity within each of four groups: baleen whales, small odontocetes (such as harbor porpoise), other odontocetes (such as beluga, sperm, and killer whales), and pinnipeds.
- Zone of responsiveness – the area within which the animal reacts behaviorally or physiologically. The behavioral responses of marine mammals to sound depend on: 1) acoustic characteristics of the noise source; 2) physical and behavioral state of animals at time of exposure; 3) ambient acoustic and ecological characteristics of the environment; and 4) context of the sound (e.g., whether it sounds similar to a predator) (Richardson et al. 1995, Southall et al. 2007). Temporary behavioral effects, however, often merely show that an animal heard a sound and may not indicate lasting consequences for exposed individuals (Southall et al. 2007). Recent analysis of potential causes of a mass stranding of 100 typically oceanic melon-headed whales (*Peponocephala electra*) in Madagascar in 2008 implicate a mapping survey using a high-power

12 kHz multi-beam echosounder (MBES) as a likely trigger for this event. Although the cause is equivocal and other environmental, social, or anthropogenic factors may have facilitated the strandings, the authors determined the MBES the most plausible factor initiating the stranding response, suggesting that avoidance behavior may have led the pelagic whales into shallow, unfamiliar waters (Southall et al. 2013).

Factors that may affect the response of a marine mammal to a given noise generally cannot be determined ahead of time. In lieu of having this information, NMFS uses a standardized noise level to help determine how many animals may be disturbed (harassed) by a given activity during the MMPA authorization process. NMFS currently uses a sound threshold of 160 dB referenced to 1 µPa (rms) for impulse noises to determine the onset of behavioral harassment for marine mammals (Level B harassment takes) (NMFS 2005b). Any animal exposed to impulse noises above this level is assumed to respond in a way consistent with the definition of a behavioral "take" under the MMPA, although NMFS acknowledges that some marine mammals may react to sounds below this threshold and that some animals exposed to sounds at or above this threshold may not react in ways consistent with behavioral harassment.

- Zone of masking – the area within which the noise may interfere with detection of other sounds, including communication calls, prey sounds, or other environmental sounds.
- Zone of hearing loss, discomfort, or injury – the area within which the received sound level is potentially high enough to cause discomfort or tissue damage to auditory or other systems. Underwater sounds produced by the active acoustic equipment used during AFSC research have several characteristics (e.g., frequency, pulse duration, directionality, and power level) that make them highly unlikely to produce hearing loss or injury (Level A harassment) in marine mammals, which is an issue of concern for industrial and military actions.

The AFSC has been using a variety of sonar systems during its research cruises to characterize marine habitats and fish aggregations. The sounds produced by equipment used by the AFSC range from 18-200 kHz and from <200 dB to 230 dB referenced to 1 µPa (Appendix C, Section 6.2). This acoustic equipment sends pulses of sound into the marine environment which provide information as they reflect back to the ship and are recorded (see Appendix A for a more detailed description of active acoustic instruments used in AFSC research, including frequency ranges, beam width, source power levels, and other sound characteristics). The LOA application (Appendix C, Section 6.2) categorized active acoustic sources used by the AFSC during research based on operating frequency and output characteristics. Category 1 active acoustic sources include short range echosounders and ADCPs. These have output frequencies >300 kHz, are generally of short duration, and have high signal directivity. Category 2 active acoustic sources include various single, dual, and MBESs, devices used to determine trawl net orientation, and current profilers of lower output frequencies than category 1 sources. Output frequencies of category 2 sources range from 12 to 200 kHz, have short ping durations, and are usually highly directional for mapping purposes.

Although these acoustic systems have been used for years and may have been a source of disturbance for nearby marine mammals, no direct observations of disturbance have been documented, primarily because any such disturbance, if it occurred, would have taken place under water. For animals at the surface, it is very difficult to determine whether a given sound source has caused any observed changes in behavior or whether the physical presence of the vessel has caused the disturbance. In many cases it is likely to be a combination of visual and audio components that causes a disturbance. It may also be difficult to determine if an animal has actually changed its behavior to avoid a disturbance or if it is moving for other reasons (e.g., to pursue nearby prey). For these reasons there have been no records or documentation of how many animals may have been disturbed (Level B harassment) by sounds generated from acoustic equipment during research cruises in the past. However, the MMPA requires applicants who are requesting authorization for incidental take of marine mammals to estimate how many animals may be affected by their actions.

50 Code of Federal Regulations (CFR) Part 216[2] distinguish between Level B harassment that causes behavioral changes in the affected marine mammals and Level A harassment that has the potential to cause injury. Animals exposed to intense sounds may experience reduced hearing sensitivity for some period of time following exposure. This change in hearing threshold is known as noise induced threshold shift (TS). The amount of TS incurred is influenced by amplitude, duration, frequency content, temporal pattern, and energy distribution of the noise (Richardson et al. 1995, Southall et al. 2007). It is also influenced by characteristics of the animal, such as hearing range of the species, behavior, age, history of noise exposure, and health. The magnitude of TS generally decreases over time after noise exposure and if it eventually returns to zero, it is known as 'temporary threshold shift' (TTS). If TS does not return to zero after some time (generally on the order of weeks), it is known as 'permanent threshold shift' (PTS). Sound levels associated with TTS onset are generally considered to be below the levels that will cause PTS, which is considered to be auditory injury.

NMFS technical guidance for Level A harassment is that cetaceans should not be exposed to impulsive sounds greater than 180 dB re 1 µPa (rms) and that pinnipeds should not be exposed to impulsive sounds greater than 190 dB re 1µPa (rms) (65 FR 39874, June 28, 2000). However, these criteria were established before information was available about minimum received levels of sound that would cause auditory injury in marine mammals. They are likely lower than necessary and are intended to be precautionary estimates above which physical injury may occur (Southall et al. 2007).

In an extensive review of the effects of noise on marine mammal hearing and behavior, Southall et al. (2007) suggest that relatively high levels of sound are likely required to cause temporary hearing threshold shifts in most pinnipeds and odontocete cetaceans (e.g., Schlundt et al. 2000; Finneran et al. 2002, 2005, 2007; Kastak et al. 1999, 2005, 2007). Based on the results of these studies, peak sound pressure levels in the range of approximately 180-220 dB re: 1µPa are required to induce onset of TTS for most species; the TTS onset values for harbor seals in air ranged from 135 to 149 dB re: 20µPa (Southall et al. 2007). PTS onset criteria, based on sound pressure level, for individual marine mammals exposed to discrete single pulse, multiple pulse, or nonpulse noise events were derived by adding 6 dB to peak pressure levels known or assumed to elicit TTS-onset. Resulting values are 230 dB re: 1µPa for cetaceans, 281 dB re: 1µPa for pinnipeds in water, and 149 db re: 20µPa for pinnipeds in air (Southall et al. 2007). Southall et al. (2007) also provided some frequency weighting functions for different marine mammal groups to account for the fact that impacts of noise on hearing depend in large part on the overlap between the range of frequencies in the sound source and the hearing range of the species. Based on the Southall et al. (2007) results, Lurton and DeRuiter (2011) modeled the potential impacts (PTS and behavioral reaction) of conventional echosounders on marine mammals. They estimated PTS onset at typical distances of 10 to 100 m for the kinds of acoustic sources used in fisheries surveys considered here. They also emphasized that these effects would very likely only occur in the cone insonified below the ship and that behavioral responses to the vessel at these extremely close ranges would very likely influence the probability of animals being exposed to these levels.

Animals are likely to avoid a moving vessel, either because of its physical presence or because of behavioral harassment resulting from exposure to sound from active acoustic sources. It is unlikely that animals would remain in the presence of a harassing stimulus absent some overriding contextual factor. Because of this likely avoidance behavior, as well as the source characteristics (i.e., intermittent pulsing and narrow cones of insonification), the AFSC has determined that the risk of animals experiencing repetitive exposures at the close range or of the duration necessary to cause PTS is negligible. The AFSC therefore does not anticipate causing any Level A harassment by acoustic sources of marine mammals and the LOA application includes no such take estimates. The potential for this type of impact on marine mammals will not be discussed further in this FPEA.

However, the AFSC recognizes that the use of active acoustic equipment in its research activities has the potential to cause Level B harassment of marine mammals. In its LOA application for the Preferred Alternative, the AFSC estimated the numbers of marine mammals that may be exposed to sound levels of 160 dB (rms) or above due to the use of acoustic sonars during research cruises (Level B harassment takes). The LOA application used the operational conditions and scope of work conducted in the past five years to estimate what may occur in the future under the Preferred Alternative. The Preferred Alternative would include a few changes in the AFSC surveys and research projects relative to the Status Quo Alternative (Table 2.3-1). Under the Preferred Alternative, the types of acoustic devices and protocols used do not differ from those employed under the Status Quo Alternative. The acoustic take estimates presented in the LOA application therefore also represent potential numbers of animals affected under the status quo conditions.

As explained in the LOA application, these estimates attempt to quantify a dynamic situation with substantial unavoidable uncertainty regarding the propagation of sound in the water and distribution of marine mammals over very large areas. The scientific description of sound generated by sonar gear and its propagation through water is complicated, especially considering a sound source that is moving (on a vessel) through waters of different depths and properties (e.g., salinity and temperature) that affect sound transmission. The LOA application provides details on the assumptions that were made about the source levels and acoustic properties of sonar pulses, the directionality of the sound, and propagation/attenuation properties that were used to calculate an "insonified area" considered loud enough to harass marine mammals. One part of the AFSC acoustic take calculation used a model of sound propagation from typical sonar equipment used during research to estimate the shape and dimensions of a typical insonified zone ≥ 160 dB re 1 μPa (rms), which was multiplied by the distance research ships travel with active sonar gear to derive an estimated total area insonified to the Level B harassment take guidelines.

Another aspect of this Level B harassment take estimation process subject to large uncertainty concerns the distribution and abundance of marine mammals in the area. No species is distributed evenly throughout its range; they are typically patchy in distribution with strong seasonal variations and preferences for certain zones within the water column. Although some preferred habitats and general distributions are known, it is not possible to know precisely how many animals will be in a given area at any point in the future. The estimation process therefore uses average density of each species to estimate how many may be affected within the insonified area. One refinement that has been built into the Level B harassment take model is to categorize each marine mammal species according to its typical dive depth range, which affects the size of the insonified zone to which they may be exposed (Appendix C). The estimation process is admittedly subject to great uncertainty and there is no way to assess how realistic these estimates are in terms of the number of animals that would be disturbed by the activity. However, development of the Level B harassment take model was conservative in that assumptions made would tend to overestimate the size of the insonified area and the number of animals affected.

This FPEA (and the LOA application) must also assess what the likely biological effects may be for the estimated Level B harassment takes by acoustic sources. The LOA application (Appendix C, Section 6.2) provides an analysis of the potential effects of acoustic equipment used in AFSC research on marine mammals. The analysis in this FPEA is a summary of the LOA application analysis and will be provided in the subsections on cetaceans and pinnipeds because their different hearing ranges and frequencies used for communication determine what the effects of different acoustic equipment might be. This effort to examine the biological importance of acoustic disturbance requires knowledge about whether animals can perceive the sonar signals, their potential reactions to various types of sounds, and the conditions under which particular sound sources may lead to biologically meaningful effects (i.e., interference with feeding opportunities or critical social communication). Many key aspects of marine mammal behavior relevant to this discussion are, however, poorly understood. Most of the data on marine mammal hearing and behavioral reactions to sound come from relatively few captive, trained animals and likely does not reflect the diversity of behaviors in wild animals. Some behavioral reactions, if they occur in one or more species, could substantially reduce the numbers of animals exposed to high sound levels (e.g., swimming away from an approaching ship before sound levels reach the 160 dB rms level). Industrial projects such as seismic exploration for oil and gas and pile driving in relation to coastal developments are typically required to monitor marine mammal behavioral responses in relation to percussive industrial sounds but there have been few efforts to document behavioral changes in response to acoustic equipment commonly used in fisheries research.

4.2.4.2 Injury or Mortality due to Ship Strikes

Vessel collisions with marine mammals, or ship strikes, can lead to death by massive trauma, hemorrhaging, broken bones, or propeller wounds (Knowlton and Kraus 2001). Large whales, such as fin whales, are occasionally found draped across the bulbous bow of large ships upon arriving in port. Massive propeller wounds can be immediately fatal. If more superficial, the whales may survive the collisions (Silber et al. 2009). Jensen and Silber (2003) summarized large whale ship strikes world-wide and found that most collisions occurred in the open ocean involving large vessels. Commercial fishing vessels were responsible for four of 134 records (three percent), and one collision (0.75 percent) was reported for a research boat, pilot boat, whale catcher boat, and dredge boat.

Numerous vessels, including commercial and recreational fishing boats, ferries, cruise ships, tankers, cargo ships, container ships, tugs and barges, and government (e.g., Coast Guard, military, and research) vessels traverse coastal and offshore Alaska waters, accessing various ports in Alaska or traveling the North Pacific Great Circle Route through the Aleutian Islands and Bering Sea to Asia. Whale-vessel collisions occur in Alaskan waters, albeit infrequently. All but one reported collisions in Alaska from 1978 to 2011 were in the GOA, primarily during May to September, and in Southeastern Alaska. Of the 89 definite and 19 probable ship strikes, 25 resulted in mortality (Neilson et al. 2012). Small vessel (<15 m) strikes were most common (60 percent), followed by medium (15–79 m, 27 percent) and large (≥80 m, 13 percent) vessels. Large vessels (190–294 m) were involved in fatal collisions for which vessel length was known and vessel speed was 12-19 knots in the three cases in which it was known (Neilson et al. 2012). There were two reports of ship strikes of fin whales and none of blue or sperm whales in Alaskan waters from 2009 to 2013. The western and central North Pacific stocks of humpback whales averaged 0.2 and 1.9 mortalities or serious injuries per year, respectively, due to ship strikes in Alaska during that same time period (Muto and Angliss 2015). Although there are no reports of vessel collisions, the possible impact of ship strikes on the recovery of North Pacific right whale populations is poorly understood. Ship strikes are a significant cause of injury and mortality for North Atlantic right whales, suggesting equal vulnerability of North Pacific right whales to such threats. However, their rare occurrence and scattered distribution make it impossible to adequately assess the threat of ship strikes to North Pacific right whales at this time (Muto and Angliss 2015, NMFS 2013b).

Vessel speed appears to be key in determining the frequency and severity of ship strikes, with the potential for collision increasing at ship speeds of 15 knots and greater (Laist et al. 2001, Vanderlaan and Taggart 2007). In the relatively few recorded cases of ship strikes at speeds below 15 knots, the chance of mortality declines from approximately 80 percent at 15 knots to approximately 20 percent at 8.6 knots (Vanderlaan and Taggart 2007). Reducing the co-occurrence of whales and vessels may be the only sure way to reduce ship strikes, but this is not always feasible (Silber et al. 2009). .

No collisions with large whales have been reported from any fisheries research activities conducted or funded by the AFSC. Transit speeds vary from 6-14 knots, with the extremes occurring when ships are running against or with fast tidal currents, but are typically 10 knots maximum. The vessel's speed during active sampling is typically 2-5 knots due to sampling design and these much slower speeds essentially eliminate the risk of ship strikes.

Given the relatively slow speeds of AFSC research vessels, the presence of bridge crew watching for marine mammals during survey activities, and the small number of research cruises, ship strikes with marine mammals during the AFSC fisheries and ecosystem research activities described in this FPEA would be considered rare in frequency, localized in geographic scope, and unlikely to occur in the near future. The potential for AFSC fisheries research vessels to cause serious injury or mortality to any cetaceans or pinnipeds due to ship strikes is considered minor adverse throughout the AFSC research areas using vessel types and protocols currently in use. This potential effect of research will not be discussed further in the following analysis.

4.2.4.3 Injury or Mortality due to Entanglement/Hooking in Research Gear

Entanglement and capture or hooking in fishing gear is a significant source of human-caused injury or mortality for some marine mammals. Although not always as immediately fatal as ship strikes, entanglements or hooking can lead to prolonged weakening or deterioration of an animal (Knowlton and Kraus 2001). This is particularly true for large whales; small whales, dolphins, porpoises, and pinnipeds are more likely to die when entangled.

Commercial fisheries in Alaska with known bycatch of marine mammals include those using longlines, set gillnets, drift gillnets, trawls, pot gear, and purse seines (Allen and Angliss 2015). Further details regarding specific fisheries and marine mammal bycatch will be discussed when considering cumulative effects (Section 5.5). Several of these gear types are employed during AFSC fisheries research surveys, including bottom and mid-water trawls, surface trawls, and longlines, with minimal use of gillnets and pot gear (Table 2.2-1).

All four incidental takes of marine mammals during AFSC fisheries research from 2004 through 2015 involved trawl gear and occurred in the GOARA (Table 4.2-9 and Figure 4.2-1). Species involved two Dall's porpoises taken in surface trawls, one northern fur seal taken in a bottom trawl, and a northern sea otter taken in a surface trawl. None survived. In August 2019 an unidentified pinniped was taken in a longline survey. There have been no takes of marine mammals incidental to AFSC fisheries research in the BSAIRA or in the CSBSRA.

Most of the mitigation measures rely on visual monitoring and detection of marine mammals near the vessel or fishing gear. There are many variables that influence the effectiveness of visual monitoring at any one time, including the lighting and sea state and the capabilities of the person(s) assigned to watch, so it is impossible to determine an overall measure of effectiveness, such as how many animals may have been avoided with visual monitoring compared to having no monitors. The value of implementing some mitigation measures is therefore based on general principles and best available information even if their effectiveness at reducing takes has not been scientifically demonstrated.

Figure 4.2-1 shows the spatial distribution of marine mammals that have been taken in AFSC surveys from 2004 through 2015, and Table 4.2-9 indicates the date and time of interaction. These historical takes are dispersed fairly widely and there does not appear to be any spatial pattern of high risk areas (i.e., "hot spots" for marine mammal takes) or any temporal pattern with regard to seasons or times of day.

The MMPA authorization process requires the applicant (AFSC) to estimate how many marine mammals may be captured or entangled in the future under the proposed set of conditions. As is the case for Level B harassment takes by acoustic sources, the LOA application describes the methodology used to estimate the species and numbers of animals that may be taken by Level A harassment and serious injury or mortality during future research conducted under the Preferred Alternative. The LOA application combines estimated Level A harassment takes with serious injury or mortality takes because the degree of injury resulting from gear interaction cannot be predicted. The lethal take estimates are based on the past history of takes by the AFSC under the status quo conditions. For the species that have been taken historically during AFSC research, the LOA application uses the calculated average annual numbers of takes that occurred in the past 12 years (2004-2015) and "rounds up" this annual average to the next highest whole number of animals. For example, an average of 0.3 animals per year was rounded up to one animal. Since the LOA application requests takes for a five-year period, this intentionally inflated annual average is multiplied by five to produce an estimate higher than the historic average take for each species that has been taken incidentally during AFSC research.

The LOA application also includes estimates for future incidental takes of species that have not been taken historically but exist in the same areas and show similar vulnerabilities as species that have been taken in the past. Factors considered when determining if a species may have similar vulnerabilities to certain types of gear as historically taken species include density, abundance, behavior, feeding ecology, group size and composition, and association with species historically taken. For these analogous species, the AFSC estimates the annual take to be equal to the maximum take per any given set of a similar species that was historically taken during 2004-2015. This method is based on the assumption that such takes would likely occur rarely, if at all, but may involve more than one animal in a given trawl or set given the social nature of many marine mammals.

The AFSC has no history of marine mammal takes in longline or gillnet gear, so all requested takes for these gear types are based on takes in analogous commercial fishing operations. For analogous commercial fisheries, the AFSC referenced the 2016 LOF. Additional factors considered in determining the likelihood of interactions with analogous gear included relative survey effort, survey location, similarity in gear type, and animal behavior. There are several species, such as large whales, that are known to interact with commercial longline fisheries but for which AFSC is not requesting take. The likelihood of interacting with AFSC longline gear is extremely low considering the low level of survey effort relative to that of commercial fisheries. Since there are neither historical takes by the AFSC or commercial fisheries in the CSBSRA, take requests for that area are based on spatial-temporal overlap between AFSC fisheries research effort and species occurrence.

Table 4.2-10 Historical Takes of Marine Mammals during AFSC Surveys from 2004 through 2015

Note that all of the AFSC historical takes occurred in the Gulf of Alaska Research Area.

Survey Name	Species Taken	Gear Type	Date (Time) Taken	# Killed	# Released	Total Taken
2011						
Gulf Project –Upper Trophic Level[2]	Dall's porpoise	Cantrawl Surface Trawl	21 September (07:41)	1	0	1
Gulf Project –Upper Trophic Level [2]	Dall's porpoise	Cantrawl Surface Trawl	10 September (16:25)	1	0	1
2009						
Gulf of Alaska Biennial Shelf and Slope Bottom Trawl Groundfish Survey	Northern fur seal (Eastern Pacific stock)	Bottom trawl	13 June (18:23)	1	0	1

Survey Name	Species Taken	Gear Type	Date (Time) Taken	# Killed	# Released	Total Taken
2008						
Southeast Alaska Coastal Monitoring	Northern sea otter[3]	Nordic 264 Surface Trawl	23 August (19:30)	1	0	1
TOTAL						
				4	**0**	**4**

1. Serious injury determinations were not previously made for animals released alive, but will be part of standard protocols for released animals after such incidental takes are authorized and will be reported in Stock Assessment Reports.
2. Survey reduced in scope and renamed the "Gulf of Alaska Assessment" under the Preferred Alternative
3. Based on location, take was most likely from the Southeastern Alaska DPS.

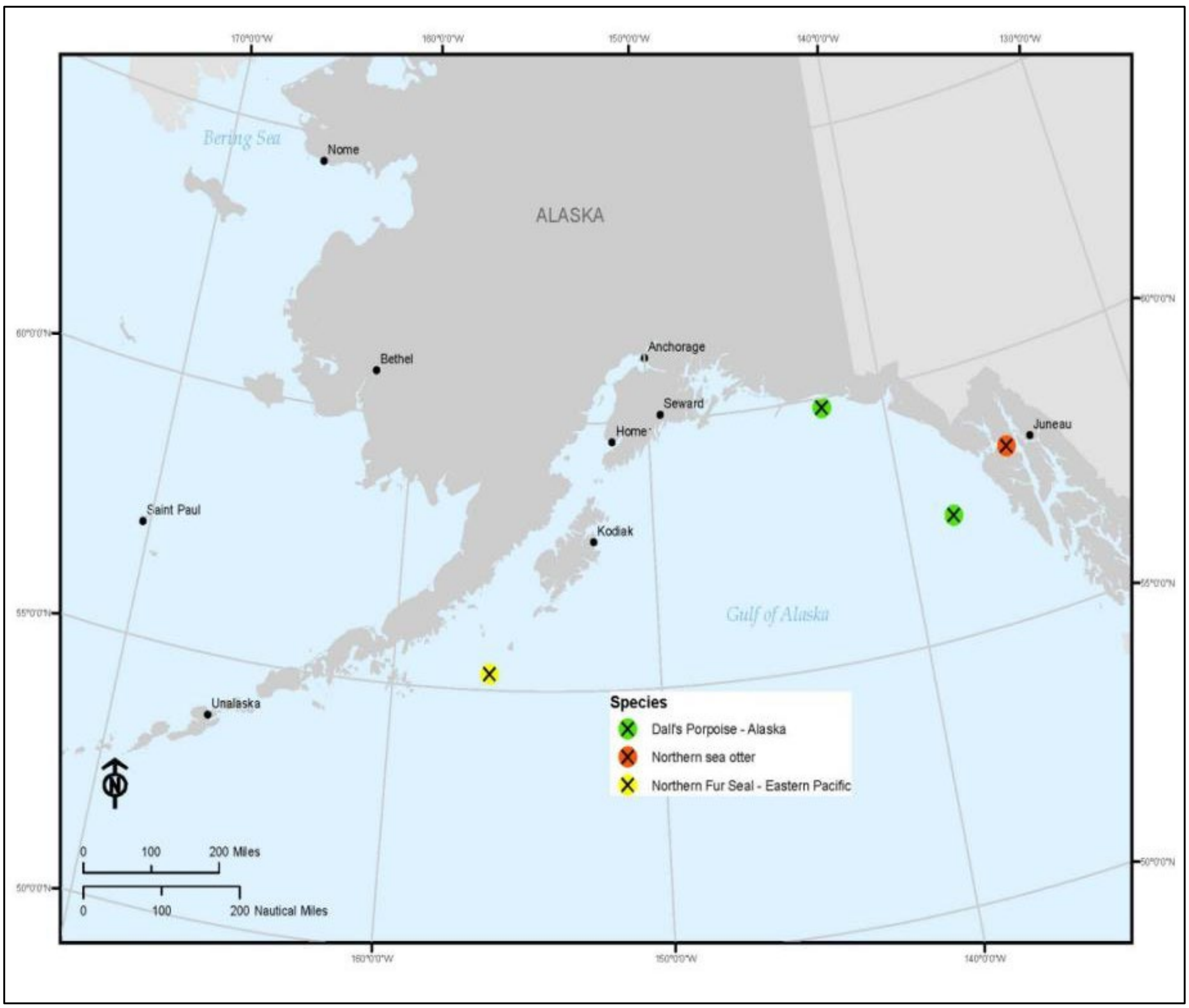


Figure 4.2-1 Location of Marine Mammal Takes during AFSC Research from 2004 through 2015

4.2.4.4 Changes in Food Availability due to Research Survey Removal of Prey and Discards

Prey of marine mammals varies by species, season, and location and, for some, is not well documented. There is some overlap in prey of marine mammals in the AFSC research areas and the species sampled and removed during fisheries research surveys. The species of primary concern in regard to this overlap are walleye pollock, Pacific cod, Atka mackerel, sablefish, salmonids, and small, energy-rich, forage fish species such as Pacific sandlance and Pacific herring. However, the total amount of these species taken in research surveys is very small relative to their overall commercial and recreational catches and biomass, when known (See Section 4.2.3 for more information on fish caught during research surveys). A more detailed analysis of AFSC fisheries research catches within Steller sea lion critical habitat is presented in Section 4.2.4.7.

In addition to the small total biomass taken, some of the size classes of fish targeted in research surveys are very small (e.g., juvenile salmonids only centimeters long) and these small size classes are not generally targeted by marine mammals. Research catches are also distributed over a wide area because of random sampling designs and other sampling protocols that take small samples within large sample areas. Fish removals by research are therefore highly localized and unlikely to affect the spatial concentrations and availability of prey for any marine mammal species.

AFSC fisheries research catch levels are very small relative to the estimated consumption of prey by marine mammals, dispersed over large areas and time periods, and are unlikely to affect changes in prey type or quantity available to any marine mammals. The potential for AFSC research to affect the availability of prey to marine mammals is considered to be minor adverse for all species and all three research areas and it will not be discussed further.

4.2.4.5 Contamination from Discharges

Discharge from vessels, whether accidental or intentional, include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and plastics. Impacts to marine mammals in the vicinity of the discharge range from superficial exposure to ingestion and related effects. Even at low concentrations that are not directly lethal, some contaminants can cause sub-lethal effects on sensory systems, growth, and behavior of animals, or may be bioaccumulated (DOE 2008).

All NOAA vessels and AFSC chartered vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (NOAA 2010a). MARPOL includes six annexes that cover discharge of oil, noxious liquid substances, harmful packaged substances, sewage, garbage, and air pollution (IMO 2010). Adherence to these regulations minimizes or negates the likelihood of discharges of potentially harmful substances into the marine environment. Annex V specifically prohibits plastic disposal anywhere at sea and severely restricts discharge of other garbage (IMO 2010).

Discharge of contaminants from AFSC vessels and AFSC chartered vessels is possible, but unlikely to occur in the next five years. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to marine mammals would be similarly short-term, localized, and likely affect a small number of animals. The overall impact of accidental contamination of marine mammals would therefore be considered minor adverse. As the potential effects of discharges, regulations governing discharges, and the likelihood of discharges is universal throughout the AFSC research areas, this will not be discussed further in this analysis.

4.2.4.6 Gulf of Alaska Research Area

ESA-listed Species

The endangered marine mammals that occur in the GOARA include Cook Inlet beluga whales, sperm, humpback, blue, fin, and sei whales, North Pacific right whales, and the Western DPS of Steller sea lions. The Southwest Alaska DPS of the northern sea otter is listed as a threatened species. Sea otters are under the jurisdiction of the USFWS, while the remainder is under the jurisdiction of NMFS in regard to compliance with the MMPA and ESA.

Disturbance and Behavioral Responses due to Acoustic Equipment and Physical Presence of Researchers

The LOA application includes calculations of the number of marine mammals that may be exposed to sound levels above 160 dB from all acoustic devices used during AFSC research activities in the GOARA over the five-year authorization period. Those calculations include a number of assumptions and elements with large variables over time and space (e.g., the volumetric densities of marine mammals and the propagation of sound under different conditions). The AFSC believes this quantitative approach benefits from its simplicity and consistency with current NMFS guidelines on estimating Level B harassment by acoustic sources, but cautions that the resulting take estimates should be considered as overestimates of behavioral harassment from acoustic devices. The FPEA reports the results of those estimates in Table 4.2-11, but see Appendix C for a discussion about the derivation and concerns about the accuracy of these estimates. The likely impact on ESA-listed species from the different types of acoustic devices is discussed below.

Table 4.2-11 Estimated Level B Harassment Takes of Marine Mammals by Acoustic Sources during AFSC Research in the GOARA over a Five Year Period

Species (Common Name)	Total Estimated Level B Take (numbers of animals)	Species (Common Name)	Total Estimated Level B Take (numbers of animals)
Baird's beaked whale - Alaska Stock	4	Killer whale - Eastern North Pacific Alaska Resident Stock	20
Beluga whale - Cook Inlet DPS [1]	3	Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	2
Blue whale [1]	1	Killer whale - Eastern North Pacific Northern Resident Stock	6
Cuvier's beaked whale - Alaska Stock	1	Killer whale - West Coast Transient Stock	13
Dall's porpoise - Alaska Stock	5200	Killer whale - Offshore Stock	24
Fin whale - Northeast Pacific Stock[1]	44	Minke whale - Alaska Stock	3
Gray whale - Eastern North Pacific Stock	4650	North Pacific right whale - Eastern North Pacific Stock[1]	1
Gray whale - Western North Pacific Stock[1]	0	Northern elephant seal	52

Species (Common Name)	Total Estimated Level B Take (numbers of animals)	Species (Common Name)	Total Estimated Level B Take (numbers of animals)
Harbor porpoise - Gulf of Alaska Stock	650	**Northern fur seal - California Stock GOA E 144**	143
Harbor porpoise - Southeast Alaska Stock	358	**Northern fur seal - Eastern Pacific Stock GOA wide, winter**	459
Harbor seal - Clarence Strait Stock	214	**Northern fur seal - Eastern Pacific Stock GOA wide, summer**	237
Harbor seal - Cook Inlet/Shelikof Strait Stock	68	**Pacific white-sided dolphin - North Pacific Stock**	33
Harbor seal - Dixon/Cape Decision Stock	123	**Sei whale[1]**	1
Harbor seal - Glacier Bay/Icy Strait Stock	49	**Sperm whale - North Pacific Stock[1]**	3
Harbor seal - Lynn Canal/Stephens Passage Stock	64	**Stejneger's beaked whale - Alaska Stock**	12
Harbor seal - North Kodiak Stock	21	**Steller sea lion - Eastern Stock GOA wide**	192
Harbor seal - Prince William Sound Stock	131	**Steller sea lion - Eastern Stock E 144**	717
Harbor seal - Sitka/Chatham Strait Stock	101	**Steller sea lion - Eastern Stock W 144**	4
Harbor seal - South Kodiak Stock	48	**Steller sea lion - Western DPS GOA wide[1]**	115
Humpback whale - Central North Pacific Stock[1]	116	**Steller sea lion - Western DPS E 144[1]**	10
Humpback whale - Western North Pacific Stock[1]	2	**Steller sea lion - Western DPS W 144[1]**	156
Killer whale - AT1 Transient/Prince William Sound Stock	2	**--**	--

1. ESA-listed species

The output frequencies of Category 1 active acoustic sources (short range echosounders, ADCPs) are >300 kHz and are generally short duration signals with high signal directivity (Appendix C, Section 6.2). The functional hearing range of baleen whales is 7 Hz-25 kHz, with highest sensitivity generally below 1 kHz, for mid-frequency hearing odontocetes (e.g., sperm whales and beluga whales) it is 150 Hz-160 kHz, with highest sensitivity from 10-120 kHz, and is 100 Hz to 40 kHz, with highest sensitivity at 1-16 kHz for otariids, such as Steller sea lions. These functional hearing ranges fall below the output frequency of Category 1 sources, which are unlikely to be detected by right, humpback, fin, sei, blue, beluga, or sperm whales, or Steller sea lions (Figure 4.2-2).

Category 2 active acoustic sources (various single, dual, and MBESs, devices used to determine trawl net orientation and several current profilers) have frequencies of 12-200 kHz, short ping durations, and are usually highly directional. These are unlikely to be heard by most baleen whales, but are within the hearing ranges of sperm and beluga whales. If detected, short term avoidance is the most likely response, which would tend to reduce the exposure of animals to high sound levels, so that the potential for direct physical injury is virtually zero (Appendix C, Section 6.2).

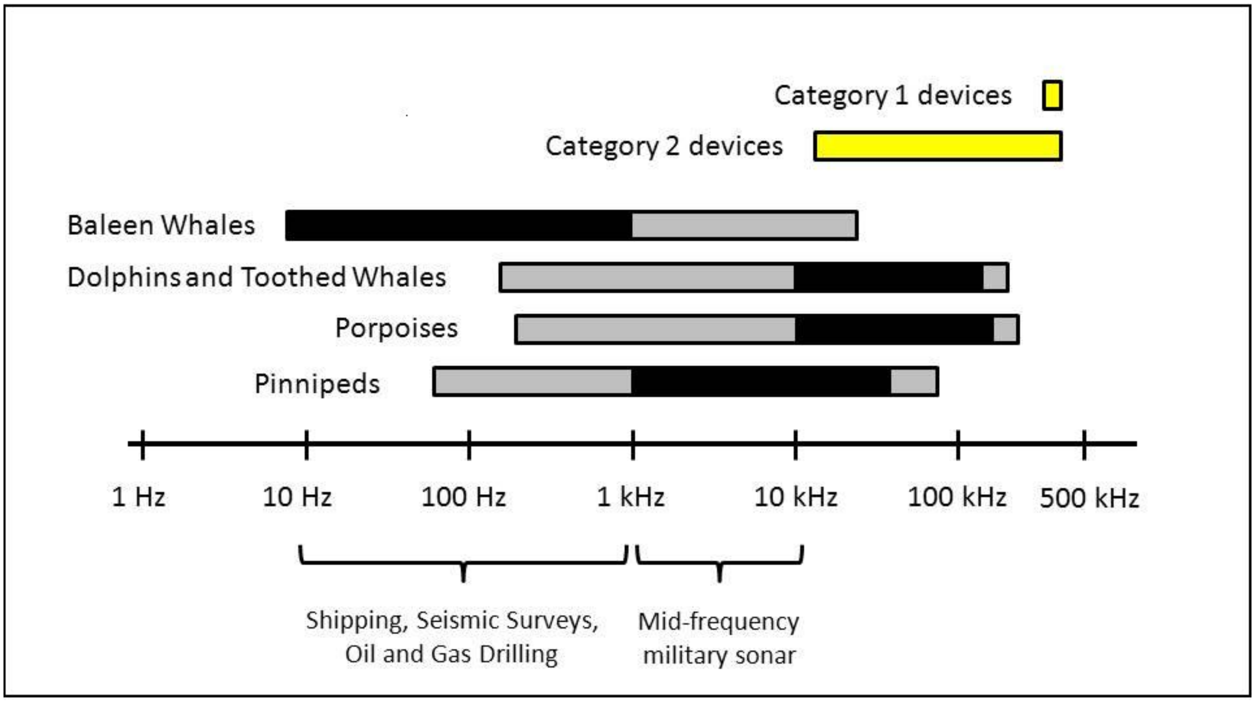


Figure 4.2-2 Typical Frequency Ranges of Hearing in Marine Mammals

Figure 4.2-2 shows hearing ranges for different marine mammal groups (gray and black bars) relative to the frequency outputs of the two categories of acoustic devices used in AFSC research (yellow bars), as identified in Appendix C, Section 6.2. Black bars indicate the most sensitive hearing ranges of different marine mammals. Brackets indicate frequency ranges of several industrial sound sources as well as U.S. Navy mid-frequency active sonar for comparison. Data on hearing ranges is from Southall et al. (2007) and modified from DON (2008b). The functional hearing range of sea otters in water has not been determined.

The anticipated effects of active acoustic sources used during AFSC fisheries research on threatened and endangered marine mammals is likely to occur infrequently, although they may occur over a large geographic area. Most of the frequencies are well above detection ranges for ESA-listed baleen whales, while Category 2 output overlaps with the hearing range of sperm whales, beluga whales, and Steller sea lions. To date, there have been no reports or observations of sounds from AFSC research activities disturbing or affecting behavioral changes in ESA-listed species.

Vessel noise may affect large whales through masking of biologically important sounds, particularly for low frequency baleen whales (Clark et al. 2009). The biological significance of masking from vessel noise is not known for any species but presumably the effects could include a decreased ability to detect sounds used in communication, predator avoidance, and orientation. However, the relatively small number of AFSC research vessels is likely to only result in temporary and minimal effects from acoustic masking as vessels pass through an area (Appendix C, Section 6.2).

The potential effects from the use of active acoustic devices during research activities would be small in magnitude and short-term in duration, although they would be dispersed over a wide geographic area and be likely to occur under the Status Quo Alternative. The overall impacts of acoustic disturbance to ESA-listed marine mammals throughout the GOARA are therefore considered to be minor adverse.

Additionally, pinnipeds using numerous haulouts and rookeries in the GOARA and BSAIRA may be disturbed by the physical presence and sounds of researchers passing nearby in boats as they travel to or from research sites or while conducting nearshore surveys. AFSC researchers are very aware of this situation and take precautions to minimize the frequency and scope of potential disturbances, including choosing travel routes as far away from hauled out pinnipeds as possible and moving sample site locations to avoid consistent haulout areas. There are, however, areas where the options for vessel traffic are limited. Combined with the fact that pinnipeds may haul out in new locations on a regular basis, it is essentially impossible for researchers to completely avoid disturbing pinnipeds as they travel around. Table 4.2-11 provides estimated numbers of Western DPS Steller sea lions that may be exposed to Level B harassment disturbance due to the presence of AFSC researchers in the GOARA and BSAIRA based on past experiences under status quo conditions. Table 4.2-11 also shows the estimated numbers of harbor seals that may be disturbed even though no stocks are currently listed under the ESA.

Estimates for potential disturbance of Steller sea lions and harbor seals on land due to nearshore passage of fisheries research vessels were derived by GIS analyses using archived count data of both species and known fisheries research survey routes and activities. The analysis assumed that all vessels which passed within 0.5 nm (0.9 km) of a known Steller sea lion or harbor seal haulout, and approached from the same side of the island as the haulout, would disturb the average count of animals known to use particular haulouts. This "buffer" distance was selected based on studies of human disturbance of Alaskan pinnipeds (Jansen et al. 2006, 2010, 2015; Young et al. 2014). Until more accurate data becomes available through the proposed new monitoring and reporting program outlined in the LOA application (i.e., in the Preferred Alternative), it is assumed that 100 percent of these animals may react to AFSC research activity. This highly pre-cautionary approach accounts for the possible (albeit unlikely) event that all animals react to each vessel pass and that multiple vessel passes (i.e., multiple opportunities for disturbance) from different surveys are possible. Therefore, the estimated annual Level B Harassment takes for the GOARA are 3,082 Western DPS Steller sea lions (pups and non-pups combined). Note that no AFSC fisheries research vessels approach near enough to known Steller sea lion haulouts or rookeries within the range of the Eastern DPS of Steller sea lions so no level B takes are expected from that stock. The AFSC recognizes these estimated take levels are likely large over-estimates and that actual taking by harassment will be considerably smaller. This level of periodic, infrequent, and temporary disturbance is unlikely to affect the use of the region by Steller sea lions.

Table 4.2-12 Estimated Average Annual Level B Harassment Takes of Pinnipeds due to the Physical Presence of Researchers in the GOARA and BSAIRA

Note that AFSC fisheries research activities do not get close enough to any known Steller sea lion haulouts or rookeries east of 144°W longitude so no Level B harassment takes of Eastern DPS animals are anticipated.

Species	Potential Average Annual Level B Harassment Take	Requested Level B Harassment over 5 yr authorization period
Steller sea lion (Western DPS) in GOARA	3,082	15,410
Steller sea lion (Western DPS) in BSAIRA	112	560
Total Steller sea lion (Western DPS) All areas	**3,194**	**15,970**
Harbor seal stocks in GOARA		
Clarence Strait	28	139
Cook Inlet/Shelikof	2,554	12,772

Species	Potential Average Annual Level B Harassment Take	Requested Level B Harassment over 5 yr authorization period
Dixon/Cape Decision	30	151
Glacier Bay/Icy Strait	20	99
Lynn Canal/Stephens	45	223
N. Kodiak	885	4,424
Prince William Sound	3,063	15,313
S. Kodiak	3,761	18,804
Sitka/Chatham	864	4,320
Total harbor seals in GOARA (all stocks)	**11,249**	**56,245**
Harbor seal stocks in BSAIRA		
Aleutian Islands	290	1,449
Bristol Bay	132	661
Pribilof Islands	28	142
Total harbor seals in BSAIRA (all stocks)	**450**	**2,252**
Harbor seal (all stocks) All areas	**11,699**	**58,497**

Injury and Mortality due to Entanglement/Hooking in Research Gear

Table 4.2-10 indicates marine mammal takes by all AFSC research activities from 2004 through 2015. None of the historical entanglements or takes of marine mammals in AFSC fisheries research from NOAA vessels or NOAA chartered vessels are ESA-listed species. The AFSC is not requesting the take of any ESA-listed cetaceans in trawl gear due to lack of historical interactions and the low probability of take due to several factors, including density, abundance, and behavior. In the case of Cook Inlet belugas, the AFSC does not conduct fisheries and ecosystem surveys using trawl gear in Upper Cook Inlet where almost all sightings of this stock occur.

As described above, the AFSC LOA application includes estimates of the potential number of marine mammals that may interact with research gear based on their similarity to historically taken species and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-12). The AFSC is therefore requesting a take of five ESA-listed Western DPS Steller sea lion in trawl gear in the GOARA over the five-year authorization period, based on similarity to historically taken northern fur seals. The AFSC has no historical takes of marine mammals in its gillnet gear, although takes of marine mammals in these commercial fisheries are well-documented. In August 2019 an unidentified pinniped was taken in a longline survey. The 2016 LOF classifies commercial fisheries based on prior interactions with marine mammals. The AFSC used this information to help make informed decisions on the probability of specific cetacean and large whale interactions with fishing gear in the AFSC research areas, while many other factors were also taken into account (e.g., relative survey effort, survey location, similarity in gear type, animal behavior, prior history of AFSC interactions, etc.). Therefore there are several species that have been shown to interact with commercial fisheries but for which AFSC is not requesting takes, such as large whales, for example. Although large whale species could become entangled in research gear, the probability of interaction is extremely low considering a lower level of survey effort relative to that of commercial fisheries.

Although the commercial sablefish longline fishery is a category III fishery in the 2016 LOF with remote likelihood of or no known interactions with sperm whale, a more recent compilation has shown that five sperm whales have been seriously injured between 2010 and 2014 in the Gulf of Alaska sablefish long line fishery (Helker et al. 2016). Because sperm whales do interact with AFSC sablefish research longlines and because of the recent, analogous commercial fishery observations, AFSC is requesting one M&SI take of sperm whale over the five-year authorization period in the GOARA. Moreover, because the longline depredation by sperm whales is limited to southeastern waters of Alaska, the requested take is limited to the North Pacific stock of sperm whales.

The AFSC is requesting a take of one Western DPS Steller sea lion in longline gear in the GOARA over the five-year authorization period based on historical takes in commercial fisheries using this gear type. As noted above, the AFSC has requested takes of some species or stocks in more than one gear type in the GOARA. The AFSC also requested takes of marine mammals in various gear types in the BSAIRA and CSBSRA (see subsections below). Since the same stock may be taken in multiple gears and research areas, analysis of potential effects relative to PBR is made for combined requested takes from all gears and research areas (Table 4.2-13).

The combined estimated average annual take of ESA-listed western Steller sea lions in trawl and longline gear in the GOARA and BSAIRA (2.4 animals) is less than one percent of PBR (Table 4.2-13). This level of mortality, were it to occur, would be considered minor in magnitude.

The LOA application also includes requests for takes of “undetermined dolphin or porpoise” and “undetermined pinniped” species in several gear types for the five-year authorization period. These requests are made to account for similar looking species that may be caught or entangled in gear, but free themselves or are released before they can be identified or photographed by research personnel. This type of situation would be more likely to occur during the night or other periods of poor visibility.

For impact analysis purposes, the AFSC must assign these undetermined takes to each stock in addition to those takes requested for the particular stock. Under these assumptions, the combined take request for western Steller sea lions and “undetermined pinnipeds” in trawl and longline gear would still be equal to one percent of PBR (Table 4.2-13) and be considered minor in magnitude.

Measures to mitigate the risk of entanglements are described in Section 2.2.1. Vessel captains, bridge officers, and crew watch for marine mammals while underway and while setting fishing gear and take action to avoid them. The lack of recent entanglements of threatened and endangered marine mammals, thus far, indicates that the frequency of these types of interactions in fisheries research gear is low. The potential effects from entanglement in research gear is therefore considered minor adverse for threatened and endangered species throughout the AFSC research area during all seasons using gear types similar to those currently in use.

Table 4.2-13 Potential Number of Marine Mammal Takes by Entanglement/Hooking in AFSC Fisheries Research Gear in the AFSC Research Areas

This table summarizes information presented in the LOA application (Appendix C of the FPEA) on the combined potential takes by Mortality and Serious Injury (M&SI) and Level A harassment over a five-year period using trawls, longline, and gillnet gear in the GOARA, BSAIRA, and CBSRA.

Species (Stock)	Requested M&SI and Level A Take for Five-year Period									
	GOARA			BSAIRA[1]		CSBSRA[2]	Total: All Areas & Gear			
	Trawl	Longline[1]	Gillnet[1]	Trawl	Longline	Trawl	Trawl	Longline	Gillnet	Total Requested Take for Species or Stock
Beluga whale (Eastern Chukchi)	0	0	0	0	0	1	1	0	0	**1**
Beluga whale (Beaufort Sea)	0	0	0	0	0	1	1	0	0	**1**
Killer Whale (Alaska Stock)	0	0	0	0	1	0	0	0	0	**1**
Sperm Whale (North Pacific)	0	1	0	0	0	0	0	0	0	**1**
Pacific white-sided dolphin (North Pacific)	5[3]	0	1	0	0	0	5	0	1	**6**
Harbor porpoise (Southeast Alaska)	1[3]	0	1	0	0	0	1	0	1	**2**
Harbor porpoise (Gulf of Alaska)	1[3]	0	1	0	0	0	1	0	1	**2**
Harbor porpoise (Bering Sea)	0	0	0	1	0	0	1	0	0	**1**
Dall's porpoise (Alaska)	5[4]	1	1	5	1	0	10	2	1	**13**
Undetermined dolphin or porpoise	1	0	1	1	0	0	2	0	1	**3**

Species (Stock)	Requested M&SI and Level A Take for Five-year Period									
	GOARA			BSAIRA[1]		CSBSRA[2]	Total: All Areas & Gear			
	Trawl	Longline[1]	Gillnet[1]	Trawl	Longline	Trawl	Trawl	Longline	Gillnet	Total Requested Take for Species or Stock
Steller sea lion (Western DPS)	5[3]	1	1	5	1	0	10	2	1	**13**
Steller sea lion (Eastern DPS)	5[3]	1	1	0	0	0	5	1	1	**7**
Northern fur seal (Eastern Pacific)	5[4]	1	1	5	1	0	10	2	1	**13**
Northern fur seal (California)	1	1	1	0	0	0	1	1	1	**3**
Harbor seal (N. Kodiak)	1[3]	0	0	0	0	0	1	0	0	**1**
Harbor seal (S. Kodiak)	1[3]	0	0	0	0	0	1	0	0	**1**
Harbor seal (Prince William Sound)	1[3]	0	1	0	0	0	1	0	1	**2**
Harbor seal (Cook Inlet/Shelikof Strait)	1[3]	0	0	0	0	0	1	0	0	**1**
Harbor seal (Glacier Bay/Icy Strait)	1[3]	0	0	0	0	0	1	0	0	**1**
Harbor seal (Lynn Canal/Stephens Passage)	1[3]	0	0	0	0	0	1	0	0	**1**
Harbor seal (Sitka/ Chatham Strait)	1[3]	0	1	0	0	0	1	0	1	**2**
Harbor seal (Dixon/Cape Decision)	1[3]	0	0	0	0	0	1	0	0	**1**

Species (Stock)	Requested M&SI and Level A Take for Five-year Period									
	GOARA			BSAIRA[1]		CSBSRA[2]	Total: All Areas & Gear			
	Trawl	Longline[1]	Gillnet[1]	Trawl	Longline	Trawl	Trawl	Longline	Gillnet	Total Requested Take for Species or Stock
Harbor seal (Clarence Strait)	1[3]	0	0	0	0	0	1	0	0	**1**
Harbor Seal (Aleutian Islands)	0	0	0	1	0	0	1	0	0	**1**
Harbor Seal (Pribilof Islands)	0	0	0	1	0	0	1	0	0	**1**
Harbor Seal (Bristol Bay)	0	0	0	1	0	0	1	0	0	**1**
Spotted Seal	0	0	0	1	0	1	2	0	0	**2**
Bearded Seal	0	0	0	1	0	1	2	0	0	**2**
Ringed Seal	0	0	0	1	1	1	2	1	0	**3**
Ribbon Seal	0	0	0	1	0	1	2	0	0	**2**
Northern elephant seal	1[1]	0	0	0	0	0	1	0	0	**1**
Undetermined pinniped species	1	1	0	1	1	1	3	2	0	**5**

1. Based on historical takes in analogous commercial fisheries.
2. Based on species range overlap with AFSC fisheries research effort in the Chukchi-Beaufort Research Area, in the absence of research takes and commercial fisheries.
3. Based on species analogous to those historically taken in AFSC fisheries research.
4. Based on historical takes in AFSC fisheries research.

Table 4.2-14 Analysis of Potential Effect on Stocks for which AFSC is Requesting Takes in All AFSC Research Areas and Gears Relative to PBR.

This table summarizes information on the combined potential takes by Mortality and Serious Injury (M&SI) and Level A harassment in all AFSC research areas using trawl, longline, and gillnet gear. Take totals for each species or stock are also adjusted to account for potential takes of undetermined species in research areas in which each respective species or stock occurs and in which takes are requested for that species or stock. Total annual takes of undetermined animals added to total takes of requested species therefore include only those for the research areas in which each respective species occurs and not the total across all areas. All Potential Biological Removal (PBR) values are from the most recent draft stock assessment reports (Allen and Angliss 2015, Muto and Angliss 2015, Carretta et al. 2015a and b). Note that PBR is an annual measure of mortality. The LOA application estimates potential takes for the five-year period and these have been averaged for an annual take estimate that can be compared with PBR.

Species (Stock)	Total Average Annual Take Request for All Areas & Gear	PBR	% of PBR Requested	Total Annual Take Request with Undetermined Animals[1]	Total Annual Take Request with Undetermined Animals as % of PBR
Beluga Whale (Eastern Chukchi)	0.2	649	0.031%	0.2	**0.031%**
Beluga Whale (Beaufort Sea)	0.2	Undetermined	N/A	0.2	**N/A**
Killer Whale (Alaska Stock)	0.2	24	0.8%	0.2	**0.8%**
Sperm Whale (North Pacific)	0.2	Undetermined	N/A	0.2	**N/A**
Pacific white-sided dolphin	1.2	Undetermined	N/A	1.4	**N/A**
Harbor porpoise (Southeast Alaska)	0.4	Undetermined	N/A	0.8	**N/A**
Harbor porpoise (Gulf of Alaska)	0.4	Undetermined	N/A	0.8	**N/A**
Harbor porpoise (Bering Sea)	0.2	Undetermined	N/A	0.4	**N/A**
Dall's porpoise (Alaska)	2.6	Undetermined	N/A	3.2	**N/A**
Undetermined dolphin or porpoise	0.6	N/A	N/A	N/A	**N/A**
Steller sea lion (Western DPS)	2.6	297	0.81%	3.2	**1.0%**
Steller sea lion (Eastern DPS)	1.4	1,645 or 2,193	0.85% or 0.06%	1.8	**0.11% or 0.08%**
Northern fur seal (Eastern Pacific)	2.6	11,802	0.02%	3.2	**0.03%**
Northern fur seal (California)	0.6	9,200	0.007%	0.8	**0.009%**
Harbor seal (N. Kodiak)	0.2	298	0.07%	0.4	**0.13%**

Species (Stock)	Total Average Annual Take Request for All Areas & Gear	PBR	% of PBR Requested	Total Annual Take Request with Undetermined Animals[1]	Total Annual Take Request with Undetermined Animals as % of PBR
Harbor seal (S. Kodiak)	0.2	314	0.06%	0.4	**0.13%**
Harbor seal (Prince William Sound)	0.4	838	0.05%	0.6	**0.07%**
Harbor seal (Cook Inlet/Shelikof Strait)	0.2	770	0.03%	0.4	**0.05%**
Harbor seal (Glacier Bay/Icy Strait)	0.2	169	0.12%	0.4	**0.24%**
Harbor seal (Lynn Canal/Stephens Passage)	0.2	155	0.13%	0.4	**0.26%**
Harbor seal (Sitka/Chatham Strait)	0.4	555	0.07%	0.6	**0.11%**
Harbor seal (Dixon/Cape Decision)	0.2	703	0.03%	0.4	**0.06%**
Harbor seal (Clarence Strait)	0.2	1,222	0.02%	0.4	**0.03%**
Harbor seal (Aleutian Islands)	0.2	173	0.12%	0.4	**0.23%**
Harbor seal (Pribilof Islands)	0.2	7	2.86%	0.4	**5.7%**
Harbor seal (Bristol Bay)	0.2	1,182	0.02%	0.4	**0.03%**
Spotted seal	0.4	11,730	0.003%	0.8	**0.01%**
Bearded seal	0.4	Undetermined	N/A	0.8	**N/A**
Ringed seal	0.6	Undetermined	N/A	1.2	**N/A**
Ribbon seal	0.4	9,785	0.004%	0.8	**0.01%**
Northern elephant seal	0.2	4,882	0.004%	0.4	**0.01%**
Undetermined pinniped species	1	N/A	N/A	N/A	**N/A**

1. Total annual takes of undetermined animals added to total takes of requested species include only those for the research areas in which each respective species occurs and not the total take of undetermined species across all areas.

Non-ESA-Listed Cetaceans

This section describes impacts to cetaceans that are not ESA-listed. Minke whales and eastern North Pacific gray whales are the only baleen whale species included in this section. The remaining cetaceans are toothed whale species (i.e., odontocetes), including whales, dolphins, and porpoises.

Disturbance and Behavioral Responses due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed for ESA-listed species above. Table 4.2-11 provides summaries of the numbers of each species that could be taken by Level B acoustic harassment during AFSC research activities. The likely impact on cetaceans from the different types of acoustic devices is discussed below.

The mid-frequency odontocetes (e.g., pilot whales, killer whales, beaked whales, and dolphins) have a functional hearing range of 150 Hz to 160 kHz, with highest sensitivity from 10-120 kHz. The high-frequency odontocetes (e.g., harbor porpoise and Dall's porpoise) have a functional hearing range of 200 Hz to 180 kHz, with highest sensitivity from 10-150 kHz. The output frequencies of Category 1 active acoustic sources (>300 kHz) are above the functional hearing range of baleen whales and cetaceans in the mid- and high-frequency hearing groups (Figure 4.2-2). Because they would not be able to hear them, cetaceans are not expected to be affected by Category 1 sound sources (Appendix C, Section 6.2).

Category 2 active acoustic sources are unlikely to be heard by most baleen whales, but are within the range of hearing for various odontocetes, especially high frequency hearing harbor and Dall's porpoises. Some of these devices are used on trawl nets during fishing so their use is intermittent, localized and directional, and they are deployed on moving sources. Other Category 2 devices, such as echosounders and current profilers, may be deployed continuously or over long periods during a research cruise. These sound sources are highly directional. The sounds could be loud to cetaceans in close proximity to the sound source but physical damage is unlikely, although TTS could occur if animals remained close to the source (tens to a few hundred meters) for prolonged periods (Appendix C, Section 6.2). Deployment of such devices on moving vessels/gear, their narrow beam widths, and the short duration of most research tows (< 30 minutes) should minimize that likelihood. If detected, short term avoidance is the most likely response (Appendix C, Section 6.2).

There have been no documented cases of marine mammals being disturbed or changing their behavior in response to AFSC research vessels other than bow-riding by dolphins, which is common with marine vessels and does not appear to have a detrimental effect on the animals. The active sound sources used during fisheries research would not likely be detected by minke whales, although they may be detected by odontocetes, particularly harbor porpoise and Dall's porpoise. The seasonal distribution of both porpoise species throughout the GOARA means they could overlap with fishery research vessels. Sound emission from these active sources is short-term in any localized area. The most likely effect on cetaceans would be localized and temporary avoidance (Appendix C, Section 6.2). Potential disturbance from active acoustic equipment used during research would therefore not have any measurable effect on the population of any cetacean and would be considered minor in magnitude. Such disturbance is likely to occur wherever survey vessels use the equipment, but cetaceans would only be close enough to a vessel to be affected on a rare or intermittent basis and any behavioral changes would be temporary. The overall impact of active acoustic sound sources on non ESA-listed cetaceans throughout the AFSC research area is considered to be minor adverse according to the criteria in Table 4.1-1.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

Table 4.2-10 shows the recent history of marine mammal takes by all AFSC research activities, including two Dall's porpoises in 2011. Both were caught in surface trawls and neither survived. This is the only cetacean species taken incidental to AFSC fisheries research between 2004 and 2015. The requested take of an average of one Dall's porpoise per year in trawl gear or five porpoises over the five-year authorization period is based on the historical takes (Table 4.2-13). Measures to mitigate the risk of entanglements are described in Section 2.2.1.

As described above, the AFSC LOA application includes estimates of the potential number of other cetaceans that may interact with research gear based on their similarity to the above species and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-13). The LOA application combines estimated Level A harassment takes with serious injury or mortality takes because the degree of injury resulting from gear interaction cannot be predicted. Note that the LOA application does not request authorization to take all species of marine mammals that occur in the AFSC research areas, only those species considered to have a reasonable risk of adverse interactions with gear used for AFSC research. The LOA application used conservative procedures to estimate potential future takes of marine mammals, so these estimates are greater than what is likely to occur in the future, especially for species that have never been taken in the past and that are infrequently encountered during research surveys.

Species in the GOARA considered similarly vulnerable to trawl gear as Dall’s porpoise are harbor porpoises and Pacific white-sided dolphins. The AFSC therefore requests a total of five potential takes over the five-year authorization period (an average of one animal/year) for Pacific white-sided dolphins. The AFSC request also includes one take (an average of 0.2 animals/year) over the five-year authorization period for each of two stocks of harbor porpoises (Table 4.2-13). Based on species previously caught in analogous commercial gillnet gear, the AFSC determined that a total take of one Pacific white-sided dolphin, two harbor porpoises (one each from the Southeast Alaska and GOA stocks), and one Dall’s porpoise in gillnets over the five-year authorization period in the GOARA is an appropriate precautionary estimate. The AFSC is not requesting takes of large whales and several other cetaceans due to lack of historical interactions and the low probability of takes due to species’ distribution, density, abundance, and behavior.

The AFSC has requested takes of some cetacean stocks in more than one gear type in the GOARA, and, for Dall’s porpoise, they also requested takes in trawl and longline gear in the BSAIRA (see subsections below). As described above for ESA-listed species, because the same stock may be taken in multiple gears and several research areas, the analysis of potential effect relative to PBR is made for the combined requested takes from all gears and research areas (Table 4.2-14).

PBR is undetermined for all cetacean species and stocks for which potential takes are requested in the GOARA. The combined total annual estimated takes in all gears and research areas, however, range from 0.2 for Bering Sea harbor porpoise to 2.4 for Dall’s porpoises (1 to 12 animals respectively over five years) and are likely sufficiently small to be considered minor in magnitude. (Table 4.2-14). This conclusion would likely hold true even if the requested “undetermined” dolphin or porpoise takes are assigned to each stock in addition to those takes requested for the particular stock. Given the low number of cetacean interactions that have occurred in the past and the implementation of current mitigation measures, future mortalities of dolphins or porpoises would likely be rare or infrequent events, if they occurred, and would be unlikely to actually occur at this estimated rate during the five-year authorization period. Any actual take would occur in a localized area, but these animals travel over large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of potential takes on harbor porpoises, Dall’s porpoises, and Pacific white-sided dolphins in AFSC research gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Non-ESA-Listed Pinnipeds

There are five species of non-ESA-listed pinnipeds commonly found in the GOARA that may interact with AFSC research: Steller sea lion (Eastern DPS), northern fur seal (two stocks), and harbor seal (several stocks) (Table 3.2-6).

Disturbance and Behavioral Responses due to Acoustic Equipment and Physical Presence of Researchers

The analysis of acoustic effects on these species is similar to that discussed for ESA-listed species above. The functional hearing range of seals in the AFSC operations areas is 75 Hz-100 kHz and, for sea lions and fur seals, it is 100 Hz to 40 kHz. This is well below the output frequency of Category 1 active acoustic sources used by AFSC, so pinnipeds are unlikely to detect these sounds. Some Category 2 acoustic sources, such as net transponders, are within the hearing range of pinnipeds. The sounds most likely to be audible are of short duration and restricted to areas very close to the research vessel, such as on an active net, so potential interactions are likely to be intermittent and infrequent. Table 4.2-11 provides summaries of the numbers of each species that could be taken by acoustic disturbance during AFSC research activities. There are no reports or anecdotal observations of pinnipeds being disturbed or altering behavior due to AFSC fisheries research activities to date. The potential impacts of acoustic disturbance to pinnipeds throughout the AFSC research area are therefore considered to be minor adverse according to the criteria described in Table 4.1-1.

As described above in the ESA-listed species section, pinnipeds using haulouts and rookeries in the GOARA and BSAIRA may be disturbed by the physical presence and sounds of researchers passing nearby in boats as they travel to or from research sites or while conducting nearshore surveys. AFSC researchers are very aware of this situation and take precautions to minimize the frequency and scope of potential disturbances, including choosing travel routes as far away from hauled out pinnipeds as possible and moving sample site locations to avoid consistent haulout areas. Table 4.2-12 includes estimated numbers of harbor seals and Steller sea lions that may be exposed to Level B harassment disturbance due to the presence of AFSC researchers in the GOARA and BSAIRA. Based on calculations detailed above, estimated Level B Harassment takes is 16,528 harbor seals per year from nine stocks in the GOARA combined. The AFSC recognizes these estimated take levels are likely large over-estimates and that actual taking by harassment will be considerably smaller. Until more accurate data becomes available through the proposed new monitoring and reporting program outlined in the LOA application (i.e., in the Preferred Alternative), it is assumed that 100 percent of these animals may react to AFSC research activity. This level of periodic, infrequent, and temporary disturbance is unlikely to affect the use of the region by harbor seals.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

Table 4.2-10 shows historical takes of pinnipeds by all AFSC research activities. A single northern fur seal was caught and killed during the Gulf of Alaska Biennial Shelf and Slope Bottom Trawl Groundfish Survey in 2009. This is the only marine mammal ever taken during this survey. The location and timing of the historical take implicates that the animals was from the Eastern Pacific stock. The requested take of an average of one northern fur seal (Eastern Pacific stock) per year in trawl gear or five fur seals over the five-year authorization period is based on this historical take (Table 4.2-13). In addition, one fur seal from the California stock is requested over the five-year authorization period in trawl gear to account for the much lower risk of taking animals from this stock, which only occur in relatively small numbers in the eastern GOARA. Measures to mitigate the risk of entanglements have been developed over the years. Section 2.2.1 describes how mitigation measures where implemented during AFSC research at the end of 2015.

The AFSC LOA application includes calculations of the number of pinnipeds that may interact with research gear based on historical takes, as well as estimates of the potential number of other pinnipeds that may interact with research gear based on their similarity (distributions, life histories, and/or vulnerabilities) to historically taken species, and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-13). The AFSC does not expect this many pinnipeds will actually be taken in the next five years, but is using a precautionary estimation procedure to ensure accounting for a maximum amount of potential take. The AFSC has also included estimated takes of undetermined pinnipeds to account for the potential that a pinniped could be caught but get free of the gear before it could be identified, as was described above for undetermined dolphins and porpoises.

The potential takes of most pinnipeds in trawl gear, as shown in Table 4.2-13, are based on the historical take of a northern fur seal during AFSC fisheries research in the GOARA. The exception is the take request of one northern elephant seal in trawl gear, which is based on commercial fisheries takes. The AFSC has no history of marine mammal takes in longline gear or gillnet gear, so requested takes in those gear types are based on takes in analogous commercial fishing operations. AFSC requests potential takes of one Eastern DPS Steller sea lion and two northern fur seals (one each from the Eastern Pacific and California stocks) in longline gear over five-year authorization period (0.2 per year per stock). The AFSC also requests one northern fur seal from both the Eastern Pacific and California stocks and two harbor seals (one each from the Prince William Sound and Sitka/Chatham stocks) in gillnets over five years (0.2 per year per stock).

As described in above sections, the AFSC has requested takes of some species or stocks in more than one gear type in the GOARA. The AFSC also requested takes of pinnipeds in various gear types in the BSAIRA and CSBSRA (see subsections below). Since the same stock may be taken in more than one gear type and research area, analysis of potential effects relative to PBR is made for combined requested takes from all gears and research areas (Table 4.2-14). The Eastern Pacific northern fur seal is the only non-ESA listed pinniped stock for which takes are requested in the GOARA and in another research area (the BSAIRA). The combined estimated average annual take for each non-ESA listed pinniped stock or species included here is well below one percent of PBR (Table 4.2-14). This level of mortality, were it to occur, would be considered minor in magnitude.

The LOA application also includes requests for takes of "undetermined pinniped" species in several gear types for the five-year authorization period. These requests are made to account for similar looking species that may be caught or entangled in gear, but free themselves or are released before they can be identified or photographed by research personnel. This type of situation would be more likely to occur during the night or other periods of poor visibility.

For impact analysis purposes, the AFSC must assign these undetermined takes to each stock in addition to those takes requested for the particular stock. Under these assumptions, the combined take request in the GOARA for northern fur seals, eastern Steller sea lions, nine stocks of harbor seals, and northern elephant seals in trawl, longline, and gillnet gear would still be less than one percent of PBR for each species (Table 4.2-14) and would be considered minor in magnitude.

Given the low number of pinniped interactions that have occurred in the past and the implementation of current mitigation measures, future mortalities of pinnipeds would likely be rare or infrequent events and would be unlikely to actually occur at this estimated rate during the five-year authorization period. Any actual take would occur in a localized area, but for species that travel over large geographic areas, the potential loss of an animal would affect more than a localized population. The overall impact of potential takes of GOARA pinnipeds in AFSC research gear, if they occurred, would therefore be considered minor adverse according to the criteria described in Table 4.1-1.

Sea Otters

All three DPSs of northern sea otter occur in the GOARA: the Southwest Alaska DPS (listed as threatened under the ESA), the Southcentral Alaska, and the Southeast Alaska DPS. The latter two are not ESA-listed. Based on survey location and ranges of the respective DPSs, the single sea otter taken by AFSC in a surface trawl in 2008 during the Southeast Coastal Monitoring Survey was most likely from the Southeast Alaska DPS. The sea otter caught in AFSC research gear was emaciated and in very poor physical condition at the time of the take, which likely influenced the outcome of the interaction with the research gear because sea otters are usually adept at avoiding vessels and fishing gear. The AFSC does not anticipate any future Level B or Level A takes of sea otters during fisheries research activities under the Status Quo Alternative.

4.2.4.7 Bering Sea-Aleutian Islands Research Area

ESA-listed Species

The endangered cetaceans that occur in the BSAIRA include sperm whales, humpback whales, fin whales, sei whales, right whales, bowhead whales, and, on rare occasions, blue whales and western North Pacific gray whales. Bowhead whales are in the western Bering Sea, along the ice edge, during winter months (November-April), so are unlikely to overlap with any AFSC fisheries research in the BSAIRA. ESA-listed pinnipeds in the BSAIRA include the endangered Western DPS of Steller sea lions, threatened ringed seals, and the Pacific walrus, which is a candidate for listing as threatened. The threatened listing of the Beringia DPS of bearded seals was vacated in 2014, following a decision in the U.S. District Court for the District of Alaska. The Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. While the appeal process is in progress, the Beringia DPS of bearded seals will retain consideration as an ESA-listed species in this FPEA. The Southwestern Alaska DPS of the northern sea otter, listed as threatened, also occurs in the BSAIRA. Pacific walrus and sea otters are under the jurisdiction of the USFWS and, due to the very low likelihood of interactions during AFSC fisheries research, the AFSC is not requesting takes of either of these species.

Disturbance and Behavioral Responses due to Acoustic Equipment and Physical Presence of Researchers

The LOA application includes calculations of the number of marine mammals that may be exposed to sound levels above 160 dB from all acoustic devices used during AFSC fisheries and ecosystem research activities in the BSAIRA over the five-year authorization period. Those calculations include a number of assumptions and elements with large variables over time and space (e.g., the volumetric densities of marine mammals and the propagation of sound under different conditions). The AFSC believes this quantitative approach benefits from its simplicity and consistency with current NMFS guidelines on estimating Level B harassment by acoustic sources, but cautions that the resulting take estimates should be considered likely overestimates of behavioral harassment from acoustic devices. The FPEA summarizes the results of those estimates in Table 4.2-15 below, but see Appendix C for a detailed discussion about the derivation of and concerns about the accuracy of and caveats to the precision of these estimates. The likely impact on ESA-listed species in the BSAIRA from the different types of acoustic devices is as discussed above for the GOARA in Section 4.2.4.1.

The anticipated effects of active acoustic sources used during AFSC fisheries research on threatened and endangered marine mammals in the BSAIRA is likely to occur infrequently, although they may occur over a large geographic area. Most of the frequencies are well above detection ranges for ESA-listed baleen whales, while Category 2 output overlaps with the hearing range of sperm whales and Steller sea lions. To date, there have been no reports or observations of sounds from AFSC research activities disturbing or affecting behavioral changes in ESA-listed species.

The potential effects from the use of active acoustic devices during research activities would be small in magnitude and short-term in duration, although they would be dispersed over a wide geographic area and be likely to occur under the Status Quo Alternative. The overall impacts of acoustic disturbance to ESA-listed marine mammals throughout the BSAIRA are therefore considered to be minor adverse.

Table 4.2-15 Estimated Level B Harassment Takes of Marine Mammals by Acoustic Sources during AFSC Research in the BSAIRA over a Five Year period

Species (Common Name)	Total Estimated Level B Take (numbers of animals)	Species (Common Name)	Total Estimated Level B Take (numbers of animals)
Baird's beaked whale - Alaska Stock	4	Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	11
Bearded seal - Alaska Stock	1710	Killer whale - Eastern North Pacific Northern Resident Stock	0
Beluga whale - Bristol Bay Stock	0	Killer whale - Offshore Stock	43
Beluga whale - Eastern Bering Sea Stock	939	Minke whale - Alaska Stock	5
Bowhead whale - Western Arctic Stock[1]	42	North Pacific right whale - Eastern North Pacific Stock[1]	1
Cuvier's beaked whale - Alaska Stock	1	Northern fur seal - California Stock	0
Dall's porpoise - Alaska Stock	143	Northern fur seal - Eastern Pacific Stock	901
Fin whale - Northeast Pacific Stock[1]	4	Pacific white-sided dolphin - North Pacific Stock	21
Gray whale - Eastern North Pacific Stock	929	Ribbon seal - Alaska Stock	801
Gray whale - Western North Pacific Stock[1]	0	Ringed seal - Arctic Subspecies/Alaska Stock[1]	1517
Harbor porpoise - Bering Sea Stock	1745	Sei Whales[1]	1
Harbor seal - Aleutian Islands Stock	12	Sperm whale - North Pacific Stock[1]	19
Harbor seal - Bristol Bay Stock	57	Spotted seal - Alaska Stock	2001
Harbor seal - Pribilof Islands Stock	1	Stejneger's beaked whale - Alaska Stock	3
Humpback whale - Central North Pacific Stock[1]	45	Steller sea lion - Western DPS[1]	52
Humpback whale - Western North Pacific Stock[1]	4	Steller sea lion - Eastern DPS	1
Killer whale - Eastern North Pacific Alaska Resident Stock	4	--	--

1. ESA-listed species

As described above, pinnipeds using haulouts and rookeries in the BSAIRA (and GOARA) may be disturbed by the physical presence and sounds of researchers passing nearby in boats as they travel to or from research sites or while conducting nearshore surveys. Table 4.2-11 includes estimated numbers of Steller sea lions from the Western DPS (112 animals per year) that may be exposed to this Level B harassment disturbance due to the presence of AFSC researchers in the BSAIRA. The AFSC recognizes these estimated take levels are likely large over-estimates and that actual taking by harassment will be considerably smaller. Until more accurate data becomes available through the proposed new monitoring and reporting program outlined in the LOA application (i.e., in the Preferred Alternative), it is assumed that 100 percent of these animals may react to AFSC research activity. This level of periodic, infrequent, and temporary disturbance is unlikely to affect the use of the region by Steller sea lions.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

Table 4.2-10 and Figure 4.2-1 indicate marine mammal takes by all AFSC research activities from 2004-2015. The AFSC has no historical takes of marine mammals, ESA-listed or otherwise, in the BSAIRA in any gear, including trawls and longlines. The AFSC is not requesting the take of large whales and several other cetaceans by trawl or longline gear due to lack of historical interactions and the low probability of take due to several factors, including density, abundance, distribution, and behavior of these species.

Sea otters are not covered in the LOA application, which is specific to marine mammals under the jurisdiction of NMFS. However, the AFSC does not expect to have any captures of sea otters in the future, including animals from the threatened Southwestern Alaska DPS, due to the avoidance behaviors of sea otters and the predominance of AFSC fisheries research efforts that take place well offshore and away from nearshore areas preferred by sea otters.

Takes of marine mammals in commercial fisheries that use trawls and longlines are well-documented. The 2016 LOF classifies commercial fisheries based on prior interactions with marine mammals. The AFSC used this information to help make informed decisions on the probability of specific marine mammal interactions with fishing gear in the AFSC research areas, while many other factors were also taken into account (e.g., relative survey effort, survey location, similarity in gear type, animal behavior, prior history of AFSC interactions, etc.). For example, there are several large whale species known to interact with commercial fisheries for which AFSC is not requesting takes. Although large whale species could become entangled in research gear, the probability of interaction is extremely low considering a lower level of survey effort relative to that of commercial fisheries. The AFSC is, however, requesting five takes of Western DPS of Steller sea lions and one take each of bearded seal and ringed seal in trawl gear in the BSAIRA over the five-year authorization period based on historical takes in commercial fisheries using this gear type (Table 4.2-13). The AFSC is also requesting one take of ringed seal in longline gear over the five-year authorization period based on takes in analogous commercial fisheries in the BSAIRA.

The commercial Pacific cod longline fishery in the BSAIRA is a category II fishery in the 2016 LOF with occasional interactions with killer whale and a more recent compilation has shown two instances of killer whale mortalities or serious injuries in the BSAIRA (Helker et al. 2016). The 2016 LOF reports takes from both transient and resident stocks of killer whale, as these stocks partially overlap in range. However, the Alaska resident stock consumes fish (Herman et al. 2005) and is most likely to be involved in depredation fishery interactions and the limited nature of AFSC sablefish longline and other surveys and sampling gears compared to commercial fisheries justifies take for only this stock. In contrast, transient killer whales feed on marine mammals and are less likely to interact with survey longline gears. Since killer whales do interact with AFSC sablefish research longlines and because of the recent and analogous commercial fishery observations, AFSC is requesting one M&SI take of Alaska resident killer whale in the BSAIRA.

As noted in above sections, the AFSC has requested takes of some species or stocks in more than one gear type in the BSAIRA. The AFSC also requested takes of marine mammals in various gear types in the GOARA and CSBSRA (see subsections above and below). Since the same stock may be taken in multiple gears and research areas, analysis of potential effects relative to PBR includes the combined requested takes from all gears and research areas (Table 4.2-14).

The combined estimated average annual take of ESA-listed western Steller sea lions in trawl and longline gear in the GOARA and BSAIRA is less than one percent of PBR (Table 4.2-14). This level of mortality, were it to occur, would be considered minor in magnitude. PBR is undetermined for both bearded and ringed seals, but the combined requested takes in trawl gear in the BSAIRA and CSBSRA (0.4 per year for bearded seal and 0.6 per year for ringed seal) are likely sufficiently small to be considered minor in magnitude (Table 4.2-14). For impact analysis purposes, the AFSC must assign undetermined pinniped takes to each stock in addition to takes requested for the particular stock. Under these assumptions, the combined take request for Western DPS Steller sea lions and "undetermined pinnipeds" in trawl and longline gear would still be less than one percent of PBR (Table 4.2-14) and be considered minor in magnitude. Assigning "undetermined pinniped" takes in trawl gear to either of the requested takes of ringed or bearded seals would not add substantially to annual take levels for either species and, despite the lack of PBR calculations, this take level would likely remain of minor magnitude (Table 4.2-14).

Additional measures to mitigate the risk of entanglements are described in Section 2.2.1. Vessel captains, bridge officers, and crew watch for marine mammals while underway and while setting fishing gear and take action to avoid them. The lack of entanglements of marine mammals in the BSAIRA indicates that the risk of these types of interactions in fisheries research gear is low. The potential effects from entanglement in research gear is therefore considered minor adverse for all ESA-listed species throughout the BSAIRA during all seasons using gear types similar to those currently in use.

Changes in Food Availability due to Research Survey Removal of Prey and Discards

One of the main factors considered to be responsible for the decline of the Western DPS of Steller sea lions and their failure to recover is the competition for prey species with fish targeted by commercial groundfish fisheries in Alaska. The potential role of those fisheries in the population decline has been the subject of major research programs (NMFS 2007b) and fisheries management actions (NMFS 2014d). NMFS has issued several BiOps on the Alaska groundfish fisheries in the BSAI and GOA and determined that the fisheries compete with sea lions for prey to the extent that they would place the Western DPS in "jeopardy" of extinction unless the impacts were reduced (NMFS 2014e). A complicated set of spatial and temporal restrictions were placed on the commercial groundfish fisheries to limit the amounts of key prey species that may be harvested in Steller sea lion critical habitats and surrounding areas. AFSC fisheries and ecosystem research surveys are exempt from the restrictions placed on the commercial fleet; the AFSC research is critical for tracking the abundance and distribution of Steller sea lion prey species both within and outside critical habitat boundaries and assessing the effectiveness of the protection measures. However, it is useful to use the management boundaries established in the regulations to help assess the potential impact of AFSC fisheries research on Steller sea lion prey.

Table 4.2-15 summarizes the average catch of Steller sea lion prey species within designated critical habitat areas in three fisheries management regions, which are subdivided into Rookery Cluster Areas (RCA) and NMFS Fisheries Management Zones (FMZ) (Figure 4.2-3). These data are from the major groundfish bottom trawl surveys conducted by the AFSC in the BSAIRA and GOARA in the past six years. Since the bottom trawl research is conducted in the two research areas in alternate years, the average annual catch is for those years when the research is conducted in a particular year. In alternate years, when the surveys are conducted in other areas, research catch in each area is zero.

Not all species or species groups have established harvest limits or other fisheries metrics with which to compare to AFSC research catches. As an example of the relative size of AFSC fisheries research catch, Table 4.2-17 compares average AFSC research catches of three species regulated in the Steller sea lion protection measures to established harvest limits (TAC) or fishery metric (ABC) in the Western Aleutians. These data are for AFSC fisheries research catches both within and outside of critical habitat areas in order to make more appropriate comparisons, although the majority of research catches are within critical habitat areas. Some assumptions and approximations are necessary to make some of these comparisons; see footnotes in the table. For these three species, which are the primary prey of Steller sea lions, the analysis suggests that AFSC fisheries research catches represent a very small fraction of the fisheries metrics and sustainable harvest limits in these areas and are considered minor in magnitude. These low levels of prey removal would be dispersed over large geographic areas and generally not repeated in the same location; research surveys sample in a stratified random design and are generally not conducted in the exact same area two years in a row. Research tows are also very short in duration, typically 15-30 minutes at depth, so the footprint of each trawl is small (Section 4.2.1). It should be noted that the eastern Bering Sea and Aleutian Islands surveys are index surveys which do re-sample the same sites annually or biennially. AFSC fisheries research is therefore unlikely to affect the availability of prey to Steller sea lions or to reduce the quality of designated critical habitat and the impact of AFSC fisheries research under the Status Quo Alternative is considered minor adverse according to the impact criteria in Table 4.1-1.

Table 4.2-16 Average Annual AFSC Fisheries Research Catch of Steller Sea Lion Prey Species within Critical Habitat in Different Management Areas

AFSC bottom trawl surveys are conducted in each area only every two years[1]. These catch data therefore show average catch for years when surveys are conducted; in alternate years catch is zero. The Rookery Cluster Area (RCA) and Fishery Management Zones (FMZs) are relevant to the commercial fishing regulations implementing the Steller Sea Lion Protection Measures (79 FR 70286, 25 November 2014). The AFSC catch is only for areas within Steller sea lion critical habitat; relatively small sampling efforts also occur outside critical habitat areas.

Species	Western Aleutians (West of 170°W) RCA 1-5 FMZs 543, 542, 541 (mt per year)	Eastern Aleutians, Western GOA, Bering RCA 6-7 FMZs 500-540, 610 (mt per year)	Central & Eastern GOA RCA 8-10 FMZs 620, 630, part of 640 (mt per year)	Average Catch All Areas Combined (mt per year)
Rockfish	197.5	23.8	20.8	**242.0**
Walleye pollock	21.8	53.3	24.6	**99.7**
Atka mackerel	76.3	10.3	<0.1	**86.7**
Arrowtooth Flounder	7.8	14.3	34.8	**56.9**
Pacific cod	12.6	14.9	8.0	**35.4**
Rock soles	7.5	21.6	5.0	**34.0**
Skates	4.9	3.2	2.6	**10.6**
Irish Lords	1.7	1.9	<0.1	**4.0**
Eulachon	-	<0.1	2.2	**2.3**
Cephalopods	0.5	0.7	0.3	**1.5**
Sole (other)	-	0.2	0.5	**0.6**
Pacific herring	-	<0.1	0.4	**0.4**
Salmon	<0.1	<0.1	0.3	**0.4**
Smooth lumpsucker	<0.1	<0.1	<0.1	**<0.1**
Sand lance (unid.)	<0.1	<0.1	<0.1	**<0.1**

Species	Western Aleutians (West of 170°W) RCA 1-5 FMZs 543, 542, 541 (mt per year)	Eastern Aleutians, Western GOA, Bering RCA 6-7 FMZs 500-540, 610 (mt per year)	Central & Eastern GOA RCA 8-10 FMZs 620, 630, part of 640 (mt per year)	Average Catch All Areas Combined (mt per year)
Snailfish	<0.1	<0.1	<0.1	**<0.1**
Lumpsucker (other)	<0.1	<0.1	<0.1	**<0.1**
Pacific sandfish	-	<0.1	<0.1	**<0.1**
Pacific sand lance	-	<0.1	<0.1	**<0.1**

1 Catch data are from the following surveys and years: Gulf of Alaska Bottom Trawl Survey (2009, 2012, 2015), Aleutian Islands Triennial Survey (2010), Aleutian Islands Bottom Trawl Survey (2012, 2014), Eastern Bering Sea Shelf Survey (2013, 2014, 2015), and Eastern Bering Sea Slope Survey (2012).

Table 4.2-17 Average AFSC Fisheries Research Catch of Major SSL Prey Species in NMFS Reporting Areas 541-543 Compared to Fishery Management Metrics

Bottom trawl surveys are conducted in each area only every two years. These catch data therefore show average catch for years when surveys are conducted; in alternate years catch is zero. The AFSC catch is for areas both within and outside sea lion critical habitat, although most catch was within critical habitat. Acceptable Biological Catch (ABC) is a calculated sustainable harvest level based on stock assessment data and Total Allowable Catch (TAC) is the harvest limit set by fisheries managers based on ABC.

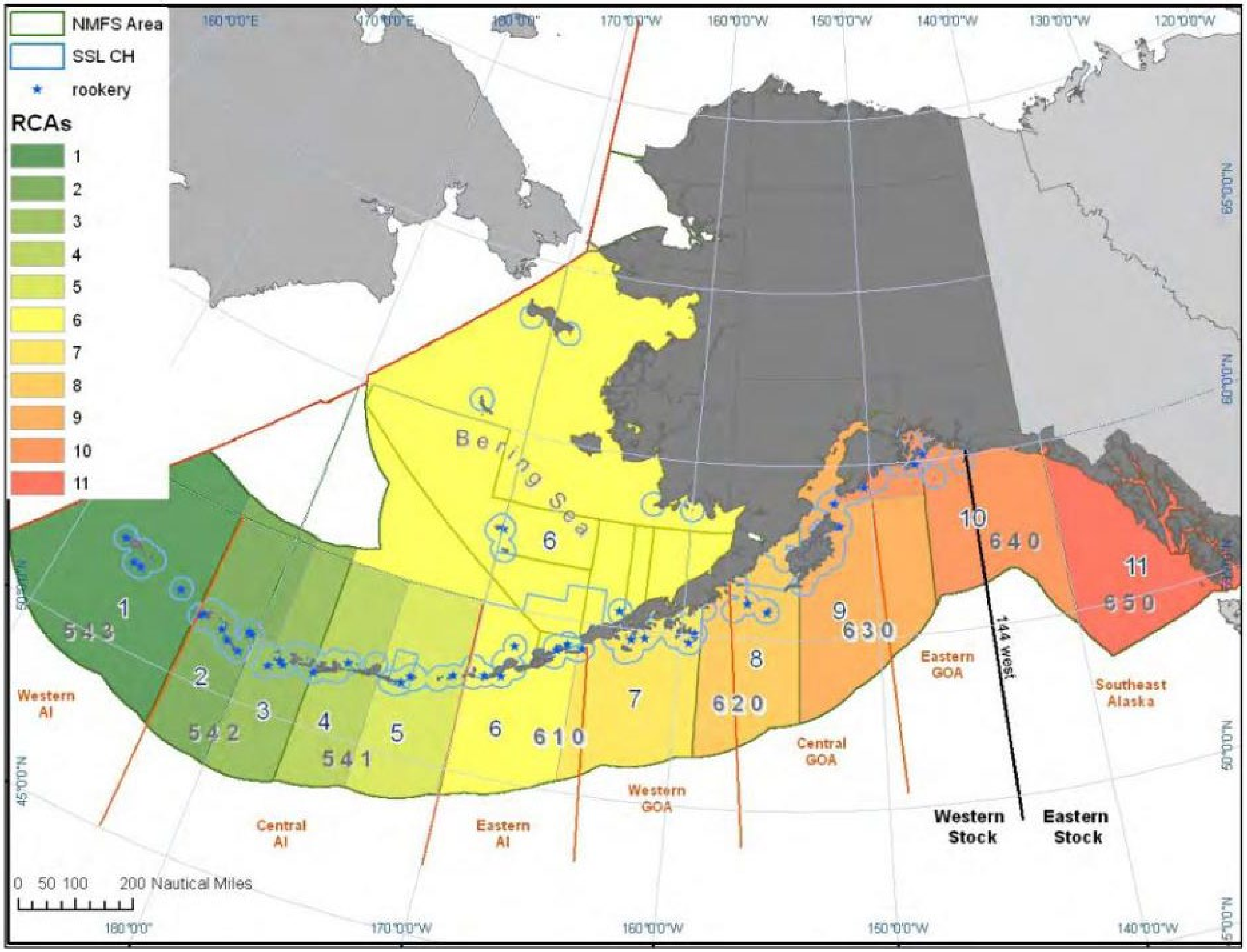
Species	AFSC average annual catch (mt)	ABC (mt)[1]	AFSC catch compared to ABC	TAC (mt)[2]	AFSC catch compared to TAC
NMFS REPORTING AREA 541					
Atka mackerel	30.4	21,769	0.14%	21,769	0.14%
Pacific cod	7.2	N/A [3]	N/A [3]	N/A [3]	N/A [3]
Walleye pollock	16.0	11,823.6	0.14%	11,300	0.14%
NMFS REPORTING AREA 542					
Atka mackerel	29.2	20,685	0.14%	20,685	0.14%
Pacific cod	2.6	N/A [3]	N/A [3]	N/A [3]	N/A [3]
Walleye pollock	5.0	5,911.8	0.08%	5,800	0.09%
NMFS REPORTING AREA 543					
Atka mackerel	39.4	22,023	0.18%	14,315	0.28%
Pacific cod	3.6	1,609 [4]	0.22%	N/A	N/A
Walleye pollock	2.0	1,970.6	0.11%	1,900	0.11%

1 There are no specific pollock ABC or TACs for Areas 541-543, but an overall harvest limit. The value provided under ABC is given as this harvest limit.

2 § 679.20(a)(5)(iii)) limits the total maximum Aleutian Islands pollock TAC to 19,000 metric tons (mt); the combined limit for Area 541-543 therefore is 19,000 mt. The pollock TACs for each above area are set at or below ABC.

3 There are no specific ABCs, TACs, or harvest limits for Areas 541-542. Total Pacific cod ABC for the Aleutian Islands is 15,000 mt and TAC is 6,487 mt

4 The value for Pacific cod is a total harvest limit specifically for Area 543



Source: NMFS 2010c, Figure 3.8

Figure 4.2-3 Rookery Cluster Areas and Fishery Management Zones in Relation to Steller Sea Lion Critical Habitat

Non-ESA-Listed Cetaceans

This section describes impacts to cetaceans that are not ESA-listed. Minke whales and eastern North Pacific gray whales are the only baleen whale species included in this section. The remaining cetaceans are toothed whale species (i.e., odontocetes), including whales, dolphins, and porpoises.

Disturbance and Behavioral Responses due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed for the GOARA and ESA-listed species above. Table 4.2-15 provides summaries of the numbers of each species that could be taken by Level B acoustic harassment during AFSC research activities. The likely impact on cetaceans from the different types of acoustic devices is discussed below.

The output frequencies of Category 1 active acoustic sources (>300 kHz) are above the functional hearing range of baleen whales and cetaceans in the mid- and high-frequency hearing groups (Figure 4.2-2). Because they would not be able to hear them, cetaceans are not expected to be affected by Category 1 sound sources (Appendix C, Section 6.2).

Category 2 active acoustic sources are unlikely to be heard by most baleen whales, but are within the range of hearing for various odontocetes, especially high frequency hearing harbor and Dall's porpoises. Some of these devices are used on trawl nets during fishing so their use is intermittent, localized and directional, and they are deployed on moving sources. Other Category 2 devices, such as echosounders and current profilers, may be deployed continuously or over long periods during a research cruise. These sound sources are highly directional. The sounds could be loud to cetaceans in close proximity to the sound source but physical damage is unlikely, although TTS could occur if animals remained close to the source (tens to a few hundred meters) for prolonged periods (Appendix C, Section 6.2). Deployment of such devices on moving vessels/gear, their narrow beam widths, and the short duration of most research tows (< 30 minutes) should minimize that likelihood. If detected, short term avoidance is the most likely response (Appendix C, Section 6.2).

There have been no documented cases of marine mammals being disturbed or changing their behavior in response to AFSC research vessels other than bow-riding by dolphins and Dall's porpoises, which is common with marine vessels and does not appear to have a detrimental effect on the animals. The active sound sources used during fisheries research would not likely be detected by minke whales, although they may be detected by odontocetes, particularly harbor porpoise and Dall's porpoise. The seasonal distribution of both porpoise species throughout the BSAIRA means they could overlap with fishery research vessels. Sound emission from these active sources is temporary or short-term in any localized area. The most likely effect on cetaceans would be localized and temporary avoidance (Appendix C, Section 6.2). Potential disturbance from active acoustic equipment used during research would therefore not have any measurable effect on the population of any cetacean and would be considered minor in magnitude. Such disturbance is likely to occur wherever survey vessels use the equipment, but cetaceans would only be close enough to a vessel to be affected on a rare or intermittent basis and any behavioral changes would be temporary. The overall impact of active acoustic sound sources on non ESA-listed cetaceans throughout the BSAIRA is considered to be minor adverse according to the criteria in Table 4.1-1.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The AFSC LOA application includes estimates of the potential number of other cetaceans that may interact with research gear based on their similarity to historically taken species and historical takes in commercial fisheries operating in similar areas and using similar gear types (Table 4.2-13). As noted above and in Table 4.2-10, there have been no historical takes of marine mammals in AFSC fisheries research gear in the BSAIRA from 2004 through 2015. In the absence of historical research takes, all requested takes in the BSAIRA are based on takes in analogous commercial fisheries. The LOA application only requests takes of species considered to have a reasonable risk of adverse interactions with gear used for AFSC research. The AFSC therefore requests takes of one harbor porpoise from the Bering Sea stock and five Dall's porpoises in trawl gear, and one Dall's porpoise in longline gear over the five-year authorization period.

The AFSC has requested takes of Dall's porpoises in trawl and longline gear in the BSAIRA and in trawl and gillnet gear in the GOARA (see subsection above). The analysis of potential effect relative to PBR is made for the combined requested takes from all gears and research areas (Table 4.2-14). PBR is, however, undetermined for both porpoise species in the BSAIRA, so potential takes as a percent of PBR cannot be calculated. The combined total annual estimated takes in all gears and research areas, however, range from 0.2 for the Bering Sea stock of harbor porpoise to 2.4 for Dall's porpoises (1 to 12 animals respectively over five years) and are likely sufficiently small to be considered minor in magnitude (Table 4.2-14). This conclusion would likely hold true even if the requested "undetermined dolphin or porpoise" takes are assigned to each stock in addition to those takes requested for the particular stock. Given the low number of cetacean interactions that have occurred in the past and the implementation of current mitigation measures, future mortalities of dolphins or porpoises would likely be rare or infrequent events, if they occurred, and would be unlikely to actually occur at this estimated rate during the five-year authorization period. Any actual take would occur in a localized area, but these animals travel over large geographic areas so the potential loss of an animal would affect more than a localized population. The overall impact of potential takes on the Bering Sea stock of harbor porpoises and Dall's porpoises in AFSC research gear, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

Non-ESA-Listed Pinnipeds

There are four species of non-ESA-listed pinnipeds commonly found in the BSAIRA that may interact with AFSC fisheries research: northern fur seal (Eastern Pacific stock), harbor seal (three stocks), spotted seal, and ribbon seal (Table 4.2-13).

Disturbance and Behavioral Responses due to Acoustic Equipment and Physical Presence of Researchers

The analysis of acoustic effects on these species is similar to that discussed above. The functional hearing range of seals in the AFSC operations areas is 75 Hz-100 kHz and, for sea lions and fur seals, it is 100 Hz to 40 kHz. This is well below the output frequency of Category 1 active acoustic sources used by AFSC, so pinnipeds are unlikely to detect these sounds. Some Category 2 acoustic sources, such as net transponders, are within the hearing range of pinnipeds. The sounds most likely to be audible are of short duration and restricted to areas very close to the research vessel, such as on an active net, so potential interactions are likely to be intermittent and infrequent. Table 4.2-15 provides summaries of the numbers of each species that could be taken by acoustic disturbance during AFSC research activities. There are no reports or anecdotal observations of pinnipeds being disturbed or altering behavior due to AFSC fisheries research activities to date. The potential impacts of acoustic disturbance to pinnipeds throughout the AFSC research area are therefore considered to be minor adverse according to the criteria described in Table 4.1-1.

Harbor seals using haulouts and rookeries in the BSAIRA (and GOARA) could be disturbed by the physical presence and sounds of researchers passing nearby in boats as they travel to or from research sites or while conducting nearshore surveys. The estimated annual Level B Harassment take of 5,067 harbor seals due to the presence of AFSC researchers includes three recognized stocks in the BSAIRA (Table 4.2-12). The AFSC recognizes these estimated take levels are likely large over-estimates and that actual taking by harassment will be considerably smaller. Until more accurate data becomes available through the proposed new monitoring and reporting program outlined in the LOA application (i.e., in the Preferred Alternative), it is assumed that 100 percent of these animals may react to AFSC research activity. This level of periodic, infrequent, and temporary disturbance is unlikely to affect the use of the region by harbor seals.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

Table 4.2-10 and Figure 4.2-1 show historical takes of pinnipeds by all AFSC research activities. There were no historical takes of any marine mammals, including pinnipeds, during AFSC fisheries research activities in the BSAIRA from 2004 through 2015. Measures to mitigate the risk of entanglements are described in Section 2.2.1.

In the absence of historical research takes, the AFSC LOA application includes estimates of the potential number of pinnipeds that may interact with research gear in the BSAIRA based on historical takes in commercial fisheries operating in similar areas and using similar gear types as those used in AFSC fisheries research (Table 4.2-13). The LOA application only requests takes of species considered to have a reasonable risk of adverse interactions with gear used for AFSC research. The AFSC therefore requests takes of 6 Eastern Pacific northern fur seals (five in trawl and one in longline gear), one Aleutian Islands harbor seal, one Pribilof Islands harbor seal, and one Bristol Bay harbor seal in trawl gear, and one spotted seal and one ribbon seal in trawl gear over the five-year authorization period.

The AFSC requested takes of northern fur seals in multiple gear types in the BSAIRA. The AFSC also requested takes of pinnipeds in various gear types in the GOARA and CSBSRA (see subsections above and below). Since the same stock may be taken in more than one gear type and research area, analysis of potential effects relative to PBR is made for combined requested takes from all gears and research areas (Table 4.2-14). Takes of the Eastern Pacific northern fur seal are requested in both the BSAIRA and the GOARA. Spotted and ribbon seal takes are requested for both the BSAIRA and the CSBSRA.

These potential takes, if they occurred, would be well below ten percent of known or potential PBR for each of these species and, for all but the Pribilof Islands stock of harbor seals, less than one percent of PBR (Table 4.2-14). This level of mortality would be considered minor in magnitude for all species for which PBR is known.

The LOA application also includes requests for takes of "undetermined pinniped" species in several gear types for the five-year authorization period. For the purposes of impact analysis, the AFSC must assign these undetermined takes to each stock in addition to those takes requested for the particular stock. The resulting combined take request would remain below ten percent of PBR and be considered minor in magnitude for all stocks (Table 4.2-14).

Given the low number of pinniped interactions that have occurred in the past and the implementation of current mitigation measures, future mortalities of pinnipeds would likely be rare or infrequent events and would be unlikely to actually occur at this estimated rate during the five-year authorization period. Any actual take would occur in a localized area, but for species that travel over large geographic areas, the potential loss of an animal would affect more than a localized population. The overall impact of potential takes of BSAIRA pinnipeds in AFSC research gear, if they occurred, would therefore be considered minor adverse according to the criteria described in Table 4.1-1.

4.2.4.8 Chukchi-Beaufort Seas Research Area

<u>ESA-listed Species</u>

The endangered marine mammals that occur in the CSBSRA include bowhead whales and occasional sightings of humpback and fin whales, primarily in the Chukchi Sea. Threatened species include ringed seals, and polar bears. The threatened listing of the Beringia DPS of bearded seals was vacated in 2014, following a decision in the U.S. District Court for the District of Alaska. The Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. While the appeal process is in progress, the Beringia DPS of bearded seals will retain consideration as an ESA-listed species in this FPEA. The Pacific walrus is a candidate species for listing. Polar bears and walrus are under the jurisdiction of the USFWS and, due to the very low likelihood of interactions during AFSC fisheries research, the AFSC is not requesting takes of either of these species. The remaining species are under the jurisdiction of the NMFS.

Disturbance and Behavioral Responses due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed above for ESA-listed species in other research areas. Table 4.2-17 provides summaries of the numbers of each species that could be taken by Level B acoustic harassment during AFSC research activities over the five-year authorization period. The likely impact from the different types of acoustic devices is briefly discussed below.

The output frequencies of Category 1 active acoustic sources (>300 kHz) are above the functional hearing range of baleen whales, cetaceans in the mid- and high-frequency hearing groups, and pinnipeds (Figure 4.2-2). Because they would not be able to hear them, none of the ESA-listed species in the CSBSRA is expected to be affected by Category 1 sound sources (Appendix C, Section 6.2).

Category 2 active acoustic sources are unlikely to be heard by most baleen whales. Some Category 2 acoustic sources, such as net transponders, are within the hearing range of pinnipeds. The sounds most likely to be audible are of short duration and restricted to areas very close to the research vessel, such as on an active net, so potential interactions are likely to be intermittent and infrequent. There are no reports or anecdotal observations of marine mammals being disturbed or altering behavior due to AFSC fisheries research activities to date. If detected, short term avoidance is the most likely response (Appendix C, Section 6.2). The potential impacts of acoustic disturbance to pinnipeds throughout the AFSC research area are therefore considered to be minor adverse according to the criteria described in Table 4.1-1.

Table 4.2-18 Estimated Level B Harassment Takes of Marine Mammals by Acoustic Sources during AFSC Research in the CSBSRA over a Five Year period

Species (Common Name)	Total Estimated Level B Take (numbers of animals)	Species (Common Name)	Total Estimated Level B Take (numbers of animals)
Bearded seal - Alaska Stock	58	**Humpback whale - Central North Pacific Stock[1]**	0
Beluga whale - Beaufort Sea Stock	3	**Humpback whale - Western North Pacific Stock[1]**	0
Beluga whale - Eastern Chukchi Sea Stock	3	**Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock**	1
Bowhead whale - Western Arctic Stock[1]	0	**Minke whale - Alaska Stock**	0
Fin whale - Northeast Pacific Stock[1]	0	**Ribbon seal - Alaska Stock**	62
Gray whale - Eastern North Pacific Stock	0	**Ringed seal - Arctic Subspecies/Alaska Stock[1]**	585

Species (Common Name)	Total Estimated Level B Take (numbers of animals)	Species (Common Name)	Total Estimated Level B Take (numbers of animals)
Gray whale - Western North Pacific Stock[1]	0	**Spotted seal - Alaska Stock**	153
Harbor porpoise	1		

1. ESA-listed species

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

There have been no historical fisheries research takes of any marine mammals in the CSBSRA and commercial fisheries are currently prohibited in the Chukchi and Beaufort seas (NPFMC 2009a). In the absence of other data, requested takes are based on the geographic and temporal overlap of AFSC fisheries research activities and marine mammal species' ranges. Based on this, the AFSC take requests for ESA-listed species include one bearded seal and one ringed seal in trawl gear over the five-year authorization period (Table 4.2-13).

The AFSC also requested takes of bearded and ringed seals in trawl gear in the BSAIRA (see above subsection). Since these stocks may be taken in two research areas, analysis of potential effects relative to PBR includes the combined requested takes from both areas (Table 4.2-14).

PBR is undetermined for both bearded and ringed seals, however the combined requested takes in trawl gear in the BSAIRA and CSBSRA (0.4 per year for bearded seal and 0.6 per year for ringed seal) are likely sufficiently small to be considered minor in magnitude (Table 4.2-14). Assigning additional "undetermined pinniped" takes to either of the combined requested takes would not add substantially to annual take levels for ringed or bearded seals and, despite the lack of PBR calculations, this take level would likely remain of minor magnitude (Table 4.2-14).

Measures to mitigate the risk of entanglements are described in Section 2.2.1. Vessel captains, bridge officers, and crew watch for marine mammals while underway and while setting fishing gear and take action to avoid them. The lack of entanglements of marine mammals, ESA-listed and otherwise, in the CSBSRA indicates that the risk of these types of interactions in fisheries research gear is low. The potential effects from entanglement in research gear is therefore considered minor adverse, according to the criteria described in Table 4.1-1, for ESA-listed species throughout the CSBSRA using gear types similar to those currently in use.

Non-ESA-Listed Cetaceans

The non-ESA-listed cetaceans that occur in the CSBSRA include two stocks of beluga whales, harbor porpoise, minke whales, and eastern North Pacific gray whales. None has been taken historically during AFSC fisheries research.

Disturbance and Behavioral Responses due to Acoustic Equipment

The analysis of acoustic effects on cetaceans is similar to that described for ESA-listed species above. Table 4.2-18 provides summaries of the numbers of each species that could be taken by Level B acoustic harassment during AFSC research activities. The likely impact from the different types of acoustic devices is briefly discussed below.

The output frequencies of Category 1 active acoustic sources (>300 kHz) are above the functional hearing range of baleen whales and cetaceans in the mid- and high-frequency hearing groups (Figure 4.2-2). Because they would not be able to hear them, none of the cetacean species in the CSBSRA is expected to be affected by Category 1 sound sources (Appendix C, Section 6.2).

Category 2 active acoustic sources are unlikely to be heard by most baleen whales, but are within the range of hearing for various odontocetes, including mid-frequency hearing beluga whales and high frequency hearing harbor porpoises. The sounds most likely to be audible are of short duration and restricted to areas very close to the research vessel, such as on an active net, so potential interactions are likely to be intermittent and infrequent. There are no reports or anecdotal observations, to date, of marine mammals being disturbed or altering behavior due to AFSC fisheries research activities. If detected, short term avoidance is the most likely response (Appendix C, Section 6.2). The potential impacts of acoustic disturbance to pinnipeds throughout the AFSC research area are therefore considered to be minor adverse according to the criteria described in Table 4.1-1.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

There have been no historical fisheries research takes of marine mammals in the CSBSRA and there are currently no commercial fisheries in the Chukchi and Beaufort seas (NPFMC 2009a). Take requests are, subsequently, based on the geographic and temporal overlap of AFSC fisheries research activities and marine mammal species' ranges. Other factors considered in determining potential spatial-temporal overlap included the occurrence of sea and shorefast ice, as fisheries research vessels typically avoid areas where sea ice is present. Based on this, the AFSC take requests for non-ESA-listed cetaceans in trawl gear include one each from the Eastern Chukchi and Beaufort Sea stocks of beluga whales over the five-year authorization period (Table 4.2-13).

This level of take of beluga whales, were it to occur, would be well below one percent of PBR for the Eastern Chukchi Sea stock; PBR is undetermined for the Beaufort Sea stock, so take as a percent of PBR cannot be calculated (Table 4.2-14). The total annual average estimated takes of 0.2 belugas from each stock is sufficiently small to be considered minor in magnitude, even in the absence of a PBR determination for one stock. There are no requested takes of either species in other gear types or research areas.

Measures to mitigate the risk of entanglements are described in Section 2.2.1. Vessel captains, bridge officers, and crew watch for marine mammals while underway and while setting fishing gear and take actions to avoid them. The lack of entanglements of any marine mammals in the CSBSRA indicates that the risk of these types of interactions in fisheries research gear has been low under the status quo conditions. The potential effects from entanglement in research gear is therefore considered minor adverse, according to the criteria described in Table 4.1-1, for non-ESA-listed cetacean species in the CSBSRA.

Non-ESA-Listed Pinnipeds

The species of non-ESA-listed pinnipeds in the CSBSRA that may interact with AFSC research include spotted seals and ribbon seals. None has been taken historically during AFSC fisheries research.

Disturbance and Behavioral Responses due to Acoustic Equipment

The analysis of acoustic effects on these species is similar to that discussed above. The functional hearing range of seals in the AFSC research areas is 75 Hz-100 kHz is well below the output frequency of Category 1 active acoustic sources used by AFSC, so seals in the CSBSRA are unlikely to detect these sounds. Some Category 2 acoustic sources, such as net transponders, are within the hearing range of pinnipeds. The sounds most likely to be audible are of short duration and restricted to areas very close to the research vessel, such as on an active net, so potential interactions are likely to be intermittent and infrequent. Table 4.2-18 provides summaries of the numbers of each species that could be taken by acoustic disturbance during AFSC research activities. There are no reports or anecdotal observations of pinnipeds being disturbed or altering behavior due to AFSC fisheries research activities to date. The potential impacts of acoustic disturbance to pinnipeds throughout the AFSC research area are therefore considered to be minor adverse according to the criteria described in Table 4.1-1.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

There have been no historical fisheries research takes of marine mammals in the CSBSRA and there are currently no commercial fisheries in the Chukchi and Beaufort seas (NPFMC 2009a). As a result, take requests are based on the geographic and temporal overlap of AFSC fisheries research activities and marine mammal species' ranges. The AFSC therefore requests takes of the following non-ESA-listed pinnipeds trawl gear in the CSBSRA: one each of spotted and ribbon seals over the five-year authorization period (Table 4.2-13).

The AFSC also requested takes of spotted and ribbon seals in trawl gear in the BSAIRA. Since these stocks may be taken in more than one research area, analysis of potential effects relative to PBR is made for combined requested takes for both areas (Table 4.2-14). These potential takes, if they occurred, would be well below one percent of PBR for spotted seals and would be considered minor in magnitude (Table 4.2-14). PBR is undetermined for ribbon seals, so potential takes as a percent of PBR cannot be calculated. The total combined annual average estimated take of 0.4 is likely sufficiently small to also be considered minor in magnitude.

The LOA application also includes requests for takes of "undetermined pinniped" species in several gear types for the five-year authorization period. For the purposes of impact analysis, the AFSC must assign these undetermined takes to each stock in addition to those takes requested for the particular stock. The resulting combined take requests would remain well below one percent of PBR and be considered minor in magnitude for spotted seals and would likely remain minor in magnitude for ribbon seals, despite the lack of PBR information (Table 4.2-14).

Given the lack of pinniped interactions that have occurred in the past and the implementation of current mitigation measures, future mortalities of pinnipeds would likely be rare or infrequent events. Any actual take would occur in a localized area, but for species that travel over large geographic areas, the potential loss of an animal would affect more than a localized population. The overall impact of potential takes of non-ESA-listed pinnipeds in AFSC research gear in the CSBSRA would therefore be considered minor adverse according to the criteria described in Table 4.1-1.

4.2.4.9 Conclusion

Potential direct and indirect effects of AFSC fisheries and ecosystem research activities on marine mammals have been considered for all gear used in research under the Status Quo Alternative. Given the very small amounts of fish and invertebrates removed from the ecosystem during scientific sampling, the dispersal of those sampling efforts over large geographic areas, and the short duration of sampling efforts, the overall risk of causing changes in food availability for marine mammals is considered minor adverse. Also, given the crew training, required emergency equipment, and adherence to environmental safety protocols on NOAA research vessels and NOAA chartered vessels, the risk of altering marine mammal habitat through contamination from accidental discharges into the marine environment is considered minor adverse.

All species may be exposed to sounds from active acoustic equipment used in AFSC fisheries research, although several acoustic sources are not likely audible to many species. Those that are audible would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through a given area. The potential for TTSs in hearing is low for high frequency cetaceans (harbor and Dall's porpoises) and very low to zero for other species, particularly low frequency cetaceans. The potential for hearing loss or injury to any marine mammal is essentially zero. Because of the minor magnitude of effects and temporary duration of acoustic disturbance, the overall effects of acoustic disturbance are considered minor adverse for all species throughout the AFSC research areas.

Steller sea lions and harbor seals in the GOARA and BSAIRA may be disturbed by the physical presence and sounds of AFSC researchers traveling by boat near haulouts and rookeries. In the absence of more accurate data and monitoring protocols under Status Quo conditions, it is assumed that 100 percent of the hauled out pinnipeds could react to AFSC research activity. These estimated take levels are likely large over-estimates and actual Level B harassment takes will be considerably smaller. This level of periodic, infrequent, and temporary disturbance is unlikely to affect the use of the region by any of these species. From 2004 through 2015, four marine mammals (two Dall's porpoises, one northern fur seal, and one northern sea otter) were caught in AFSC fisheries research gear in the GOARA. There have been no research takes in either the BSAIRA or the CSBSRA. These historic data and data on mortalities in commercial fisheries using similar gear were used to estimate potential takes (combined Level A harassment and serious injury and mortality) in the GOARA and BSAIRA in the next five years under status quo conditions. In the absence of both historical research takes and commercial fisheries, takes in the CSBSRA were based on spatial and temporal overlap of marine mammal species and AFSC fisheries research effort. AFSC survey protocols under status quo conditions include a suite of mitigation measures designed to minimize or avoid marine mammal takes. Future takes, if they occur, would likely be fewer than the estimates since they are based on a precautionary approach to ensure accounting for a maximum level of potential take. The estimated annual potential takes for all species for which PBR is known are less than 10 percent of PBR and would be considered to have minor magnitudes of effect at the population level. Adverse interactions with research gear would likely continue to occur rarely but could occur anywhere the AFSC conducts fisheries research; impacts would likely be dispersed over time and space. The overall impact of the potential takes of these species, if they occurred, would be considered minor adverse according to the criteria described in Table 4.1-1.

The overall effects of the Status Quo Alternative on marine mammals would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration (for effects other than mortality), and would therefore be considered minor adverse according to the impact criteria in Table 4.1—1.

4.2.5 Effects on Birds

Tables 3.2-9, 3.2-10, and 3.2-11 list the seabird species that occur in the three AFSC research areas, including three ESA-listed species (short-tailed albatross, Steller's eider, and spectacled eider), four birds of conservation concern (black-footed albatross, Laysan albatross, Kittlitz's murrelet, and yellow-billed loon), and other species that regularly occur offshore of Alaska. This section describes the effects of the status quo AFSC research activities on seabirds. The potential effects of research vessels, survey gear, and other associated equipment on seabirds include:

- Injury or mortality due to ship strikes and entanglement in gear
- Changes in food availability due to survey removal of prey and discards
- Contamination or degradation of habitat

4.2.5.1 Injury and Mortality Due to Ship Strikes and Entanglement in Fishing Gear

There are several potential mechanisms for AFSC research activities to cause injury or mortality to seabirds. Many seabirds are attracted to fishing vessels in order to forage on bait, offal, discards, and natural prey disturbed by the fishing operation. This attraction to fishing vessels creates the opportunity for birds to inadvertently collide with cables or lines and other structures on the vessel as well as being caught in the fishing gear. Bird strikes are probably most numerous during the night and during storms or foggy conditions when bright deck lights are on, which can cause the birds to become disoriented (NMFS

2004). However, such collisions with gear or vessels are hard to detect, especially without a dedicated research effort to monitor bird interactions.

There are no records of any bird injuries or mortalities due to ship strikes during AFSC fisheries research activities, but it is usually very difficult to detect seabird collisions with gear or vessels. There is still a potential for injury or mortality to occur from ship strikes, but they are likely to be such rare events that they would not affect seabird populations. Therefore the potential effects of research on seabirds through injury or mortality from ship strikes are considered minor adverse.

In some parts of the world, mortality of seabirds in commercial fishing gear, especially longlines and gillnets, is a major conservation concern for albatross, gulls, and other species that follow commercial fishing vessels. Diving birds are vulnerable to getting caught in gillnets while they are being fished and other fishing gear near the surface as it is being set or hauled in.

In Alaska the commercial longline fleet has traditionally been responsible for about 91% of the overall seabird bycatch in the Alaska groundfish fisheries, with most of the remainder occurring in trawl fisheries and a few occurring in pot fisheries (NMFS 2014b), although there is a known bias in trawl seabird bycatch that could affect this percentage (Fitzgerald, et al, in prep). Other fisheries that may involve incidental catch of seabirds, such as longline fisheries targeting halibut and various gillnet fisheries, have not required outside observers onboard so estimates of seabird catch are not available. Observer coverage for the longline halibut fleet began in 2013 but no data on bird bycatch in that fishery is currently available. Bycatch in the groundfish longline fishery showed a marked decline beginning in 2002 due to the deployment of streamer (tori) lines as bird deterrents. Since then, annual bycatch has remained below 10,000 birds, dropping as low as 4,007 in 2010. Numbers increased to 8,940 in 2011, the second highest in the streamer line era, but fell back to 4,571 in 2012 and further decreased to 4,246 in 2013 (NMFS 2014b). Although variations in fishing effort and mitigation measures used likely play a role in how many birds are caught in a given year, fluctuations in prey availability from year to year are also important. Many fishermen and observers have reported instances where flocks of birds swarmed the vessel and appeared to be unusually aggressive and persistent in going after bait, ignoring all attempts to deter them. These birds were assumed to be under great nutritional stress due to an area-wide shortage of natural food and the fishing vessel provided the only source of food available. Certain years have anomalously high incidental take rates for many species groups which indicates that these years may have had widespread food shortages, at least for certain periods during the longline seasons (NMFS 2004).

The numbers and composition of birds caught in commercial longline fisheries in Alaska varies by region. In the GOA an estimated 1,142 seabirds were incidentally caught per year from 2007 through 2013 and the species composition was 45 percent fulmars, 26 percent gull species,14 percent black-footed albatross, 8 percent Laysan albatross, 5 percent unidentified seabirds, and 1 percent shearwater species (NMFS 2014b). In the Aleutian Island demersal longline fisheries an estimated 195 seabirds were incidentally caught per year from 2007 through 2013 and the species composition was 34 percent fulmars, 30 percent Laysan albatross, 23 percent gull species, and 10 percent shearwater species. In the Bering Sea an estimated 5,366 seabirds were incidentally caught per year from 2007 through 2013 and the species composition was 62 percent fulmars, 16 percent gull species, 15 percent shearwater species, 6 percent unidentified, and less than 0.5 percent Laysan and black-footed albatross combined (NMFS 2014b).

Trawls also account for an average estimated incidental catch of 774 seabirds per year in the Alaska groundfish fisheries, all areas combined (NMFS 2014b). It should be noted that this estimate is based only on the observer samples and seabird mortalities are known to occur in the trawl catch outside the observer samples; the AFSC is currently working on protocols to monitor and estimate this additional source of mortality. The species composition of seabirds taken in groundfish trawls (2007-2013) was 63 percent fulmars, 18 percent shearwaters, 8 percent gulls, and about 4 percent murres and other alcids (NMFS 2014b). Some birds, including eiders, may also be injured or killed by striking the vessel superstructure or fishing gear while flying in the vicinity (USFWS 2003b).

Almost all of the birds taken by AFSC research projects from 2004 through 2015 (45 of 46 total) have been taken during the Alaska Longline Summer survey, which is conducted alternately in the GOA and Bering Sea. The other survey that resulted in a bird take was the BASIS, which caught a common murre using a surface trawl. Figure 4.2-4 shows the species and location of all 46 seabird takes by the AFSC research activities since 2004. Table 4.2-19 indicates the year, species, and number of birds incidentally caught during AFSC fisheries research since 2004.

The species composition of birds caught during AFSC fisheries research, 84.8 percent of which are black-footed albatross (39 of 46 birds), does not match the catch of birds in the commercial groundfish fisheries. Fulmars, the most frequently caught species in Alaska groundfish fisheries in all areas and gears, represent only 8.7 percent (4 of 46 birds) of birds caught in AFSC fisheries research. It is not clear why this is the case.

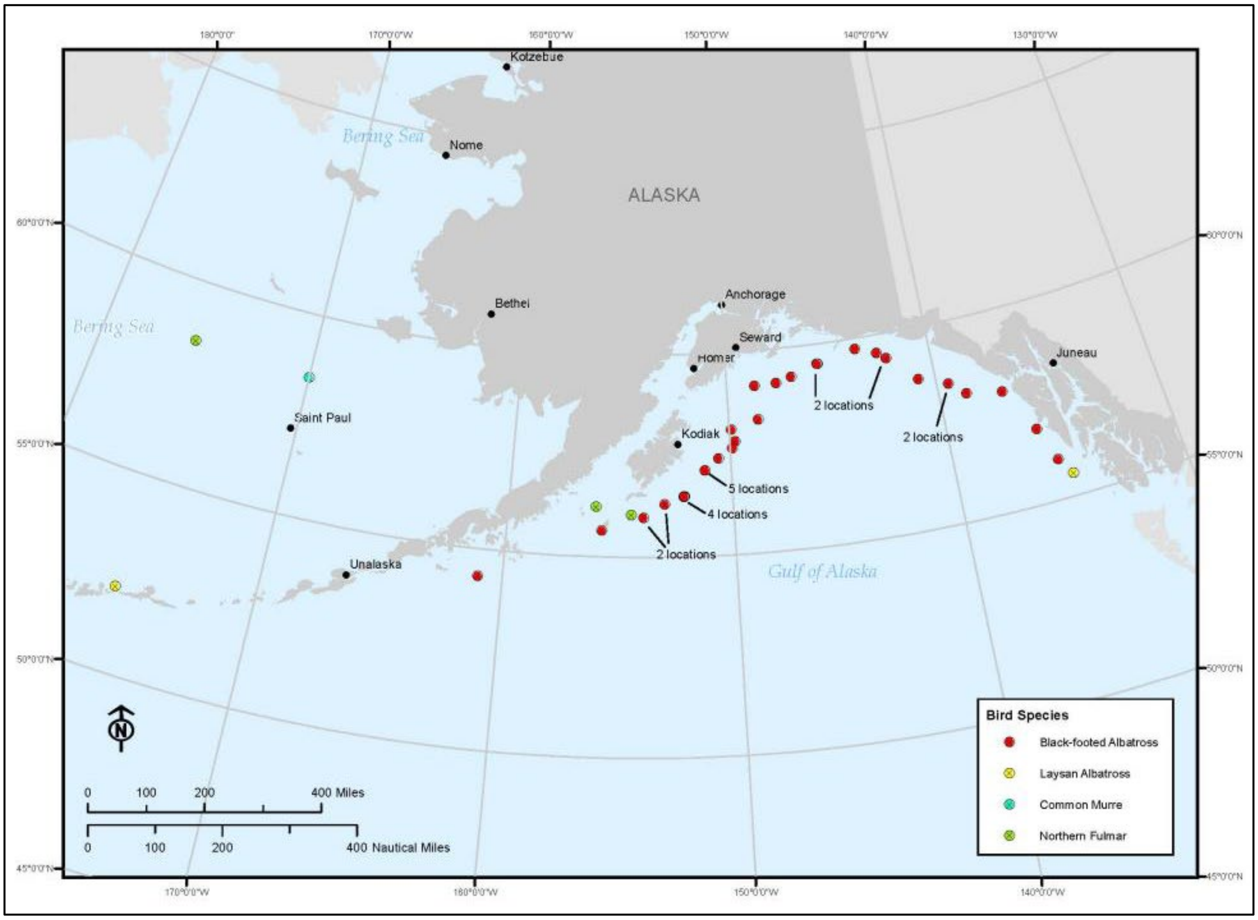


Figure 4.2-4 Seabird Incidental Catch by AFSC Research from 2004 through 2015

Under the Status Quo Alternative the following mitigation measures are used during AFSC research with longline gear:

<u>Monitoring methods</u>

- The officer or vessel operator on watch, Chief Scientist or other designated member of the scientific party, and any crew standing watch visually monitor the area of operation for short-tailed albatross (and other protected species) prior to and during all longline operations.

Operational procedures

- Tori lines, consisting of paired streamers, are deployed with every longline set to mitigate entanglement of seabirds diving on baited hooks. The tori line gear and deployment protocols are consistent with the seabird-avoidance measures required by federal regulation in the commercial longline fleet in the Alaska groundfish fisheries. A crewman is responsible for ensuring the tori lines are working properly and the Chief Scientist is present during the set to ensure protocols are being followed. Additionally, the vessel is instructed to set at a slow speed to ensure the line sinks quickly. Seven pound lead balls are attached at the end of each skate to increase the sink rate and ensure the groundline reaches the seafloor.
- AFSC longline protocols specifically prohibit chumming before or during the longline setting operations (i.e., releasing additional bait to attract target species to the gear). However, longline surveys are conducted on contracted commercial fishing catcher/processor vessels and fish are processed as the longline is retrieved. Spent bait and processing offal are discarded away from the longline gear as it is being retrieved, which often serves to attract seabirds away from the longline. Due to the volume of fish caught with each set and the length of time it takes to retrieve the longline (up to 8 hours), the retention of spent bait and offal until the gear is completely retrieved is not possible and the attraction of birds to the vessel is unavoidable.

Table 4.2-19 Birds Incidentally Taken During AFSC Fisheries Research since 2004

Year	Survey	Gear Used	Species	Number Taken
GOARA				
2004	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	3
2005	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	6
2006	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	5
2007	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	7
			Northern fulmar	2
2008	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	3
			Northern fulmar	1
2009	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	2
2010	Alaska Longline Survey_Summer	Bottom longline	Laysan albatross	1
2011	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	5
2013	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	1
2014	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	2
2015	Alaska Longline Survey_Summer	Bottom longline	Black-footed albatross	5
BSAIRA				
2007	BASIS	Surface trawl	Common murre	1
2011	Alaska Longline Survey_Summer	Bottom longline	Northern fulmar	1
2012	Alaska Longline Survey_Summer	Bottom longline	Laysan albatross	1

Source: NMFS 2016 PSITDB Summary

4.2.5.2 Changes in Food Availability

Under the Status Quo Alternative, we examine whether AFSC fisheries and ecosystem research activities could potentially affect seabirds through changing the abundance or distribution of their prey species. A recent study (Cury et al. 2011) examined data from the past 45 years and all of the world's oceans and found that reductions in prey abundance (small fish and invertebrates) to below one third of maximum documented biomass results in substantial declines in seabird reproductive success. This response was common to all seabird species and ecosystems examined in the Pacific, Atlantic, and Southern Oceans (Cury et al. 2011). Many factors influence the abundance and distribution of seabird prey, including strong roles for oceanographic and weather fluctuations, but commercial fisheries are also a factor. Although it is very difficult to demonstrate the indirect effects of fishing for other species and size classes on the availability of prey for seabirds, directed fishing on small schooling fish (e.g., sardines and anchovies) and invertebrates (e.g., krill) have played major roles in driving seabird prey populations below the "one third" limit in many areas (Cury et al. 2011).

Fisheries and ecosystem research activities proposed under the Status Quo Alternative may also have beneficial effects on seabirds by providing offal and discards that would otherwise be unavailable to birds. In some areas with intensive commercial fishing efforts, offal may provide a substantial portion of the total food consumed by scavenging species such as gulls (Tasker and Furness 1996). However, while scavenging may benefit individual birds, it also places them in danger from entanglement and incidental mortalities in fishing gear.

AFSC fisheries and ecosystem research activities proposed under the Status Quo Alternative would remove very small quantities of potential food for seabirds. The dispersal of research effort over wide areas of sea and the relatively small number of research surveys over time makes it very unlikely that any measurable impacts to the abundance or distribution of seabird prey would occur as a result of research activities proposed under the Status Quo Alternative. This is especially true for the small size classes of fish and pelagic invertebrates favored by most seabirds because of their large biomasses and the minimal amounts taken in research samples (Sections 4.2.3 and 4.2.7). For the same reasons, the amount of food made available through research activities is unlikely to have more than temporary and highly localized beneficial effects on seabirds.

4.2.5.3 Contamination or Degradation of Habitat

For the same reasons described for fish (Section 4.2.3) and marine mammals (Section 4.2.4), potential effects on seabirds from accidental discharges of fuel or other contaminants from vessels engaged in AFSC fisheries and ecosystem research activities are possible but unlikely. In the unlikely event that fuel, oil, or other contaminants are discharged, the volume of discharged material is likely to be small and the area of influence would be localized. Any potential effects to seabirds would be similarly short-term, localized, and would likely affect a small number of birds. The overall impact of accidental contamination of seabirds would therefore be considered minor adverse. This type of potential effect on seabirds will not be discussed further in this analysis.

4.2.5.4 ESA-listed Species

AFSC fisheries research surveys use several gear types that have resulted in seabird mortality in commercial fisheries offshore of Alaska (longlines, trawls, and gillnets). On NOAA vessels or chartered vessels, any seabird mortalities during survey efforts should be recorded. No ESA-listed species have been taken in the past. The potential for AFSC fisheries and ecosystem research activities to contaminate the marine environment or change the availability of prey for seabirds is discussed above and those conclusions apply to all ESA-listed species as well.

Short-tailed albatross

At least 11 short-tailed albatross have been taken in commercial longline gear since 1987, with the most recent birds (two) being caught in 2014 (NMFS 2014a). These mortalities of a critically endangered species led to the development of effective and mandatory mitigation measures (tori lines) that were required in 2004 but adopted by most of the BSAI longline fleet several years earlier (NMFS 2004). The AFSC's Alaska Longline Survey is conducted in the same areas of the GOA and BSAI where takes of short-tailed albatross in the commercial fisheries have occurred in the past. AFSC longline surveys use the seabird mitigation measures required of the commercial fleet and take extra precautions to avoid setting gear when short-tailed albatross are present. Although the Alaska Longline Survey has never caught short-tailed albatross, it has infrequently but regularly caught black-footed albatross and, rarely, Laysan albatross. The use of this research gear continues to pose a risk of capture/hooking to short-tailed albatross but the AFSC considers that risk to be minimal given the use of tori lines and monitoring for short-tailed albatross during setting operations, which is when albatross are susceptible to hooking. A future take is therefore possible but unlikely. AFSC does not anticipate that research activities will result in the taking of significant numbers of short-tailed albatross. As a precautionary measure, however, two takes for short-tailed albatross are requested over a five-year period in the event unexpected circumstances occur during planned activities. Additional details on effects to short-tailed albatross from AFSC research activities are detailed in the Biological Opinion (USFWS 2018).

Spectacled eider

Spectacled eiders occur in the Bering Sea in the winter and spring months but are associated with sea ice, which is strictly avoided by AFSC fisheries research vessels. In the summer they are present in the CSBSRA but are on land/freshwater or in nearshore marine waters and do not overlap spatially with the great majority of AFSC fisheries research activities, which occur further offshore. The few nearshore AFSC fisheries research activities in the CSBSRA involve small boats and small fishing gears (e.g., beach seines) that are unlikely to catch birds of any kind. Incidental mortality of spectacled eiders in AFSC fisheries research gear is therefore unlikely to occur in the future.

The USFWS has established long-term monitoring sites in the spectacled eider critical habitat area near St. Lawrence Island to monitor shellfish populations. The locations of these monitoring sites were given to the AFSC RACE Division which makes sure to avoid those areas when selecting bottom trawl survey locations each year.

Steller's eider

Steller's eiders occur in nearshore marine waters of the GOARA and BSAIRA during the fall, winter, and spring months and in nearshore waters or freshwater in the CSBSRA during the summer. For similar reasons as described for spectacled eiders, incidental mortality of Steller's eiders in AFSC fisheries research gear is unlikely to occur in the future given the minimal spatial overlap with research activities.

The AFSC has also agreed with USFWS to avoid bottom trawl survey locations within Steller's eider critical habitat in Norton Sound.

4.2.5.5 Birds of Conservation Concern

Black-footed albatross are the most frequently caught seabird species in AFSC fisheries research gear (39 out of 46 birds caught since 2004). This represents an average of 3.25 black-footed albatross caught per year from 2004 through 2015. This infrequent but regular catch of black-footed albatross, in spite of the careful deployment of tori lines before and during longline sets, is very small compared to the estimated population of this species (61,700 breeding pairs), which appears to be stable over this time period in spite of mortality in commercial fisheries (Arata et al. 2009). This level of mortality is considered minor in magnitude for black-footed albatross.

Two Laysan albatross have been incidentally caught during AFSC fisheries research since 2004, one in the GOARA and one in the BSAIRA. It is not clear why catch of Laysan albatross is apparently rare in AFSC fisheries research while black-footed albatross are caught on a more regular basis. In the GOA commercial longline fisheries (at least the fisheries that are observed and for which data is available), black-footed albatross are caught about twice as frequently as Laysan albatross. But in the BSAI, Laysan albatross are caught more frequently than black-footed (NPFMC 2014b). In any case, this level of mortality is very small compared to the estimated population of this species (approximately 3.4 million birds, NMFS 2005a), which appears to be stable over this time period in spite of mortality in commercial fisheries (Arata et al. 2009). This level of mortality is considered minor in magnitude for Laysan albatross.

There are no records of red-legged-kittiwakes, Kittlitz's murrelets, or yellow-billed loons interacting with research gear or vessel structures during AFSC fisheries research. Red-legged kittiwakes have a relatively small range around the Pribilof Islands and Buldir and AFSC fisheries research activities are regularly conducted in these waters. However, kittiwakes are surface feeders and, judging by the scarcity of their capture in the commercial groundfish fisheries, appear to be less susceptible to being caught by AFSC research gear than tubenoses and large gulls. Kittlitz's murrelets primarily occur in nearshore waters near glacial outwashes and do not overlap spatially with the great majority of AFSC fisheries research activities, which occur further offshore. Yellow-billed loons are also primarily nearshore birds in winter and freshwater birds during the breeding season when AFSC fisheries research occurs in the arctic. For both of these species, incidental mortality in AFSC fisheries research gear is unlikely to occur in the future given minimal spatial overlap with research activities.

4.2.5.6 Other Bird Species

The only other seabird species that have been caught in AFSC fisheries research gear are northern fulmar (four birds since 2004) and common murre (one bird since 2004). For both of these species, such rare mortalities in research gear are very small compared to their estimated populations (millions of birds) and are considered minor in magnitude for both fulmars and murres.

4.2.5.7 Conclusion

The short duration of fisheries research tows, the dispersal of research effort over wide areas of sea, and the relatively small number of research surveys over time makes it very unlikely that the abundance or distribution of seabird prey would be affected by research activities. This is especially true for the small size classes of fish and pelagic invertebrates favored by most seabirds because of their large biomass and the minimal amounts taken in research samples (Sections 4.2.3 and 4.2.7). For the same reasons, the amount of food made available through research activities is unlikely to have more than temporary and highly localized beneficial effects on seabirds. The potential effects of research on seabirds through changes in food availability are therefore considered minor adverse.

The potential for research vessels to degrade seabird habitat and prey through contamination would only be through accidental spills and discharges. Given the crew training previously discussed and the small number of fisheries research vessels, these would likely be limited in scope, infrequent, and localized and would therefore considered minor adverse.

Incidental mortality of seabirds by hooking/capture in AFSC fisheries research gear, almost exclusively during the Alaska Longline Survey, occurs on an infrequent but regular basis. Black-footed albatross are most frequently caught in research gear with small numbers of northern fulmars, Laysan albatross, and common murres caught since 2004. The level of mortality for all species is considered minor in magnitude compared to their estimated population numbers. AFSC does not anticipate that research activities will result in the taking of significant numbers of short-tailed albatross. As a precautionary measure, however, two takes for short-tailed albatross are requested over a five-year period in the event unexpected circumstances occur during planned activities.

The overall effects on seabirds from AFSC research activities are expected to be short-term in duration (other than mortalities in gear interactions), rare in frequency, dispersed over a huge geographic area, and would not result in any measurable changes to seabird populations under the Status Quo Alternative; effects are therefore considered minor adverse according to the criteria in Table 4.1-1. This conclusion holds for each of the three AFSC research areas and for all gear types used in research.

4.2.6 Effects on Sea Turtles

This section describes the types of effects of the Status Quo Alternative on four species of ESA-listed sea turtles: leatherback, olive ridley, green, and loggerhead. The cold waters of Alaska are above the typical northern limits for sea turtles, so few are expected to be present. There are incidental records of four species of sea turtles found in Alaska waters; showing that under certain oceanographic conditions (e.g., warmer currents), they do occur. The few numbers of turtles incidentally observed likely represent a small percentage of a larger number of sea turtles that actually occur in Alaska waters.

There are no records of sea turtles occurring in the Chukchi Sea/Beaufort Sea Research Area, so no effects would occur there. In the Bering Sea only leatherback sea turtles have been recorded. In the GOA all four species could occur and be affected, although leatherbacks and green sea turtles have been recorded much more frequently than are olive ridley or loggerhead sea turtles.

In the unlikely event that sea turtles encounter AFSC research activities, the direct and indirect effects may include:

- Disturbances and changes in sea turtle behavior due to physical movements and sounds
- Injury or mortality due to ship strikes or entanglement in fishing gear
- Changes in food availability due to survey removal of prey
- Contamination or degradation of sea turtle habitat

4.2.6.1 Disturbance and Changes in Behavior Due to Physical Movements and Sound Sources

There is a potential for research activities to disturb sea turtles and cause changes in behavior, primarily through the physical presence of marine vessels and fishing gear and operational sounds from engines and hydraulic equipment.

Little is known about hearing in sea turtles, but the available information suggests that their underwater hearing capabilities are quite limited both in functional hearing bandwidth and in absolute hearing sensitivity. . The limited data suggest that sea turtles probably have functional hearing sensitivity between about 100 Hz and 1.2 kHz (Ketten and Bartol 2005, Dow Piniak et al. 2012), which is well below the frequencies of acoustic instruments used in fisheries research. The higher frequency sounds are unlikely to be audible to sea turtles and therefore unlikely to have adverse effects on sea turtles.

Sea turtles may be disturbed or displaced from their normal behavior or movements by passing vessels or fishing gear in the water. Given the small number of AFSC research vessels and their dispersal over a wide area, behavioral disturbances resulting from AFSC research activities would be temporary in nature, lasting only a few minutes as the research vessel passes, and are therefore likely to have no more than negligible effects on turtle foraging success or survival.

Injury or Mortality Due to Ship Strikes

The two main mechanisms for research activities to cause injury or mortality to sea turtles are ship strikes and entanglement in fishing gear. Sea turtles come to the surface to breathe, and also to rest, making them susceptible to ship strikes. Because it is often difficult for observers on vessels underway to see turtles, there is little data available on the frequency of ship strikes on sea turtles. Bridge crew on AFSC research cruises routinely watch for floating obstacles while underway and would take measures to avoid collisions with sea turtles if they could. There have been no reported incidents of ship strikes by AFSC research vessels, although there is the possibility that such strikes have occurred without notice by the crew.

Transit speeds on AFSC research cruises vary from 6-14 knots depending primarily on tidal currents, but are typically about 10 knots. The vessel's speed during active sampling is typically 2-5 knots due to sampling design, and these slower speeds are assumed to minimize the risk of collisions with sea turtles. Given the relatively slow speeds of research vessels, the presence of bridge watches during survey activities, the small number of research cruises, and the rarity of sea turtles in Alaska, collisions with sea turtles resulting from the research activities conducted under the Status Quo Alternative would likely be rare events, if they occurred.

Injury or Mortality Due to Interactions with Fishing Gear

There are many factors that may contribute to the likelihood of sea turtles interacting with fishing gear, including capture or entanglement in various nets, collisions with mobile gear, and getting hooked by longline gear. Some of the variables involve details of the fishing gear such as the type and size of hooks and the bait used for longline surveys. Other variables involve the distribution and abundance of sea turtles in the area which may be related to the presence of prey sources, seasonal migration patterns, and oceanographic features. Sea turtles migrate toward southern waters for the winter, so the overlap of AFSC fisheries research and sea turtles is not uniform over time and space. The primary risk of interactions with sea turtles is for AFSC research activities that occur in summer months in the southern parts of the GOA. Six of the 19 leatherback sea turtles recorded in Alaska were found after interacting with fishing gear (Hodge and Wing 2000 as cited in ANHP 2012). However, there are no recorded incidents of sea turtle interactions with any AFSC research gear, and all four species are uncommon to rare in Alaska waters, so the chance of future interactions in AFSC fisheries research gear is small and none are expected to occur in the foreseeable future.

Changes in food availability due to survey removal of prey

Leatherback turtles forage seasonally on dense aggregations of jellyfish off the West Coast of the U.S. (Graham 2009). Several species of jellyfish are regularly caught as a result of AFSC fisheries research activities in the GOA and Bering Sea, including the two common large jellyfish species, *Chrysaora fuscescens* and *Aurelia labiata*. In the GOA an average of 140 kgs of *Chrysaora fusescens* and 9 kgs of *Aurelia labitata* are caught annually. In the Bering Sea an average of 11 kgs of *Chrysaora fusescens* and 39 kgs of *Aurelia labitata* are caught annually. This level of jellyfish removal as a result of AFSC surveys is minimal and is not expected to have any measurable effect on the availability of jellyfish as a food source for leatherback sea turtles.

Green turtles eat seagrasses and algae (NMFS 2015h), and would therefore not be affected by changes in food availability due to removal of prey.

Olive ridley and loggerhead sea turtles eat mainly crustaceans and fish, small numbers of which are removed by AFSC research activities; however neither of these species is expected to occur in large enough numbers to be affected.

Contamination or Degradation of Habitat

Bottom trawls and other bottom-contact gear can disrupt the ocean floor and benthic sediment. This can disturb or damage important foraging habitats for sea turtles, and cause turbidity in the water that could make it difficult for turtles to locate prey. However, surveys conducted by AFSC research programs impact very small areas of the ocean floor relative to the entire area and relative to the footprint of commercial fisheries (see Section 4.2.2), and, due to the stratified random design of many surveys, typically do not occur in the same geographic location from year to year. The impacts of research gear on benthic habitat, are therefore small in magnitude and temporary or short-term in duration.

For the same reasons described for fish (Section 4.2.3) and marine mammals (Section 4.2.4), potential effects on sea turtles from accidental discharges of fuel or other contaminants from AFSC research vessels are possible but unlikely to occur in the near future. If an accidental discharge does occur, it is likely to be a rare event and the potential volume of material is likely to be small and localized. The potential impacts to sea turtles would be similarly short-term, localized, and likely affect, at most, a small number of animals. The overall risk of accidental contamination of sea turtles by AFSC fisheries research activities would therefore be considered negligible.

4.2.6.2 Conclusion

AFSC fisheries research activities conducted under the Status Quo Alternative involve a relatively small number of research vessels, short deployments of fishing gear, and sample sites dispersed over a wide area. All four species of sea turtles are uncommon to rare in Alaska, making the chance of any AFSC research activity encountering them very small. Any behavioral disturbances of sea turtles from research vessels or fishing gear would be temporary in nature, lasting only a few minutes as the research vessel passes, and are therefore likely to have negligible effects on turtle foraging success or survival. There have been no gear interactions with sea turtles and AFSC research activities in the past so the potential for injury or mortality under the Status Quo Alternative is very small. The potential for research vessels to degrade turtle habitat through benthic disturbance, changes in prey availability, or contamination from accidental spills and discharges would likely be minor in magnitude, infrequent or rare, and localized.

The magnitude of effects of the Status Quo Alternative on ESA-listed sea turtles would be minor since there would be no measurable population changes, the duration of any effects would be temporary or short-term, and the effects would be dispersed widely over a large area. The overall effects on all species of sea turtles would be minor adverse according to the impact criteria in Table 4.1-1.

4.2.7 Effects on Invertebrates

This section describes the types of effects of the Status Quo Alternative on invertebrate species in the AFSC research areas. The potential effects of research vessels, survey gear, and other associated equipment on invertebrates are generally similar for all three AFSC fisheries research areas and include:

- Physical damage to infauna and epifauna
- Changes in species composition
- Contamination or degradation of habitat
- Mortality from fisheries research activities

4.2.7.1 Physical Damage to Infauna and Epifauna

AFSC bottom trawl surveys and other bottom contact gear can impact infauna and epifauna invertebrates in sand, silt, and gravel substrates. Infauna live in the seafloor or within structures that are on the seafloor and include clams, tubeworms, and burrowing crabs that usually construct tubes or burrows and commonly occur in deeper and subtidal waters. Epifauna, including mussels, crabs, starfish, sponges, and corals live on the surface of the seafloor or on structures on the seafloor such as rocks, pilings, or vegetation. They either attach to these surfaces or range freely over them by crawling or swimming. Fishing gear that contacts the seafloor can disturb infauna and epifauna by crushing them, burying them, removing them, or exposing them to predators, and thus can reduce complexity and species diversity (Schwinghamer et al. 1998, Collie et al. 2000). The level of biological damage to infauna and epifauna can vary from very minimal with infrequent disturbance to severe with repeated disturbance in the same areas (Stevenson et al. 2004). Since most AFSC fisheries research surveys are conducted with randomly selected sample sites every year, the potential for repeated disturbance due to AFSC research activities in a particular area is very low.

Organisms such as cold water corals create structure on the seafloor that may provide important habitat for many organisms, including fishes (Auster and Langton 1999, Stevenson et al. 2004). Cold water corals are generally slow growing, long-lived, and fragile, which makes them particularly vulnerable to damage. Bottom contact fishing gear can break or disrupt corals, thereby reducing the structural complexity of habitat, which may lead to reductions in the species diversity of the corals and other animals that utilize this habitat (Freiwald et al. 2004, Heifetz et al. 2009). However, AFSC bottom trawl surveys are only conducted on suitable benthic substrates, e.g., sand, silt or gravel bottoms with few large rocks or sharp surfaces that may damage the gear. Rocky areas that are more likely to support hard corals are avoided by using sonar to examine the bottom contours before surveys are conducted.

The removal of structural organisms may only be reversible through natural recovery that may occur over hundreds of years (Freiwald et al. 2004). Cold-water corals such as *Primnoa pacifica* and *Halipteris willemoesi* are known to exist throughout the AFSC research areas although their exact distribution and abundance are poorly understood. Heifetz (2002) analyzed historical bottom trawl data and came up with some basic distribution patterns but data locations were limited to areas where survey trawls occurred (i.e., highly variable substrate was not sampled). Potential effects on organisms that produce structure would be independent of what season the research was conducted because the organisms are not mobile and could take long periods to recover.

AFSC research activities have taken corals and other organisms that produce structure in benthic habitats in the past, but catch rates are small (less than 100 kg per year for most species groups) and footprints of surveys do not cover large areas relative to the size of the research areas. Unidentified sea pens and sea whips, of the order *Pennatulacea*, are the most commonly found coral in AFSC research in the BSAIRA, amounting to approximately 230 kg per year (2009-2013 average). Kamchatka coral, *Paragorgia arborea*, is the next most common coral species caught in AFSC surveys, amounting to 176 kg per year. Smoothstem seawhip, *Virgularia sp.,* has average catches of 116 kg per year. In the GOARA, *Primnoa pacifica* catch is 165 kg per year average, and *Pennatulacea* survey catch in the GOARA is approximately 135 kg per year. By comparison, coral catch by commercial groundfish fisheries in 2004 was more than 81 mt per year, 91 percent of which was from waters of the BSAIRA (NMFS 2004).

AFSC fisheries and ecosystem surveys bring trained scientists aboard who have the ability to identify these animals to a very high level of specificity, providing a level of detail that fisheries observers sampling at sea on commercial vessels and other potential sources of data may not be able to. Thus, a better understanding of geographic distribution patterns may frequently result from AFSC surveys. The magnitude and geographic extent of potential impacts to benthic organisms due to AFSC research activities would be considered minor. Such impacts could be long-term for some species such as slow-growing corals but temporary or short-term for other species.

4.2.7.2 Changes in Species Composition

Massive removals of marine invertebrate species from an ecosystem could potentially alter community structure and predator-prey relationships at possibly unsustainable levels (Donaldson et al. 2010).

Commercially important invertebrate species are managed under FMPs with the management intent to harvest at rates that promote optimum yield, with an increasing emphasis on taking ecosystem considerations into account when setting harvest levels. In commercial fisheries, bycatch is either returned to the sea or landed if it has adequate commercial value and is allowed by the appropriate FMP. Bycatch can be minimized through gear and operational modifications, including localized fishing closures.

Studies conducted in the North Sea on cumulative impacts of benthic disturbance found that chronic commercial trawling reduced benthic biomass by approximately 50 percent (Hiddink et al. 2006). Species richness and the functional composition of benthic communities were also impacted. Species most affected by the trawling were permanently attached species, larger bodied and longer-lived species, and filter-feeders, while scavengers, burrowers, and short-lived and small species were not significantly affected (Hiddink et al. 2006, Tillin et al. 2006). Despite large reductions in infauna and epifauna biomass in intensively trawled areas, the mean trophic level of the benthic communities and trophic relationships within the communities were relatively unchanged (Jennings et al. 2001). The study concluded that trophic structure of intensively trawled benthic invertebrate communities may be a robust feature of the North Sea ecosystem. Contrary to the intensive and chronic bottom trawling conducted by commercial fisheries in localized regions of high catch probability, AFSC research bottom trawl surveys are of short duration, generally of randomized design, are rarely repeated in the same location over time, and are collectively much smaller in scale. They are, therefore, likely to have only minor and short-term effects on benthic communities.

4.2.7.3 Contamination or Degradation of Habitat

Fishing activities involving bottom trawl gear and other bottom-contact gear can physically disturb benthic habitat used by invertebrate species. Such effects can include furrowing and smoothing of the sea floor (Schwinghamer et al. 1998, Kaiser et al. 2002). Physical effects to the sea floor from fishing gear increase with increasing frequency and duration. In addition, bottom trawl activities can locally increase turbidity which may interfere with feeding activities of filter-feeding organisms.

However, many research surveys conducted by the AFSC are stratified random designs, meaning the exact location of a survey trawl is randomly determined each year within an area of interest. Repeated trawls in the same location are rare or infrequent. Research tows are also generally less than 30 minutes so the footprint of each tow is very small. An analysis of the area involved in bottom trawl surveys in Section 4.2.1 indicates that research surveys in the Status Quo Alternative would cover less than 0.01 percent of AFSC research areas in any given year. Recovery time from trawl surveys in the soft-bottom environments they target is estimated to be less than two years (Jennings et al. 2001). Therefore, effects to invertebrate habitat from research surveys are expected to be minor in magnitude and short-term in duration.

The potential for research vessels to cause degradation of benthic and pelagic habitat through contamination would only be through accidental spills and discharges, which would likely be limited in magnitude, rare, and localized for the reasons described in Section 4.2.3.

4.2.7.4 Mortality from Fisheries Research Activities

The AFSC uses various research methods and gear to sample invertebrates, including bottom trawls, pelagic trawls, and a variety of plankton nets (see Table 2.2-1 and Appendix A for descriptions of the equipment used for each survey). Invertebrate catch in AFSC research is spread across all research areas and the majority (by weight) is caught during the following six surveys:

- ADFG Large-mesh Trawl Survey
- Aleutian Islands Bottom Trawl Survey

- Chukchi Sea Trawl Survey
- Conservation Engineering (Bering Sea) Bottom Trawl
- Eastern Bering Sea Crab/Groundfish Bottom Trawl Survey
- Eastern Bering Sea Crab/Groundfish Bottom Trawl Survey - Triennial Extension

Some surveys primarily record catches by count and not by weight, the most prolific of which is the Rockfish Habitat Studies survey. This survey utilizes a bongo net and catches large numbers of very small organisms, such as copepods (168,000 per year). Considering the very small size of caught animals, even generous average weight applications would prevent this survey from being included in the above list.

Benthic invertebrates can be crushed by fishing gear that contacts the sea floor, such as bottom trawls. There is decreased crush injury to invertebrates in locations where the substrate consists of sand, silt and/or mud (Hiddink et al. 2006). Acoustic survey equipment and underwater photo platforms, including drop cameras and ROVs, are also used to survey benthic habitats, minimizing impacts to invertebrates.

In both the BSAIRA and the GOARA, multiple invertebrate taxa are caught during AFSC research surveys which amount to over 1 mt per year each. Some surveys only identify animals to family, order or genus, and some identify these animals to species. There are many reasons why different surveys identify invertebrate catch to different levels including time constraints in sorting and identifying large volumes of catch, research priorities, and difficulty in identifying species with very similar characteristics (see Wing and Barnard 2004). To account for these limitations, the RACE's Species Code database has over 2500 species codes for various invertebrate species and species groups, which are used by survey personnel to report invertebrate catches (AFSC 2015).

The variety of species groups make catch comparisons difficult. However, comparisons of catch data of disparate species groups can be informative as they allow emergent patterns to assist with assessment of ecosystem change over time. For example, two of the most commonly caught species groups in GOARA surveys are from the Actinaria (anemones) - anemone unidentified, and the gigantic anemone (*Metridium farcimen*). Anemones as a group average over 8 mt per year of survey catch. Similarly, hermit crab defined as "unidentified" account for nearly 1.5 mt of survey catch per year, with similar catches of hermit crabs identified to species.

The impact of mortality from fisheries research depends on the magnitude of the research catch relative to the overall biomass or population level of the species. Measuring these relative effects for invertebrates is difficult because there are very few species for which total populations have been estimated with any degree of certainty and only commercially important species may be monitored for population trends. For a few species that are caught and monitored regularly in commercial fisheries, this FPEA compares the amount of invertebrates caught in AFSC research to the amount caught in commercial fisheries as a metric for the magnitude of research catch. Because commercial harvest limits are set at a fraction of estimated population, the magnitude of research catches relative to overall population levels would be much less than what is indicated by the comparisons with commercial landings. This FPEA does not attempt to analyze the effects of research mortality on each of the invertebrate species groups caught in the various surveys, only those species with average annual catch exceeding one mt (1000 kgs) from within the GOARA and BSAIRA; and average annual catch exceeding 500 kg from within the CSBSRA. Table 4.2-19 shows the average annual catch of managed and unmanaged invertebrate species in the GOARA during a recent five year period (2009-2013) to represent the level of catch under the Status Quo Alternative. Table 4.2-20 shows this for the BSAIRA; and Table 4.2-21 shows this for the CSBSRA. These average annual research catches are compared to 2015 commercial quotas for species where such information is available.

The incidence of managed crab species in survey catches is large in both the GOARA and BSAIRA, greater than 20 tons for some species. Several AFSC fisheries surveys target crab for the purpose of informing fisheries managers of population strength and structure, so bycatch is not unexpected. In all cases, the amount of crab catch in surveys is substantially less than 4 percent of commercial fishing quotas, which are significantly less than population biomass estimates for these species.

Weathervane scallop catch in the GOARA is approximately 1.43 percent of the commercial fishery quota. However, this is an overestimate because the quota is specified in shelled meat weight, not round weight. One account of the amount meat weight contributes to the overall weight of the scallop comes from ADFG (1985), where meat weight was estimated to be about 10.1 percent of the total live weight. This indicates that the relative impact of survey catch is likely much smaller, potentially a tenth of the calculated percent.

During the 2009-2013 period, blue king crab survey catches averaged 0.46 mt per year throughout the BSAIRA (Table 4.2-20). There are multiple stocks of this species but the Pribilof Islands stock is the only one considered overfished, therefore the impact of survey catches is evaluated in the context of this stock. A directed fishery on Pribilof Islands blue king crab was open from 1973 to 1988, with catches up to 5 million pounds (NPFMC 2014f). In 1988, the fishery was closed, reopened from 1995 to 1999, and declared overfished in 2002. The target fishery has not been open since and there was no commercial quota for the 2014-2015 season. As outlined in the Crab SAFE report (NPFMC 2014f), mature male biomass at mating (one measure of population strength) for the 2014/2015 season was estimated to be 0.48 million pounds. Conservatively assuming all survey catch of blue king crab in the BSAIRA came from this stock, the total amount taken by surveys would be less than 0.21 percent of mature male biomass at mating, which would likely not be enough to have a significant impact on overall population strength. Additionally, although BSAIRA surveys can potentially catch Pribilof Islands blue king crab, survey data has the ability to inform researchers of changes to this sensitive population over time.

The most commonly caught non-managed species in the GOARA are sunflower sea stars and sea anemone unidentified. The most common non-managed species in the BSAIRA are purple orange sea stars, sponge unidentified, and *Chrysaora melanaster* (a common species of jellyfish). These, and most other invertebrate species caught in AFSC fisheries surveys, are not managed with caps or quotas; population estimates are difficult and exact distribution and abundance are poorly understood. For one measure of comparison, NMFS (2004) estimated the amount of sponges caught in commercial groundfish fisheries in the BSAIRA to be 352.6 mt per year. This would indicate that survey catch is about 5 percent of bycatch, and likely much smaller than overall sponge populations. A similar calculation can be done on GOARA anemones, where 16.5 mt per year is taken in groundfish fisheries and 6.02 tons is taken in surveys, for a catch level of 36 percent. This is a much larger value that could be due to incorrect estimations of fishery bycatch rates, or indicative of a species group that needs the additional information that surveys can provide.

Overall, the amounts of invertebrates removed as a result of AFSC research activities under the Status Quo Alternative is small relative to available commercial quotas. Where comparisons cannot be made, AFSC survey data can be used to supplement information on data-poor species.

Table 4.2-20 Average Annual AFSC Research Catch of Invertebrates in the GOARA with some Comparisons to Commercial Catch (Landings)

Species are listed in descending order of total research catch by weight. Only species/groups with total average catch greater than 1 mt (1000 kg) are listed.

Species or species group	Stock Status[a]	Average AFSC research catch per year (mt) (2009-2013)	Commercial Quota (mt)	Average AFSC Research Catch Compared to Commercial Quota (percentage)
Southern Tanner crab	NA	31.97[b]	995.74[b]	3.21%
Sunflower sea star	NA	8.84	NA	NA
Sea anemone unidentified	NA	6.02	NA	NA
Alaskan pink shrimp	NA	3.42	NA	NA
Octopus species[c]	Status unknown	2.69	1507[d]	0.18%
***Cyanea* sp.**	NA	2.53	NA	NA
Jellyfish unidentified	NA	2.44	NA	NA
Weathervane scallop	No overfishing, overfished status unknown	2.09	146.29[e]	1.43%
Gigantic anemone	NA	1.82	NA	NA
Hermit crab unidentified	NA	1.45	NA	NA
Red king crab	NA	1.14	NA	NA
Majestic armhook squid	NA	1.10	9,675[f]	0.01%

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Data is from 2009-2010 fisheries. Source: ADFG 2011b and ADFG 2014b.

c. All octopus species are included under a single group in the GOA FMP and the values presented here are for all species. However the vast majority of research catch is of giant octopus (*Enteroctopus dofleini*).

d. Source: 2013-2014 Alaska Groundfish Harvest Specification. Available online: https://alaskafisheries.noaa.gov/sustainablefisheries/specs14_15/

e. Data is from 2015/2016 Fisheries. Source: ADFG 2015. Weight is in shucked meat.

f. Squids in the GOA are managed as a single stock comprising all species with a single TAC. For increased specificity, this value represents 2012 biomass estimates for only majestic armhook squid as noted in the 2014 GOA SAFE report (NPFMC 2014g).

Table 4.2-21 Average Annual AFSC Research Catch of Invertebrates in the BSAIRA with some Comparisons to Commercial Catch (Landings)

Species are listed in descending order of total research catch by weight. Only species/groups with total average catch greater than 1 mt (1000 kg) are listed.

Species or species group	Stock Status[a]	Average AFSC research catch per year (mt) (2009-2013)	Commercial Quota (mt)	Average AFSC Research Catch Compared to Commercial Quota (percentage)
Purple-orange sea star	NA	39.27	NA	NA
Snow crab	No overfishing, not overfished	27.97	30,822.12[c]	0.09%
Red king crab	No overfishing, not overfished	22.04[b]	4,529.65[c]	0.49%
Sponge unidentified	NA	17.89	NA	NA
Chrysaora melanaster	NA	13.99	NA	NA
Basketstar	NA	11.92	NA	NA
Sea potato	NA	10.44	NA	NA
Empty gastropod shells	NA	8.87	NA	NA
Sea nettle	NA	7.11	NA	NA
Fuzzy hermit crab	NA	7.1	NA	NA
Sea peach	NA	6.64	NA	NA
Neptunea heros	NA	5.67	NA	NA
Sea glob	NA	5.65	NA	NA
Deep sea papillate cucumber	NA	4.36	NA	NA
Tanner crab unidentified	No overfishing, not overfished	3.82	NA	NA
Boltenia ovifera	NA	3.74	NA	NA
Leptasterias polaris	NA	3.54	NA	NA
Circumboreal toad crab	NA	3.03	NA	NA
Pribilof whelk	NA	2.93	NA	NA
Tentacle-shedding anemone	NA	2.69	NA	NA
Strongylocentrotus sp.	NA	2.25	NA	NA
Aleutian hermit	NA	2.09	NA	NA
Hairy hermit crab	NA	1.91	NA	NA
Sea peach unident.	NA	1.83	NA	NA
Common mud star	NA	1.81	NA	NA
Southern Tanner crab	No overfishing, not overfished	1.78	6,851.63[c]	0.03%
Gorgonocephalus sp. cf. arcticus	NA	1.71	NA	NA

Species or species group	Stock Status[a]	Average AFSC research catch per year (mt) (2009-2013)	Commercial Quota (mt)	Average AFSC Research Catch Compared to Commercial Quota (percentage)
Sponge hermit	NA	1.68	NA	NA
Barrel sponge	NA	1.58	NA	NA
Fat whelk	NA	1.56	NA	NA
Notched brittlestar	NA	1.52	NA	NA
Green sea urchin	NA	1.33	NA	NA
Clay pipe sponge	NA	1.29	NA	NA
Lyre whelk	NA	1.27	NA	NA
Sea blob	NA	1.27	NA	NA
Ophiacantha normani	NA	1.19	NA	NA
Gigantic anemone	NA	1.1	NA	NA
Blackspined sea star	NA	1.07	NA	NA
Oregon triton	NA	1.03	NA	NA
Golden king crab	No overfishing, overfished status unknown	1.02	2,853.14[c]	0.04%
Majestic armhook squid	No overfishing, overfished status unknown	1.00	17,041[d]	0.01%
Pribilof Islands blue king crab	No overfishing, overfished	0.46[e]	217.73[f]	0.21%

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Stock assessments distinguish between Bristol Bay, Norton Sound and Pribilof Islands stocks of red king crab, none of which are considered overfished. However, survey data does not characterize which stock caught red king crab are from. For the purposes of this analysis, all red king crab caught in BSAIRA surveys are assumed to be from the Bristol Bay stock, the only one that has had an allocated quota in recent years.

c. Source: 2014-2015 Crab TAC, from https://alaskafisheries.noaa.gov/sustainablefisheries/crab/crfaq.htm

d. Squids in the BSAI are managed as a single stock comprising all species with a single TAC. For improved specificity, this value represents 2013 biomass estimates for only majestic armhook squid as noted in the 2014 BSAI SAFE report (NPFMC 2014h).

e. Stock assessments distinguish between St. Matthew and Pribilof Islands stocks of blue king crab and Pribilof Islands blue king crab are considered overfished. However, survey data does not characterize which stock caught blue king crab are from. For the purposes of this analysis, all blue king crab caught in BSAIRA surveys are assumed to be from the Pribilof Islands stock.

f. There is no commercial quota for this species since it is considered overfished. This value represents 2014/2015 mature male breeding biomass estimate from NPFMC 2014.

Table 4.2-22 Average Annual AFSC Research Catch of Invertebrates in the CSBSRA

Species are listed in descending order of total research catch by weight. Only species/groups with total average catch greater than 500 kg are listed

Species or species group	Stock Status[a]	Average AFSC research catch per year (mt) (2009-2013)
Sea nettle	NA	3.00
Green sea urchin	NA	2.25
Purple-orange sea star	NA	1.23
Fuzzy hermit crab	NA	1.08
Brownscaled sea cucumber	NA	0.68
Neptunea heros	NA	0.6
Leptasterias polaris	NA	0.58
Gorgonocephalus sp. cf. arcticus	NA	0.52

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

4.2.7.5 Conclusion

AFSC fisheries and ecosystem research conducted under the Status Quo Alternative could have direct and indirect effects on many invertebrate species through physical damage to infauna and epifauna, changes in species composition, contamination or degradation of habitat, and mortality from survey catch.

For all invertebrate species targeted by commercial fisheries and managed under FMPs, mortality due to research surveys and projects is less than 3.5 percent of commercial harvest and is considered to be minor in magnitude for all species. Mortality for all species would be distributed across a wide geographic area rather than concentrated in particular localities and the risk of altering benthic community structure would be minimal. Disturbance of animals and benthic habitats from research activities would be temporary or short-term in duration and minor in magnitude for all species. As described in Section 4.2.1, the potential for accidental contamination of marine habitats from accidental spills from research vessels is considered unlikely and would be minor in magnitude and temporary or short-term in duration. The overall direct and indirect effects of the Status Quo Alternative on invertebrates would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

In contrast to these adverse effects, AFSC fisheries research also provides long-term beneficial effects for managed invertebrate species throughout the Alaska Region through its contribution to sustainable ecosystem-based fisheries management. The AFSC conducts stock assessment, habitat research, and bycatch reduction research for several invertebrate species that are important for commercial and recreational fisheries. Scientific information from the AFSC on the status and trends of lower trophic levels is crucial for understanding the health of the marine environment and is incorporated into ecosystem-based management models. The beneficial effects of the oceanographic and fisheries time-series data provided by AFSC research programs are especially valuable for tracking long-term trends in the marine environment important to invertebrate populations.

4.2.8 Effects on the Social and Economic Environment

Section 3.3 describes the interaction of the AFSC with the social and economic environment of the North Pacific and Alaska Region. This section describes the effects of AFSC fisheries and ecosystem research conducted under the Status Quo Alternative on socioeconomic resources present in the AFSC research areas. Major factors that could be influenced by the AFSC research program include:

- Effects on subsistence
- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry, subsistence users, and fisheries research
- Fulfillment of legal obligations specified by laws and treaties

4.2.8.1 Effects on Subsistence

Subsistence in Alaska is the traditional way of life through which rural communities, many of which have at least 90 percent of residents that are Alaska Native, secure a significant portion of their food and goods through hunting, trapping, and fishing. Subsistence foods compose a large portion of household food consumption with a large aspect of subsistence resources coming from marine resources. There are also many sociocultural aspects related to subsistence. While serving as a vital source of food, the subsistence livelihood is also essential to maintaining the social organizations, traditional beliefs, and culture of a community – harvest techniques, cooperative labor, and sharing practices serve as unifying elements.

As outlined in Section 3.3.4, multiple laws and treaties protect the status of Native Alaskans throughout Alaska and ensure the protection of subsistence fishing and hunting rights, which includes the harvest of marine resources. Both federal and state regulations define subsistence uses to include the customary and traditional uses of wild renewable resources for food, shelter, fuel, clothing, and other uses (ANILCA, Title VIII, Section 803, and AS 16.05.940[33]). The federal subsistence law is found in Title VIII of ANILCA and the implementing regulations are at 36 CFR § 242.1 and 50 CFR § 100.1. Under the federal law, the term "subsistence users" is defined and refers to, customary and traditional uses by rural Alaska residents. The MMPA references that the Secretary must determines that harassment will not have an unmitigable adverse impact on the availability of the species or stock for taking for subsistence uses [16 USC 1371 Sec. 101 a (5) (D)(i)(II)].

In Alaska all residents of the state are defined as "subsistence users" (AS 16 and 5AAC 99). Both federal and state law use similar language regarding the definition of subsistence, with minor wording differences in the clause regarding any bartering, sharing, and trade (16 U.S.C. §3113). The main difference between federal and state regulatory definitions is that federal law gives a preference to *rural* Alaskans, whereas state law allows no such preference.

Potential Effects on Subsistence Resources

Potential effects of AFSC fisheries and ecosystem research include direct and indirect effects on marine subsistence resources (fish [Section 4.2.3], marine mammals [Section 4.2.4], birds [Section 4.2.5], and invertebrates [Section 4.2.7]) which may affect their availability to subsistence users. There is also a potential for AFSC fisheries and ecosystem research activities to interfere with access to those subsistence resources.

In general, AFSC trawl and longline research gears are the most likely gear types to cause injury or mortality of marine mammals but the physical presence of research vessels and the use of active acoustic signals for fisheries and ecosystem research may also cause disturbance of animals used for subsistence. Fish species used for subsistence that may be caught during AFSC fisheries research include salmon, cod, halibut, herring, and various whitefish species. Some communities harvest invertebrates, primarily crab and clams, and seabirds and eggs are harvested by some communities. The greatest potential for impacts comes from research activities that occur near subsistence communities and in the near shore zone where most subsistence activities occur, and near migratory paths important to animals used for subsistence. Potential research interactions/impacts on subsistence resources and activities can be categorized as follows:

- Mortality or injury (fish caught in research gear, ship strikes or gear entanglement of marine mammals)
- Modification of behavior that may have an effect on life history function, distribution, or availability of resources for subsistence harvest (interruption of feeding, deflection of migratory paths due to acoustic sources used in research or the physical presence of vessels)

The AFSC employs a suite of mitigation measures to avoid and minimize adverse impacts on animals used for subsistence activities (Section 2.2.1).

Potential Interference with Subsistence Activities

The potential for real or perceived interference with subsistence harvest activities (ability to access harvest areas or set subsistence harvest gear) is determined by a number of factors, including;

- The timing and proximity of AFSC fisheries research activities to subsistence harvest activities and the migration/distribution of fish and wildlife used for subsistence
- The gear types and associated activities used for AFSC fisheries research
- The level of communication between AFSC fisheries researchers and subsistence users prior to and during research conducted in subsistence areas

AFSC fisheries and ecosystem research has historically occurred in virtually all areas off the Alaska coast, with the exception of the Beaufort Sea east of Prudhoe Bay. There are approximately 100 potentially affected coastal/marine subsistence harvest communities in the AFSC research areas. Each one of these communities is likely to have a federally recognized tribal government, and in some cases a regional tribal government or Native non-profit organization. The AFSC has reached out to each of these communities and Alaska Native organizations as part of the scoping process and Government to Government Consultation for developing this FPEA (See Section 6.10 and Appendix C).

In general subsistence harvest patterns are seasonal, respond to biological cycles and the locations of nearby resources, and depend on environmental conditions and the logistics of travel to obtain resources. Harvest patterns have a long historical basis and have been modified with the establishment of permanent settlements. The seasonal movement of subsistence resources influences travel to fishing or hunting sites, camps, and the use of traditional areas around communities. The resources that a group relies upon vary from community to community and are dependent on resource abundance, seasonal distribution, and proximity to the community. Areas utilized for subsistence harvest activities can vary over time for specific communities, given the availability and distribution of resources, weather and ice conditions, and economic resources to support subsistence in a given year. Therefore, areas used for subsistence harvest are often portrayed as areas of contemporary and historic harvest.

Table 4.2-23 presents the general seasonality of some marine subsistence activities for different regions and communities in Alaska and indicates when AFSC fisheries and ecosystem research has occurred in those areas under the Status Quo Alternative. This table is not exhaustive regarding all marine resources that are used for subsistence in all communities. As noted above, the timing and location of subsistence activities depends on many variables and may be different year to year. The timing and exact location of AFSC fisheries research activities also varies year to year and is dependent on environmental variables (i.e., weather and sea state) and logistical considerations. The purpose of the table is to illustrate the fact that there is broad overlap in time and space between subsistence activities and AFSC fisheries research across the state, with the exception of communities on the North Slope east of Barrow. The potential for effects on subsistence resources and activities is therefore widespread, although actual effects would depend on overlap of research and subsistence in particular places and times, which cannot be predicted ahead of time.

Table 4.2-23 Timing of AFSC Fisheries Research and Select Subsistence Activities in the AFSC Research Areas

Cells shaded in gray indicate months when subsistence resources are harvested in each area. Cells with fish icons indicate months when AFSC fisheries and ecosystem research occurs in the general area (see Appendix B). Cells that are shaded gray and have a fish icon indicate potential overlap of AFSC fisheries research with subsistence activities. Sources of subsistence resources and timing in different communities include Wolfe et al. (2006, 2009, 2012, and 2013), Georgette et al. (1998), Magdanz (1981), Thomas (1981), and Marchioni et al. (2015)

Area	Subsistence Resource	January	February	March	April	May	June	July	August	September	October	November	December
GULF OF ALASKA RESEARCH AREA													
Southeast [1]	Harbor seal						🐟	🐟	🐟	🐟	🐟	🐟	
	Steller sea lion						🐟	🐟	🐟	🐟	🐟	🐟	
Southcentral [2]	Harbor seal	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟
	Steller sea lion	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟
Cook Inlet/Upper Kenai Peninsula [3]	Harbor seal	🐟	🐟	🐟	🐟	🐟	🐟	🐟		🐟	🐟	🐟	🐟
	Steller sea lion	🐟	🐟	🐟	🐟	🐟	🐟	🐟		🐟	🐟	🐟	🐟
Kodiak Archipelago [4]	Harbor seal	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟
	Steller sea lion	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟
	Marine invertebrates	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟
Southern Alaska Peninsula [5]	Harbor seal	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟
	Steller sea lion	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟	🐟
Aleutian Islands [6]	Harbor seal		🐟	🐟	🐟	🐟	🐟	🐟	🐟				
	Steller sea lion		🐟	🐟	🐟	🐟	🐟	🐟	🐟				

Area	Subsistence Resource	January	February	March	April	May	June	July	August	September	October	November	December
BERING SEA/ALEUTIAN ISLANDS RESEARCH AREA													
South Bristol Bay [7]	**Steller sea lion**		➔				➔	➔					
	Harbor seal		➔				➔	➔					
North Bristol Bay [8]	**Steller sea lion**						➔		➔				
	Harbor seal (includes spotted seal)						➔		➔				
Pribilof Islands [9]	**Steller sea lion**		➔	➔	➔	➔	➔	➔		➔	➔		
St. Lawrence Island [10]	**Ice seals**									➔	➔		
	King crab									➔	➔		
Norton Sound [11]	**Ice seals**			➔	➔	➔	➔	➔	➔	➔	➔		
	King crab			➔	➔	➔	➔	➔	➔	➔	➔		
Bering Strait [12]	**Ice seals**						➔	➔	➔	➔	➔		
CHUKCHI SEA/BEAUFORT SEA RSEARCH AREA													
Kotzebue	**Bowhead whale** *Agviq*						➔	➔	➔	➔			
	Beluga whale *Quilalugaq*						➔	➔	➔	➔			
	Bearded, ringed, spotted seals *Ugruk, qasigiaq, qaigulik*						➔	➔	➔	➔			
	Walrus *Aiviq*						➔	➔	➔	➔			
	Polar bear *Nanuq*						➔	➔	➔	➔			
	Marine and freshwater fishes						➔	➔	➔	➔			

Area	Subsistence Resource	January	February	March	April	May	June	July	August	September	October	November	December
Kivalina	Bowhead whale						→	→	→	→			
	Beluga whale						→	→	→	→			
	Bearded, ringed, spotted seals						→	→	→	→			
	Walrus						→	→	→	→			
	Polar bear						→	→	→	→			
	Marine and freshwater fishes						→	→	→	→			
Point Hope	Bowhead whale						→	→	→	→			
	Beluga whale						→	→	→	→			
	Bearded, ringed, spotted seals						→	→	→	→			
	Walrus						→	→	→	→			
	Polar bear						→	→	→	→			
	Marine and freshwater fishes						→	→	→	→			
Point Lay	Bowhead whale						→	→	→	→			
	Beluga whale						→	→	→	→			
	Bearded, ringed, spotted seals						→	→	→	→			
	Walrus						→	→	→	→			
	Polar bear						→	→	→	→			
	Marine and freshwater fishes						→	→	→	→			

Area	Subsistence Resource	January	February	March	April	May	June	July	August	September	October	November	December
Wainwright	**Bowhead whale**						→	→	→	→			
	Beluga whale						→	→	→	→			
	Bearded, ringed, spotted seals						→	→	→	→			
	Walrus						→	→	→	→			
	Polar bear						→	→	→	→			
	Marine and freshwater fishes						→	→	→	→			
Barrow	**Bowhead whale**						→	→	→	→			
	Beluga whale						→	→	→	→			
	Bearded, ringed, spotted seals						→	→	→	→			
	Walrus						→	→	→	→			
	Polar bear						→	→	→	→			
	Marine and freshwater fishes						→	→	→	→			

1 Southeast includes Yakutat, Klukwan, Haines, Juneau, Hoonah, Pelican, Angoon, Sitka, Kake, Petersburg, Wrangell, Klawock, Craig, Ketchikan, Saxman, and Hydaburg (Wolfe et al. 2006, Wolfe et al. 2009, Wolfe et al. 2013)

2 Southcentral includes Chenega Bay, Cordova, Nalwalek, Port Graham, Seldovia, Seward, Tatitlek, and Valdez

3 Cook Inlet/Upper Kenai Peninsula includes Anchorage, Tyonek, Kenai, and Homer.

4 Kodiak Archipelago includes Akhiok, Karluk, Kodiak City, Larsen Bay, Old Harbor, Ouzinkie, and Port Lions.

5 Southern Alaska Peninsula includes Chignik, Chignik Lagoon, Chignik Lake, False Pass, Ivanoff Bay, King Cove, Nelson Lagoon, Perryville, and Sand Point.

6 Aleutian Islands includes Adak, Akutan, Atka, Nikolski, and Dutch Harbor/Unalaska.

7 South Bristol Bay includes Egegik, King Salmon, Levelock, Naknek, South Naknek, Pilot Point, and Port Heiden.

8 North Bristol Bay includes Aleknagik, Clark's Point, Dillingham, Manokotak, Togiak, and Twin Hills.

9 Pribilof Islands includes St. Paul and St. George.

10 St. Lawrence Island includes Gambell and Savoonga.

11 Norton Sound includes Nome, White Mountain, Golovin, Elim, Koyuk, Shaktoolik, Unalakleet, St. Michael, and Stebbins.

12 Bering Strait includes Little Diomede, Wales, Brevig Mission, and Teller.

Communication Plan

Identifying this broad nexus is important because it highlights the need for awareness on the part of AFSC researchers that, when they are operating in locations and seasons when subsistence activities are occurring, there is a potential for actual or perceived interference that must be avoided if possible. This dynamic situation emphasizes the need for ongoing communication between the AFSC research scientists and potentially affected communities when the location and timing of research vessel visits to particular areas, and the practice of subsistence activities in those areas, are better known. This type of in-season communication is important to avoid any actual or perceived interference with subsistence activities.

Under the Status Quo Alternative, the AFSC has not had a formal communication plan to avoid potential interference with subsistence activities. The AFSC has not been aware of any such interference in the past, although there was one situation in the Chukchi Sea in 2009 when there was confusion in subsistence communities about a commercial trawl vessel that was chartered by the AFSC to conduct the Chukchi Sea Bottom Trawl Survey. Since commercial fishing is closed in the Chukchi Sea, local communities expressed concern that a commercial fishing vessel was working offshore. These concerns eventually reached the AFSC and scientists responsible for the research contacted the communities to explain that it was an AFSC research activity, limited in scope and not commercial fishing. This incident brought more awareness within the AFSC to reach out to coastal communities when research is being conducted nearby, especially in the Arctic, and those efforts grew in recent years. The AFSC developed a formalized communication plan to address this issue (see Appendix B of the LOA Application, which is Appendix C of this FPEA), although that plan is considered part of the Preferred Alternative and does not reflect the Status Quo conditions.

Of foremost concern to many subsistence users are marine mammals, which include bowhead and beluga whales, various seals and walrus, polar bears and sea otters. All of these species are protected under the MMPA and some have additional protection under the ESA. The last three species are under the jurisdiction of the USFWS but most marine mammals are under the jurisdiction of NMFS. In order to effectively protect marine mammal species while supporting the legal right of Alaska Natives to harvest them for subsistence, NMFS and USFWS have entered into a number of standing marine mammal co-management agreements with a number of Alaska Native organizations, including:

- Alaska Eskimo Whaling Commission
- Alaska Beluga Whale Committee
- Ice Seal Committee
- Eskimo Walrus Commission
- Alaska Native Harbor Seal Commission
- Alaska Sea Otter and Steller Sea Lion Commission
- Nanook Polar Bear Commission

The work of these commissions has not typically involved coordination with AFSC fisheries and ecosystem research to date, with the exception of the Chukchi Sea Bottom Trawl Survey described above. However, the AFSC is planning to make use of these existing organizations and co-management relationships to help implement the new communication plan being developed to avoid interference with subsistence activities under the Preferred Alternative.

Conclusion Regarding Subsistence

Under the Status Quo, the AFSC would continue existing research operations at current levels and using current research methods and mitigation measures to reduce impacts on protected species. AFSC fisheries research programs under the Status Quo Alternative have the potential to directly affect marine mammals, fish and other marine resources considered important to subsistence. These effects primarily involve the removal of fish and invertebrates through sampling with various gear types, potential interactions with marine mammals, and potential interference with subsistence activities.

Regarding effects on AFSC fisheries research on fish and invertebrates used for subsistence, those research surveys that involve direct impacts to adult salmon would likely have the greatest potential effect on subsistence marine resources. However, potential impacts of AFSC research on fish and invertebrate populations would be small in magnitude, disbursed over wide geographic areas, and short-term or temporary in duration; they are considered minor adverse for all species (see Sections 4.2.3 and 4.2.7).

The historic and estimated future takes of marine mammals in research (4.2.4) is very rare, has occurred only in the GOARA, and would have minimal effects on all species used for subsistence. As outlined in Section 2.1 and illustrated in Appendix B, AFSC research activities would occur primarily away from shorelines with limited research activities occurring in the near shore environment. These research activities would also take place well away from ice pack or floating sea ice, where many marine mammal subsistence activities are concentrated. These spatial and seasonal distributions of AFSC research effort limit potential impacts on animals used for subsistence and on the accessibility of those animals to subsistence users. However, the potential overlap of AFSC fisheries and ecosystem research and subsistence activities in any particular place and time speaks to the need for better communication among researchers and subsistence communities on a real-time basis.

The socioeconomic outlook of subsistence users would not be adversely impacted by AFSC fisheries and ecosystem research activities or the limited impacts to physical and biological resources, such as by reducing or limiting the number of fish or shellfish resources available for subsistence purposes. The AFSC research data would also provide an economic benefit to subsistence activities by providing the basis for fisheries management in the region, thereby providing an economic benefit to subsistence dependent communities by contributing to the long-term sustainability of fishery resources with the resulting social and economic benefits to coastal communities.

Under the Status Quo Alternative, the potential direct and indirect effects of AFSC fisheries research on subsistence resources would continue to occur infrequently or rarely, be small in magnitude, and would be dispersed over a large geographical area and not likely to be located near important sites of subsistence use. AFSC research activities are therefore considered to have minor adverse effects on subsistence resources and activities under the Status Quo Alternative according to the impact criteria in Table 4.1-1.

4.2.8.2 Collection of Scientific Data used in Sustainable Fisheries Management

The AFSC fisheries research program has the most potential to affect the social and economic environment through its contribution to the fisheries management process. The MSA, as amended by the Sustainable Fisheries Act, establish a collaborative fisheries management process with key roles for NMFS, the regional Fishery Management Councils, and the Interstate Marine Fisheries Commissions. These entities jointly develop FMPs for the Nation's fishery resources through extensive discussions with states, Alaska Native groups, other federal agencies, the commercial fishing industry, public interest groups, universities, and the general public, and through partnerships with international science and management organizations. Under the MSA, FMPs must contain conservation and management measures which prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery. The MSA defines optimum yield as:

A. The amount of fish which will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems;

B. Is prescribed as such on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and

C. In the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.

Among other considerations, FMPs must also contain provisions to conserve EFH, minimize bycatch and the mortality of bycatch, and provide for the sustained participation of fishing communities while minimizing adverse economic impacts on them, to the extent practicable and consistent with conservation aims and requirements. In carrying out Congress's mandate under the MSA, NMFS is responsible for ensuring that management decisions involving fishery resources are based on the highest quality, best available scientific information on the biological, social, and economic status of the fisheries.

Under the Status Quo Alternative, the long-term, standardized resource surveys conducted by the AFSC and its cooperating research partners, as summarized in Table 2.2-1, provide a rigorous scientific basis for the development of fisheries stock assessments and federal fishery management actions in the Alaska Region. The extended time-series of data helps identify trends that inform fisheries management planning. This information is essential to establishing annual species-specific sustainable harvest limits on an optimal yield basis. Many Status Quo research surveys also provide important comparative information on open, managed, and closed fishing areas, such as the differences between recovery rates, biodiversity, and species density that is vital to assessing the success of fisheries management measures. AFSC fisheries research also provides information on ecosystem characteristics that is essential to management of commercial fisheries. Climate change and increase in ocean acidification have the potential to impact the population and distribution of marine species. Long-term, predictable marine research provides information on changes to and trends regarding the marine ecosystem that must be considered by fisheries managers. The scientific information provided by the AFSC is therefore used not just for current management decisions, but also to conserve resources and anticipate future trends, ensure future fishing utilization opportunities, and assess the effectiveness of the agency's management efforts.

The fisheries management process can be contentious when fisheries stocks are relatively scarce and resources must be rationed and allocated among competing commercial, recreational, subsistence, and environmental interests. The fishery management process has imposed significant reductions in harvest limits for some fisheries in order to rebuild particular depleted stocks (e.g., Chinook salmon in many river drainages). These reductions in harvest limits have resulted in adverse economic impacts on certain sectors of the fishing industry with associated adverse social impacts on fishing communities. However, rebuilding stocks important to commercial, subsistence, and recreational users would result in long-term beneficial effects on the economies and social relations and cultural institutions of many fishing communities throughout Alaska. Scientific data provided through the long-term and short-term fisheries research conducted and associated with the AFSC has played an important role in the development of fisheries and conservation policies through informing the fisheries management process.

4.2.8.3 Economic Support for Fishing Communities of the North Pacific and Alaska

One of the ways the AFSC research activities support the social and economic environments is through its role in supporting commercial, and recreational fisheries management in Alaska. As discussed in Section 3.3, North Pacific commercial fishermen landed about 6 billion pounds of finfish and shellfish, earning $1.7 billion in landings revenue in 2015. Overall, commercial fishing (exclusive of imports) contributed to 53,400 jobs, $4.4 billion in sales, and $2.3 billion in value added. In that same period, 309 thousand recreational saltwater anglers spent approximately 975 thousand days fishing. Overall, recreational fishing contributed to 5,407 jobs, $619 million in sales, $223 million in income, and $362 million in value added (NMFS 2017c).

Within this context, social and economic data collection and analysis in Alaska allows for determination of the relative social and economic impacts of a set of proposed management alternatives. This type of information is also important for compliance with Executive Order (EO) 12898 on environmental justice, which directs agencies to assess actions that may disproportionately affect low income and minority populations. Where conservation outcomes are similar, NMFS attempts to choose alternatives with the most positive or, at a minimum, lowest negative social and economic impact on fishermen, the fishing industry, related shore side industries, and fishing communities.

Another way the AFSC contributes to the social and economic environments is through direct expenditures on fisheries research. The AFSC was federally-funded at $62.18 million in fiscal year 2015. (AFSC Operations Management and Information Staff pers. comm. 2015). This spending has direct and indirect beneficial economic effects on the communities and ports in Seattle and the Alaska Region through expenditures in support of NOAA vessels, chartered vessels, and research facilities as well as providing employment and contracted services that contribute to local economies. Some commercial fishing operations are compensated for participation in cooperative research projects through grants or cost recovery programs. Other cooperating research partners, including state agencies, universities, and commercial fishing associations, receive funding through the AFSC which supports their employees, research vessels, and facilities and therefore supports a large number of local economies. As covered in Section 3.3.5, state and federal expenditures in support of Alaska commercial fisheries management and research were estimated at $317.8 million in 2006. These expenditures are spread over a variety of state and federal entities located in several regions, including Alaska. The AFSC receives additional project-specific funds from both internal (NOAA and NMFS) and external sources (other federal agencies and non-governmental research institutions) each year. Similarly, in addition to benefits of social and economic research to the fisheries management enterprise, AFSC supplies contracts and grants to individual social science researchers and to academic and other institutions throughout Alaska that conduct social science research on how humans impact and are impacted by ecosystems, climate change, interactions with protected species, energy development, and other issues.

The magnitude of the economic impacts of AFSC fisheries research activities must be placed in the context of regional and local economies according to the impact criteria in Table 4.1-1. While the contribution of research-related employment and purchased services is undoubtedly important and beneficial for many individuals and families, the total sums spent for research are very small compared to the value of commercial, recreational, and subsistence fisheries in the area as well as the overall economy of those communities. The contribution of AFSC research is relatively larger for some communities where the research is centered and may be considered moderate in magnitude for those communities but the overall direct impact would be minor in magnitude for most communities. These direct impacts would be certain to occur under the Status Quo Alternative, would affect numerous communities throughout the region, and would be long-term and beneficial. Overall, the beneficial economic impacts of AFSC fisheries research activities would be considered minor to moderate according to the impact criteria in Table 4.1-1.

There are certainly indirect impacts of fisheries research to the economic status of fishing communities but these impacts are filtered through a long and complicated fisheries management environment. It is not possible to assign a monetary value to these indirect impacts although, as stated before, these impacts are generally considered beneficial to fishing communities through their contribution to sustainable fisheries management. In any case, fisheries management decisions by the NPFMC and NMFS are subject to their own NEPA compliance processes where these types of economic impacts are analyzed in depth so they will not be assessed in this FPEA.

4.2.8.4 Collaborations between the Fishing Industry, Subsistence Users and Fisheries Research

Under the Status Quo Alternative, the relationships that are being built between scientists, the fishing industry, and subsistence users through collaboration efforts would continue to serve as a vehicle for sharing knowledge and building mutual understanding and respect. As more members of the fishing industry become engaged in the research programs that ultimately feed into the development of fisheries management measures, there will be an increased level of public education and awareness about the basis for fishery regulatory changes. The participation of highly experienced and resourceful members of the fishing industry and subsistence users also leads to valuable advances in conservation engineering, which in turn results in more efficient fishing and fewer adverse effects on the marine environment. The AFSC fisheries research program fulfills these legal obligations by providing rigorous scientific data for the development of fisheries stock assessments and federal fishery management actions in the North Pacific and Alaska Region. The survey data from AFSC research surveys thereby provides the scientific basis for fisheries management in the region. As a result, many communities are directly affected by the fisheries research program and fisheries management.

4.2.8.5 Fulfillment of Legal Obligations Specified by Laws and Treaties

Chapter 6 provides a list of laws and treaties applicable to the AFSC fisheries research program. These obligations include the 1996 amendment to the MSA, which requires assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities (NMFS 2007c). The AFSC fisheries research programs in the GOARA, BSAIRA, and CSBSRA help fulfill these obligations under the MSA for the North Pacific and Alaska Region. In addition, research conducted by the AFSC contributes to co-management agreements with Native Alaskan entities and helps fulfill U.S. treaty obligations.

4.2.8.6 Conclusion

Under the Status Quo Alternative, the potential direct and indirect effects of AFSC fisheries and ecosystem research on subsistence resources would continue to occur infrequently or rarely, be small in magnitude, and would be dispersed over a large geographical area and not likely to be located near important sites of subsistence use. AFSC research activities are therefore considered to have minor adverse effects on subsistence resources and activities under the Status Quo Alternative according to the impact criteria in Table 4.1-1.

AFSC fisheries and ecosystem research conducted under the Status Quo Alternative would also provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of depleted resources and ultimately rebuilding these stocks to appropriate levels. It also contributes directly and indirectly to local economies, promotes collaboration and positive relationships between NMFS and other researchers as well as with commercial and recreational fishing interests, and helps fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Status Quo Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the North Pacific and Alaska Region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Status Quo Alternative on the social and economic environment would be minor to moderate and beneficial.

4.3 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 2 - PREFERRED ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 2 – Preferred Alternative on the physical, biological, and social environment. Under this Alternative, the AFSC would conduct a new suite of research activities and implement new mitigation measures in addition to the Status Quo program to comply with the MMPA and ESA compliance process (see Section 2.3). The new suite of research activities is a combination of past research and additional, new research. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 2 is presented below in Table 4.3--1.

Table 4.3-1 Alternative 2 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	**4.3.1**	**4.3.2**	**4.3.3**	**4.3.4**	**4.3.5**	**4.3.6**	**4.3.7**	**4.3.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.3.1 Effects on the Physical Environment

The effects of the Preferred Alternative on the physical environment would be similar to those of the Status Quo Alternative (Section 4.2.1). The additional mitigation measures for protected species proposed under the Preferred Alternative would not change the effects of the research activities on physical properties of the environment. The changes to the suite of research activities conducted under the Preferred Alternative would result in minimal changes to the physical effects to the benthic environment relative to the Status Quo Alternative. There are no proposed changes to research in the CSBSRA that would affect impacts to physical resources. In the BSAIRA and GOARA, there are several changes under the Preferred Alternative that affect the number of bottom trawl sets deployed.

One survey represents additional bottom trawling under the Preferred Alternative, the Ongoing Rockfish Biological Sampling and Sampling Theory Research Study. This survey represents an increase of 70 trawls in the BSAIRA and GOARA. The Pollock Summer Acoustic Trawl Survey in both the BSAIRA and GOARA would include additional camera gear, but there are no proposed changes to the trawling itself so changes would not affect physical resources. In the GOARA, the Sablefish Maturity, Acoustic Assessment of Snakehead Bank, and ADFG Small-mesh Shrimp and Forage Fish surveys would not be continued under the Preferred Alternative, reducing the total number of trawls by 197. Overall, these changes represent a decrease of 127 tows in the GOARA, and an increase of 70 tows in the BSAIRA. Resulting impacts to these research areas represent less than 0.01 percent of each research area, similar to that under the Status Quo Alternative.

The overall effects of the Preferred Alternative on the physical environment would be minor in magnitude. Small areas (less than 0.01 percent of the total of the research areas) would be impacted, and the areas of impact would be dispersed over a large geographic area. The majority of impacts resulting in measurable changes to the physical environment would be temporary or short-term in duration. The overall impacts of AFSC fisheries and ecosystem research activities on the physical environment under the Preferred Alternative would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.3.2 Effects on Special Resource Areas and EFH

AFSC fisheries and ecosystem research conducted under the Preferred Alternative would have the same types of effects on special resource areas as described for the Status Quo Alternative (Section 4.1.1). There are small changes in the research projects conducted under the Preferred Alternative (Table 2.3-1) that would likely have minimal effects on the catch rate and species of fish and invertebrates caught relative to the Status Quo. However, none of these changes would significantly impact the types of gear used or level of research effort within EFH or HAPC. The level of research effort using bottom trawl gear would remain approximately the same so potential impacts to benthic habitat would be as described in the Status Quo.

There would be no change to CSBSRA activities. In the GOARA and BSAIRA, there are several changes under the Preferred Alternative that affect the number of bottom trawl sets deployed.

Two surveys represent additional bottom trawling under the Preferred Alternative, including Using Trawl Cameras Instead of Bottom Trawls, and the Ongoing Rockfish Biological Sampling and Sampling Theory Research Study. These two surveys represent an increase of 70 trawls deployed for 15-30 minutes each in the BSAIRA and GOARA. The Pollock Summer Acoustic Trawl Survey in both the BSAIRA and GOARA would include additional camera gear, but there are no proposed changes to the trawling itself so changes would not affect special resource areas. In the GOARA, the Sablefish Maturity, Acoustic Assessment of Snakehead Bank, and ADFG Small-mesh Shrimp and Forage Fish surveys would not be continued under the Preferred Alternative, reducing the total number of trawls by 197 and the number of towing hours by 97. Combined, these changes represent a decrease of 127 tows in the GOARA and an increase of 70 tows in the BSAIRA, an overall impact to each Research Area of less than 0.01%, similar to that under the Status Quo Alternative.

The overall effects of the Preferred Alternative on special resource areas would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria described in Table 4.1-1. As was the case for the Status Quo Alternative, the scientific data generated from AFSC research activities under the Preferred Alternative would also have beneficial effects on special resource areas through their contribution to science-based conservation management practices.

4.3.3 Effects on Fish

AFSC fisheries research conducted under the Preferred Alternative would have the same types of effects on fish species as described for the Status Quo Alternative (Section 4.2.3) through mortality, disturbance, and changes in habitat. There are numerous changes in the research projects conducted under the Preferred Alternative. Some of these could affect the catch rate or species of fish caught relative to the Status Quo, and some have little expected effect on catch rates because they would use survey equipment such as cameras or sonar technology that do not catch or affect animals. The following surveys from Table 2.2-1 would be eliminated or altered under the Preferred Alternative:

- Acoustic Assessment of Snakehead Bank
- ADFG Small-mesh Shrimp and Forage Fish Survey
- Cooperative Acoustic Surveys in the Western Gulf of Alaska
- Growth and Survival of Released Hatchery Red King Crab
- Gulf Project - Upper Trophic Level (reduced in scope and renamed the “Gulf of Alaska Assessment” under the Preferred Alternative)
- Sablefish Maturity Study

- Juvenile Cod Survey
- A Miniaturized Acoustic Transponder for Red King Crab
- Deep Water Sponge Recovery
- Effects of Ocean Acidification on Larval Tanner Crab
- Juvenile Flatfish and Tanner Crab Habitat Studies in the Gulf of Alaska
- Survey and Impact Assessment for Derelict Crab Pots in the Juneau, Southeast Alaska, Dungeness Crab Fisheries
- Reconnaissance Habitat Survey of Pribilof Canyon

Several new surveys would be added in order to target areas or fish that are not currently being studied; see Table 2.3-1 for a list of these surveys. There are no changes to surveys that occur in the CSBSRA.

None of the differences between the Preferred Alternative and the Status Quo Alternative would substantially change the potential impacts of research on the risk of accidental contamination or disturbance of fish. These potential effects were considered minor adverse under the Status Quo Alternative because of their relatively low magnitude, dispersal over time and space, and, in the case of contamination, the small risk of occurrence (Section 4.2.3). These types of effects would also be considered minor adverse under the Preferred Alternative for the same reason.

4.3.3.1 ESA-Listed Species

Salmonids

Nine ESUs of Pacific salmon and five DPSs of steelhead (Table 3.2-1) are currently listed under the ESA that potentially range into the project area. The NEPA context for impacts to these species is considered important due to their status as ESA species. Directed research on ESA-listed species requires permitting under section 10 of the ESA, which is subject to its own NEPA analysis, and is not covered under this FPEA. The following discussion involves effects on ESA-listed species incidental to the purpose of AFSC fisheries research.

Most surveys in the Status Quo Alternative that have caught salmonids in the past are unchanged under the Preferred Alternative. The Southeast Coastal Monitoring survey and the Pollock Acoustic surveys in the GOARA and BSAIRA have had relatively large catches of salmonids. As outlined in Section 4.2.3.1, ESA-listed salmonid catch rates in these and other surveys are considered to be very small in magnitude, if they occur, dispersed in time and geographic area, and likely to have minimal impact on all ESUs. However, there are some surveys with altered components under the Preferred Alternative and new surveys.

The renamed Gulf of Alaska Assessment has historically caught large numbers of salmonids; 9 percent of all salmonids enumerated by count surveys. The majority of these, 66 percent, have been pink and sockeye salmon, neither of which have ESA-listed ESUs. About 18 percent of salmon caught in the Gulf of Alaska Assessment are chum (2,225 fish), 12 percent are coho (1,559 fish) and 3 percent are Chinook (410 fish). Under the Preferred Alternative, this survey would conduct about 65 percent fewer tows than the Status Quo Alternative (from 225 to 80 surface trawls). Assuming a proportional decrease in the number of salmon caught consistent with this percentage decrease in tows, this translates to an estimated annual catch of 791 chum, 554 coho, and 146 Chinook. Even though the ESU to which any of these fish belongs is unknown, the decrease in catch due to the reduced scope of the Gulf of Alaska Assessment supports the conclusion that these catches are likely not going to impact the overall population strength of ESA-listed salmonids.

Multiple new surveys (Table 2.3-1) utilize trawl gear, the source of some salmonid catch. However, most of the historical salmonid trawl catch is from surveys which target salmon in areas where salmonid catch is expected, and none of the new surveys in the GOARA or BSAIRA do this.

The overall impact on ESA-listed salmonid species would be similar under the Preferred Alternative to what they were in the Status Quo Alternative (Section 4.2.3.44). Under the Preferred Alternative, the anticipated impacts of AFSC research on ESA-listed salmonid species would be low in magnitude, would occur rarely or infrequently, would be dispersed over time and space, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

<u>Green Sturgeon</u>

The AFSC considers the adverse impacts of its various research activities on Southern DPS green sturgeon to be very small in magnitude, dispersed in time and geographic area, and likely to have minimal impact. The principal cause of decline and current threat to the Southern DPS of green sturgeon is the reduction of historically accessible spawning habitat, most notably by impoundments (NMFS 2019). Additional threats to green sturgeon include freshwater habitat alteration, impaired water quality, dredging and ship traffic, ocean energy development, incidental catch in recreational and commercial fisheries, poaching, scientific research, disease, predation, displacement by non-native invasive species, inadequacy of existing regulatory mechanisms, and entrainment of larvae and juveniles in water diversions (NMFS 2019). Overall, the impact of AFSC research on Southern DPS green sturgeon under the Preferred Alternative are considered minor adverse.

4.3.3.2 Target and Other Species

<u>Mortality from Fisheries Research Activities</u>

There are a number of surveys under the Status Quo that are not continued under the Preferred Alternative, most of which will result in minimal catch reductions compared to the Status Quo. However, several surveys that are either being eliminated or reduced have large catches that make substantial contributions to the overall mortality of several fish species in the GOARA. Included in this list are the Acoustic Assessment of Snakehead Bank, ADFG Small-mesh Shrimp and Forage Fish, GOA Assessment, and the Cooperative Acoustic Western Gulf of Alaska surveys. The contribution of the above listed surveys to the total AFSC research catch in the GOARA under the Status Quo (Table 4.2-7) varies by species; 48 percent of dusky rockfish catch, 57 percent of harlequin rockfish, 18 percent of eulachon, and smaller decreases for other species such as spiny dogfish, plain sculpin, and walleye pollock. While none of these are species of concern or overfished, reductions in catches relative to the Status Quo reduces the potential for impacts on their respective populations under the Preferred Alternative, which were considered minor under the Status Quo.

Conversely, there are a number of new surveys in the GOARA which would likely increase catches of some species under the Preferred Alternative. However, there are numerous uncertainties about how these future research activities would affect overall catch rates, which makes quantitative estimates difficult. Table 4.3-2 tallies the difference in total AFSC research effort by gear type for the Preferred Alternative compared to the Status Quo Alternative. For each research survey, this estimate uses the maximum projected sampling effort for any year the survey is conducted; since many surveys are conducted biennially or on a less frequent basis, this estimate is greater than what would actually occur in any given year. Table 4.3-2 indicates that research effort in the GOARA would be relatively reduced with bottom trawl gear but increased with pelagic trawl gear and longline gear. In the BSAIRA, research effort would be relatively increased with bottom trawl gear and pelagic trawl gear but longline effort would remain the same as the Status Quo. These changes in research effort are likely to increase the catch of many species of fish and invertebrates in both the GOARA and BSAIRA under the Preferred Alternative relative to catches documented under the Status Quo Alternative, although there is no way to project what catches may be in the future. That is, after all, why surveys must be conducted – to determine how the abundance and distribution of different species changes over time. For the purposes of this FPEA, we will take a fairly conservative approach and assume that total survey catches under the Preferred Alternative will increase by 50 percent relative to the Status Quo.

There would be no changes to the research effort in the CSBSRA so research catches would be similar to what they are under the Status Quo Alternative; the impacts of AFSC fisheries research on all fish species in the CSBSRA were considered minor adverse (Section 4.2.3.4).

Table 4.3-2 Estimated Change in Research Effort by Gear Type from Status Quo Alternative to Preferred Alternative in the GOARA and BSAIRA

Only gear types with the largest amount of overall survey catch included

Gear Type	Estimated Effort in Status Quo	# Estimated Sets in Preferred Alternative	Difference Between Status Quo and Preferred Alternative	Percent Change
GOARA				
Bottom Trawl	1,780 tows	1,649 tows	-131 tows	-7.4%
Mid-water Trawl	563 tows	591 tows	28 tows	5.0%
Longline Hooks	542,100 hooks	68,100 hooks	144,000 hooks	26.6%
BSAIRA				
Bottom Trawl	1,357 tows	2,132 tows	775 tows	57.1%
Mid-water Trawl	625 tows	725 tows	100 tows	16.0%
Longline Hooks	540,000 hooks	540,000 hooks	0	0%

Prohibited Species in AFSC Research Areas

Prohibited fish species (as defined in section 3.2.1.2) are those prohibited from catch and sale in commercial groundfish fisheries managed by NMFS and include Pacific halibut, Pacific herring, and, as discussed earlier, Pacific salmon. The effects of AFSC research catches under the Preferred Alternative on Pacific salmon are described in the ESA-listed species section above; Pacific halibut and Pacific herring are discussed here.

Changes to surveys under the Preferred Alternative are discussed above, concluding that effects for target and other non-prohibited species are conservatively assumed to increase by 50 percent relative to the Status Quo. An analysis of individual survey alterations indicates that changes to catch rates of Pacific halibut and Pacific herring are not expected to be different than target species. Therefore the effect of changes to surveys under the Preferred Alternative on Pacific Halibut and Pacific Herring are also assumed to result in 50 percent increases in catches relative to the Status Quo.

Pacific halibut in the GOARA under the Status Quo was calculated to amount to 72.55 mt per year. Under the Preferred Alternative, a 50% increase in catch would result in about 108.83 mt per year, equaling about 1.38 percent of the 2015 quota of halibut for all sectors in the GOARA (7,892.64mt). In the BSAIRA, AFSC surveys account for 51.85 mt per year under the Status Quo, which would increase under the Preferred Alternative to 77.78 mt per year. This represents 4.49 percent of a combined 2015 quota of 1,730.48 mt.

Pacific herring in the GOARA under the Status Quo was calculated to amount to 2.15 mt per year, 0.011 percent of the 20,336 mt GOARA-wide commercial herring quota. Under the Preferred Alternative, this would increase to 0.02 percent of the quota (3.23 mt). Survey catch in the BSAIRA amounts to an average of 6.48 mt per year under the Status Quo, and to 9.72 mt under the Preferred Alternative. Total Pacific herring quota in the BSAIRA equals 49,649 mt, and survey catch under the Preferred Alternative would be 0.02 percent of the total Pacific herring quota for the BSAIRA.

As stated in the discussions of the Status Quo Alternative, fisheries managers would account for anticipated fisheries research catch when determining future catch quotas for these species under the Preferred Alternative. Quotas may increase or decrease in the future as a result of changing stock assessments but the relative contribution of research mortality on the populations will be considered in setting annual sustainable fishing quotas for each area.

AFSC survey capture rates for Pacific halibut and Pacific herring under the Preferred Alternative are expected to remain relatively low considering biomass estimates and commercial and sport allocations. Bycatch of these species in AFSC surveys helps inform fishery managers as well as AFSC scientists of abundance in times and areas where directed surveys for these species may not occur.

Under the Preferred Alternative, the anticipated impacts of AFSC research on prohibited species would be low in magnitude, would occur rarely or infrequently, would be dispersed over time and space, and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

Target and Other Species in AFSC Research Areas

Tables 4.3-3 and 4.3-4 provide catch levels for the most frequently caught species in the GOARA and BSAIRA under the Status Quo, the additional catch assumed to occur under the Preferred Alternative, and a comparison of these estimates with appropriate fishing metrics.

Table 4.3-3 Comparison of Estimated Fish Caught under the Preferred Alternative Compared to Commercial TAC in the GOARA

Species are listed in descending order of total research catch by weight. Only survey species with average annual research catch greater than one metric ton (1 mt = 1000 kilograms) are shown.

Species Group	Stock Status[a]	Species	Average AFSC research catch per year under Status Quo[b] (mt)	Average AFSC research catch per year for species group under Status Quo (mt)	Estimated AFSC research catch under Preferred Alternative (Status Quo * 1.5) (mt)	2014 commercial GOA TAC (mt)[c]	Estimated AFSC research catch under Preferred Alternative compared to commercial TAC (percentage)
Walleye pollock	No overfishing, not overfished	Walleye pollock	288.71	288.71	433.07	111,530	0.39%
Arrowtooth flounder	No overfishing, not overfished	Arrowtooth flounder	268.37	268.37	402.56	103,300	0.39%
Sablefish	No overfishing, not overfished	Sablefish	237.78	237.94	356.91	11,731	3.04%
Grenadiers	Status unknown	Giant grenadier	165.77	167.23	250.85	30,691	0.82%
		Pacific grenadier	1.46				
Pacific cod	No overfishing, not overfished	Pacific cod	153.68	153.68	230.52	63,150	0.37%

Species Group	Stock Status[a]	Species	Average AFSC research catch per year under Status Quo[b] (mt)	Average AFSC research catch per year for species group under Status Quo (mt)	Estimated AFSC research catch under Preferred Alternative (Status Quo * 1.5) (mt)	2014 commercial GOA TAC (mt)[c]	Estimated AFSC research catch under Preferred Alternative compared to commercial TAC (percentage)
Flathead sole	Not overfished	Flathead sole	106.53	106.53	159.8	30,632	0.52%
Pacific ocean perch	Not overfished	Pacific ocean perch	101.47	101.47	152.21	16,133	0.94%
Shallow-water flatfish	No overfishing, not overfished	Northern rock sole	39.18	86.95	130.43	37,077	0.35%
		Yellowfin sole	19.47				
		Southern rock sole	10.09				
		Starry flounder	6.9				
		Alaska plaice	5.75				
		Butter sole	3.54				
		English sole	2.02				
Longnose skate	No overfishing, overfished status unknown	Longnose skate	22.26	22.26	33.39	2,625	1.27%
Dusky rockfish	No overfishing, not overfished	Dusky rockfish	16.87	16.87	25.31	4,413	0.57%
Thornyhead rockfish	No overfishing, overfished status unknown	Shortspine thornyhead	16.63	16.78	25.17	1,665	1.51%
		Longspine thornyhead	0.15				
Shortraker rockfish	No overfishing, overfished status unknown	Shortraker rockfish	14.13	14.13	21.2	1,081	1.96%
Northern rockfish	No overfishing, not overfished	Northern rockfish	13.58	13.58	20.37	4,850	0.42%
Rex sole	No overfishing, not overfished	Rex sole	12.56	12.56	18.84	9,460	0.20%
Rougheye and Blackspotted rockfish	No overfishing, not overfished	Rougheye rockfish	11.06	13.09	19.64	1,254	1.57%
		Blackspotted rockfish	2.03				
Atka mackerel	No overfishing, overfished status unknown	Atka mackerel	9.1	9.1	13.65	2,000	0.68%
Deep-water flatfish	No overfishing, not overfished	Dover sole	8.03	8.03	12.05	5,126	0.23%

Species Group	Stock Status[a]	Species	Average AFSC research catch per year under Status Quo[b] (mt)	Average AFSC research catch per year for species group under Status Quo (mt)	Estimated AFSC research catch under Preferred Alternative (Status Quo * 1.5) (mt)	2014 commercial GOA TAC (mt)[c]	Estimated AFSC research catch under Preferred Alternative compared to commercial TAC (percentage)
Big skate	No overfishing, overfished status unknown	Big skate	7.66	7.66	11.49	3,767	0.31%
Forage fish species	Status unknown	Eulachon	5.59	5.59	8.39	262	3.20%
Other skates	No overfishing, overfished status unknown	Aleutian skate	3.69	8.94	13.41	2,030	0.66%
		Bering skate	2.53				
		Skates unidentified	2.72				
Sharks	No overfishing, overfished status unknown	Pacific sleeper shark	3.04	14.36	21.54	6,028	0.36%
		Spiny dogfish	11.32				
Other rockfish	No overfishing, overfished status unknown	Silvergray rockfish	2.97	7.76	11.64	1,080	1.08%
		Redbanded rockfish	2.49				
		Harlequin rockfish	1.19				
		Sharpchin rockfish	1.11				
Sculpins	No overfishing, overfished status unknown	Great sculpin	2.91	7.13	10.7	5,884	0.18%
		Yellow Irish lord	2.57				
		Plain sculpin	1.65				
Not allocated	Status unknown	Spotted ratfish	2.13	2.13	3.2	NA	NA
Not allocated	Status unknown	Lingcod	1.77	1.77	2.66	NA	NA
Demersal shelf rockfish	No overfishing, overfished status unknown	Yelloweye rockfish	1.04	1.04	1.56	303	0.51%

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Some surveys reported number only; estimates of weight were made and included in the total for that species.

c. Source: 2013-2014 Alaska Groundfish Harvest Specification. Available online: https://alaskafisheries.noaa.gov/sustainablefisheries/specs13_14/

d. Grenadier are considered an "ecosystem component species", for which an ABC is not required. However, in 2014 Rodgveller and Hulson estimated ABC for this group and this value is presented here.

e. Forage fish, including eulachon, are not required to have an ABC. For this species, the estimated biomass is unknown and the number presented here represents the 2014 estimated catch according to the Alaska Region (http://alaskafisheries.noaa.gov/sustainablefisheries/forage/2014catch.pdf).

Table 4.3-4 Comparison of Estimated Fish Caught under the Preferred Alternative Compared to Commercial TAC in the BSAIRA

Species are listed in descending order of total research catch by weight. Only survey species with average annual research catch greater than one metric ton (1 mt = 1000 kilograms) are shown.

Species complex	Stock Status[a]	Species	Average AFSC research catch per year under Status Quo[b] (mt)	Average AFSC research catch per year for species group under Status Quo (mt)	Estimated AFSC research catch under Preferred Alternative (Status Quo * 1.5) (mt)	2014 commercial BSAI TAC (mt)[c]	Estimated AFSC research catch under Preferred Alternative compared to commercial TAC (percentage)
Walleye pollock	No overfishing, not overfished[d]	Walleye pollock	309.62	309.62	464.43	1,266,100	0.04%
Pacific ocean perch	No overfishing, not overfished	Pacific ocean perch	293.22	293.22	439.83	66,200	0.66%
Grenadiers	Status unknown	Giant grenadier	268.45	280.34	420.51	75,274	0.56%
		Popeye grenadier	11.89				
Atka mackerel	No overfishing, not overfished	Atka mackerel	101.15	101.15	151.725	50,758	0.30%
Pacific cod	No overfishing, not overfished	Pacific cod	107.74	107.74	161.61	260,880	0.06%
Northern rockfish	No overfishing, not overfished	Northern rockfish	46.14	46.14	69.21	3,000	2.31%
Arrowtooth flounder	No overfishing, not overfished	Arrowtooth flounder	114.28	114.28	171.42	25,000	0.69%
Yellowfin sole	No overfishing, not overfished	Yellowfin sole	104.01	104.01	156.015	198,000	0.08%
Flathead sole	No overfishing, not overfished	Flathead sole	99.02	99.02	148.53	22,543	0.66%
Rock soles	No overfishing, not overfished	Northern rock sole	93.08	94.38	141.57	92,000	0.15%
		Southern rock sole	1.31				
Other flatfish	No overfishing, overfished status unknown	Rex sole	38.94	42.7	64.05	4,000	1.60%
		Starry flounder	3.76				
Alaska plaice	No overfishing, not overfished	Alaska plaice	38.27	38.27	57.405	20,000	0.29%
Skates	No overfishing, not overfished	Alaska skate	20.67	49.38	74.07	25,000	0.30%
		Whiteblotched skate	12.95				
		Aleutian skate	6.35				
		Commander skate	3.92				
		Leopard skate	1.81				
		Mud skate	1.49				
		Bering skate	1.14				
		Skates unidentified	1.05				

Species complex	Stock Status[a]	Species	Average AFSC research catch per year under Status Quo[b] (mt)	Average AFSC research catch per year for species group under Status Quo (mt)	Estimated AFSC research catch under Preferred Alternative (Status Quo * 1.5) (mt)	2014 commercial BSAI TAC (mt)[c]	Estimated AFSC research catch under Preferred Alternative compared to commercial TAC (percentage)
Sablefish	No overfishing, not overfished	Sablefish	19.18	19.18	28.77	3,490	0.82%
Kamchatka flounder	No overfishing, not overfished	Kamchatka flounder	14.28	14.28	21.42	10,000	0.21%
Other rockfish	No overfishing, overfished status unknown	Shortspine thornyhead	13.8	13.8	20.7	2,318	0.89%
Greenland turbot	No overfishing, not overfished	Greenland turbot	12.16	12.16	18.24	5,300	0.34%
Shortraker rockfish	Status unknown	Shortraker rockfish	5.31	5.31	7.965	370	2.15%
Sculpins	No overfishing, overfished status unknown	Yellow Irish lord	5.71	15.98	23.97	5,600	0.43%
		Bigmouth sculpin	2.13				
		Plain sculpin	2.88				
		Darkfin sculpin	1.52				
		Great sculpin	2.26				
		Warty sculpin	1.49				
Rougheye rockfish	No overfishing, not overfished	Blackspotted rockfish	3.33	5.75	8.625	858	1.01%
		Rougheye rockfish	2.43				
Non-allocated	Status unknown	Western eelpout	5.63	5.63	8.445	NA	NA
Non-allocated	Status unknown	Saffron cod	2.94	2.94	4.41	NA	NA
Non-allocated	Status unknown	Eulachon	2.13	2.13	3.195	NA	NA
Non-allocated	Status unknown	Arctic cod	1.9	1.9	2.85	NA	NA
Non-allocated	Status unknown	Capelin	1.42	1.42	2.13	NA	NA

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Some surveys reported number only; estimates of weight were made and included in the total for that species.

c. Source: 2013-2014 Alaska Groundfish Harvest Specification. Available online: https://alaskafisheries.noaa.gov/sustainablefisheries/specs13_14/

d. Walleye pollock is not considered overfished in the Eastern Bering Sea stock or in the Aleutian Islands stock. It is unknown whether the Bogoslof stock is overfished or not.

e. Grenadier are considered an "ecosystem component species", for which an ABC is not required. However, Rodgveller and Hulson 2014 (http://www.afsc.noaa.gov/REFM/Docs/2014/GOAgrenadier.pdf) estimated ABC for this group and this value is presented here.

f. Forage fish, including capelin and eulachon, are not required to have a TAC.

Table 4.3-3 and Table 4.3-4 indicate that for most species the estimated amount of fish killed in AFSC fisheries and ecosystem research in the GOARA and BSAIRA under the Preferred Alternative is much less than 1.5 percent of commercial quotas. For these species, the magnitude of estimated research mortality is very small relative to the fisheries and even smaller relative to the estimated populations of these fish.

The largest estimated catches in the GOARA are walleye pollock and arrowtooth flounder, comprising less than half of 1 percent of the annual TACs for these species as shown in Table 4.3-3. Both species are considered to be healthy and not overfished. The largest estimated catches in the BSAIRA are walleye pollock, Pacific ocean perch, and giant grenadier, comprising less than 1 percent of the annual TACs for each of these species as shown in Table 4.3-4. Pacific ocean perch and giant grenadier are considered to be healthy and not overfished and estimated amounts taken are small enough to have only minor impacts on these species.

Walleye pollock is the largest single-species fishery in both the GOARA and BSAIRA. This fish has been exhaustively studied due to its significant economic value and the GOA stock is managed independently of populations north of the Aleutian Islands, where the vast majority of quota is allocated to the Eastern Bering Sea stock. A small TAC (19,000 mt in 2014) is allocated for the Aleutian Islands stock, and an even smaller amount of 100 mt in 2014 was allocated to the Bogoslof stock. Pollock have a relatively short time to maturity (50 percent maturity at 4.9 years, NPFMC 2014d), a wide overall population distribution and high reproductive potential.

While the information in Table 4.3-4 takes into account all pollock in the BSAIRA as a whole, it is informative to also consider the potential impact on individual BSAI stocks. The Eastern Bering Sea stock had a 2014 TAC of 1,247,000 mt. Conservatively assuming all survey catch of pollock in the BSAIRA came from this stock, the total amount estimated taken by surveys would be less than 0.04 percent of the TAC. Similarly, if all catch came from the Aleutian Islands stock, the impact on the population would be 24.44 percent of the total TAC, or 1.02 percent of the OFL for that stock (78FR13815). If all research catch of pollock came from the Bogoslof stock, only 3.47 percent of the 13,400 mt OFL would be taken annually. These values would be more than enough to insure overfishing does not occur due to high research catches.

Sablefish in the GOARA has the next highest estimated catch rate, the bulk of which are caught during the Alaska longline survey, which targets sablefish and other groundfish for stock assessment purposes. About five percent of sablefish are tagged and released alive. However, survivability of these fish is not guaranteed so for the purposes of this FPEA, 100 percent mortality is assumed to maintain a conservative comparison. Using this metric, the maximum mortality rate represents less than 3.1 percent of the total TAC for this species in the GOARA, with actual mortality likely lower.

For forage fish species in the BSAIRA, TACs are not set because they are considered essential to the ecosystem and a directed commercial fishery is discouraged. Thus it is difficult to gauge the impact of survey catches of capelin and eulachon on overall population strengths. However, some metrics exist that can be used for comparison. In the 2014 BSAI SAFE report, eulachon catch in the targeted yellowfin sole fishery from 2009 to 2013 ranged from an estimated 19.89 mt to 453.29 mt. For capelin, the catch ranged from 251.49 to 3,768.89 mt. Keeping in mind that these are estimates only from the directed yellowfin sole fishery and not any other fisheries, the relative size of them indicates that the 2.1 to 3.2 mt estimated research catches for these two species is likely very small in magnitude and unlikely to affect the populations of either species.

The rest of the fish with quota allocations caught in the GOARA have estimated research catch rates of less than two percent of TAC, with most being considerably lower than one percent The rest of fish caught in BSAIRA research have estimated catch rates less than 2.3 percent of TAC, with most being considerably lower than one percent. These catches are considered small in magnitude and unlikely to affect the populations of any species.

Research data is necessary for monitoring the status of stocks where overfishing is unknown and other stocks of conservation concern and to determine if management objectives are being met. Under the Preferred Alternative, AFSC fisheries and ecosystem research activities would require SRPs or experimental fishing permits before they are conducted. The potential impacts of those proposed projects would be assessed for each stock, including stocks that may be approaching an overfished condition, before those permits are issued. Fisheries managers typically consider the estimated amount of research catch from all projects along with other sources of mortality (e.g., bycatch in other fisheries and predation) before setting commercial fishing limits to prevent overfishing of stocks or to help overfished stocks rebuild. Any future proposed projects targeting stocks with overfishing or other conservation concerns, or projects likely to have substantial bycatch of such stocks, would receive additional scrutiny on a stock by stock basis to ensure minimal impact on the stock before a research permit is issued. These annual permitting reviews would also determine whether the proposed projects were consistent with the NEPA analysis presented in the FPEA or whether additional NEPA analysis was required (see Section 2.3.5).

Table 4.3-3 and Table 4.3-4 indicate that, while mortality to fish species is a direct effect of AFSC fisheries and ecosystem research activities, there will likely be no measurable population changes under the Preferred Alternative occurring as a result of these research activities because they represent such a small percentage of allowable quota in commercial fisheries, which are just fractions of the total populations of these species. Overall, the impact of AFSC research on target and bycatch fishes under the Preferred Alternative is considered minor adverse according to the impact criteria described in Table 4.1-1.

4.3.3.3 Conclusion

The overall effects of the Preferred Alternative on fish would be similar to those discussed under the Status Quo Alternative (Section 4.2.3). There are some differences in the level of effort and location of research fishing activities from status quo, which would in some cases increase or decrease the catch of specific fish species such as salmon and halibut. However, potential effects would likely be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration (for effects other than mortality) and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

The Preferred Alternative would also contribute to long-term beneficial effects on managed fish species throughout the Alaska Region through the contribution of AFSC fisheries and ecosystem research to sustainable fisheries management. Data from AFSC fisheries research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by AFSC research programs are especially valuable for long-term trend analysis for commercially harvested fish and, combined with other oceanographic data collected during fisheries research, provide the basis for monitoring changes to the marine environment important to fish populations.

4.3.4 Effects on Marine Mammals

The direct and indirect effects of the Preferred Alternative on marine mammals are very similar to those described for the Status Quo Alternative (Section 4.2.4). Differences between the alternatives that may affect the impacts of AFSC fisheries research on marine mammals include:

- Improved and formalized protected species training, awareness, and reporting procedures to facilitate and improve implementing mitigation measures (see below).

- Discontinuation of 13 projects and the addition or modification of several other projects (Section 2.3, Tables 2.2-1 and 2.3-1).
- A new communication plan to facilitate pre-survey and in-season communication with Alaska Native subsistence communities and co-management organizations intended to reduce the chance that AFSC fisheries research activities might interfere with subsistence activities.

The following analysis draws heavily on the analysis provided under the Status Quo Alternative (Section 4.2.4), but focuses on differences that may result from the new research elements and mitigation measures added under the Preferred Alternative.

The Preferred Alternative is the AFSC fisheries and ecosystem research program and suite of mitigation measures, communication plan, and monitoring and reporting procedures that are being proposed in the MMPA LOA application (Appendix C). The analysis of effects in the LOA application was based primarily on the history of past effects under status quo conditions, including mitigation measures as they were implemented at the end of 2015. However, the nature of the status quo conditions has changed in the last ten years in terms of the specific research being conducted and the implementation of mitigation measures for protected species interactions. The AFSC regularly assesses their effects on the marine environment and explores ways to effectively reduce adverse interactions while fulfilling their mission to collect scientific information for fisheries and natural resource management. The Status Quo Alternative therefore reflects the mitigation equipment and procedures as they were implemented through the end of 2015, while the Preferred Alternative includes ongoing efforts to reduce unintentional adverse effects on protected species and potential impacts on subsistence.

The Preferred Alternative includes the same suite of mitigation measures described under the Status Quo Alternative with the following modifications to reduce the risk of adverse interactions with protected species (Section 2.3.2). The AFSC proposes improvements to its protected species training, awareness, and reporting procedures under the Preferred Alternative in order to facilitate and improve the implementation of mitigation measures described under the Status Quo Alternative. Enhancements include:

- The AFSC will initiate procedures to facilitate communication between Chief Scientists and vessel captains about protected species interactions during research surveys in order to improve decision-making regarding avoidance of adverse interactions. The intent is to draw on the collective experience of people who have been making those decisions, provide a forum to exchange information about what worked or did not work, apply lessons learned and improve upon future decisions regarding avoidance practices. The AFSC would coordinate among its staff and vessel captains and with those from other fisheries science centers, cooperating research partners, and other interested NMFS offices with similar experience.
- Proposed development of a formalized protected species training program for all crew members that would be required for all AFSC fisheries research projects. AFSC Chief Scientists and appropriate members of AFSC research crews will be trained using customized monitoring, data collection, and reporting protocols for protected species developed with assistance from the North Pacific Fisheries Observer Program. This would formalize and standardize the information provided to all crew that might experience protected species interactions during research activities.
- For all AFSC fisheries research projects and vessels, instructions and protocols for avoiding adverse interactions with protected species will be reviewed and, if needed, made fully consistent with Observer Program training materials and any guidance on decision-making that arises from training opportunities. Informational placards and reporting procedures will be reviewed and updated as necessary for consistency and accuracy. The AFSC will incorporate specific language

into its contracts that specifies all training requirements, operating procedures, and reporting requirements for protected species that will be required for all vessels, including charter vessels and cooperating research partners.

- Develop a monitoring and reporting program to facilitate tracking and, ultimately, mitigating vessel disturbance of pinnipeds on land-based rookeries and haulouts.
- Develop a communication plan in compliance with the MMPA requirement that activities have no unmitigable adverse impacts on the availability of marine mammal species or stocks for subsistence uses. The communication plan (Appendix B in the LOA Application, which is Appendix C in this FPEA) identifies measures that will be taken to minimize any such adverse effects.

The potential effects of the Preferred Alternative on marine mammals involve adverse interactions with research vessels, survey gear, sonar and other active acoustic devices, and other associated equipment, including:

- Disturbance and behavioral responses due to acoustic equipment and the physical presence of researchers
- Injury or mortality due to ship strikes and entanglement in gear
- Changes in food availability due to research survey removal of prey and discards
- Contamination from discharges

These mechanisms of potential effects are discussed under the Status Quo Alternative (Section 4.2.4), most of which will not be repeated here. The mechanism in the first component of the first bullet, acoustic disturbance, would be similar under the Preferred Alternative as it is for the Status Quo Alternative because there are no new acoustic sound sources that would be introduced and no new mitigation measures are being proposed that would address potential effects due to acoustic disturbance. Although every species of marine mammal in the research area may be exposed to sounds from active acoustic equipment used in AFSC research, many of the acoustic sources are likely not audible to most species and the others would likely cause temporary and minor changes in behavior for nearby animals as the ships pass through a given area. A new monitoring and reporting system for documenting disturbance of hauled out pinnipeds by the physical presence of researchers under the Preferred Alternative will facilitate tracking impact levels and generate more accurate data from which appropriate mitigation could arise. An anticipated effect of better tracking of disturbance is a more accurate assessment of Level B harassment takes. The overall effects from acoustic disturbance are considered minor adverse for all species in the AFSC research areas. The potential effects from changes in food availability and contamination were also considered to be minor adverse for all species of marine mammals and will not be discussed further. The following discussion will therefore focus on the potential effects from entanglement or incidental capture in fishing gear used in AFSC research, especially with regard to any differences between the Status Quo Alternative and the Preferred Alternative.

4.3.4.1 Gulf of Alaska Research Area

<u>ESA-listed Species</u>

The endangered marine mammals that occur in the GOARA include Cook Inlet beluga whales, sperm, humpback, blue, fin, and sei whales, North Pacific right whales, and the Western DPS of Steller sea lions. Threatened species include the Southwest Alaska DPS of the northern sea otter. Sea otters are under the jurisdiction of the USFWS, while the remainder is under the jurisdiction of NMFS in regard to compliance with the MMPA and ESA.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). Potential takes are determined by historical takes in fisheries research, species with similar vulnerabilities to historically taken species, and historical takes in analogous commercial fisheries. There have been no entanglements or takes of ESA-listed marine mammals in AFSC fisheries research, so take requests are based on species analogous to those historically taken or known takes in commercial fisheries using analogous fishing gear. Potential effects under the Preferred Alternative would be similar to those expected under Status Quo conditions, although the AFSC anticipates that new mitigation enhancement measures included in the Preferred Alternative could further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Tables 4.2-12 and 4.2-13).

The LOA application does not include any estimated Level A harassment or serious injury and mortality takes of threatened or endangered cetaceans or sea otters during the five-year authorization period. The AFSC is, however, requesting 6 takes of ESA-listed Western DPS Steller sea lions in the GOARA over the five-year authorization period: five in trawl gear based on similarity to historically taken northern fur seals and one in longline gear based on historical takes in commercial fisheries using this gear type (Table 4.2-13).

As described for the Status Quo Alternative (Section 4.2.4), analysis of potential effects relative to PBR is made for combined requested takes from all gears and research areas (Table 4.2-14). For the Western DPS of Steller sea lions, that includes takes in trawls in the GOARA and the BSAIRA and in longline gear in the GOARA. This combined estimated average annual take for combined gears and areas for western Steller sea lions is less than one percent of PBR (Table 4.2-14). This level of mortality, were it to occur, would be considered minor in magnitude.

In addition, the AFSC must assign “undetermined pinniped” takes to each stock in addition to those takes requested for each particular known stock for impact analysis purposes. The resulting combined take request for western Steller sea lions and undetermined pinnipeds in trawl and longline gear would equal one percent of PBR (Table 4.2-14) and be considered minor in magnitude.

In addition to the mitigation measures that have been implemented in recent years under the Status Quo Alternative, the Preferred Alternative includes new measures that may further reduce the risk of future marine mammal takes. Measures to mitigate the risk of entanglements or hooking are described in Section 2.3.1 and summarized above. Given these measures and the lack of prior entanglement/hooking of ESA-listed marine mammals, the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement or hooking in research gear in the GOARA under the Preferred Alternative are therefore considered minor adverse for ESA-listed marine mammal species.

<u>Non-ESA-Listed Cetaceans</u>

This section describes impacts to cetaceans that are not ESA-listed. Minke whales and eastern North Pacific gray whales are the only baleen whale species included in this section. The remaining cetaceans are toothed whale species (i.e., odontocetes), including whales, dolphins, and porpoises.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). Potential takes are determined by historical takes in fisheries research, species with similar vulnerabilities to historically taken species, and historical takes in analogous commercial fisheries. New research and training programs included in the Preferred Alternative should further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Table 4.2-13 and 4.2-13).

Dall's porpoise is the only cetacean species historically taken during AFSC fisheries research and the sole species for which takes in trawl gear are thusly based. Requested takes of harbor porpoises and Pacific white-sided dolphins are based on these species being similarly vulnerable to trawl gear as Dall's porpoises. Additional takes of Dall's porpoise and harbor porpoise (from each of two stocks) in gillnet gear are based on commercial fisheries takes in similar gear.

In addition to requested takes in more than one gear type in the GOARA, the AFSC also requested takes for the same stock of Dall's porpoises in trawl and longline gear in the BSAIRA (see subsections below). The analysis of potential effects relative to PBR is therefore made for combined requested takes from all gears and research areas (Table 4.2-14).

PBR is undetermined for Dall's porpoises, all stocks of harbor porpoises, and Pacific white-sided dolphins in the GOARA. Since the combined total annual estimated takes in all gears and research areas, range from 0.4 for harbor porpoise to 2.4 for Dall's porpoises (2 to 12 animals respectively over five years), they are likely sufficiently small to be considered minor in magnitude (Table 4.2-14). This conclusion would likely hold true even if the requested "undetermined dolphin or porpoise" takes are assigned to each stock in addition to those takes requested for the particular stock. Given the low number of cetacean interactions that have occurred in the past, the continued implementation of mitigation measures instituted under the Status Quo Alternative, and new measures included under the Preferred Alternative (Section 2.3.1 and summarized above) the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement in research gear in the GOARA under the Preferred Alternative are therefore considered minor adverse for non-ESA-listed cetaceans according to the criteria described in Table 4.1-1.

<u>Non-ESA-Listed Pinnipeds</u>

There are five species of non-ESA-listed pinnipeds commonly found in the GOARA that may interact with AFSC research: Steller sea lion (Eastern DPS), northern fur seal, harbor seal (several stocks), and northern elephant seal (Table 3.2-6).

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for pinnipeds in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4), with potential takes determined by historical takes in fisheries research, species with similar vulnerabilities to historically taken species, and historical takes in analogous commercial fisheries. Potential effects under the Preferred Alternative would be similar to those expected under Status Quo conditions, although the AFSC anticipates that new mitigation measures included in the Preferred Alternative could further reduce risks of adverse interactions with pinnipeds. Since any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative, the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Tables 4.2-12 and 4.2-13).

A single northern fur seal is the only pinniped species historically taken during AFSC fisheries research, so is the only pinniped for which historical takes is the basis for requested takes. Requested takes of harbor seals and Eastern DPS Steller sea lions in trawl gear is based on these species being similarly vulnerable to trawl gear as northern fur seals. Requested takes of Steller sea lions and fur seals in longline gear, harbor seals in gillnets, and a northern elephant seal in trawl gear are based on commercial fisheries takes in similar gear (Table 4.2-13).

In addition to takes requested for multiple gear types in the GOARA, the AFSC also requested takes for northern fur seals in trawl and longline gear in the BSAIRA (see subsections below). The analysis of potential effects relative to PBR is therefore made for combined requested takes from all gears and research areas (Table 4.2-14). The combined estimated average annual take for each non-ESA listed pinniped stock or species included here is well below one percent of PBR (Table 4.2-14). This level of mortality, were it to occur, would be considered minor in magnitude.

In addition, the AFSC must assign undetermined species takes to each stock in addition to those takes requested for each particular known stock for impact analysis purposes. The resulting combined take requests for Eastern DPS Steller sea lions, northern fur seals, harbor seals (several stocks), and northern elephant seals with "undetermined pinnipeds" in trawl and longline gear would still be less than one percent of PBR (Table 4.2-14) and be considered minor in magnitude.

Given the relative infrequency of pinniped interactions that have occurred in the past, the continued implementation of mitigation measures instituted under the Status Quo Alternative, and new measures included under the Preferred Alternative (Section 2.3.1 and summarized above) the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement in research gear in the GOARA under the Preferred Alternative are therefore considered minor adverse for non-ESA-listed pinnipeds according to the criteria described in Table 4.1-1.

4.3.4.2 Bering Sea Aleutian Islands Research Area

ESA-listed Species

The endangered cetaceans that occur in the BSAIRA include sperm whales, humpback whales, fin whales, sei whales, right whales, bowhead whales and, on rare occasions, blue whales and western North Pacific gray whales. Bowhead whales are in the western Bering Sea, along the ice edge, during winter months (November-April), so are unlikely to overlap with any AFSC fisheries research in the BSAIRA. ESA-listed pinnipeds in the BSAIRA include the endangered Western DPS of Steller sea lions, ringed seals, and the Pacific walrus, which is a candidate for listing as threatened. The threatened listing of the Beringia DPS of bearded seals was vacated in 2014, following a decision in the U.S. District Court for the District of Alaska. The Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. While the appeal process is in progress, the Beringia DPS of bearded seals will retain consideration as an ESA-listed species in this FPEA. The Southwestern Alaska DPS of the northern sea otter, listed as threatened, also occurs in the BSAIRA. Pacific walrus and sea otters are under the jurisdiction of the USFWS and, due to the very low likelihood of interactions during AFSC fisheries research, the AFSC is not requesting takes of either of these species.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). Potential takes are determined by historical takes in fisheries research, species with similar vulnerabilities to historically taken species, and historical takes in analogous commercial fisheries. There have been no entanglements or takes of ESA-listed marine mammals in AFSC fisheries research and all historical takes occurred in the GOARA, so take requests in the BSAIRA are based on known takes in commercial fisheries using analogous fishing gear. Potential effects under the Preferred Alternative would be similar to those expected under Status Quo conditions, although the AFSC anticipates that new mitigation measures included in the Preferred Alternative could further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Tables 4.2-12 and 4.2-13).

The LOA application does not include any estimated Level A harassment or serious injury and mortality takes of threatened or endangered cetaceans, sea otters, or walruses during the five-year authorization period. The AFSC is, however, requesting takes of five Western DPS of Steller sea lions and one each of bearded seals and ringed seals in trawl gear in the BSAIRA over the five-year authorization period based on historical takes in commercial fisheries using this gear type (Table 4.2-13). In addition, the AFSC is requesting one take each of Western Steller sea lions and ringed seal in longline gear based on commercial takes in longline gear in the BSAIRA.

As described above for the Status Quo Alternative (Section 4.2.4), analysis of potential effects relative to PBR is made for combined requested takes from all gears and research areas (Table 4.2-14). For the Western DPS of Steller sea lions, that includes takes in trawls in the GOARA and the BSAIRA and in longline gear in the GOARA. This combined estimated average annual take for combined gears and areas for western Steller sea lions is less than one percent of PBR, which would be considered minor in magnitude. PBR is undetermined for both bearded and ringed seals, but the combined requested takes in trawl gear in the BSAIRA and CSBSRA (0.4 per year for bearded seal and 0.6 per year for ringed seal) are likely sufficiently small to be considered minor in magnitude for each stock.

The AFSC must also assign undetermined species takes to each stock in addition to those takes requested for each particular known stock for impact analysis purposes. The resulting combined take request for Western Steller sea lions and “undetermined pinnipeds” in trawl and longline gear would equal one percent of PBR (Table 4.2-14) and be considered minor in magnitude. Assigning “undetermined pinniped” takes in trawl gear to either of the requested takes of ringed or bearded seals would not add substantially to annual take levels for either species and, despite the lack of PBR calculations, this take level would likely remain of minor magnitude (Table 4.2-14).

In addition to the mitigation measures that have been implemented in recent years under the Status Quo Alternative, the Preferred Alternative includes new measures that may further reduce the risk of future marine mammal takes. Measures to mitigate the risk of entanglements are described in Section 2.3.1 and summarized above. Given these measures and the lack of prior entanglements of ESA-listed marine mammals, the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement/hooking in research gear in the BSAIRA under the Preferred Alternative are therefore considered minor adverse for ESA-listed marine mammal species in accordance with the criteria in Table 4.1-1.

<u>Non-ESA Listed Cetaceans</u>

This section describes impacts to cetaceans that are not ESA-listed. Minke whales and eastern North Pacific gray whales are the only baleen whale species included in this section. The remaining cetaceans are toothed whale species (i.e., odontocetes), including whales, dolphins, and porpoises.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). Potential takes are determined by historical takes in fisheries research, species with similar vulnerabilities to historically taken species, and historical takes in analogous commercial fisheries. There have been no entanglements or takes of marine mammals in AFSC fisheries research in the BSAIRA, so all take requests in the BSAIRA are based on known takes in commercial fisheries using analogous fishing gear. New research and training programs included in the Preferred Alternative should further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Table 4.2-13 and 4.2-13).

The AFSC is requesting takes of one harbor porpoise from the Bering Sea stock and five Dall's porpoises in trawl gear, and one Dall's porpoise in longline gear in the BSAIRA over the five-year authorization period.

In addition to requested takes in more than one gear type in the BSAIRA, the AFSC also requested takes for Dall's porpoises in trawl and longline gear in the GOARA (see subsection above). The analysis of potential effects relative to PBR is therefore made for combined requested takes from all gears and research areas (Table 4.2-14).

PBR is, however, undetermined for both porpoise species in the BSAIRA, so potential takes as a percent of PBR cannot be calculated. The combined total annual estimated takes in all gears and research areas are likely sufficiently small to be considered minor in magnitude. This conclusion would likely hold true even if requested "undetermined dolphin or porpoise" takes are assigned to each stock and added to requested takes for these stocks. Given the historically low number of cetacean interactions in AFSC research (including none in the BSAIRA), the continued implementation of mitigation measures instituted under the Status Quo Alternative, and new measures included under the Preferred Alternative (Section 2.3.1 and summarized above) the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement/hooking in research gear in the BSAIRA under the Preferred Alternative are therefore considered minor adverse for non-ESA-listed cetaceans according to the criteria described in Table 4.1-1.

Non-ESA Listed Pinnipeds

There are four species of non-ESA-listed pinnipeds commonly found in the BSAIRA that may interact with AFSC research: northern fur seal (Eastern Pacific stock), harbor seal (three stocks), spotted seal, and ribbon seal (Table 4.2-13).

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). Potential takes are determined by historical takes in fisheries research, species with similar vulnerabilities to historically taken species, and historical takes in analogous commercial fisheries. There have been no entanglements or takes of marine mammals in AFSC fisheries research in the BSAIRA, so all take requests in the BSAIRA are based on known takes in commercial fisheries using analogous fishing gear. New research and training programs included in the Preferred Alternative should further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Table 4.2-13 and 4.2-13).

Based on takes in analogous commercial fisheries, the AFSC requests takes of six Eastern Pacific northern fur seals (five in trawl and one in longline gear); one Aleutian Islands harbor seal, one Pribilof Islands harbor seal, one Bristol Bay harbor seal, one spotted seal, and one ribbon seal in trawl gear over the five-year authorization period (Table 4.2-13).

In addition to take requests for multiple gear types in the BSAIRA, the AFSC also requests takes of Eastern Pacific northern fur seals in the GOARA and spotted and ribbon seals in the CSBSRA (see subsections above and below). Analysis of potential effects relative to PBR is made for combined requested takes from all gears and research areas (Table 4.2-14). These potential takes, if they occurred, would be less than ten percent of known or potential PBR for each of these species and, for all but the Pribilof Islands stock of harbor seals, less than one percent of PBR. This level of mortality would be considered minor in magnitude for all species for which PBR is known. For the purposes of impact analysis, the AFSC must assign "undetermined pinniped" takes to each stock in addition to those takes requested for the particular stock. The resulting combined take request would remain below ten percent of PBR and be considered minor in magnitude for all stocks (Table 4.2-14).

Given the historically low number of pinniped interactions in AFSC research (including none in the BSAIRA), the continued implementation of mitigation measures instituted under the Status Quo Alternative, and new measures included under the Preferred Alternative (Section 2.3.1 and summarized above) the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement/hooking in research gear in the BSAIRA under the Preferred Alternative would therefore be considered minor adverse for non-ESA-listed pinnipeds according to the criteria described in Table 4.1-1.

4.3.4.3 Chukchi Sea/Beaufort Sea Research Area

<u>ESA-listed Species</u>

The endangered marine mammals that occur in the CSBSRA include bowhead whales and occasional sightings of humpback and fin whales, primarily in the Chukchi Sea. Threatened species include ringed seals and polar bears. The threatened listing of the Beringia DPS of bearded seals was vacated in 2014, following a decision in the U.S. District Court for the District of Alaska. The Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. While the appeal process is in progress, the Beringia DPS of bearded seals will retain consideration as an ESA-listed species in this FPEA. The Pacific walrus is a candidate species for listing. Polar bears and walrus are under the jurisdiction of the USFWS and, due to the very low likelihood of interactions during AFSC fisheries research, the AFSC is not requesting takes of either of these species. The remaining species are under the jurisdiction of the NMFS.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). There have been no historical fisheries research takes of marine mammals in the CSBSRA and there are currently no commercial fisheries in the Chukchi and Beaufort seas, so all takes requested for the CSBSRA are based on the geographic and temporal overlap of AFSC fisheries research activities and marine mammal species' ranges. Potential effects under the Preferred Alternative would be similar to those expected under Status Quo conditions, although the AFSC anticipates that new mitigation enhancement measures included in the Preferred Alternative could further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Tables 4.2-12 and 4.2-13).

The LOA application does not include any estimated Level A harassment or serious injury and mortality takes of threatened or endangered cetaceans, walruses, or polar bears during the five-year authorization period. The AFSC is, however, requesting one take each of bearded and ringed seals in trawl gear over the five-year authorization period (Table 4.2-13).

Since the AFSC also requested takes of bearded and ringed seals in trawl gear in the BSAIRA, analysis of potential effects relative to PBR includes the combined requested takes from both areas (Table 4.2-14). PBR is, however, undetermined for both species. The combined requested takes in trawl gear in the BSAIRA and CSBSRA (0.4 per year for bearded seal and 0.6 per year for ringed seal) are likely sufficiently small to be considered minor in magnitude. Assigning additional "undetermined pinniped" takes to either of the combined requested takes would not add substantially to annual take levels for ringed or bearded seals and, despite the lack of PBR calculations, this take level would likely remain of minor magnitude.

In addition to the mitigation measures that have been implemented in recent years under the Status Quo Alternative, the Preferred Alternative includes new measures that may further reduce the risk of future marine mammal takes. Measures to mitigate the risk of entanglements/hookings are described in Section 2.3.1 and summarized above. Given these measures and the lack of prior entanglements/hookings of ESA-listed marine mammals, the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement/hooking in research gear in the CSBSRA under the Preferred Alternative are therefore considered minor adverse for ESA-listed marine mammal species in accordance with the criteria in Table 4.1-1.

Non-ESA-Listed Cetaceans

The non-ESA-listed cetaceans that occur in the CSBSRA include two stocks of beluga whales, harbor porpoise, minke whales, and eastern North Pacific gray whales. None has been taken historically during AFSC fisheries research.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). There have been no historical fisheries research takes of marine mammals in the CSBSRA and there are currently no commercial fisheries in the Chukchi and Beaufort seas, so all takes requested for the CSBSRA are based on the geographic and temporal overlap of AFSC fisheries research activities and marine mammal species' ranges. Potential effects under the Preferred Alternative would be similar to those expected under Status Quo conditions, although the AFSC anticipates that new mitigation enhancement measures included in the Preferred Alternative could further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Tables 4.2-12 and 4.2-13).

The AFSC is requesting one take each from the Eastern Chukchi and Beaufort Sea stocks of beluga whales over the five-year authorization period (Table 4.2-13). This level of take would be well below one percent of PBR for the Eastern Chukchi Sea stock; PBR is undetermined for the Beaufort Sea stock, so take as a percent of PBR cannot be calculated (Table 4.2-14), although a total annual average estimated take of 0.2 belugas is sufficiently small to be considered minor in magnitude. There are no requested takes of either species in other gear types or research areas.

In addition to the mitigation measures that have been implemented in recent years under the Status Quo Alternative, the Preferred Alternative includes new measures that may further reduce the risk of future marine mammal takes. Measures to mitigate the risk of entanglements/hookings are described in Section 2.3.1 and summarized above. Given these measures and the lack of prior entanglements/hookings of non-ESA-listed cetaceans, the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement/hooking in research gear in the CSBSRA under the Preferred Alternative are therefore considered minor adverse for non-ESA-listed cetacean species in accordance with the criteria in Table 4.1-1.

Non-ESA-Listed Pinnipeds

The species of non-ESA-listed pinnipeds in the CSBSRA that may interact with AFSC research include spotted seals and ribbon seals. None has been taken historically during AFSC fisheries research.

Injury, Serious Injury, or Mortality due to Entanglement/Hooking in Research Gear

The analysis of historical takes and estimated takes for cetaceans in the LOA application are the same as presented under the Status Quo Alternative (Section 4.2.4). There have been no historical fisheries research takes of marine mammals in the CSBSRA and there are currently no commercial fisheries in the Chukchi and Beaufort seas, so all take requests for the CSBSRA are based on the geographic and temporal overlap of AFSC fisheries research activities and marine mammal species' ranges. Potential effects under the Preferred Alternative would be similar to those expected under Status Quo conditions, although the AFSC anticipates that new mitigation enhancement measures included in the Preferred Alternative could further reduce risks of adverse interactions with marine mammals. However, any attempt to quantitatively estimate how much these enhancements would reduce potential interactions would be speculative so the effects analysis for the Preferred Alternative is based on the estimated marine mammal takes in the LOA application (Appendix C and Tables 4.2-12 and 4.2-13).

The AFSC requests takes of one spotted seal and one ribbon seal in trawl gear over the five-year authorization period (Table 4.2-13). The AFSC also requested takes of spotted and ribbon seals in trawl gear in the BSAIRA, so analyses of potential effects relative to PBR are made for combined request takes for both areas. These potential takes, if they occurred, would be less than one percent of PBR for spotted seals and would be considered minor in magnitude (Table 4.2-14). PBR is undetermined for ribbon seals, so potential takes as a percent of PBR cannot be calculated. The total combined annual average estimated take of 0.4 is, however, likely sufficiently small to be considered minor in magnitude. Assigning additional "undetermined pinniped" takes in trawl gear to either of the requested takes would not add substantially to annual take levels for either species. Take level as a percent of PBR would still be less than one percent for spotted seals and, despite the lack of PBR calculations for ribbon seals, this take level would likely remain of minor magnitude (Table 4.2-14).

In addition to the mitigation measures that have been implemented in recent years under the Status Quo Alternative, the Preferred Alternative includes new measures that may further reduce the risk of future marine mammal takes. Measures to mitigate the risk of entanglements/hookings are described in Section 2.3.1 and summarized above. Given these measures and the lack of prior entanglements/hookings of non-ESA-listed pinnipeds, the likelihood of these types of interactions in fisheries research gear under the Preferred Alternative would be low. The potential effects from entanglement/hooking in research gear in the CSBSRA under the Preferred Alternative are therefore considered minor adverse for non-ESA-listed pinniped species in accordance with the criteria in Table 4.1-1.

4.3.4.4 Conclusion

Under the Preferred Alternative, potential direct and indirect effects on marine mammals through acoustic disturbance, potential changes in prey availability, and contamination or degradation of habitat would be similar to those described for the Status Quo Alternative (Section 4.2.4) and would be considered minor adverse for all species. Effects due to entanglement/hooking in AFSC fisheries research gear would also be similar to those anticipated under the Status Quo alternative and would be considered minor adverse.

The numbers of marine mammals estimated to be taken in future AFSC fisheries and ecosystem research under the Preferred Alternative are based on the historical takes of four marine mammals (two Dall's porpoises, one northern fur seal, and one northern sea otter) during AFSC research surveys from 2004 through 2015. All takes occurred in the GOARA using either surface or bottom trawl gear. In August 2019 an unidentified pinniped was taken in a longline survey. Available historic data, data on mortalities in commercial fisheries using similar gear, and, for the CSBSRA where neither of these exist, overlap of species' ranges and AFSC fisheries research effort were used to estimate the potential for combined Level A harassment takes and serious injuries and mortalities under the Preferred Alternative.

The Preferred Alternative also includes a suite of mitigation measures currently implemented for AFSC surveys under the Status Quo Alternative and several new training, communication, monitoring, reporting, and mitigation enhancement programs intended to improve the effectiveness of the existing mitigation measures used, or to add those where none currently exist, to protect marine mammals and other protected species. New measures proposed under the Preferred Alternative should help reduce impacts relative to the Status Quo Alternative. Future takes, if they occur, would likely be fewer than the estimated numbers since estimates are based on a precautionary approach to ensure accounting for a maximum level of potential take. The estimated potential takes in all research gears and in all research areas would be less than 10 percent of PBR for all species/stocks for which PBR is known and would be considered to have minor magnitudes of effect on the population level for each stock.

The overall effects of the Preferred Alternative on marine mammals would be minor to moderate in magnitude, dispersed over a large geographic area, and temporary or short-term in duration (for effects other than mortality), and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.3.5 Effects on Birds

The Preferred Alternative is comprised of a combination of research activities continued from the past (Table 2.2-1) and additional, new research surveys and projects (Table 2.3-1). Several surveys and research projects conducted under the Status Quo Alternative will not be continued under the Preferred Alternative as noted in Table 2.2-1.

The Preferred Alternative includes mitigation for MMPA and ESA compliance, including status quo mitigation measures to monitor for short-tailed albatross before setting longline gear, prohibiting setting if short-tailed albatross are present, and deployment of tori lines before setting longline gear. It may also include additional measures to reduce the risk of taking seabirds if such measures are identified and required as a result of this NEPA process and subsequent consultations with USFWS. ESA-listed seabirds are under the jurisdiction of the USFWS, which has completed BiOps (USFWS 2003a, 2015) for the Alaska groundfish fisheries at the FMP level. Both BiOps concluded that the groundfish fisheries and the annual setting of harvest specifications were unlikely to cause the jeopardy of extinction, or the adverse modification or destruction of critical habitat for ESA-listed seabirds.

No ESA-listed bird species have been taken incidental to AFSC fisheries research activities, although the potential for gear interactions does exist due to the use of longline gear and attraction of tubenoses to such fishing activities AFSC does not anticipate that research activities will result in the taking of significant numbers of short-tailed albatross. As a precautionary measure, however, two takes for short-tailed albatross are requested over a five-year period in the event unexpected circumstances occur during planned activities.

The effects of the Preferred Alternative on birds are similar to those described for the Status Quo (Section 4.2.5) although there would be a slightly increased risk of incidental hooking on longline gear under the Preferred Alternative due to the addition of one new research activity in the GOARA using longline gear; the Deep Water Groundfish Survey would involve 20 sets per year and would include mitigation measures similar to the Alaska Longline Survey (Table 2.3-1). This additional longline research effort would likely have a small proportional increase in the risk of catching birds, especially albatross. If injuries or mortalities do occur, they would likely be rare occurrences and unlikely to have any measurable effect on the populations of seabirds in the GOA.

The Preferred Alternative also includes a number of new training opportunities and communication protocols for scientists and crew concerning mitigation measures intended to help reduce adverse interactions with protected species. Although these measures would likely raise awareness about potential interactions with seabird species, scientists and crew on the Alaska Longline Survey, which is responsible for almost all seabird gear interactions, are already highly aware of seabird bycatch avoidance procedures. Any new research activities involving longline gear would also be staffed with scientists and crew trained for implementation of these measures, although the new training efforts may re-emphasize their importance and promote consistency in their implementation.

4.3.5.1 Conclusion

The potential for research vessels to degrade seabird habitat and prey through contamination would only be through accidental spills and discharges. Given the crew training previously discussed and the small number of fisheries research vessels, these would likely be limited in scope, infrequent, and localized and would therefore considered minor adverse.

Incidental mortality of seabirds by hooking/capture in AFSC fisheries research gear, almost exclusively during the Alaska Longline Survey and potentially in new research efforts with longline gear, occurs on an infrequent but regular basis. Black-footed albatross are most frequently caught in research gear with small numbers of northern fulmars, Laysan albatross, and common murres caught since 2004. The level of mortality for all species is considered minor in magnitude compared to their estimated population numbers. No incidental catches of ESA-listed species are anticipated under the Preferred Alternative.

The overall effects on seabirds from AFSC research activities are expected to be short-term in duration (other than mortalities in gear interactions), rare in frequency, dispersed over a huge geographic area, and would not result in any measurable changes to seabird populations under the Preferred Alternative; effects are therefore considered minor adverse according to the criteria in Table 4.1-1. This conclusion holds for each of the three AFSC research areas and for all gear types used in research.

4.3.6 Effects on Turtles

The effects of the Preferred Alternative on sea would be very similar to those described for the Status Quo Alternative (Section 4.2.6). Direct and indirect effects of AFSC research activities on sea turtles may include: disturbances or changes in sea turtle behavior due to physical movements and sounds, injury or mortality due to ship strikes, entanglement in gear, and contamination or degradation of sea turtle habitat. These mechanisms are described in Section 4.2.6.

The additional surveys that would be conducted under Alternative 2 include some that use gear types with the potential to cause sea turtle entanglement in both the GOA and Bering Sea. These additional surveys increase the risk of adverse interactions between sea turtles and fishing gear.

Mitigation measures for protected species proposed under the Preferred Alternative could potentially decrease the likelihood of adverse impacts to sea turtles. However, because no adverse interactions have occurred in the past between sea turtles and AFSC research surveys, the expected reduction in potentially adverse impacts to sea turtles would be minimal.

Under the Preferred Alternative, the AFSC would apply for authorizations under the MMPA and the ESA for incidental take of protected species. All four species of sea turtles potentially present in Alaska waters are listed under the ESA, so the consultation would likely include them.

In 2000, NOAA Fisheries Protected Resources Division issued a BiOp on the interaction of leatherback turtles and the BSAI and GOA groundfish fishery (NMFS 2000). In that document, NOAA Fisheries noted that the GOA groundfish FMP area is at the extreme edge of the leatherback turtle's historic range and there have been no direct takes of leatherbacks in the commercial fisheries in the BSAI and GOA. It was noted that no information was available to help NOAA Fisheries assess the potential competition or cascade effects of the fisheries on the trophic level of leatherbacks, either positively or negatively, but that there is no fishery that is targeting the prey of this species. NOAA Fisheries concluded that the direct and indirect effects of commercial fisheries in the BSAI and GOA on leatherback turtles are negligible and unlikely to jeopardize its survival or recovery.

4.3.6.1 Conclusion

AFSC fisheries research activities conducted under the Preferred Alternative would involve a relatively small number of research vessels, short deployments of fishing gear, and sample sites dispersed over a wide area. Behavioral disturbances of sea turtles from research vessels or fishing gear would be temporary in nature, lasting only a few minutes as the research vessel passes, and are therefore likely to have negligible effects on turtle foraging success or survival. There have been no gear interactions with sea turtles and AFSC research activities in the past so the potential for injury or mortality under the Preferred Alternative is very small. The potential for research vessels to degrade turtle habitat through benthic disturbance, changes in prey availability, or contamination from accidental spills and discharges would likely be possible, but unlikely, negligible in magnitude, infrequent or rare, and would affect a non-vital area.

The magnitude of effects of the Status Quo Alternative on ESA-listed sea turtles would be minor since there would be no measurable population change, the duration of any effects would be temporary or short-term, and the effects would be dispersed widely over a large area. The overall effects on all species of sea turtles would be minor adverse according to the impact criteria in Table 4.1-1.

4.3.7 Effects on Invertebrates

AFSC fisheries and ecosystem research conducted under the Preferred Alternative would have the same types of effects on invertebrate species as described for the Status Quo Alternative (Section 4.2.7) through physical damage, changes in species composition, contamination or degradation of habitat, and mortality. The following surveys from Table 2.2-1 would be eliminated or altered under the Preferred Alternative:

- Acoustic Assessment of Snakehead Bank
- ADFG Small-mesh Shrimp and Forage Fish Survey
- Cooperative Acoustic Surveys in the Western Gulf of Alaska
- Growth and Survival of Released Hatchery Red King Crab
- Gulf Project - Upper Trophic Level (reduced in scope and renamed the “Gulf of Alaska Assessment” under the Preferred Alternative)
- Sablefish Maturity Study
- Juvenile Cod Survey
- A Miniaturized Acoustic Transponder for Red King Crab
- Deep Water Sponge Recovery
- Effects of Ocean Acidification on Larval Tanner Crab
- Juvenile Flatfish and Tanner Crab Habitat Studies in the Gulf of Alaska
- Survey and Impact Assessment for Derelict Crab Pots in the Juneau, Southeast Alaska, Dungeness Crab Fisheries
- Reconnaissance Habitat Survey of Pribilof Canyon

Most eliminated AFSC surveys have very little impact on catches of invertebrate species. The ADFG Small mesh survey catches large amounts of Alaska pink shrimp and jellyfish and significant decreases in the catches of these species would result if this survey were eliminated. There are no changes to surveys that occur in the CSBSRA and invertebrate catches in this area are assumed to be the same as the Status Quo Alternative.

There would be multiple additional research projects conducted under the Preferred Alternative (Table 2.3-1). Several of the new research projects are focused on a particular species or group of invertebrates (e.g., blue king crabs or red tree coral). However, impacts of these surveys would be localized. New survey components include camera and acoustic technologies but gear parameters are not appreciably different than existing technologies under the Status Quo Alternative and therefore the expectation is that their effects on benthic habitats, epifauna, and infauna would be similar under the Preferred Alternative.

There are also many new surveys which utilize gear that is designed to catch and retain fish and invertebrates and these may increase catches of some species. However, there are some uncertainties about specific future survey locations and diversity of invertebrates found, so direct comparisons to past survey catches, while informative, may not translate to actual programmatic changes in invertebrate catches. Converting the increase in research fishing effort into quantitative estimates of catch is not possible without making some assumptions.

As discussed in Effects on Fish (Section 4.3.3), there is an overall increase in the amount of traditional fishing gear (trawl and longline) under the Preferred Alternative, and therefore there is a likely increase in the potential for increased invertebrate catches. For the purposes of this FPEA analysis, the resulting catch from all surveys combined for both the GOARA and BSAIRA under the Preferred Alternative will be assumed to be 150 percent of the Status Quo Alternative. This also assumes historic catch rates will be consistent among similar gear types and universal throughout the Research Areas, which is not necessarily the case since some new surveys are focused on particular areas. However, this computed level of catch is likely to be substantially higher than what might actually occur and therefore provides a conservative estimate of the impacts of research. Table 4.3-5 provides the same analysis of research catch in the GOARA and BSAIRA relative to commercial quotas as the Status Quo Alternative (Table 4.2-15 and Table 4.2-16), but multiply the overall survey catch by 1.5. Included are only those species with available commercial quotas (or other similar assessment metric) for comparison; non-managed species catches would also increase by a factor of 1.5 but there are no factors for comparison.

Table 4.3-5 Comparison of Estimated Invertebrates Caught under the Preferred Alternative with Some Comparisons to Commercial Quotas in the GOARA and BSAIRA

Species are listed in alphabetical order. Only survey species from Table 4.2-15 and Table 4.2-16 with listed commercial quota comparisons are shown.

Species	Research Area	Stock Status[a]	Average AFSC research catch per year (mt) (2009-2013)	Average AFSC research catch per year (mt) (2009-2013) * 1.5	Commercial Quota (mt)	Estimated AFSC research catch compared to commercial quota (percentage)
Giant octopus	GOARA	NA	2.61	3.92	256.52[b]	1.53%
Golden king crab	BSAIRA	No overfishing, overfished status unknown	1.02	1.53	2,853.14[c]	0.05%
Majestic armhook squid	BSAIRA	No overfishing, overfished status unknown	1.00	1.50	17,041[d]	0.01%
Pribilof Islands blue king crab	BSAIRA	No overfishing, overfished	0.46[e]	0.69	297.11[c]	0.23%

Species	Research Area	Stock Status[a]	Average AFSC research catch per year (mt) (2009-2013)	Average AFSC research catch per year (mt) (2009-2013) * 1.5	Commercial Quota (mt)	Estimated AFSC research catch compared to commercial quota (percentage)
Red king crab	BSAIRA	No overfishing, not overfished	22.04	33.07	4,529.65[c]	0.73%
Snow crab	BSAIRA	No overfishing, not overfished	27.97	41.95	30,822.12[c]	0.14%
Southern Tanner crab	BSAIRA	No overfishing, not overfished	1.78	2.67	6,851.63[c]	4.82%
Southern Tanner crab	GOARA	NA	31.97	47.96	995.74[f]	0.04%
Weathervane scallop	GOARA	No overfishing, overfished status unknown	2.09	3.13	146.29[g]	2.14%

a. Source: Status of stocks information from NOAA Fisheries Office of Sustainable Fisheries, First Quarter 2015 Status of U.S. Fisheries. Available online: http://www.nmfs.noaa.gov/sfa/fisheries_eco/status_of_fisheries/status_updates.html

b. Data is from 2009-2010 fisheries. Source: ADFG 2011b.

c. Source: Crab TAC, from https://alaskafisheries.noaa.gov/sustainablefisheries/crab/crfaq.htm

d. Squids in the BSAI are managed as a single stock comprising all species with a single TAC. For improved specificity, this value represents 2013 biomass estimates for only majestic armhook squid as noted in the 2014 BSAI SAFE report (NPFMC 2014h).

e. Stock assessments distinguish between St. Matthew and Pribilof Islands stocks of blue king crab and Pribilof Islands blue king crab are considered overfished. However, survey data does not characterize which stock caught blue king crab are from. For the purposes of this analysis, all survey-caught blue king crab caught in BSAIRA surveys are assumed to be from the Pribilof Islands stock.

f. Data is from 2009-2010 fisheries. Source: ADFG 2011b and ADFG 2014b.

g. Data is from 2015-2016 Fisheries. Source: ADFG 2015e. Weight is in shucked meat.

As shown in Table 4.3-6, while overall catch of invertebrates could increase under the Preferred Alternative, the amount caught during AFSC surveys would in most cases still be less than two percent of commercial quotas, and less than five percent in all cases. These values are manageable when considered in relation to the overall health of these species.

4.3.7.1 Conclusion

All of the potential effects on invertebrates were considered minor adverse under the Status Quo Alternative (Section 4.2.3) and would also be considered minor adverse under the Preferred Alternative for the same reasons. The overall effects of the Preferred Alternative on invertebrates would likely be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the criteria in Table 4.1-1.

The Preferred Alternative would also contribute to long-term beneficial effects on managed invertebrate species throughout the Alaska Region through the contribution of AFSC fisheries research to sustainable ecosystem-based fisheries management. Data from AFSC fisheries and ecosystem research provides the scientific basis to reduce bycatch, establish optimal fishing levels, prevent overfishing, and recover overfished stocks. The beneficial effects of the time-series data provided by AFSC research programs are especially valuable for long-term trend analysis for commercially harvested invertebrates and, combined with other oceanographic data collected during fisheries research, provide the basis for monitoring changes to the marine environment important to invertebrate populations.

4.3.8 Effects on the Social and Economic Environment

4.3.8.1 Effects on Subsistence

The AFSC fisheries research program under the Preferred Alternative includes the addition or modification of several surveys and the discontinuation of several other surveys conducted under the Status Quo Alternative as described in Section 2.3 and Table 2.3-1. Under the Preferred Alternative the AFSC would also apply for authorizations of incidental take of marine mammals under the MMPA, which includes provisions to ensure that any federal activity does not have unmitigable adverse effects on subsistence.

Under the Preferred Alternative, the AFSC would add new protected species training requirements for all research personnel and crew that may be charged with monitoring for marine mammals or making decisions regarding mitigation measures (Section 2.3.2). These training opportunities are expected to improve the consistency and effectiveness of efforts to reduce the already minor impacts on marine mammals and other protected species.

Similar to the Status Quo Alternative, research activities conducted under the Preferred Alternative would primarily occur further offshore than most subsistence hunting sites and would avoid ice floes and pack ice preferred by whale, seal, and walrus hunters. However, as described in Section 4.2.8.1 and illustrated in Table 4.2-23, there is broad overlap of AFSC fisheries and ecosystem research activities with potential subsistence hunting locations around Alaska and a great deal of variability in exactly where and when both research and subsistence occurs each year.

Under the Preferred Alternative, the AFSC will further refine and implement a new communication plan for pre-survey and real-time outreach to subsistence communities and Alaska Native marine mammal co-management organizations to avoid the potential for AFSC research activities to interfere with subsistence activities (see Appendix B in the LOA application, which is Appendix C in this FPEA). This communication plan is also intended to provide outreach and education about why the AFSC is conducting fisheries and ecosystem research in each area and share the results of that research with the communities. The implementation of this new communication plan under the Preferred Alternative will likely reduce the already small chance of minor adverse effects of AFSC research activities on subsistence relative to the Status Quo Alternative.

The changes in the research surveys and mitigation measures implemented under the Preferred Alternative are not expected to change other types of socioeconomic effects relative to those described for the of AFSC fisheries research Status Quo Alternative. This includes the collection of scientific data used in sustainable fisheries management (Section 4.2.8.2), economic support for fishing communities of the North Pacific and Alaska (Section 4.2.8.3), collaborations between the fishing industry, subsistence users and fisheries research (Section 4.2.8.2), and fulfillment of legal obligations specified by laws and treaties (Section 4.2.8.2).

4.3.8.2 Conclusion

Under the Preferred Alternative, the potential direct and indirect effects of AFSC fisheries and ecosystem research on subsistence resources would continue to occur infrequently or rarely, be small in magnitude, and would be dispersed over a large geographical area. AFSC research activities would not likely be located near important sites of subsistence use and a new communication plan with subsistence communities should minimize the potential for AFSC research activities to interfere with subsistence activities. AFSC research activities would therefore be considered to have minor adverse effects on subsistence resources and activities under the Preferred Alternative according to the impact criteria in Table 4.1-1.

AFSC fisheries and ecosystem research conducted under the Preferred Alternative would also provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of depleted resources and ultimately rebuilding these stocks to appropriate levels. It would also contribute directly and indirectly to local economies, promote collaboration and positive relationships between NMFS and other researchers as well as with commercial and recreational fishing interests, and help fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Preferred Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the North Pacific and Alaska Region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Preferred Alternative on the social and economic environment would be minor to moderate and beneficial.

4.4 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 3 – MODIFIED RESEARCH ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 3 – Additional Mitigation Alternative on the physical, biological, and social environment. Under this Alternative, the AFSC would conduct a new suite of research activities and implement new mitigation measures in addition to the Status Quo program. The new suite of research activities is a combination of past research and additional, new research, as described for the Preferred Alternative. Potential direct and indirect effects were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under Alternative 3 is presented below in Table 4.4-1.

Table 4.4-1 Alternative 3 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	**4.4.1**	**4.4.2**	**4.4.3**	**4.4.4**	**4.4.5**	**4.4.6**	**4.4.7**	**4.4.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *beneficial*

4.4.1 Effects on the Physical Environment

The effects of the Modified Research Alternative on the physical environment would be similar to those of the Status Quo Alternative (see Section 4.2.1). Additional mitigation measures for protected species required under the Modified Research Alternative would not change the effects of the research activities on physical properties of the environment with the potential exception of temporal or geographic restrictions intended to reduce adverse impacts to protected species (i.e., spatial/temporal restrictions). This type of mitigation measure could potentially alter where and when the research occurs. However, the overall intensity of effects on the physical environment would be essentially the same as those described under the Status Quo Alternative. Small areas (much less than one percent of the total of the research areas) would be impacted, and the areas of impact would be dispersed over a large geographic area. The majority of impacts resulting in measurable changes to the physical environment would be temporary or short-term in duration. The overall impacts of AFSC fisheries and ecosystem research activities on the physical environment under the Modified Research Alternative would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.2 Effects on Special Resource Areas and EFH

The effects of the Modified Research Alternative on special resource areas and EFH would be similar to those of the Status Quo Alternative (see Section 4.1). Most of the additional mitigation measures for protected species proposed under the Modified Research Alternative would not change the effects of the research activities on the physical components of the environment or on most biological components; they would only tend to decrease effects on protected species, which were considered minor under the Status Quo.

Specific spatial/temporal restrictions on AFSC research have not been proposed although there is the possibility of doing so to reduce adverse affects to protected species under the Modified Research Alternative; the overall level of research effort and therefore effects on the marine environment are assumed to be essentially the same as those described under the Status Quo Alternative, although they may occur in slightly different areas. Therefore, the overall effects of the Modified Research Alternative on special resource areas would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.3 Effects on Fish

Under the Modified Research Alternative, the AFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Most of the additional mitigation measures would be unlikely to affect the amount of fish caught for research purposes. The exceptions are the potential for spatial/temporal restrictions on AFSC fisheries research in areas considered important to protected species and the potential for incorporation of marine mammal excluder devices in research trawls.

Spatial/temporal restrictions could reduce research fishing and hence impacts on fish in some locations. However, researchers may respond to spatial/temporal restrictions by redirecting research efforts to other locations if such movements are consistent with research goals and do not compromise time-series data sets. If so, overall research efforts could remain the same. The Modified Research Alternative does not specify particular spatial/temporal restrictions but it is assumed for the FPEA analysis that overall research effort and therefore impacts to fish would be very similar under the Modified Research Alternative as they are for the Preferred Alternative, although they may occur in somewhat different locations and times.

The modified move-on rule would require the AFSC to monitor for marine mammals for a 30 minute period before trawl gear was deployed. If any marine mammals were sighted anywhere from the ship in that time period, no gear would be deployed. This measure would result in a substantial extension of the time it takes to complete trawl surveys. Under the Preferred Alternative, the AFSC would deploy up to 1,780 bottom trawls and 563 mid-water trawls in the GOARA and 1,357 bottom trawl sets and 625 mid-water trawl sets in the BSAIRA. The addition of a 30 minute monitoring period before each tow, and perhaps more time if marine mammals are sighted, would add a minimum of 45 days to all trawl surveys combined each year, which would compromise the ability of these surveys to be completed within seasonal limits. At an average cruising speed of 10 knots, this minimum waiting period would reduce the distance that could be traveled between sampling stations by about 10,800 nm compared to the typical Preferred Alternative time period, thereby either extending the time required to complete surveys or reducing the geographical extent of the surveys. Significant increases in operating costs resulting from delays and extra sea time would likely lead to cutbacks on the numbers of stations sampled each year, with a resulting decrease in the amount of fish caught during research. While this reduction in effort would reduce mortality and disturbance impacts on fish, it would also reduce the quality of data used to inform stock assessments, compromise the statistical continuity of time-series data sets, and have potentially adverse indirect effects on fisheries management decisions. The magnitude of these effects on any given species of fish cannot be determined due to great uncertainty about budget decisions and loss of data implications, but the effects would likely be adverse to the mission of various AFSC research programs to provide the “best available” scientific data for fisheries management purposes as required under the MSA.

Gear modifications, such as marine mammal excluder devices or open codend video sampling would also potentially result in reduced catch of target fish species, thus altering the effectiveness of surveys in time –series comparisons. Under the Status Quo and Preferred Alternatives, the Rockfish Habitat Studies survey uses video cameras to capture animal distribution data. However, this survey does not utilize a closed codend or other net modification proposed under the Modified Research Alternative so its applicability to proposed alterations under the Modified Research Alternative, and potential effects to catchability of desired fish species is unknown.

It is assumed for this FPEA analysis that overall impacts to fish under the Modified Research Alternative would be substantially the same as those described under the Preferred Alternative. These effects would be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration (for effects other than mortality) and would therefore be considered minor adverse according to the criteria in Table 4.1-1. As was the case with the Status Quo and Preferred Alternatives, the Modified Research Alternative would also contribute to long-term beneficial effects on managed fish species throughout the Alaska Region through the contribution of AFSC fisheries research to sustainable fisheries management.

4.4.4 Effects on Marine Mammals

The Modified Research Alternative includes the same scope of research in all three AFSC research areas as the Preferred Alternative, including the same mitigation measures currently implemented or to be implemented, and intended to reduce potentially adverse interactions with marine mammals and other protected species. The Modified Research Alternative differs from the Preferred Alternative in that it also includes a suite of mitigation measures that the AFSC is not proposing to implement as part of the proposed action in the AFSC LOA application (Appendix C). The AFSC considers the suite of mitigation measures to be implemented under the Preferred Alternative to represent the most effective and practicable means to reduce the risk of adverse interactions with protected species without adversely affecting the scientific integrity of its research programs. However, NMFS's OPR must consider a broad range of mitigation measures under the MMPA authorization and ESA consultation processes, and these additional measures will be considered in this alternative. These additional mitigation measures focus on reducing the likelihood of mortality or injury from interaction with fisheries research gear (Level A harassment and serious injury and mortality take), particularly trawl and longline, and are described in Section 2.4 of this FPEA. They involve:

- The use of additional personnel and equipment/technologies to improve detection of marine mammals, especially at night or other low-visibility conditions.
- Modification of the move-on rule to require a 30 minute monitoring period before deployment of trawl gear.
- Operational restrictions on survey activities at night or other low-visibility conditions.
- The use of additional acoustic or visual deterrents to keep marine mammals away from research gear.
- Gear modifications, including marine mammal excluder devices and the use of video sampling with an open cod end on trawl nets
- Temporal or geographic restrictions to avoid known concentrations of marine mammals or federal and state MPAs.
- Use of decoy vessels to distract marine mammals away from research sets.

None of the additional mitigation measures directly concern the reduction of noise from vessels or acoustic devices (Level B harassment take), reducing the numbers of fish and invertebrates caught in research samples, or reducing the risk of accidental contamination from spills. The analyses of effects through these mechanisms (disturbance or changes in habitat quality) are the same as described for the Status Quo and Preferred Alternatives and will not be discussed further. The following analysis will therefore focus on the potential for the additional mitigation measures to reduce the risk of Level A harassment, injury, and mortality through entanglement in fishing gear or ship strikes.

Scientists at the AFSC continually review their procedures to see if they can do their work more efficiently and with fewer incidental effects on the marine environment, including effects on marine mammals. Many of the additional mitigation measures included in this alternative have been discussed and considered in the past by AFSC scientists; however, any changes to operational procedures or the equipment used during surveys must also be considered from the standpoint of how they affect the integrity of the scientific data collected, the cost of implementing equipment or operational changes, and the safety of the vessel and crew. It is not possible at this time to quantify how much any one of these measures (or some combination of them) may reduce the risk of future takes relative to the Status Quo or Preferred Alternatives. Any revisions to the estimated takes of each species to directly compare with the Status Quo or Preferred Alternatives would be based on speculation. This analysis will therefore provide a qualitative discussion of the potential for each additional mitigation measure to reduce takes and other effects on marine mammals as well as how each measure may affect practicability, data integrity, and other aspects of the survey work.

4.4.4.1 Trawl Surveys

Several AFSC surveys use bottom, midwater, and surface trawl gear (see Tables 2.2-1 and 2.3-1). The following mitigation measures would apply to all trawl gear, even though three out of four takes from 2004 through 2015 involved surface trawls.

<u>Monitoring Methods</u>

Visual observations (using bridge binoculars as needed) by the officer on watch, Chief Scientist or other designated scientist, and crew standing watch are currently the primary means of detecting protected species in order to avoid potentially adverse interactions. However, there are other detection methods that have been tested or used in commercial fisheries, naval exercises, and geotechnical exploration that could be considered. These additional types of detection methods would be intended to be used in specific circumstances, such as operating at night or in low visibility conditions.

Visual surveillance by dedicated Protected Species Observers (PSO)

This measure would require the AFSC to use trained PSOs whose dedicated job is to detect the presence of marine mammals and other protected species within the survey area and communicate their presence to ship operations personnel. Considerations include the use of dedicated observers for all surveys or during trawl surveys of particular concern.

Under the Status Quo Alternative, the officer on watch (or other designated member of the scientific party), and crew standing watch on the bridge visually scan for marine mammals (and other protected species) during all daytime operations. Bridge binoculars are used as necessary to survey the area upon arrival at the station, during reconnaissance of the trawl line to look for potential hazards (e.g., presence of commercial fishing gear, sonar sweeps to check if bottom topography is suitable for trawling, etc.), and while the gear is deployed. If any marine mammals are sighted by the bridge or deck crew prior to or after setting the gear, the bridge crew and/or Chief Scientist are alerted as soon as possible. Currently, not all crew members have received formal training in marine mammal identification or marine mammal mitigation procedures, although they are briefed on what they are looking for and may have considerable experience with the task. However, the Preferred Alternative does include a new program to refine and formalize the training and decision-making process for all Chief Scientists, bridge crew, and deck crew that may be assigned to the observer post in the future. This new program would provide similar types of training for all appropriate crew members as PSOs trained for that specific task. This training would be in conjunction with the Observer Program staff at NMFS using similar course materials and reporting forms as used to train PSOs for applicable commercial fisheries. The difficulty in having crew members assigned only to PSO duties is that most vessels have limited carrying capacity for personnel and any berths given to PSOs would mean a reduction in personnel available to help with other research or vessel duties. This could compromise crew safety or the amount of research that could be conducted. For research projects using contracted commercial fishing vessels, there is often no additional space on the vessels for personnel other than essential crew. By providing formal protected species training for crew already trained in other skills, the AFSC believes it can provide the same quality of visual monitoring for marine mammals and other protected species as would occur with dedicated PSOs while maintaining the flexibility to fulfill all other crew duties.

Use of underwater video systems to monitor trawl gear

Underwater video technology may allow the AFSC to determine the frequency of marine mammal interactions with the trawl gear and evaluate the effectiveness of mitigation measures to prevent injurious or lethal interactions. Underwater video systems have been used for these purposes in several fisheries, both in the U.S. and abroad (Northridge 2003, Lyle and Willcox 2008, Dotson et al. 2010). Northridge (2003) describes a twin camera system used to monitor the grid and escape hole of a Marine Mammal Excluder Device (MMED) and quantify the frequency and outcome of marine mammal interactions with trawl gear. Video images were carried by cable from the cameras to the wheelhouse for continuous display and recording (Northridge 2003). Similarly, Lyle and Willcox (2008) used a low-light black and white digital camera with a 90 degree wide-angle lens coupled to a commercially available hard drive unit to monitor interactions involving marine mammals and other megafauna.

Underwater video equipment may provide useful information about the efficacy of additional mitigation measures but the video equipment itself is unlikely to influence bycatch rates of protected species. In order to directly reduce takes of marine mammals, a video system to detect marine mammals underwater would have to be linked to a means of avoiding entanglement in gear. However, ships with deployed trawl nets cannot "swerve" to avoid a marine mammal for two reasons: 1) all marine mammals can swim faster than the tow speed so trying to move gear away from an animal that is likely attracted to fish in the net will be ineffective, and 2) changing the vessel direction suddenly risks tangling the gear, making it difficult and dangerous to retrieve, delaying retrieval and making the risk of marine mammal entanglement worse.

Use of passive acoustic monitoring

Passive acoustic monitoring involves the detection of animals by listening for the sounds that they produce (Barlow and Gisiner 2006). Use of passive acoustic monitoring may aid in the detection of marine mammals present in survey areas, and could potentially be used to inform decisions about when to implement appropriate modifications of fishing operations to prevent interactions with marine mammals. Marine mammal calls can be reliably detected using hydrophones mounted on ships, autonomous underwater gliders, buoys, moorings, or bottom-founded installations. However, not all marine mammals vocalize and the vocalization rates of marine mammals may vary in a complex fashion depending upon environmental factors, including long periods of silence (Barlow and Gisiner 2006). While detection of a marine mammal call indicates the presence of a marine mammal, the absence of marine mammal calls does not necessarily indicate the absence of marine mammals. In addition, if the intent is to locate marine mammals so that they can be avoided, hydrophones in multiple locations combined with real-time processing are required to allow triangulation of the acoustic signal. This may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Taking the time to set up a triangulated hydrophone system in an area prior to each 20 minute trawl would greatly lengthen the time and cost of collecting a certain amount of sample data. In summary, passive acoustic monitoring may be useful for detecting underwater marine mammals that could potentially interact with research activities but it would have substantial costs in terms of the research data collected and it would not guarantee the avoidance of all adverse interactions; passive acoustic monitoring inevitably overlooks those marine mammals that are not vocalizing and marine mammals may move into an area after trawl gear is deployed and still be at risk.

Use of aircraft or unmanned aerial or underwater gliders to expand detection of marine mammals

Currently, surveys using manned aircraft are routinely conducted to obtain unbiased estimates of marine mammal populations and their distributions. Aerial surveys provide reliable information about marine mammal populations because they are able to cover large areas over relatively short periods of time. In addition, airborne survey platforms generally do not influence the distribution or behavior of the marine mammals being counted, whereas many species of marine mammals are either attracted to or avoid seagoing vessels (Barlow and Gisiner 2006). The usefulness of manned aerial surveys for detection of marine mammals that could interact with fisheries research activities is limited by the range that the aircraft may travel from shore, flight time constraints, weather conditions, poor visibility in rough seas, logistical difficulties in matching a fast-moving airplane with a slow-moving research vessel, and considerable expense that would likely decrease the amount of ship-based research that could be conducted. Aerial surveys may be more practicable for planning large-scale activities at a set time and place rather than directing specific locations for research sampling, which involves continuous movement of a vessel from widely spaced sampling stations. Even with this capacity, the risk of marine mammal interactions would remain because any marine mammals that are not near the surface would not be detectable by airborne observers and, as with other extended detection methods, marine mammals may move into an area after trawl gear is deployed but before it is retrieved.

Unmanned aerial vehicles have the potential to overcome many of the limitations associated with manned aerial surveys for detection of marine mammals. Unmanned aerial systems range from inexpensive lightweight radio-controlled aircraft to complex autonomous aircraft developed for military applications. Unmanned aerial systems could be launched and retrieved from the research vessel, stream video data to observers onboard or at a shore station, and provide near-real-time data of marine mammals in proximity to fisheries research activities. Several systems are commercially available that have the ability to remain airborne for up to 24 hours and can be operated up to 93 miles from the control station. Several tests have successfully used unmanned aerial vehicles for marine mammal detection (NOAA 2006). However, these systems can only be operated in mild to moderate wind conditions, with increasing wind speeds strongly reducing their range and making recovery difficult.

Advantages associated with the use of unmanned aerial systems include the ability to operate in areas far from shore, long flight times, increased safety of observers who can monitor the data from the ship or a shore based location, and decreased expense relative to surveillance conducted from manned aircraft. Unmanned aerial technologies are rapidly evolving; over the next five to 10 years, increased video resolution and advanced sensors are likely to increase the utility of these systems for monitoring marine mammals. However, approval from additional regulatory agencies, including the Federal Aviation Administration, would be required for operation of unmanned aerial vehicles for marine mammal monitoring or research purposes. Federal Aviation Administration approval has been very difficult to obtain, even in areas with very little air traffic, which currently limits the potential for using these systems over large areas.

Autonomous underwater gliders are highly successful platforms for the collection of oceanographic data and environmental characterization. Gliders offer an attractive platform for marine mammal detection due to their relatively low cost, low power consumption, and the ability to cover large areas of ocean during long-term deployments (Olmstead et al. 2010). Gliders have been used to locate and identify marine mammals using passive acoustic technology, and the U.S. Navy is conducting additional research and development using autonomous underwater gliders to support efforts to mitigate impacts from marine mammal interactions (Hildebrand et al. 2009). The use of underwater gliders to provide mitigation options for research activities is limited by the same issues as described above for other passive acoustic detection systems.

Use of infrared technologies

IR sensors may be useful for detection of marine mammals under certain circumstances. IR sensors used for marine mammal detection generally measure the spatial distribution of mid-wavelength IR radiation (three to five micrometers). IR emissivity of an object in this waveband is closely correlated to the object's surface temperature, such that IR sensor arrays can detect slight variations in temperature across relatively large areas. This technology, also known as 'thermal imaging', could be useful to augment visual detection of marine mammals, particularly in conditions with low ambient light when visual detection of marine mammals would be difficult. IR image data also lends itself to automated image processing. With additional research and development, it is possible that an automated marine mammal detector could be designed to recognize the IR 'signatures' of certain marine mammals. However, several major drawbacks currently preclude such use of IR detection for automated marine mammal detection.

First, because emitted IR radiation is absorbed in the first few millimeters of water surrounding an object, IR technology is only able to detect animals at the surface, and only those parts that are above the surface of the water. Since water is virtually opaque to IR radiation, IR detection of marine mammals is also complicated by the thin film of water that covers the dorsal surfaces of marine mammals at the sea surface. The temperature measured by an IR sensor is the temperature of the water on the surface of the animal, which may only be a couple degrees above the surface water temperature (Cuyler et al. 1992, Kasting et al. 1989). Under ideal conditions (flat calm seas and close proximity to the IR detector), this slight temperature difference can be detected. However, waves cause the measured temperature of the sea surface to be much more variable and the thermal signature of the animal can easily be masked (Graber et al. 2011).

Second, the likelihood of detecting a temperature signature from a marine mammal falls off quickly with distance from the detector. In tests under ideal conditions, the ability of an IR system to detect killer whales, which present a large portion of their body and a tall dorsal fin above the surface of the water, was very poor beyond 330 feet (Graber et al. 2011). The ability of an IR system to detect much smaller targets like dolphins and porpoises would presumably be much less than it is for killer whales. Finally, considerable effort and time is required to process the video data so that the thermal signatures of animals can be distinguished from the surrounding water. This greatly reduces the effectiveness of the technique for real-time monitoring tied to potential mitigation. In summary, the logistical difficulties of using IR detectors in a real-life context on a research vessel would be overwhelming and currently preclude this potential tool as a practical element of mitigation.

Use of night vision devices

Like IR imaging devices, night vision devices may be used for detecting marine mammals at or above the water surface in low-light conditions. Unlike IR sensors, night vision devices operate by amplifying the signal produced when visible light interacts with a detector. Although night vision devices could potentially improve an observer's ability to detect a marine mammal under low light conditions, previous studies have shown that the effective range of detection for marine mammals using night vision devices is only about 330 feet (Calambokidis and Chandler 2000, Barlow and Gisner 2006). These devices work best when there is a little light on the water (from the moon or nearby land sources) but they must be directed away from deck lights because they are too bright. This means they could not be used to monitor trawl gear as it is being deployed or retrieved because of the deck lights used for crew safety. They also have a very narrow field of view, making broad area searches inefficient and unreliable, and if sea conditions are rough the many reflections off waves make it very difficult to distinguish objects in the water. Some observers found the devices disorienting and uncomfortable and all observers said it was very difficult to estimate distances while using the night vision devices (Calambokidis and Chandler 2000). Failure to detect marine mammals using such devices would not decrease the uncertainty about whether marine mammals are actually in the immediate area or not and would thus offer no help in deciding whether to deploy trawl gear or not.

Operational Restrictions

The “move-on” rule would be modified to require a 30-minute monitoring period for all trawl surveys. This new protocol would be intended to improve the chances of seeing marine mammals present in the sampling area before gear is deployed, thus reducing the risk of incidental capture or entanglement in research gear. This measure is based on the fact that marine mammals typically spend most of their time under water and are difficult to see. Further, it is based on the premise that extending the monitoring period to allow them time to surface and be seen by ship-board observers improves the chances of avoiding adverse gear interactions. While this measure is reasonable from the perspective of observing marine mammals under good conditions, its effectiveness would vary considerably depending on lighting conditions and sea state, with essentially no potential for reducing interactions at night or other conditions of poor visibility, which occur frequently. In addition, the link between seeing marine mammals and reducing the risk of adverse gear interactions is dependent on some assumptions that may not be supported by the experience of AFSC researchers. The measure assumes that visually spotting animals is directly correlated to gear interactions (i.e., animals are seen before they are caught and, conversely, animals are not caught when they were not seen previously). AFSC fisheries research activities have had only four marine mammal takes, which is too few to adequately evaluate the validity of this assumption or to assess whether this extended monitoring period would reduce the risk of interactions with these gears.

Table 4.2-10 indicates the time of day when historical marine mammal gear takes have occurred during AFSC research. All occurred during daylight hours when animals could presumably have been seen if they were at the surface. The type of marine mammals seen and their behavior in relation to the ship and gear are currently part of the ship-board judgment about whether any marine mammals present are in danger of interactions with research trawls. The AFSC believes that adding a longer monitoring period in which no marine mammals could be seen before trawl gear is deployed would preempt the professional judgment of its scientists and ship crews in avoiding interactions and would not reduce the risk of incidentally taking marine mammals.

Another concern for the AFSC is the potential for this mitigation measure to bias its data by forcing it to abandon sampling stations that are “hotspots” for marine life. Marine mammals and other predators are often drawn to areas and oceanic conditions where fish and invertebrate prey are concentrated. Region-wide, multi-species surveys such as the Eastern Bering Sea Upper Continental Slope Trawl Survey are designed to assess the distribution and abundance of many species through randomized sampling of many dispersed sites. The validity of statistical methods used to expand sampling results into inferences about the range-wide population status of these species depends on the random sampling of “hotspots” as well as sites with lower densities of animals. If these surveys could not sample in areas rich in marine life, as indicated by the presence of marine mammals, even if the marine mammals did not appear to be at risk of interaction with the research gear, the sampling results would not accurately reflect the variability in abundance for different species and the ability of the AFSC to provide the “best available” scientific data for fisheries management purposes would be compromised. This type of ecological information is also important to agencies and other institutions concerned about the health of the marine environment important to marine mammals themselves.

Another potential mitigation measure would require the AFSC to suspend trawl operations at night or during periods of low visibility (including fog and high sea state) to minimize interactions with marine mammals that would be difficult to detect by visual monitoring. However, all previous marine mammal takes occurred during daylight hours (Table 4.2-10), so restricting operations to only daylight hours would not eliminate the majority of risk. In addition, restrictions on trawling at night could seriously hinder the ability of the AFSC to complete their sampling protocol. If survey vessels had to stand down when they encountered fog or rough seas, survey periods would have to be extended or fewer stations would have to be sampled to accommodate such delays. This would mean substantially higher costs and/or decreased quality of data. Although visual monitoring is a reasonable and practicable precaution to undertake for trawl surveys, it does not ensure that marine mammals will be detected or that entanglement can be prevented even if they are detected.

Acoustic and Visual Deterrents

This measure would require the AFSC to use acoustic deterrents on all trawl gear on which it is not already employed, including pingers and recordings of predator (e.g., killer whale) vocalizations to deter interactions with trawl gear. This measure would also require the AFSC to use visual deterrence techniques (e.g., lights, light sticks, reflective twine/rope) to reduce marine mammal interactions with the gear.

Acoustic pingers have been shown to be effective in deterring some marine mammals, particularly harbor porpoises, from interacting with gillnet gear (Nowacek et al. 2007, Carretta and Barlow 2011). There are, however, few studies testing their efficacy when used with trawl gear. Studies of acoustic deterrents in a trawl fishery in Australia concluded that pingers are not likely to be effective in deterring bottlenose dolphins, as they are already aware of the gear due to the noisy nature of the fishery (Stephenson and Wells 2008, Allen et al. 2014). Acoustic deterrents were also ineffective in reducing bycatch of common dolphins in the U.K. bass pair trawl fishery (Mackay and Northridge 2006). Although acoustic deterrents may be effective in preventing bycatch in gillnets, their efficacy in preventing bycatch in trawl nets is currently uncertain. A primary reason for this is that the noise associated with trawl gear (chains, ropes, trawl doors) is sufficiently loud that any acoustic device used would have to be louder than that generated by the ship and fishing gear which could, in turn, cause auditory damage or exclusion of cetaceans from important habitat (Zollett 2005). Underwater broadcasting of pre-recorded predator sounds (e.g., killer whale calls) to scare animals away from the fishing operation has been suggested as a potential mitigation measure but Jefferson and Curry (1996) concluded that this technique was largely ineffective for reducing marine mammal interactions with commercial fisheries based on their review of multiple studies.

Several methods have been suggested to help protected species visually detect fishing gear and avoid entanglement. Increasing acoustic reflectivity of nets through the addition of materials such as barium sulphate or acoustic reflectors has been tested, with varying degrees of success, in several set-net fisheries (Mooney et al. 2004, Rowe 2007). The applicability and efficacy in trawl fisheries is currently unknown. Similarly, nets could be illuminated with phosphorescent or luminescent materials and, ultimately, reduce the potential for entanglement. Wang et al. (2013) tested the efficacy of illuminating nets used in a Mexican bottom set-net fishery with ultraviolet (UV) light-emitting diodes to reduce sea turtle bycatch. UV net illumination significantly reduced green sea turtle bycatch without impacting target fish catch rates. Applicability in trawl fisheries and efficacy in deterring marine mammals with similar technology are, however, currently unknown.

Gear Modifications

Under the Modified Research Alternative, AFSC would include a MMED on all trawl nets or a subset of those nets considered of high risk for marine mammal interactions. Marine mammal excluder devices have been developed for several types of trawl nets and at least one device is being used by the SWFSC during fisheries research with the Nordic 264 trawl. The NWFSC uses a similar device on its Nordic 264 trawl but its position in the trawl and orientation are different than the SWFSC deployment in order to minimize changes in the net's catchability for their target species (juvenile salmon). In addition, the SWFSC is developing a MMED for the modified Cobb midwater trawl (SWFSC 2013). These devices are similar to turtle excluder devices and are designed to allow fish to pass through the bars of the excluder while marine mammals are guided to an escape hatch built into the net. The challenge with developing an excluder device is to minimize the impact on the fishing performance of the net while effectively reducing captures of marine mammals in the net. The shape, size, design, and positioning of an excluder device in the net can substantially impact the fishing performance of the net (Dotson et al. 2010).

An important factor to consider when developing excluder devices or any other gear modifications is to determine how the device or gear modification impacts the scientific objectives of the research. In the case of the SWFSC survey that now uses a MMED on the Nordic 264 trawl, the relevant objective of the survey is to collect a sample of individual fish for a variety of measurements and to examine their reproductive status. The reduced efficiency of the modified net in catching fish therefore does not substantially interfere with the scientific objective of the research. However, the scientific objective of most of the AFSC surveys using trawl gear is to estimate overall population abundance, size class distribution of target stocks, and distribution of numerous species across large geographic areas. Reductions in catchability of one or more fish species or size classes of fish, or increasing the variability of catch rates under different ocean conditions, could compromise the validity of the research survey and disrupt time-series data sets used to inform stock assessments. Given the value of these long time-series data sets for tracking ecosystem changes and the potentially huge economic implications for fisheries management of highly valuable commercial fisheries, any potential changes to research gear or protocols that may introduce uncertainty and bias into survey results must be thoroughly examined and planned years in advance of their implementation.

If required to use marine mammal excluder devices under this alternative, the AFSC would need to explore alternatives for excluder devices for each net type used at times and in places where marine mammals are at risk for capture and assess their efficacy and compatibility with research objectives.

Another gear modification proposed under this alternative involves using video cameras to identify fish and their encounter rates instead of a closed cod end in which fish (and marine mammals are captured) on trawl surveys. This could be appropriate for surveys designed to determine fish density or to verify acoustic target identification if the species of fish could be determined with a video image. However, this may not be possible for juvenile size classes or in murky waters. Such a system would not work for surveys designed to determine the reproductive condition of adult fish or the growth rates of fish, since these require the dissection of specimens. Considerable insight and experience may be gained by experimenting with open cod end trawls and associated high-resolution, high-speed video cameras, particularly with real-time video feeds to the ship. In some cases, this experience could lead to routine use of cameras instead of capture. In other situations the number of closed cod end trawls required for estimating vital rates could be reduced. While it would not be the primary objective, video camera data may also provide documentation of marine mammal interactions with trawl gear and provide insight into the efficacy of other measures intended to reduce the interactions with marine mammals (e.g., excluder devices).

Temporal or Geographic Restrictions

Spatial/temporal restrictions can be a direct way of reducing adverse impacts to protected species if there are known overlaps in time and space of the survey's footprint with concentrations of protected species. This measure would require the AFSC to identify areas and times that are most likely to result in adverse interactions with marine mammals (e.g., areas of peak abundance) and to avoid, postpone, or limit their research activity to minimize the risk of such interactions with marine mammals. This may include limits on specific locations, physical or oceanographic features, biologically important times, and/or gear types.

While the rationale for such restrictions is clear, the methods for identifying appropriate places and times for effective restrictions are not. The SWFSC has been conducting marine mammal surveys along the West Coast for many years to monitor the changing patterns of marine mammal abundance and distribution. These patterns of abundance are dynamic and often correlated to particular oceanographic conditions, which vary among seasons and years, so marine mammal survey information from the previous year or even the previous month may not reflect actual conditions when it is time to deploy trawl gear. It might be possible to conduct aerial surveys or passive acoustic surveys in an area prior to conducting trawls, but such surveys require time to process data before actual density information is available.

Assuming recent marine mammal survey data are available for delimiting time or area restrictions, questions remain about what standards of density should be used for limiting research. This is important to the potential effectiveness of such restrictions because it is not clear if marine mammal density is a key factor in the risk of catching animals in a research trawl. Marine mammals can all swim much faster than an active trawl tow (two to four knots) so they can easily avoid such gear if they perceive it and choose to move. This is true no matter how many animals are in a given area. The risk of entanglement is likely influenced much more by the attraction of marine mammals to fish caught in the trawl or disturbed by it as the trawl passes by, which in turn may be influenced by the overall availability of prey and the nutritional status of the marine mammals. Even if there are only a few marine mammals in an area, the risk of entanglement could be high if they are very hungry and strongly attracted to fish in a trawl. Conversely, the risk of entanglement could be quite small even if there are many marine mammals in an area if they have been foraging successfully and are inclined to avoid the disturbance of a trawl operation.

In any case, under the Status Quo and Preferred Alternatives, the "move-on" rule would be applied if any marine mammals are sighted from the vessel within 10 minutes before deploying trawl gear and appear to be at risk of interactions with the gear. If an area has a high density of marine mammals, they would likely be sighted during this 10 minute monitoring period prior to setting the gear and the station would be moved away or abandoned to avoid the marine mammals.

A special case of spatial/temporal restrictions would be for the AFSC to avoid trawl survey work within federal and state MPAs (see Section 3.1.4). While the AFSC has conducted survey work within some MPAs under the authority of special use permits, these permits primarily provide authority to scientifically sample fish in areas that are otherwise closed to fishing and do not concern the incidental take of marine mammals. The AFSC will continue to apply for special use permits to sample in MPAs as necessary to meet the scientific needs of their surveys and, if the managing agencies of any MPAs prohibit such sampling, the AFSC will avoid those areas. However, as described above, the same concerns about the effectiveness of spatial/temporal restrictions as a mitigation measure would apply to MPAs. They may or may not have high concentrations of marine mammals relative to the surrounding areas but, given the uncertainty about what factors contribute to high risk of entanglement in trawl gear and the imposition of the "move-on" rule, the potential for actually reducing incidental take by avoiding certain areas is not clear. Such avoidance also comes at the cost of not sampling in areas that are important to different fish species or that were established to promote recovery of depleted stocks. Scientific sampling is often the only reliable way to track the status of these stocks and the effectiveness of the MPA in fulfilling its established goals.

4.4.4.2 Longline Gear

The Alaska Longline Survey, the Barotrauma and Tagging of Deep-water Fish Survey, and Deep Water Groundfish Survey use, or propose to use, longline gear and would be subject to the following additional mitigation measures.

<u>Monitoring Methods</u>

The potential to use additional monitoring methods during longline surveys mostly involves the same considerations discussed with trawl surveys above. However, the potential to use dedicated PSOs is restricted primarily by vessel and crew size considerations. Longline surveys are conducted on smaller vessels than trawl surveys and the size of the crew is typically smaller. Under the Status Quo, at least one member of the crew is charged with watching for protected species before the gear is set. Dedicated PSOs would not be distracted by other vessel or research gear duties and would thus offer an advantage in monitoring for protected species. However, given the current size of vessels and crews used for these surveys, the inclusion of a crew member dedicated to only one task would compromise the ability of the remaining crew to conduct the survey safely.

Operational Procedures

This measure would require use of a decoy research vessel or other method of playing pre-recorded longline fishing sounds to distract marine mammals away from research longline sets. This potential method of deterrence has been tested with very few marine mammals but it is likely that cetaceans would quickly learn to tell the difference between decoys and actual fishing operations (Gillman et al. 2006). One situation where tests of its potential efficacy have begun is with sperm whales in Southeast Alaska.

The Southeast Alaska Sperm Whale Avoidance Project (SEASWAP) was initiated in 2003 by fishermen concerned by the increasing depredation of sablefish and halibut from longline boats by sperm whales. This ongoing research project is a collaborative effort of the Alaska Longline Fishermen's Association, University of Alaska Southeast, Sitka Sound Science Center, and the Scripps Institution of Oceanography, with funding support from NMFS and other federal and state agencies (www.seaswap.info). SEASWAP has explored the clues sperm whales use to find longline boats hauling up gear and examined a number of potential ways to distract them or otherwise limit depredation, including the use of decoy vessels and recordings of hydraulic gear and engine sounds deployed on buoys set up to ten miles away that can be triggered remotely (Thode et al. 2015). Initial tests of remote buoy systems, which also have passive acoustic monitoring devices that can track sperm whale calls near the buoy, indicate that sperm whales can be attracted to playback recordings and the system may have some practical uses. However, logistical maneuvers of the vessel between setting the playback buoy and setting the actual baited longline as well as the timing of the playback appear to be important variables that may affect the success of the decoy technique (Thode et al. 2015). Similar issues have developed with killer whales depredating longline sets in the eastern Aleutians and GOA. However, no research has been conducted to determine if a similar system could be effective in reducing longline depredation by killer whales.

The use of decoy vessels to lure sperm whales, killer whales, or any other marine mammals away from longline research gear would involve either the additional cost of chartering another vessel to serve as a decoy or having two vessels work in tandem but with only one fishing at a time. Both options would certainly compromise the AFSC research budget and restrict the amount of data that could be collected.

The use of remotely controlled recordings on buoys such as those developed by SEASWAP may have potential to reduce depredation of catches on AFSC research longlines, which is certainly an issue for the scientific sampling purposes of the surveys, but it may not reduce the chances of hooking marine mammals. Both sperm whales and killer whales are very adept at picking fish off of longline gear and unlikely to be hooked while doing so.

4.4.4.3 Conclusion

Under the Modified Research Alternative, the AFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Of the potential techniques and procedures considered under this alternative to improve monitoring of trawl gear, three techniques appear to offer some promise in helping to detect marine mammals in conjunction with the current visual monitoring protocol. These include the use of underwater video technology, passive acoustic monitoring, and unmanned aerial or underwater surveillance vehicles. However, all three techniques have substantial limitations in terms of conditions under which they may be useful (e.g., weather and sea state), the logistics of incorporating them into sampling procedures (e.g., timing of deployment, crew responsibilities, and data processing), and how they might be incorporated into actual marine mammal take-avoidance decisions like the "move-on" rule. These three techniques may warrant further examination to explore these limitations and to see how they may be applied under actual survey conditions if the technology advances and is improved. The other technological approaches considered, infra-red imaging and use of night vision devices, have severe limitations to their usefulness in a real-world situation and therefore offer no advantages for actual mitigation.

The use of dedicated and trained personnel to monitor for protected species would occur under the Preferred Alternative once the crew and scientists of research surveys complete the new protected species training program. Currently, at least one member of the trawl survey crew or scientific party is dedicated to monitoring for protected species before research gear is deployed. Given the new protected species training program for all crew members under the Preferred Alternative, the use of dedicated PSOs for monitoring during trawl operations would offer limited advantage to what will occur under the Preferred Alternative.

Operational restrictions such as not allowing trawls to be set at night or in poor visibility conditions could reduce the risk of taking marine mammals. However, part of their effectiveness may be due to reduced overall sampling effort rather than because marine mammals are more likely to be caught under those conditions Such restrictions could have a serious impact on the ability of the AFSC to collect certain kinds of research data and would have impacts to the cost and scope of research that could be conducted. The spatial/temporal restrictions that were considered to avoid high densities of marine mammals are similar in that they would reduce risk of take by reducing overall sampling effort but also strongly impact the ability of the AFSC to pursue certain scientific goals.

The use of additional acoustic and visual deterrents may warrant further investigation if new devices enter the market and are demonstrated to be effective. However, the effectiveness of the devices considered in this alternative appears to be species specific; mitigation advantages for some species may lead to higher risk for other species. The effectiveness of these techniques may also decrease with time as animals habituate to various devices and techniques.

The analysis of additional measures considered to decrease the risk of marine mammal takes in longline gear is similar to trawl gear. Longline surveys are conducted on much smaller vessels with limited crew. Dedicated PSOs could offer an advantage for monitoring, but the lack of crew space is limiting; all crew members have multiple tasks that are necessary for safe navigation and to conduct the survey. Decoy vessels or remote buoy systems may be difficult to implement logistically and are unlikely to provide consistent mitigation value for all species. New variations on these techniques may be developed in the future that address some of these concerns.

In conclusion, some elements of the Modified Research Alternative (e.g., dedicated PSOs) could offer mitigation advantages compared to the Status Quo Alternative. The Modified Research Alternative does not, however, appear to offer a substantial reduction in the risk of adverse interactions with marine mammals compared to the Preferred Alternative other than through reducing overall fishing effort. The impacts of the Modified Research Alternative on marine mammals would therefore be similar to the impacts of the Preferred Alternative, which were considered minor adverse under the criteria described in Table 4.1-1. Some concepts and technologies considered in the Modified Research Alternative are promising and NMFS will evaluate the potential for implementation if they become more practicable.

4.4.5 Effects on Birds

Under the Modified Research Alternative, the AFSC would continue fisheries research as described in Section 2.3 and would apply for authorizations of incidental take of protected species under the MMPA and the ESA. The Modified Research Alternative would include all of the same mitigation measures as the Preferred Alternative as well as a number of additional mitigation measures considered under the

MMPA and ESA processes, primarily dealing with efforts to reduce potential impacts on marine mammals.

The only mitigation measure specific to seabirds that is being considered (use of streamer lines during research with longline gear) is already included in the Status Quo and Preferred Alternatives. However, there are several other mitigation measures included in the Modified Research Alternative which may affect impacts on seabirds to some extent, including potential spatial/temporal restrictions on where and when AFSC research could occur. If a specific area was closed to AFSC fisheries research in order to protect a concentration of marine mammals, for example, the risk of adverse interactions with seabirds in that area would also be reduced as a secondary effect. Specific determinations about potential research restrictions have not been made in this FPEA and it is assumed that the overall research effort would be very similar under the Modified Research Alternative as it would be under the Status Quo Alternative. Overall effects on seabirds would therefore be similar even if research was conducted in somewhat different places and times.

The effects of the Modified Research Alternative on birds are therefore very similar to those described for the Status Quo (Section 4.2.5) and essentially the same as the Preferred Alternative (Section 4.3.5) as there would be no change in the type of surveys or research gears being used.

4.4.5.1 Conclusion

The overall effects of AFSC research activities on seabirds under the Modified Research Alternative would likely be minor in magnitude, dispersed over a large geographic area, infrequent or rare, and temporary or short-term in duration (for effects other than incidental mortality), and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1.

4.4.6 Effects on Sea Turtles

The Modified Research Alternative would include the same scope of research activities as the Preferred Alternative but those activities would be conducted under different operating procedures and gears in order to mitigate, to the greatest possible extent, any potentially adverse impacts on protected species, including sea turtles. Most of these additional mitigation measures are being considered in this FPEA in order to address marine mammal protection issues under the MMPA (see Section 4.4.4) but many of them may have implications for avoiding potentially adverse interactions with sea turtles, including:

- The use of dedicated PSOs and additional equipment/technologies to improve monitoring
- Operational restrictions on research activities in low visibility conditions
- The use of acoustic and visual deterrents on selected gear types
- The incorporation of high-resolution, high-speed video cameras into trawl nets with open cod ends
- Temporal or geographic restrictions to avoid known concentrations of marine mammals or federal and state MPAs

The potential for these additional mitigation measures to reduce impacts on marine mammals and their practicability for implementation within AFSC research protocols is addressed in Section 4.4.4. Many of the same logistical difficulties and concerns about impacts on the scientific mission of the surveys would be the same in regard to sea turtles as they would for marine mammals. However, the AFSC has no history of taking sea turtles in its research efforts so the likelihood of future takes is remote. The potential impacts of AFSC research on sea turtles are already minimal so the implementation of additional mitigation measures which may have adverse effects on the scientific mission of the surveys would not be warranted.

4.4.6.1 Conclusion

The magnitude of effects of the Modified Research Alternative on ESA-listed sea turtles would be minor since there would be no measurable population change, the duration of any effects would be temporary or short-term, and the effects would be dispersed widely over a large area. The overall effects on all species of sea turtles would be minor adverse according to the impact criteria in Table 4.1-1.

4.4.7 Effects on Invertebrates

Under the Modified Research Alternative, the AFSC would implement additional mitigation measures for protected species while conducting the same scope of research as described under the Preferred Alternative. Most of the additional mitigation measures would be unlikely to affect the amount of invertebrates caught for research purposes. The exceptions are the potential for spatial/temporal restrictions on AFSC fisheries research in areas considered important to protected species and the potential for incorporation of marine mammal excluder devices in research trawls.

Spatial/temporal restrictions could reduce research fishing and hence impacts on invertebrates in some locations. However, researchers may respond to spatial/temporal restrictions by redirecting research efforts to other locations if such movements are consistent with research goals and do not compromise time-series data sets. If so, overall research efforts could remain the same. The Modified Research Alternative does not specify particular spatial/temporal restrictions but it is assumed for the FPEA analysis that overall research effort and therefore impacts to invertebrates would be very similar under the Modified Research Alternative as they are for the Preferred Alternative, although they may occur in somewhat different locations and times.

The modified move-on rule would require the AFSC to monitor for marine mammals for a 30 minute period before trawl gear was deployed. If any marine mammals were sighted anywhere from the ship in that time period, no gear would be deployed. This measure would result in a substantial extension of the time it takes to complete trawl surveys. As shown in Tables 2.2-1 and 2.3-1, the AFSC would deploy approximately 1,780 bottom trawl and 563 mid-water trawl sets in the GOARA and 1357 bottom trawl sets and 625 mid-water trawl sets in the BSAIRA. The addition of a 30 minute monitoring period before each tow, and perhaps more time if marine mammals are sighted, would add a minimum of 45 days to all trawl surveys combined each year, which would compromise the ability of these surveys to be completed within seasonal limits. At an average cruising speed of 10 knots, this minimum waiting period would reduce the distance that could be traveled between sampling stations by about 10,800 nm compared to the typical Preferred Alternative time period, thereby either extending the time required to complete surveys or reducing the geographical extent of the surveys. Significant increases in operating costs resulting from delays and extra sea time would likely lead to cutbacks on the numbers of stations sampled each year, with a resulting decrease in the amount of invertebrates caught during research. While this reduction in effort would reduce mortality and disturbance impacts on invertebrates, it would also reduce the quality of data used to inform stock assessments, compromise the statistical continuity of time-series data sets, and have potentially adverse indirect effects on fisheries management decisions. The magnitude of these effects on any given species of invertebrate cannot be determined due to great uncertainty about budget decisions and loss of data implications, but the effects would likely be adverse to the mission of various AFSC research programs to provide the "best available" scientific data for fisheries management purposes as required under the MSA.

Gear modifications, such as marine mammal excluder devices or open codend video sampling would also potentially result in reduced catch and bycatch of invertebrate species, thus altering the effectiveness of time–series surveys used for stock assessment purposes, such as those for crabs. Under the Status Quo and Preferred Alternatives, the Rockfish Habitat Studies survey uses video cameras to capture animal distribution data. However, this survey does not utilize a closed codend or other net modification proposed under the Modified Research Alternative so its applicability to proposed alterations under the

Modified Research Alternative and potential effects to catchability of desired invertebrate species is unknown.

It is assumed for this FPEA analysis that overall impacts to invertebrates under the Modified Research Alternative would be substantially the same as those described under the Preferred Alternative. These effects would be low in magnitude, distributed over a wide geographic area, and temporary or short-term in duration and would therefore be considered minor adverse according to the impact criteria in Table 4.1-1. As was the case with the Status Quo and Preferred Alternatives, the Modified Research Alternative would also contribute to long-term beneficial effects on managed and unmanaged invertebrates throughout the Alaska Region through the contribution of AFSC fisheries research to sustainable ecosystem-based fisheries management.

4.4.8 Effects on the Social and Economic Environment

Under the Modified Research Alternative, the AFSC would conduct fisheries research as described in the Preferred Alternative (Section 2.3 and Appendix A) and would apply for authorizations of incidental take of protected species under the MMPA and ESA. Research activities under the Modified Research Alternative would include all of the same mitigation measures required by the MMPA and ESA authorization processes as described for the Preferred Alternative, including the new communication plan with subsistence communities designed to minimize the potential for AFSC fisheries research to interfere with subsistence activities. Additional mitigation measures considered under the Modified Research Alternative (Section 2.4.1) would be derived from a variety of sources including: (1) comments submitted from the public on similar fisheries actions, (2) discussions within NMFS as a part of the proposed rulemaking process, and (3) a literature review of past and current research into potential mitigation measures.

The effects of the Modified Research Alternative on the social and economic environment depend on the extent that additional mitigation measures would be implemented. Some of the mitigation measures require additional equipment than is currently used and the addition of trained PSOs to the crew, which may increase spending on wages, rentals, and equipment (see Section 2.4.1). However, on surveys conducted on relatively small vessels with limited crew space, the inclusion of crew dedicated to protected species monitoring would decrease the number of crew available to conduct research, thereby decreasing the amount of research that could be conducted in a given time period and potentially creating safety concerns. Other measures such as no night fishing and broad spatial/temporal restrictions could curtail research operations in areas important for stock assessment and fishery management purposes. Spatial/temporal restrictions may reduce some operational costs if surveys are reduced in scope, with a resulting loss of scientific information, but may also increase survey expenses if surveys need to be extended in time to compensate for restricted data collection opportunities.

The scientific value of data collected with changes in research protocols due to additional mitigation measures has not been evaluated because the number of unresolved variables would make any such analysis speculative. It is therefore uncertain if an altered AFSC fisheries research program under the Modified Research Alternative would contribute a similar value to fisheries management as the Status Quo Alternative. However, it is probable that some of the additional mitigation measures included in the Modified Research Alternative, if implemented, would decrease the ability of the AFSC to provide comparable levels or quality of scientific information to the fisheries management process. While these conditions may reduce the scientific value of AFSC research relative to the Status Quo Alternative, the overall contribution of AFSC research to the socioeconomic environment would likely be similar to those described for the Preferred Alternative (Section 4.3.8).

Under the Modified Research Alternative, the potential direct and indirect effects of AFSC fisheries and ecosystem research on subsistence resources would continue to occur infrequently or rarely, be small in magnitude, and would be dispersed over a large geographical area. AFSC research activities would not likely be located near important sites of subsistence use and a new communication plan with subsistence communities should minimize the potential for AFSC research activities to interfere with subsistence activities. AFSC research activities would therefore be considered to have minor adverse effects on subsistence resources and activities under the Status Quo Alternative according to the impact criteria in Table 4.1-1.

The direct and indirect effects of the Modified Research Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be felt throughout the North Pacific and Alaska Region. According to the impact criteria established in Table 4.1-1, the direct and indirect effects of the Modified Research Alternative on the social and economic environment would be minor to moderate and beneficial.

4.5 DIRECT AND INDIRECT EFFECTS OF ALTERNATIVE 4 – NO RESEARCH ALTERNATIVE

This section presents an analysis of the potential direct and indirect effects of Alternative 4 – the No Research Alternative – on the physical, biological, and social environment. Under the No Research Alternative, the AFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this FPEA. This moratorium on fieldwork would not extend to research that is not in scope of this FPEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents. NMFS would need to rely on other data sources, such as fishery-dependent data (i.e., harvest data), and state or privately supported data collection programs to fulfill its responsibility to manage, conserve, and protect living marine resources in the U.S.

The potential direct and indirect effects of implementing Alternative 4 were evaluated according to the criteria described in Table 4.1-1. A summary of the impact rating determinations for all topics evaluated under this Alternative are presented below in Table 4.5-1.

Table 4.5-1 Alternative 4 Summary of Effects

Resource	Physical Environment	Special Resource Areas	Fish	Marine Mammals	Birds	Sea Turtles	Invertebrates	Social and Economic
Section #	**4.5.1**	**4.5.2**	**4.5.3**	**4.5.4**	**4.5.5**	**4.5.6**	**4.5.7**	**4.5.8**
Effects Conclusion	Minor *adverse*	Minor *adverse*	Minor to Moderate *adverse*	Minor *adverse*	Minor *adverse*	Minor *adverse*	Minor to Moderate *adverse*	Moderate *adverse*

4.5.1 Effects on the Physical Environment

Under the No Research Alternative, the AFSC would no longer conduct or fund fisheries and ecosystem research involving fieldwork in marine waters. This would eliminate the potential for direct adverse impacts to the physical environment from AFSC fisheries research, although such impacts may continue through research activities conducted and funded by other entities.

The research conducted by the AFSC includes assessments of fisheries and marine ecosystems that are used to inform a wide range of plans, policies, and resource management decisions. Many of the plans, polices and decisions that are partially based upon AFSC data are concerned with conservation of ecological properties of the environment, and maintenance of the habitat that sustains living marine resources. FMPs developed for the Alaska Region are partially based on scientific advice derived from AFSC data. These FMPs strategically limit impacts to physical habitat such as disturbance of benthic habitat. Without a relatively continuous input of AFSC data, including long-term time-series data, management authorities would lose some of the information necessary to establish management measures in a meaningful fashion. Discontinuance of AFSC research under the No Research Alternative would also substantially reduce the capacity of NMFS to monitor and investigate changes to the physical environment due to coastal developments, marine industrial activities, and climate change among other factors.

The loss of information on physical resources under the No Research Alternative would affect a number of different federal and state resource management agencies to various degrees. The AFSC research program is not the only source of information available to these resource managers but the No Research Alternative could lead to changes in some management scenarios based on greater uncertainty. Given the potential for resource management agencies to compensate for this loss of information to some extent, and the preference to avoid rapid, major changes in management strategies, the potential magnitude of effects on the physical environment would likely be minor and be limited in geographic extent in the near future. Under the No Research Alternative, the overall impact of these indirect effects on physical resources would be considered adverse and minor according to the impact criteria in Table 4.1-1.

4.5.2 Effects on Special Resource Areas and EFH

The No Research Alternative would result in the elimination of the minor adverse direct impacts to special resource areas described in Section 4.2.2 for the Status Quo Alternative. However, the beneficial effects of AFSC research on the conservation management of special resource areas would also be lost under the No Research Alternative.

The loss of scientific information from these areas would make it difficult for fisheries managers to assess the habitats, resources, and ecosystem functions that EFH, closed areas, HAPC, and MPAs are designed to protect through the implementation of sound science-based management practices. Furthermore, a loss of input from AFSC research would handicap the monitoring and effective management of these areas, and would encumber the designation of additional special resource areas in the future. Implications from the loss of information about special resource areas under the No Research Alternative would vary for different federal and state resource management agencies. The AFSC research program is not the only source of information available to these resource managers but eliminating this source of data could lead to changes in some management scenarios based on greater uncertainty (e.g., greater restrictions on commercial fisheries).

If the AFSC discontinued collecting information on special resource areas, especially from surveys with long time-series data, management authorities would lose important information needed to establish meaningful management measures and current conservation measures in place to protect ecological properties of the environment could become less effective. The indirect effects of these potential management implications would likely vary among the many special resource areas considered. Given the potential for resource management agencies to compensate for this loss of information to some extent and the tendency to avoid rapid, major changes in management strategies, the potential magnitude of effects on special resource areas would likely vary from minor to moderate and be limited to a few local areas in the near future. Under the No Research Alternative, the overall impact of these indirect effects on special resource areas would be considered minor adverse according to the impact criteria in Table 4.1-1.

4.5.3 Effects on Fish

Under the No Research Alternative, there would be no direct effects of AFSC fisheries and ecosystem research on fish because the AFSC would no longer conduct or fund fieldwork in Alaska. The lack of at-sea research activities would eliminate the risk of mortality from fisheries research activities, disturbance and changes in behavior due to the presence of vessels and research gear, and potential contamination from vessel discharges. However, the loss of scientific information about fish populations and their habitats, especially commercially valuable species, would impede the ability of fisheries managers to effectively monitor stock status, set commercial harvest limits, or develop fishery regulations to recover depleted stocks or protect vulnerable stocks, especially as information used in stock assessments gets older and less reliable. For non-commercial species, the absence of new fieldwork conducted and funded by the AFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular fish species is unknown.

The conservation and management of fishery resources is a core mission for NMFS and is listed among the ten National Standards set forth in the MSA. In carrying out Congress's mandate under the MSA, NMFS is responsible for ensuring that management decisions involving fishery resources are based on the highest quality, best available scientific information on the biological, social, and economic status of the fisheries. In the GOARA, BSAIRA, and CSBSRA this is achieved through the work of the AFSC, which provides supporting scientific information that NMFS uses as the basis for their fisheries management actions. In addition to assessing the status of stocks and examining potential effects of commercial fishing activities, NMFS uses AFSC research data in the development and implementation of FMPs. The ability to acquire scientific information is essential to the agency's responsibility to manage our nation's fishery resources.

Without AFSC fisheries research, NMFS would need to rely on other data sources, such as fishery-dependent harvest data and state or privately supported fishery-independent data collection surveys or programs. It is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the AFSC.

Although other data sources are available to support resource management decisions, the No Research Alternative would be expected to result in increased uncertainty and changes in some management scenarios. If the AFSC discontinued collecting information on fish stocks, management authorities would lose important information needed to establish sustainable harvest limits and other management measures in a meaningful fashion, and current conservation measures in place to rebuild overfished stocks and protect ecological properties of the environment would become less effective. The indirect effects of these potential management implications would likely vary among fisheries management areas and the different fish stocks assessed by the AFSC. There are too many unknown variables to estimate what the indirect effects of this loss of information would mean to any particular fish stock. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on fish stocks would likely vary from minor to moderate but the effects could be regional in geographic scope and have long-term effects. Through these indirect effects on future management decisions, the overall impact on commercially important fish stocks would be considered minor for non-managed species and moderate adverse for managed species in the areas surveyed by the AFSC according to the impact criteria in Table 4.1-1.

4.5.4 Effects on Marine Mammals

Under the No Research Alternative, the AFSC would no longer conduct or fund fieldwork for the fisheries and ecosystem research considered in the scope of this FPEA in marine waters of the GOA, Bering Sea-Aleutian Islands, and the Chukchi and Beaufort Seas. This would eliminate the potential for direct effects of AFSC fisheries research on marine mammals through disturbance, injury and mortality in research gear, changes to prey fields, and contamination of the marine environment. This moratorium on fieldwork would not include research outside the scope of this FPEA, such as directed research on marine mammals and ESA-listed species covered under separate research permits and NEPA documents.

In addition to conducting fisheries research, AFSC surveys are sometimes used as "ships of opportunity" for at-sea observational surveys of seabirds and marine mammals. Given the difficulty in getting long-term funding for dedicated surveys, these fairly consistent data collection opportunities on long-term AFSC fisheries research cruises are valuable contributions to multidisciplinary ecosystem research efforts. Under the No Research Alternative, the use of AFSC research cruises as ships of opportunity would be eliminated. While these opportunistic transects are not the primary source of information about the status of many marine mammals, they do contribute to NMFS annual marine mammal stock assessments. Oceanographic and fisheries data collected by the AFSC is also important for monitoring the ecological status of the environment important to marine mammals. While there would be no direct effects on marine mammals due to adverse interactions with ships and scientific gear, the loss of observational and ecological information important to marine mammals could indirectly and adversely affect resource management decisions concerning the conservation of marine mammals, especially as time went on and uncertainty about the status of the marine environment increased. There are too many unknown variables to estimate the magnitude of effects this lack of information would mean to any particular stock of marine mammal but they would likely be minor in magnitude over the next five years. These indirect effects could have short-term to long-term effects on management of marine mammal species that interact with fisheries and have impacts over a large geographic area. Through these indirect effects on future management decisions, the overall impact on marine mammals would be adverse and minor according to the impact criteria in Table 4.1-1.

4.5.5 Effects on Birds

The No Research Alternative would eliminate the minor adverse direct impacts of AFSC fisheries research to seabirds through disturbance, entanglement in gear, changes to prey fields, and contamination of the marine environment for all species of birds (Section 4.2.5) However, some of the AFSC surveys that would be eliminated under this alternative have been "ships of opportunity" for seabird biologists when berths have been available and these opportunities have resulted in the collection of scientific data on seabird distributions (transects while vessels are underway) which provide valuable data that may otherwise be unavailable because other options for vessel support are very expensive.

Oceanographic and fisheries data collected by the AFSC is also important for monitoring the ecological status of the environment important to seabirds. While there would be no direct effects on seabirds, the loss of observational and ecological information important to seabirds could adversely affect resource management decisions concerning the conservation of seabirds. Although NMFS does not have regulatory jurisdiction over birds, the scientific contribution from opportunistic seabird research is used, at least partially, to support fishery management decisions, USFWS conservation efforts, and international treaties. If the AFSC discontinued collecting observational information on seabirds and ecological information important to seabirds, the ability of state and federal agencies as well as international treaty organizations to make informed decisions about the marine environment would be adversely affected, especially as time went on and uncertainty about the status of various populations of birds increased. Resource management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect ecological properties of the environment would become less effective.

Given the fact that the AFSC is not the only source of information available to federal and state resource managers, and the potential for resource managers to compensate for this loss of information, the No Research Alternative is expected to have a minor indirect adverse effect on seabirds in the AFSC research areas according to the impact criteria in Table 4.1-1. There are too many unknown variables to estimate what the indirect effects of this loss of information would mean to any particular species.

4.5.6 Effects on Sea Turtles

Under the No Research Alternative, the AFSC would no longer conduct or fund fisheries research involving fieldwork in marine waters, which would eliminate the potential for minimal adverse impacts to sea turtles through disturbance, entanglement in gear, changes to prey fields, or contamination associated with AFSC research activities.

However, the elimination of AFSC research activities would also substantially reduce the collection of oceanographic and fisheries data important for monitoring the ecological status of the Alaska marine environment. These data may be useful to track changes in the marine environment due to climate change that may affect the capacity of turtles to expand their ranges northward and may thus be important for sea turtle conservation efforts. However, collection of data on sea turtles is not a focus of AFSC fisheries research and there are other sources of scientific data used by sea turtle biologists to monitor the status of different species.

There are too many unknown variables to estimate what the indirect effects of this loss of information and associated management implications would mean to any particular sea turtle species but all of them are considered important resources because of ESA-listing. Under the No Research Alternative, the loss of information currently provided by AFSC research activities is expected to have minor adverse indirect effects on ESA-listed sea turtles in Alaska according to the impact criteria in Table 4.1-1.

4.5.7 Effects on Invertebrates

Under the No Research Alternative, there would be no direct effects of AFSC research on invertebrates through physical damage, changes in species composition, contamination or degradation of habitat, or mortality. However, the loss of scientific information about invertebrates and their habitats, especially commercially valuable species, would impede the ability of fisheries managers to effectively assess and monitor stocks, set harvest limits, or develop necessary regulations to protect vulnerable stocks, especially as information used in stock assessments gets older and less reliable. For non-managed species (e.g., corals, sponges, etc.), the absence of new fieldwork conducted and funded by the AFSC would interrupt time-series data sets important for tracking ecosystem-level changes due to fishing impacts, climate change, ocean acidification, and other factors. The loss of this information would increase uncertainty about future trends which may be important to natural resource managers, although the impact of this uncertainty on particular invertebrate species is unknown.

As described in Section 4.5.3 for fish, the conservation and management of marine invertebrate resources is a core mission for NMFS under the MSA and needs to be based on the best available scientific information. In addition to assessing the status of invertebrate stocks and examining potential effects of commercial fishing activities, NMFS uses AFSC research data to develop and implement FMPs. The ability to acquire scientific information is essential to the agency’s responsibility to manage our nation’s fishery resources.

Without AFSC fisheries research, NMFS would need to rely on other data sources, such as fishery-dependent harvest data and state or privately supported fishery-independent data collection surveys or programs. It is unlikely that any of the state or other institutional research programs would be able to undergo the fundamental realignment of budgets and scientific programs necessary to maintain the level and continuity of information currently provided by the AFSC.

Although other data sources are available to support resource management decisions, the No Research Alternative would be expected to result in increased uncertainty and changes in some management scenarios. If the AFSC discontinued collecting information on invertebrates, management authorities would lose important information needed to establish sustainable harvest limits and help conserve and restore benthic habitats. Given the potential for resource management agencies to compensate for this loss of scientific information to some extent and the tendency to avoid major changes in management strategies, the potential magnitude of effects on invertebrate stocks would likely vary from minor to moderate but the loss of scientific data could affect the entire geographic area where AFSC fisheries research is conducted and last for many years (i.e., have long-term effects). These indirect impacts of the No Research Alternative on invertebrates would therefore be considered minor for non-managed species and moderate adverse for managed species according to the criteria in Table 4.1-1.

4.5.8 Effects on the Social and Economic Environment

Section 3.3 describes baseline information on the interaction of the AFSC with the social and economic environment of the North Pacific and Alaska Region. This section describes the effects of the No Research Alternative on socioeconomic resources of the North Pacific and Alaska Region. Major factors that would be affected by the cessation of fieldwork associated with the AFSC fisheries research program include:

- Effects on subsistence
- Collection of scientific data used in sustainable fisheries management
- Economic support for fishing communities
- Collaborations between the fishing industry and fisheries research
- Fulfillment of legal obligations specified by laws and treaties

4.5.8.1 Effects on Subsistence

Under the No Research Alternative, AFSC fisheries at-sea fieldwork would be suspended in all three research areas. With no field operations and no personnel actively engaged in research activities, the No Research Alternative would not have a direct impact on subsistence resources or subsistence activities because there would be no actions that could affect these resources. However, the loss of fisheries and oceanographic information provided by the AFSC could have adverse indirect effects on fisheries management and other marine resource managers, especially in tracking changes in the environment that may be important to subsistence resources. Although the marine mammal co-management commissions and other resource managers would use other sources of information to inform their decisions, the loss of long-term and systematic AFSC research programs could adversely affect the type and quality of information available to monitor the health of subsistence resources and the habitats that support them.

4.5.8.2 Collection of Scientific Data used in Sustainable Fisheries Management

Without the scientific data for updated stock and habitat assessments provided by AFSC research, scientists and fisheries managers would have to rely on other data sources, such as commercial and recreational fisheries harvest data and fisheries-independent research conducted and funded by state agencies, academic institutions, or other independent research organizations. Organizations that have participated in cooperative research programs may or may not continue their research efforts depending on whether they are able to secure alternative sources of funding. This would have a direct adverse effect on the statistical confidence of stock assessments and other scientific information important to fisheries management. Without federal fisheries-independent research, areas closed to fishing for various conservation reasons, such as stock or habitat recovery, would be without the primary scientific data used to monitor the effectiveness of those conservation measures and the recovery of depleted species.

The use of fishery-dependent data alone may severely limit the ability of managers to evaluate and make predictions about the status of some stocks because harvest data do not sample early age classes and therefore provide little data on potential recruitment to harvestable stocks. Uncertainty about stock assessments would increase over time as knowledge of population structures diminish. This, in turn, could require use of ever more precautionary management approaches, which could reduce commercial and recreational fishing opportunities, and therefore associated income, through such means as reduced fishing quotas or target catch levels and/or extended closures of fishing areas. The redistribution of research effort to non-NMFS entities would also require new lines of communication with the NPFMC, new data review processes, and new procedures for integrating separate research results into the regional perspective. Cessation of fisheries research conducted and funded by the AFSC would gradually undermine the statistical basis for use of more sophisticated management models, leading to reliance on less sophisticated and more conservative fishery management.

Another potential result of greater uncertainty in the scientific basis for fisheries management is that fisheries managers may overestimate overfishing levels and set harvest limits too high for some species, resulting in overfishing and depletion of fish stocks. The initial effect of this could be to increase the revenues from commercial fishing and its related industries. However, over time, the depletion of fish stocks could result in lower catches and therefore reduced incomes. Further, quotas that are lower than objectively necessary mean losses to the fishing industry, fisheries dependent shoreside industries, and fishing families and communities. Even with a precautionary approach, in the absence of objective data, quotas may still be set too high; meaning the long-term yield from the fishery could be driven down due to unsustainable harvest levels. This could result in both a conservation loss and a long-term economic loss to the North Pacific and Alaska Region.

The absence of federal fishery-independent research surveys and the long-term data sets they provide would eliminate the primary set of trend information used to monitor broad changes in the marine ecosystem. Climate change and ocean acidification have the potential to impact the population and distribution of many marine species. Long-term, scientifically robust research that provides information on changes to and trends in the marine ecosystem, and on human impacts from and adaptations to those changes and trends, would be greatly diminished if the AFSC ceased conducting and funding fisheries and ecosystem fieldwork.

The end result could be an undermining of confidence in the fisheries management program. This could lead to less cooperation and exchange of important information and data. Without this cooperation the NPFMC could find it more difficult to sustain the support of the individual states, potentially undermining the fisheries management process. The No Research Alternative clearly does not enable collection and development of adequate, timely, high quality scientific information comparable to that provided by the AFSC under any of the three research alternatives. In NMFS view, the inability to acquire scientific information essential to developing fisheries management actions that must prevent overfishing and rebuild overfished stocks would ultimately imperil the agency's ability to meet its mandate to promote healthy fish stocks and fully restore the nation's fishery resources.

4.5.8.3 Economic Support of Fishing Communities

As stated previously, the AFSC has currently been federally funded for approximately $62.18 million annually in support of fisheries research that support local economies in the form of employment, services, chartered vessels, fees, taxes, equipment, and fuel. Under the No Research Alternative, this financial contribution to local economies and the resulting support of the social environment would cease. A number of people currently employed to conduct fisheries research either as federal employees or contractors would likely lose their jobs and the number of support services required for the AFSC would decrease substantially. It is unlikely that state agencies or other funding sources would be able to completely compensate for this loss of federal funding to support fisheries research by state agencies, academic institutions, and industry groups.

While the loss of research-related employment and purchased services would be important and adverse for many individuals and families, the total sums spent for research are very small compared to the value of commercial and recreational fisheries in the area as well as the overall economy of those communities. The lost economic contribution of AFSC research would be relatively larger for some communities where the research is centered (i.e., Kodiak or Dutch Harbor, Alaska) and may be considered moderate in magnitude for those communities but the overall direct impact of that loss would be minor in magnitude for most communities.

4.5.8.4 Collaborations between the Fishing Industry and Fisheries Management

Over time, the No Research Alternative could cause an adverse indirect effect on the social and economic environment by degrading the relationships that have been established between scientists and fishing groups through working together on research and the application of data to the fisheries management process. This deterioration in trust and cooperation would likely get worse if commercial fisheries were managed more conservatively because of higher uncertainty resulting from less reliable information to feed into fisheries management. It is not clear what impacts this would have on particular economic or regulatory issues but an atmosphere of distrust often complicates and slows down public decision-making processes such as those used to develop fisheries regulations and harvest allocations. Additionally, under the No Research Alternative there would be no establishment of a communication plan to provide outreach and educational collaborative opportunities among AFSC fisheries researchers and subsistence communities.

4.5.8.5 Fulfillment of Legal Obligations Specified by Laws and Treaties

The cessation of field work associated with the AFSC research programs considered in this FPEA could compromise the ability of NMFS to fulfill its obligations under various U.S. laws and international treaties (Chapter 6). NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the MSA, MMPA, and ESA. Fulfilling the obligations of these statutes requires NMFS to provide specific research data and scientific expertise to support legal reviews and management decision-making processes. The cessation of field research would substantially erode the value of scientific advice provided to these various processes and increase uncertainty about the effects of conservation and management measures on fishing communities as well as NMFS ability to provide socioeconomic analyses required for fisheries regulatory actions. It would also compromise the U.S. partnership and collaboration with other agencies, entities, and countries that collect, analyze, and share complementary data for management of highly migratory species and other international resources.

4.5.8.6 Conclusion

The direct and indirect effects of the No Research Alternative on the social and economic environment would be subject to a great deal of uncertainty depending on the response of many entities to the cessation of AFSC fisheries research and the ensuing uncertainty in the fisheries management process. The impacts on the economies of local communities could be adverse, minor to moderate in magnitude depending on the community, long-term in duration, and could be felt throughout the North Pacific and Alaska Region. The loss of research related to highly migratory species could compromise the ability of the U.S. to comply with its international treaty obligations. The loss of collaborative research programs could also cause deterioration in the relationships between NMFS scientists and fisheries managers with the fishing industry, subsistence communities, and the public, with decreasing public trust in fisheries management regulations. The overall direct and indirect effects of the No Research Alternative on the social and economic environment would be minor to moderate in magnitude, felt across a broad geographic area, and long-term and would therefore be considered moderate adverse according to the impact criteria established in Table 4.1-1.

4.6 COMPARISON OF THE ALTERNATIVES

4.6.1 Summary of Effects on the Physical Environment

Under the three research alternatives, direct impacts to benthic habitats would occur through the use of several types of bottom-contact equipment. Bottom-contact fishing gear used in AFSC fisheries and ecosystem research activities under the three research alternatives would include bottom trawl equipment, as well as some types of equipment that are either fixed or anchored to the benthic substrate (Table 2.2-1; also see Appendix A for description of gear types). Due to the small areas affected by the bottom-contact fishing gear proposed for use under each of the three alternatives, the geographic extent of impacts would be limited to less than 0.01 percent of the total project area and would therefore be considered minor in magnitude and localized according to the impact criteria provided in Table 4.1-1.

Most disturbances to benthic habitats would be expected to recover with several months due to the action of ocean currents and natural depositions. Water quality could be affected through disturbance of bottom sediments, causing temporary and localized increases in turbidity. The potential for accidental fuel spills or other contamination from research vessels is considered small and any incidents would be rare due to the training and spill response equipment required for work on all research vessels, and adherence to Coast Guard regulations regarding safety and pollution prevention, and the experience of the NOAA Office of Marine and Aviation Operations and charter captains and crew. The overall effects on benthic habitat and water quality are considered minor in magnitude, small areas would be impacted, and the areas of impact would be dispersed over a large geographic area. The majority of impacts resulting in measurable changes to the physical environment would be temporary or short-term in duration. Overall impacts of AFSC fisheries and ecosystem research on the physical environment would therefore be considered minor adverse under all three of the research alternatives.

Under the No Research Alternative, there would be no direct impacts on the physical environment from AFSC fisheries and ecological research. However, the loss of scientific information generated by AFSC research would contribute to greater uncertainty about the effects of climate change, ocean acidification, commercial fisheries impacts, and other external factors on benthic ecosystems. Under the No Research Alternative, indirect effects could result from poorly informed decisions by resource management agencies. The loss of information from the AFSC would likely affect a large geographic area but would be minor in magnitude given other potential sources of scientific research data. Impacts to the physical environment would therefore be considered minor adverse under the No Research Alternative.

4.6.2 Summary of Effects on Special Resource Areas and EFH

Under the three research alternatives, the AFSC would conduct some fisheries and ecosystem research activities with the potential to impact special resource areas, including EFH, closed areas, HAPCs, and MPAs; however, the research activities conducted within such special resource areas would be limited. The potential effects on special resource areas resulting from AFSC research under the Status Quo Alternative are similar to those discussed for physical, biological, and socioeconomic resources elsewhere in this FPEA. The magnitude of effects on benthic habitats is relatively small and such effects would be temporary or short-term in duration. The removal of fish and invertebrates during research is also relatively small in magnitude and dispersed over time and space and unlikely to affect the populations of any species.

The analysis of research impacts within the MPAs is consistent with the relatively small and temporary or short-term effects described in general. The overall effects on special resource areas under Alternative 1 would be minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration, and would therefore be considered minor adverse according to the impact criteria listed in Table 4.1-1. In contrast to these adverse effects, the scientific data generated from AFSC research activities within special resource areas could contribute to beneficial effects on these areas and resources therein through their contribution to marine ecosystem knowledge and science-based conservation management practices.

Impacts to special resource areas under Alternative 2 would be very similar to the impacts under Alternative 1. Alternative 3 includes the potential for spatial/temporal restrictions on AFSC fisheries research as a means to reduce impacts on protected species. This provision may reduce impacts on certain areas if such closures were determined to be effective mitigation measures. However, specific determinations about potential research restrictions have not been made and it is assumed that impacts to special resource areas under Alternative 3 would be very similar to those under Alternatives 1 and 2, although they may occur in slightly different areas.

Under the No Research Alternative, there would be no direct impacts on special resource areas from AFSC fisheries and ecosystem research. However, the indirect effects on resource management agencies and conservation plans for protected areas due to the loss of scientific information would be similar to those described for the physical environment and would be considered minor adverse.

4.6.3 Summary of Effects on Fish

The AFSC conducts and funds stock assessment and habitat research for many commercially valuable and recreationally important fish species, providing the scientific basis for sustainable fisheries management. AFSC research also provides critical information on oceanographic conditions and the status of fish species that are not harvested but which play key roles in the marine food web, providing the scientific basis for NMFS goal of ecosystem-based management, as outlined in NMFS Strategic Plan for Fisheries Research (NMFS 2007). Under the three research alternatives, relatively small adverse impacts to fish populations are expected as a result of on-going research activities.

Mortality due to AFSC research is a potential negligible impact for some ESA-listed species of Pacific salmon. Only two fish from ESA-listed ESUs of Pacific salmon have been reported in AFSC surveys since 2009, so impacts to these species are expected to occur rarely and be minor adverse. The FPEA analysis provides estimates of impact to ESA-listed ESUs of Pacific salmon based on past capture rates and population size estimates under the different alternatives. These species would likely continue to be caught in the future but mortality would likely be rare and overall effects are considered minor adverse.

For most species targeted by commercial fisheries and managed under FMPs, mortality due to research surveys and projects is much less than one percent of commercial quotas and is considered to have minor adverse effects for all species in all research areas under Alternative 1 (Tables 4.2-6, 4.2.7, and 4.2-8). For species that are not managed under FMPs, research catch is also relatively small and considered to have minor adverse effects on the populations of all species. The FPEA uses an average level of catch and bycatch over the status quo period to determine the impacts of research on fish species based on their current or recent stock status and conservation concerns. However, the status of fish stocks varies over time and by fishery management region. If a future project proposes to conduct research on a fish or invertebrate stock that is overfished or depleted at the time, or if it would occur in areas and with gear that would likely result in substantial bycatch of depleted stocks, the potential effects of the proposed research project could be much greater than estimated in this FPEA and could conflict with rebuilding plans or present other conservation concerns. These future research projects may require additional NEPA analyses before they are issued research permits.

In contrast to the adverse effects of research on fish, AFSC fisheries and ecosystem research also provides long-term beneficial effects on target species populations through its contribution to sustainable fisheries management.

The suite of research programs conducted under Alternatives 2 and 3 are similar but not the same as Alternative 1; several past surveys/projects have been discontinued or modified and several new research programs are anticipated to begin in the near future. The estimated level of future research effort with different gear types (Table 2.3-1) is somewhat greater than the average annual effort described for Alternative 1. It is difficult to quantitatively estimate future catch of fish and invertebrates in this new suite of research programs given high levels of variability in fish abundance over time and space. Greater research effort does not necessarily translate into higher catch levels but, for the purposes of this FPEA, the research effort under Alternative 2 is assumed to result in a 50 percent increase in catch relative to Alternative 1. This level of catch is likely to be higher than what might actually occur and therefore provides a conservative estimate of the impacts of future research. Table 4.3-3 and Table 4.3-4 provide the same analysis of research catch relative to commercial quotas for Alternative 2 as was presented for Alternative 1, but multiplies the catch from status quo research by 1.5 to get an estimate of future research catch. The analysis indicates that overall research catch levels would still be relatively small in magnitude and the overall conclusion about the effects of AFSC fisheries and ecosystem research on fish mortality are the same for Alternatives 1 and 2.

Another potential difference with regard to research catch of fish is the potential for spatial/temporal restrictions on AFSC fisheries research under Alternative 3. If particular areas and times were determined to be important to avoid as a means to reduce impacts on protected species, research fishing and hence impacts on fish could be reduced in some locations. However, researchers may respond to spatial/temporal restrictions by redirecting research efforts to other locations such that overall research effort remains the same. Alternative 3 does not specify particular spatial/temporal restrictions but it is assumed for the FPEA analysis that overall research effort and therefore impacts to fish under Alternative 3 would be very similar to those under Alternative 2, although they may occur in somewhat different locations.

Under the No Research Alternative, there would be no direct adverse impacts on fish from AFSC fisheries and ecosystem research. However, the loss of scientific information for fisheries management could impact fish stocks through increasing uncertainty in fisheries management decisions, which could lead to potential overfishing on some stocks, uncertainty about the recovery of depleted stocks, and increasing uncertainty about the efficacy of fishing regulations designed to protect fish stocks and habitat from overfishing. Inappropriate management decisions could have minor to moderate magnitudes of effects on given stocks, depending on how fisheries managers responded to the loss of scientific information from the AFSC. These indirect effects would likely be long-term and occur over a large geographic area. The overall impacts to fish stocks under Alternative 4 are therefore considered moderate adverse.

4.6.4 Summary of Effects on Marine Mammals

The FPEA analyzes several types of potential effects of AFSC fisheries research on marine mammals, including ship strikes, contamination of the marine environment, removal of marine mammal prey, behavioral disturbance through the use of active acoustic instruments and the physical presence of researchers, and interactions with research gear. Given the same basic scope of research effort in all three research alternatives (although some details would be different), and the use of the same vessels and research gear, the potential effects from all of these factors are considered similar or the same for the three research alternatives.

No collisions with large whales have been reported from any fisheries research activities conducted or funded by the AFSC. Given the relatively slow speeds of research vessels, the presence of bridge crew watching for marine mammals during many survey activities, and the small number of research cruises, ship strikes with marine mammals during the research activities described in this FPEA would be unlikely to occur in the near future.

AFSC fisheries and ecosystem research removes very small amounts of fish, invertebrates, and plankton relative to the amount estimated to be consumed by marine mammals every year. These research removals are distributed broadly throughout the research areas in numerous brief, small sampling efforts.

These small removals are unlikely to affect the prey availability or foraging success of any marine mammals. An analysis is presented on past removals of Steller sea lion prey from designated critical habitats in the GOARA and BSAIRA which supports the general conclusion about minimal effects of AFSC fisheries research on removals of prey for marine mammals.

All NOAA vessels and AFSC chartered vessels are subject to the regulations of MARPOL 73/78, the International Convention for the Prevention of Pollution from Ships, which prohibits discharges of potentially harmful substances into the marine environment. In addition, all NOAA vessels are fully equipped to respond to emergencies, including fuel spills, and crew receive extensive safety and emergency response training. These precautionary measures help reduce the likelihood of fuel spills occurring and increase the chance that they would be responded to and contained quickly. Accidental spills of noxious compounds from research vessels could occur but would likely be rare, temporary, and localized and would be unlikely to have any adverse effects on marine mammals.

All three research alternatives would use the same type of acoustic instruments for reconnaissance and scientific mapping/survey purposes. These devices produce sounds that may be detected by marine mammals and cause changes in their behavior which would constitute Level B harassment under the MMPA. None of the AFSC acoustic equipment is likely to present risks of hearing loss or injury to any marine mammal. The AFSC LOA application (Appendix C) includes estimates of Level B harassment takes through the use of acoustic instruments in the AFSC research area using the scope of research and mitigation measures described in Alternative 2, which is assumed to be the same amount of Level B harassment that would take place under Alternatives 1 and 3 (Tables 4.2-11, 4.2-15, and 4.2-16). A detailed description of the data and analyses used to derive these take numbers can be found in the LOA application (Appendix C, Section 6.2). The numbers of Level B takes for each species are relatively small and the potential effects are likely to be temporary. The overall impact of acoustic disturbance to marine mammals under any of the three research alternatives is therefore considered to be minor adverse. As described earlier, Alternative 3 includes potential spatial/temporal restrictions that may lead to differences in where and when effects on marine mammals occur relative to Alternatives 1 and 2.

Steller sea lions and harbor seals using haulouts and rookeries in the GOARA and BSAIRA may also be disturbed by the physical presence and sounds of researchers passing nearby in boats. AFSC researchers take precautions to minimize such disturbances, yet complete avoidance of haulouts is not possible. Table 4.2-12 provides estimated numbers of harbor seals and Steller sea lions that may be exposed to Level B harassment disturbance due to the presence of AFSC researchers in the GOARA and BSAIRA. Until more accurate data becomes available through the proposed new monitoring and reporting program outlined in Alternative 2, it is assumed that 100 percent of these animals may react to AFSC research vessel activity and that multiple vessel passes from different surveys are possible. These estimated take levels are likely gross over-estimates and actual taking by harassment will be considerably smaller. This level of periodic, infrequent, and temporary disturbance is unlikely to affect the use of the region by either species.

Incidental take of marine mammals includes animals captured, hooked, or entangled in fishing gear but released without serious injury (Level A harassment under the MMPA), and incidental capture, entanglement, or hooking resulting in serious injury or mortality. Because it is impossible to predict whether future interactions will lead to serious injury or mortality or whether an animal may be released with only non-serious injury, the AFSC combined estimates for Level A harassment and serious injury and mortality in its LOA application.

Estimated take numbers are based on historical takes in AFSC fisheries research, estimates of the potential number of other marine mammal species that may interact with research gear based on their similarity (distributions, life histories, and/or vulnerabilities) to historically taken species, and historical takes in commercial fisheries operating in similar areas and using similar gear types. Historical takes include four marine mammals (two Dall's porpoises, one northern fur seal, and one northern sea otter) during AFSC research surveys from 2004 through 2015. All takes occurred in the GOARA using either surface or bottom trawl gear. There have been no research takes in either the BSAIRA or the CSBSRA. These historic data and data on mortalities in commercial fisheries using similar gear were used to estimate potential takes in the GOARA and BSAIRA. In the absence of both historical research takes and commercial fisheries in the Chukchi and Beaufort seas, takes in the CSBSRA were based on spatial and temporal overlap of marine mammal species and fisheries research effort as well as a demonstrated vulnerability to fishing gear in other areas.

The FPEA uses the estimated takes in the LOA application to assess the impacts on marine mammals for all three research alternatives in the GOARA, BSAIRA, and CSBSRA (Table 4.2-13). Future takes, if they occur, could be substantially less than the estimates since they are based on a precautionary approach to ensure accounting for a maximum level of potential take. For all stocks for which take is requested and PBR has been determined, the average annual take in all gear types and all research areas combined is less than 10 percent of PBR (Table 4.2-14). This level of mortality, were it to occur, would be considered minor in magnitude for all stocks. The AFSC take request also includes "undetermined" species (dolphin or porpoise and pinniped) takes to account for similar-looking animals that may escape from gear before being identified. For impact analysis purposes, these undetermined takes are assigned to each stock in addition to those takes requested for the particular stock. The combined take request would still be less than 10 percent of PBR for all stocks and would be considered minor in magnitude.

The main difference between the alternatives in regard to marine mammals is the mitigation measures that would be implemented to reduce the risk of marine mammal interactions with research gear. The FPEA does not attempt to quantify the effectiveness of the different mitigation measures considered in the different alternatives; the analysis provides a qualitative description of how such measures could reduce the risk of interactions with marine mammals and how their incorporation into scientific protocols may impact the fisheries research programs.

Alternative 1 represents the Status Quo conditions as they existed through 2015, although the implementation of mitigation measures has not been static over the past ten years. Alternative 1 mitigation measures for marine mammals include at least one member of the ships' crew or scientific party designated to monitor for marine mammals before any research fishing gear (trawls, gillnets, longlines, etc.) are deployed. If any marine mammals are sighted around the vessel before setting the gear, the vessel may be moved away from the animals to a different section of the sampling area if the animals appear to be at risk of interaction with the gear; this protocol is called the move-on rule. The crew standing watch continue to monitor the waters around the vessel while the gear is in the water and, if any marine mammals are sighted that appear to be in danger of interacting with the gear, the gear may be removed from the water immediately or other appropriate actions taken to reduce the risk. Standard tow and set durations have also been reduced as part of standard scientific protocols, which may help to reduce the risk of serious injuries and drowning.

Alternative 2 includes these same mitigation measures plus some additional measures and gear modifications. The AFSC proposes a series of improvements to its protected species training, awareness, and reporting procedures under Alternative 2. These include a new program for its Chief Scientists and vessel captains and crew to communicate with each other about their experiences with protected species interactions during research work with the goal of improving decision-making regarding avoidance of adverse interactions. Alternative 2 also includes new training requirements for all scientists and relevant crew members on protected species protocols to formalize and standardize the information provided to all crew that might experience protected species interactions during research activities. Written cruise instructions, protocols, and information signage on the research vessel regarding avoidance of adverse interactions with protected species will be reviewed and, if found insufficient, made fully consistent with the protected species training materials and any guidance on decision-making that arises out of the two new training programs described above. In addition, a monitoring and reporting program to facilitate tracking and, ultimately, mitigating vessel disturbance of pinnipeds on land-based rookeries and haulouts will be developed and implemented under Alternative 2. The AFSC expects these new procedures to facilitate and improve the implementation of the mitigation measures described under Alternative 1.

Alternative 3 includes the same mitigation measures as Alternative 2 but also includes a number of other potential mitigation measures that the AFSC is not proposing to implement in its LOA application. These include a number of alternative methods for monitoring for protected species (e.g., use of dedicated PSOs, night-vision goggles and passive acoustics during low visibility), gear modifications such as a camera or underwater video system to monitor interactions of protected species with trawl gear, and aircraft, unmanned aerial vehicles, or autonomous underwater gliders for additional detection capabilities. The analysis describes how these potential mitigation measures could reduce adverse impacts to marine mammals. However, some of these additional mitigation measures would have limited or no utility for mitigation, would have a serious adverse impact on the ability of the AFSC to collect certain kinds of research data, would compromise the scientific value of time-series data, and would have prohibitive impacts on the cost of research and therefore greatly reduce the scope of research that could be conducted. Some concepts and technologies considered in Alternative 3 are promising as a means to reduce risks to marine mammals and NMFS will evaluate the potential for implementation if they become more practicable.

Under the No Research Alternative, no direct adverse impacts to marine mammals from AFSC fisheries and ecosystem research (i.e., takes by gear interaction and acoustic disturbance) would occur. However, many of the AFSC research projects that would be eliminated under this alternative contribute valuable ecological information important for marine mammal management, especially for ESA-listed species and stocks considered depleted under the MMPA. The loss of information on marine mammal habitats, especially Steller sea lion critical habitat, would indirectly affect resource management decisions concerning the conservation of marine mammals, especially as time went on and uncertainty about the status of the marine environment increased. There are too many unknown variables to estimate the specific effects this lack of information could have on any particular stock of marine mammals but the No Research Alternative would likely have minor adverse effects for the foreseeable future.

4.6.5 Summary of Effects on Birds

All three of the research alternatives include the use of fishing gear (e.g., longlines and trawls,) that have had substantial incidental catch of seabirds in commercial fisheries. However, research gear is generally smaller than commercial gear and research protocols are quite different than commercial fishing practices. In particular, fisheries research trawls are much shorter in duration than commercial fisheries and catches are correspondingly less, thereby reducing the attraction of seabirds to research vessels. The overall effects on seabirds from AFSC research activities under the Status Quo Alternative are expected to be short-term in duration (except from incidental mortality in gear), infrequent or rare, distributed over a huge geographic area, and would not result in any measurable changes to seabird populations; effects are therefore considered minor adverse according to the impact criteria in Table 4.1-1. This conclusion holds for each of the three AFSC research areas and for all gear types used in research.

This FPEA also considers the potential for fisheries research to affect the habitat quality of seabirds through removal of prey and contamination of seabird habitat and, as described above for marine mammals, concludes that these effects would be minor adverse for all species. The overall effects on seabirds are therefore considered minor adverse under all three research alternatives.

Some AFSC surveys take bird biologists on board when there is bunk space available to conduct transect surveys for bird distribution and abundance in the AFSC research areas. This information as well as oceanographic information collected during AFSC fisheries and ecosystem research is used by NMFS, USFWS, and other international resource management agencies to help with bird conservation issues and is considered to have indirect beneficial effects on birds.

Under the No Research Alternative, the risk of direct adverse effects on seabirds from AFSC research would be eliminated, but there could be minor adverse indirect impacts to seabirds because resource management authorities would lose ecological information about the marine environment important to seabird conservation.

4.6.6 Summary of Effects on Sea Turtles

All three of the research alternatives considered for this analysis have the potential to adversely impact sea turtles as a result of ship strikes, entanglement in research equipment, changes in food availability, disturbances due to physical movements and sounds, and degradation of turtle habitat. However, the cold waters of Alaska are above the typical northern limits for sea turtles, so few turtles are expected to be present. There are incidental records of four species of sea turtles found in Alaska waters; showing that under certain oceanographic conditions (e.g., warmer currents), they do occur. The few numbers of turtles incidentally observed likely represent a small percentage of a larger number of sea turtles that actually occur in Alaska waters.

There are no records of sea turtles occurring in the Chukchi Sea/Beaufort Sea Research Area, so no effects would occur there. In the Bering Sea only leatherback sea turtles have been recorded. In the GOA all four species could occur and be affected, although leatherbacks and green sea turtles have been recorded much more frequently than olive ridley or loggerhead sea turtles. The potential for ship strikes, removal of prey, and contamination of marine habitat would be similar to the risks described for marine mammals; these effects are considered minor adverse for all species under all three research alternatives. Sea turtles hearing range is apparently well below the frequencies of acoustic instruments used in fisheries research so turtles are unlikely to detect these sounds or be affected by them. The AFSC has no history of interactions with sea turtles in research gear and the potential for injury or mortality under all of the research alternatives is very small. The overall effects of the research alternatives would therefore be considered minor adverse on all species of sea turtles.

As with marine mammals and seabirds, the No Research Alternative would eliminate the risk of direct adverse effects on sea turtles from AFSC research. However, there could be minor adverse indirect impacts due to the loss of AFSC fisheries and ecosystem research that could inform sea turtle conservation.

4.6.7 Summary of Effects on Invertebrates

The following discussion compares and contrasts the direct and indirect impacts of the four alternatives Summary of Effects on Invertebrates

The AFSC conducts and funds stock assessment and habitat research for many commercially valuable and recreationally important invertebrate species, providing the scientific basis for sustainable fisheries management. AFSC research also provides critical information on oceanographic conditions and the status of other invertebrate species that are not harvested but which play key roles in the marine food web, providing the scientific basis for NMFS goal of ecosystem-based management, as outlined in NMFS Strategic Plan for Fisheries Research (NMFS 2007). Under the three research alternatives, relatively small adverse impacts to fish populations are expected as a result of on-going research activities.

For most species targeted by commercial fisheries and managed under FMPs, mortality due to research surveys and projects is much less than two percent of commercial quotas and is considered to have minor adverse effects for all species in all research areas under Alternative 1 (Table 4.2-20, Table 4.2-21, and Table 4.2-22). For species that are not managed under FMPs, research catch is also relatively small and considered to have minor adverse effects on the populations of all species. The FPEA uses an average level of catch and bycatch over the status quo period to determine the impacts of research on fish species based on their current or recent stock status and conservation concerns. However, the status of fish stocks varies over time and by fishery management region. If a future project proposes to conduct research on an invertebrate stock that is overfished or depleted at the time, or if it would occur in areas and with gear that would likely result in substantial bycatch of overfished stocks or species of concern, the potential effects of the proposed research project could be much greater than estimated in this FPEA and could conflict with rebuilding plans or present other conservation concerns. These future research projects may require additional NEPA analyses before they are issued research permits.

In contrast to the adverse effects of research on invertebrates, AFSC research also provides long-term beneficial effects on target species populations through its contribution to sustainable ecosystem-based fisheries management.

The suite of research programs conducted under Alternatives 2 and 3 are similar but not the same as Alternative 1; several past surveys/projects have been discontinued or modified and several new research programs are anticipated to begin in the near future. The estimated level of future research effort with different gear types is somewhat greater than the average annual effort described for Alternative 1. It is difficult to estimate future catch of fish and invertebrates in these research programs given three conditions: 1) funding levels from Congress are variable year to year and support to conduct particular projects as scheduled may be uncertain, 2) research projects often have some element of randomized sample site selection so samples are taken from different areas every year, and 3) natural fluctuations in species abundance and distribution impacts catch rates. Given these uncertainties, the FPEA assumes that the increase in fisheries research effort under Alternative 2 would result in a 50 percent increase in invertebrate catch in overall AFSC fisheries and ecosystem survey catch. This level of catch is likely to be higher than what might actually occur and therefore provides a conservative estimate of the impacts of research. Table 4.3-5 provides the same analysis of research catch relative to commercial quotas for Alternative 2 as was presented for Alternative 1, but multiplies the Alternative 1 catch levels by 1.5 to account for expanded research effort. The analysis indicates that overall research catch levels under Alternative 2 would still be relatively small in magnitude and the overall conclusion about the effects of AFSC fisheries research on invertebrate mortality are the same for Alternatives 1 and 2.

Another potential difference with regard to research catch of invertebrates is the potential for spatial/temporal restrictions on AFSC fisheries research under Alternative 3. If particular areas and times were determined to be important to avoid as a means to reduce impacts on protected species, research fishing and hence impacts on invertebrates could be reduced in some locations. However, researchers may respond to spatial/temporal restrictions by redirecting research efforts to other locations such that overall research effort remains the same. Alternative 3 does not specify particular spatial/temporal restrictions but it is assumed for the FPEA analysis that overall research effort and therefore impacts to invertebrates under Alternative 3 would be very similar to those under Alternatives 1 and 2, although they may occur in somewhat different locations and times.

Under the No Research Alternative, there would be no direct adverse impacts on invertebrates from AFSC fisheries and ecosystem research. However, the loss of scientific information for fisheries management could impact crab, shrimp, scallop, and other species stocks through increasing uncertainty in fisheries management decisions, which could lead to potential overfishing on some stocks, uncertainty about the recovery of overfished stocks, and increasing uncertainty about the efficacy of fishing regulations designed to protect stocks and habitat from overfishing. Inappropriate management decisions could have minor to moderate magnitudes of effects on given stocks, depending on how fisheries managers responded to the loss of scientific information from the AFSC. These indirect effects would likely be long-term and occur over a large geographic area. The overall impacts to fish stocks under Alternative 4 are therefore considered moderate adverse.

4.6.8 Summary of Effects on the Social and Economic Environment

The effects of AFSC fisheries and ecosystem research on the social and economic environment are expected to be very similar under all three research alternatives. Each of these alternatives would include minor adverse effects on marine species used for subsistence and a minimal chance for AFSC fisheries research to interfere with subsistence activities. Each of these alternatives would also include important scientific contributions to sustainable fisheries management for some of the most diverse and important commercial and recreational fisheries throughout the North Pacific and Alaska Region, which benefits commercial, recreational, and subsistence fisheries and the communities that support them. These industries have regionally large economic footprints, generate millions of dollars' worth of sales and thousands of commercial fishing-related jobs, and provide millions of people across the country with highly valued seafood. Thousands of recreational fishers also participate and support fishing service industries. AFSC fisheries research activities would also have minor to moderate beneficial impacts to the economies of fishing communities through direct employment, purchase of fuel, vessel charters, and supplies. Continued AFSC fisheries research is important to build trust and cooperation between the fishing industry and NMFS scientists and fisheries managers. The overall effects of AFSC research would be long-term, distributed widely across the North Pacific and Alaska Region, and would be considered minor to moderately beneficial to the social and economic environment for all three research alternatives.

The impacts of the No Research Alternative would be the inverse of the three research alternatives. The No Research Alternative would not have a direct impact on subsistence resources or subsistence activities because there would be no actions that could affect these resources. It would likely have minor to moderate adverse impacts on the social and economic environment through greater uncertainty in fisheries management, which could lead to more conservative fishing quotas (i.e., underutilized stocks and lost opportunity) or an increased risk of overfishing, followed by reductions in commercial and recreational fisheries harvests. The lack of scientific information would also compromise efforts to rebuild depleted stocks and monitor the effectiveness of no-fishing conservation areas. These impacts would adversely affect the ability of NMFS to comply with its obligations under the MSA. It would also eliminate research-associated federal spending on charter vessels, fuel, supplies, and support services in various communities. The No Research Alternative would also have long-term adverse impacts on the scientific information the AFSC contributes to meet U.S. obligations for living marine resource management under international treaties.

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5.1 INTRODUCTION AND ANALYSIS METHODOLOGY

The CEQ defines cumulative impact as:

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

Cumulative effects are assessed by aggregating the potential direct and indirect effects of the proposed action with the impacts of past, present, and RFFAs in the vicinity of the project. The ultimate goal of identifying potential cumulative effects is to provide for informed decisions that consider the total effects (direct, indirect, and cumulative) of the project alternatives. As suggested by the CEQ handbook, *Considering Cumulative Effects Under the National Environmental Policy Act* (1997), the following basic types of cumulative effects are considered:

- Additive – the sum total impact resulting from more than one action,
- Countervailing – adverse impacts that are offset by beneficial impacts, and
- Synergistic – when the total impact is greater than the sum of the effects taken independently.

Cumulative effects may result from the incremental accumulation of similar effects or the synergistic interaction of different effects. Repeated actions may cause effects to build up over time, or different actions may produce effects that interact to produce cumulative impacts greater than (or less than) the sum of the effects of the individual actions.

As directed by CEQ's NEPA regulations (40 CFR 1502.16), this chapter discusses direct and indirect impacts on specific physical, biological, and social resources in combination with varying levels of effects, ranging from minor to major. While the effects of individual actions may be only minor, substantial cumulative effects may result from multiple actions occurring in the same geographic area. The implementing regulations of NEPA require analysis of cumulative effects in order to alert decision makers of the full consequences of all actions affecting a resource component and assess the relative contribution of the proposed action and alternatives.

Chapter 3 of this FPEA provides baseline information on the physical, biological, and social components of the environment that may be affected by AFSC research activities. Chapter 4 provides an analysis of the direct and indirect effects on these resources of the four alternatives considered in this FPEA.FPEA. Because the first three alternatives involve the continuation of AFSC research activities (referred to collectively as the research alternatives) and contribute similar effects to the cumulative effects on most resources, they are generally considered together in the following Chapter 5 analysis. The contribution of the No Research Alternative to cumulative effects is quite different and is considered separately for each resource.

5.1.1 Analysis Methodology

The cumulative effects analysis methodology is similar to the effect assessment methodology for direct and indirect effects in Section 4.1. It consists of the following steps:

1. Define the geographic area and timeframe. These may vary between resource components.

Identify external actions[12], including:

a. Past actions that have already occurred and resulted in lasting effects (see Chapter 3),

b. Present actions occurring within the same timeframe as the proposed action and alternatives (see Chapter 3), and

c. Reasonably foreseeable future actions (RFFAs), which are planned and likely to occur (see Table 5.1-1).

Evaluate the direct and indirect effects of the proposed action and alternatives along with the adverse and beneficial effects of external actions and rate the cumulative effect using the effects criteria table (Table 4.1-1).

Assess the relative contributions of the alternatives to the cumulative effects.

5.1.2 Geographic Area and Timeframe

This cumulative effects analysis considers external actions that influence the geographic areas where AFSC fisheries research activities occur. Some actions that originate outside of the AFSC research areas, such as discharge of pollutants, or actions that influence populations of highly migratory species, could potentially contribute to cumulative effects within the geographic areas of interest; such actions are considered in the analysis of cumulative effects. Other actions considered in the analysis of cumulative effects may be geographically widespread, such as those that could potentially result in climate change or ocean acidification.

5.1.3 Reasonably Foreseeable Future Actions (RFFAs)

Table 5.1-1 summarizes the RFFAs external to AFSC fisheries research that are likely to occur in the next five years and the resources they are likely to affect. This information has been collected from a wide variety of sources, including recent NEPA documents covering the Northwest marine environment, federal and state fishery agency websites and documents, U.S. Navy websites and documents, and a variety of documents concerning industrial developments such as Liquefied Natural Gas import terminals, offshore wind farms, ocean current energy projects, dredging, and ocean disposal. Wildlife management documents such as endangered species recovery plans and take reduction plans for sea turtles and marine mammals were also consulted to identify conservation concerns for different species and habitats.

Deciding whether to include actions that have already occurred, are ongoing, or are reasonably foreseeable in the cumulative impacts analysis depends on the resource being analyzed. Past, ongoing, and future actions must have some known or expected influence on the same resources that would be affected by the alternatives to be included in the cumulative impacts analysis. CEQ refers to this as the cause-and-effect method of connecting human activities and resources or ecosystems. The magnitude and extent of the effect of an action on a resource or ecosystem depends on whether the cumulative impacts exceed the capacity of the resource/ecosystem to sustain itself and remain productive over the long-term.

CEQ guidelines state that "it is not practical to analyze cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful." In general, actions can be excluded from the analysis of cumulative impacts if:

- The action is outside the geographic boundaries or time frame established for the cumulative impacts analysis.

[12] External actions are human activities other than AFSC fisheries research activities and natural occurrences that have resulted or will result in effects to the resource components that comprise the affected environment.

- The action will not affect resources that are the subject of the cumulative impacts analysis.

The action is not planned or is not reasonably foreseeable (e.g., formally proposed, planned, permitted, authorized, or funded).

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Table 5.1-1 Reasonably Foreseeable Future Actions related to AFSC Research Areas

Blank cells indicate no effects on that resource

Action	AFSC Research Area			Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	Gulf of Alaska	Bering Sea/ Aleutian Islands	Chukchi Sea/ Beaufort Sea								
Other (Non-AFSC) Scientific Research	X	X	X	Presence of additional vessel traffic Sea floor disturbance Generation of Marine debris	Habitat disturbance Contamination (Spills, Discharges)	Habitat disturbance Removal of individuals and biomass Behavioral disruptions	Behavioral displacement Loss/injury from ship strikes Noise responses	Loss from avian by-catch Potential for ship collisions (lighting attraction)	Loss/injury from ship strikes	Loss or displacement due to habitat disturbance Removal of individuals and biomass	Increased understanding of environment leading to better resource management
Federal and State Managed Commercial Fisheries	X	X		Presence of additional vessel traffic Sea floor disturbance Generation of marine debris Discards and processing waste	Habitat disturbance Contamination (Spills, Discharges) Generation of marine debris	Removal of managed targeted fisheries species By-catch removal of non-target species Habitat disturbance Behavioral disruption Loss from capture by derelict gear	Loss/injury from ship strikes Loss/injury from entanglement Noise responses Altered or reduced prey resources Behavioral displacement	Loss from avian by-catch Potential for ship collisions (lighting attraction) Alteration or reduction of prey resources	Loss/injury from ship strikes Loss/injury from turtle by-catch Loss/injury from entanglement with fishing gear	Direct loss or displacement due to bottom trawling Indirect loss or displacement due to habitat disturbance	Provision of jobs and economic opportunity Provision of food and industrial raw materials Cost of operations and gear requirements Need for catch limits for resource management Need for time/area closures for resource management
Non-commercial Fisheries	X	X		Presence of additional vessel traffic Sea floor disturbance Generation of marine debris	Habitat disturbance Contamination (Spills, Discharges) Generation of marine debris	Removal of managed targeted fisheries species By-catch removal of non-target species Habitat disturbance Behavioral disruption Loss from capture by derelict gear	Loss/injury from ship strikes Loss/injury from entanglement Noise responses Altered or reduced prey resources Behavioral displacement	Loss from avian by-catch Potential for ship collisions (lighting attraction) Alteration or reduction of prey resources	Loss/injury from ship strikes Loss/injury from turtle by-catch Loss/injury from entanglement with fishing gear	Direct loss or displacement due to bottom trawling Indirect loss or displacement due to habitat disturbance	Provision of jobs and economic opportunity Provision of recreational opportunities Provision of food
Military Operations activities in GOA)	X (Gulf of Alaska Navy Training Activities JPARC)	X	X	Contamination of water and sediment Generation of marine debris, including munitions	Contamination Generation of marine debris, including munitions	Noise effects (stress, altered behavior, auditory damage) Mortality near detonation Loss/injury from contamination Contamination of fish for human consumption	Loss/injury from ship strikes Noise effects (stress, altered behavior, auditory damage) Behavioral disturbance Displacement Injury/loss due to ingestion or entanglement in marine debris Mortality near detonation	Loss/injury due to entanglement in marine debris Potential for loss from ship collisions (lighting attraction) Behavioral disturbance Mortality near detonation Displacement	Noise effects (stress, altered behavior, auditory damage) Loss/injury from ship strikes Loss/injury from ingestion/entangleme nt in marine debris Mortality near detonation	Injury/loss due to contamination Mortality near detonation	Temporary and localized disruption of fishing due to operations Maintaining National Defense

Action	AFSC Research Area			Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	Gulf of Alaska	Bering Sea/ Aleutian Islands	Chukchi Sea/ Beaufort Sea								
Liquid Natural Gas (LNG) terminal	X			Increased turbidity (construction phase) Sea floor disturbance Presence of additional vessel traffic Provision of new underwater structures	Contamination Increased turbidity Sea floor disturbance	Loss/injury from contamination Construction related habitat disturbance Provision of new structured habitat Contamination of fish for human consumption	Loss/injury from ship strikes Noise effects (construction, vessel) Behavioral disturbance Loss/injury from contamination Loss/injury due to ingestion/entanglement in marine debris Loss/injury due to entanglement in buoy chains Alteration or reduction of prey resources	Loss/injury from contamination Loss from structure or ship collision (lighting attraction) Loss/injury due to ingestion/entanglement in marine debris Alteration or reduction of prey resources	Loss/injury from ship strikes Noise effects (construction, vessel) Behavioral disturbance Loss/injury from contamination Loss/injury due to ingestion/entanglement in marine debris Alteration or reduction of prey resources	Habitat disturbance Increased risk from invasive species due to long-distance shipping activity Loss/injury from contamination Creation of new hard substrate habitats on structures	Fishing exclusion zones may displace fisheries Provision of new jobs Increased capacity for inexpensive fuel transport and handling
Oil and Gas Exploration, Development, and Extraction	X (Cook Inlet)		X	Increased turbidity (construction phase) Sea floor disturbance	Contamination Increased turbidity Sea floor disturbance	Loss/injury from contamination Habitat disturbance Contamination of fish for human consumption	Loss/injury from ship strikes Noise effects (construction, vessels) Behavioral disturbance Loss/injury from contamination Alteration or reduction of prey resources	Loss/injury from contamination Loss from structure or ship collision (lighting attraction) Alteration or reduction of prey resources	Loss/injury from ship strikes Noise effects (construction, vessel) Behavioral disturbance Loss/injury from contamination Loss/injury due to ingestion/entanglement in marine debris Alteration or reduction of prey resources	Habitat disturbance Loss/injury from contamination	Fishing exclusion zones may displace fisheries Provision of new jobs
Vessel Traffic (Shipping)	X	X	X	Contamination of water and sediment	Increased risk from invasive species due to long-distance shipping activity Contamination	Loss due to competition or predation from invasive species Loss/injury from contamination Noise effects (stress, altered behavior)	Loss/injury from ship strikes Displacement Noise effects (stress, altered behavior) Behavioral disturbance Loss/injury due to ingestion/entanglement in marine debris	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine debris Ship collision (lighting attraction)	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine debris	Loss due to competition or predation from invasive species Loss/injury from contamination	Provision of jobs and economic opportunity
Vessel Traffic (Other)	X	X	X	Contamination of water and sediment	Increased risk from invasive species due to long-distance shipping activity Contamination	Loss due to competition or predation from invasive species Loss/injury from contamination Noise effects (stress, altered behavior)	Loss/injury from ship strikes Displacement Noise effects (stress, altered behavior) Behavioral disturbance Loss/injury due to ingestion/entanglement in marine debris	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine debris Ship collision (lighting attraction)	Loss/injury from contamination Noise effects (stress, altered behavior) Loss/injury due to ingestion/entanglement in marine debris	Loss due to competition or predation from invasive species Loss/injury from contamination	

Action	AFSC Research Area			Effect on Physical Environment	Effect on Special Resource Areas and EFH	Effect on Fish	Effect on Marine Mammals	Effect on Seabirds	Effect on Sea Turtles	Effect on Invertebrates	Effect on Social and Economic Environment
	Gulf of Alaska	Bering Sea/ Aleutian Islands	Chukchi Sea/ Beaufort Sea								
Ocean Disposal and Discharges	X	X	X	Sea floor disturbance Sedimentation	Contamination Disturbance of benthic habitats Sea floor disturbance Sedimentation	Bioaccumulation of contaminants Loss/injury from contamination Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Loss/injury from ship strike Alteration or reduction of prey resources Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Alteration or reduction of prey resources Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Alteration or reduction of prey resources Habitat disturbance	Bioaccumulation of contaminants Loss/injury from contamination Habitat disturbance	Potential indirect impact on subsistence resources
Dredging	X	X	X	Sea floor disturbance Increased turbidity	Sea floor disturbance Increased turbidity	Loss of habitat due to sea floor disturbance Displacement due to turbidity	Noise effects (stress, altered behavior) Loss/injury from ship strikes Habitat disturbance/alteration Alteration or reduction of prey resources	Noise effects (stress, altered behavior) Habitat disturbance/alteration Alteration or reduction of prey resources	Mortality by entrainment in dredge Habitat disturbance/alteration	Direct loss or displacement due to bottom trawling Indirect loss or displacement due to habitat disturbance Loss/displacement due to turbidity	
Geophysical/ Geotechnical Activities	X	X	X	Sea floor disturbance	Sea floor disturbance	Habitat disturbance Noise effects from acoustic surveys	Noise effects from acoustic surveys Loss/injury from ship strikes Behavioral disturbance	Potential for loss due to ship collisions (lighting attraction) Behavioral disturbance	Loss/injury from ship strikes Behavioral disturbance	Habitat disturbance Localized benthos disturbance	
Subsistence Harvest	X	X	X			Mortality of targeted species	Mortality/injury of targeted species Disturbance	Mortality Disturbance Loss of eggs		Mortality of targeted species Habitat disturbance	Provision of food, fur, skins
Marine Mammal Conservation Measures	X	X	X				Decreased serious injury and mortality				Cost to fisheries Displacement of personnel from fishing and other marine activities Need for time/area closures
Climate Change	X	X	X	Sea level rise, saltwater infusion in estuaries and coastal habitats Increased erosion and siltation Increased water temperatures More extreme storm events	Sea level rise, saltwater infusion in estuaries and coastal habitats Increased erosion and siltation Increased water temperatures More extreme storm events	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Unknown ecosystem level changes, variable effects on different species	Rising water levels in coastal areas Potential changes in fisheries due to ecosystem changes New regulations on greenhouse gas emissions Incentives for higher vessel fuel efficiency
Ocean Acidification	X	X	X	Increased pCO_2 Decreased pH	Decreased calcification among food web organisms Change in primary production	Potential adverse effects on prey, availability of nutritional minerals Potential direct adverse effects on growth, reproduction, development	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Potential adverse effects on prey, availability of nutritional minerals	Decreased calcification, shell hardening impaired Potential adverse effects on prey, availability of nutritional minerals	Potential effects on fisheries, especially for invertebrate species

ALCOM. 2012. Draft Environmental Impact Statement (EIS) for the Modernization and Enhancement of Ranges, Airspace, and Training Areas in the Joint Pacific Alaska Range Complex in Alaska. Volume 1. 776pp. Available online at www.jparceis.com.

DoN. 2011. Gulf of Alaska Navy Training Activities Preliminary Final Environmental Impact Statement/Overseas Environmental Impact Statement. Volume 1, Chapters 1-9. Commander, U.S. Pacific Fleet, Environmental-N01CE1, 250 Makalapa Dr., Bidg 251, Pearl Harbor, HI 96860-3131. 804pp. http://goaeis.com/Portals/GOAEIS/files/EIS/GOA_FEIS_Volume_I.pdf

BOEM. 2012. Outer Continental Shelf Oil and Gas Leasing Program: 2012-2017, Final Programmatic Environmental Impact Statement. OCS EIS/EA BOEM2012-030. U.S. Dept of the Interior, Bureau of Ocean Energy Management.

NMFS. 2011. Effects of Oil and Gas Activities in the Arctic Ocean Draft Environmental Impact Statement. US Dept. Commerce, NOAA, NMFS, Office of Protected Resources.

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5.2 CUMULATIVE EFFECTS ON THE PHYSICAL ENVIRONMENT

Activities external to AFSC fisheries research that have occurred and are expected to continue to occur in the future and could potentially affect the physical environment in the GOARA, BSAIRA, and CSBSRA may include other scientific research, federal and state managed fisheries, other fishing operations, military operations, vessel traffic, ocean disposal and discharges, dredging, coastal development, geophysical activities, climate change, ocean acidification, and natural disasters. The potential effects of these activities are summarized in Table 5.1-1 and include:

- Seafloor disturbance and potential loss of benthic habitat
- Presence of vessel traffic and survey equipment
- Generation of marine debris
- Contamination of water and sediments
- Increased turbidity and sedimentation and re-suspension of sediments
- Effects of climate changes such as water temperatures and sea level rise
- Increased pCO_2 and decreased pH
- Effects of natural disasters such as increased erosion and siltation

5.2.1 External Factors in the AFSC Research Areas

The physical environment of the Pacific and Arctic oceans off Alaska has been affected by human activity since humans first lived along these coasts. Until recent times, however, the magnitude of the effects was limited. With the advent of substantial coastal development and exploitation of resources from the ocean environment, cumulative impacts on the physical environment have increased. Within the AFSC research area, the physical environment continues to experience impacts resulting from both natural and anthropogenic factors, including climate change, ocean acidification, seafloor disturbance from commercial fisheries, substrate disturbance from geophysical/geotechnical activities, oil spills and other discharges from vessel accidents, including major disasters such as the *Exxon Valdez* oil spill, runoff and airborne contamination from terrestrial systems, and discharge of plastics and other debris into the marine environment. Sources of effects to the physical environment from RFFAs are identified in Table 5.1-1.

Activities that physically disturbed the seafloor include bottom-contact fishing activities, which can be can repeatedly impact large areas of the seafloor on a repeated basis in heavily fished areas (i.e., shelf areas of the Bering Sea where the pollock trawl fleet concentrates their efforts). However, much of this fishing takes place on sedimentary substrates which recover in relatively short time periods due to natural water currents and sedimentation (Stevenson et al. 2004). Other types of disturbance such as off-shore developments tend to have longer-term effects but affect smaller areas. Other activities that could affect more localized areas include nearshore developments, the laying of underwater cables and pipelines, channel dredging, and construction of various offshore developments such as oil platforms in Cook Inlet and oil production islands in the Beaufort Sea. These activities cause re-suspension of sediments into the water column, changes in bathymetric contours, and permanent loss of benthic habitat. Proposed development of large, offshore energy projects have the potential for long-term effects, but impacts would likely be limited to the areas immediately adjacent to the projects. Such projects would be evaluated for environmental effects, including cumulative effects, before they would be permitted by the appropriate federal agency.

Contamination from spills and discharges can accumulate in the seafloor and marine life and have a toxic effect on the plants, animals and humans through the food chain (NOAA 2010d). There are several potential sources of both direct and indirect marine contamination, including tankers and other marine vessels, military operations, ocean dumping, airborne deposition, and runoff from industrial sources on land. Some chemical compounds, such as polychlorinated biphenyl and pesticides, can persist for many years while others, such as petroleum products, breakdown relatively quickly. Similarly, marine debris can affect the physical environment (NOAA 2010b) but most of these effects are manifested through impacts to biological systems, which are discussed in other sections of this document. Pollution is a long-term and widespread issue in the marine environment, although it varies substantially in intensity on a local basis. In recent years there has been a concerted national and international effort to reduce pollution of ocean environments through restrictions on discharges and design features of ocean-going vessels that reduce the probability and severity of spills. As a result, although the historic problems remain, recent incidents involving unauthorized spills or discharges have either been localized and limited or, if large and widespread, have generated significant cleanup and mitigation responses. Broadly speaking therefore, the cumulative effects of pollution and contamination on water quality of the AFSC research areas is expected to be minor to moderate and adverse from sources external to AFSC fisheries research.

Climate change may affect the marine environment in a variety of ways, including changes in sea level, changes in water temperatures, extreme weather events, and alteration of ocean currents. These changes and others are expected to continue over the reasonably foreseeable future and could aggregate with the effects of industrial activity to impact the physical environment. These changes contribute in turn to changes in the population and distribution of marine fish, mammals, seabirds, and turtles; changes in the population and distribution of fishery resources harvested in commercial fisheries, with related socioeconomic effects; and changes in FMPs to address potential climate change effects.

In addition to changes in air and water temperatures, a related effect of climate change is increased acidification in the ocean caused by dissolved carbon dioxide (CO_2). Changes in the acidity of the world's oceans are expected to continue and accelerate over the reasonably foreseeable future (United States Geological Survey [USGS] 2011). Ocean acidification can harm organisms that build shells of calcium carbonate, including calcareous phytoplankton and zooplankton, corals, mollusks, and crustaceans. These organisms provide shellfish resources for humans, play vital roles in marine food webs, and add to the physical structure of the ocean floor (NEA 2010). Although the dynamics of climate change and the potential magnitude and timing of its effects are poorly understood, there is general acknowledgement that the potential impacts resulting from climate change could be substantial.

5.2.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on the physical environment in the AFSC Research Areas are discussed in Sections 4.2.1, 4.3.1, and 4.4.1. Direct and indirect effects to benthic habitat (seafloor disturbance) would be minor and adverse. Since no ocean disposal or discharges would be authorized for AFSC research activities under the research alternatives, there would be no contribution to cumulative effects from this action. There is the potential for accidental spills to occur. However, given the high degree of emphasis placed on safety and emergency preparedness on NOAA vessels and Coast Guard requirements for training and safety equipment on commercial vessels, the magnitude of these potential spills is likely to be very small and the contribution of fisheries research to the cumulative effects of contamination is considered minor.

Although CO_2 emissions from AFSC research vessels would contribute to atmospheric CO_2 levels, the contribution would be minor compared to other natural and anthropogenic CO_2 sources. When aggregated with the impacts of past, present, and RFFAs in the vicinity of the AFSC research areas, AFSC research activities would make a minor additive contribution to cumulative adverse effects on the physical environment under each of the research alternatives.

Fisheries research programs contribute to the understanding of changes in the physical environment, including those associated with climate change and ocean acidification. Continued fisheries research programs with long-term data sets are essential to understanding changes in the physical and biological environment, and allowing NMFS to take appropriate management actions. AFSC fisheries research therefore makes a beneficial contribution to cumulative effects on the physical environment.

5.2.3 Contribution of the No Research Alternative

The No Research Alternative would eliminate the risk of direct adverse impacts to physical resources within the AFSC research areas resulting from AFSC research activities. However, many of the AFSC projects that would be eliminated under this alternative generate a great deal of information that, when combined with research conducted by other branches of NOAA and other agencies and institutions is used to monitor the effects of climate change, ocean acidification, and other changes in the physical environment. It may also be used by resource managers to limit fishing-related impacts to physical habitat such as disturbance of benthic habitat from trawls and other bottom-contact gear. Without the input of AFSC data, management authorities would lose important information needed to establish management measures in a meaningful fashion, and current conservation measures in place to protect physical properties of the environment would become less effective. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios. Through these indirect effects on future management decisions, the contribution of this alternative to adverse cumulative impacts on physical resources would be minor to moderate depending on how well other agencies would be able to compensate for the loss of AFSC research.

5.3 CUMULATIVE EFFECTS ON SPECIAL RESOURCE AREAS AND EFH

Activities external to AFSC fisheries research that could potentially affect special resource areas in the GOARA, BSAIRA, and CSBSRA may include commercial and recreational fisheries, coastal development, tourism, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Contamination resulting from spills or discharges
- Presence of additional vessel traffic
- Habitat disturbances
- Increased risk of invasive species introductions resulting from long-distance shipping activity
- Effects of climate change such as increased water temperatures and sea level rise
- Effects of ocean acidification such as decreased calcification among food web organisms

5.3.1 External Factors in the AFSC Research Areas

As described in Section 3.1.2, Special Resource Areas include EFH, HAPC, and MPAs. The cumulative effects of activities that disturb the seafloor in special resource areas are similar to those discussed for the physical environment in Section 5.2.1. Cumulative impacts to biological resources within special resource areas are discussed in Sections 5.4 through 5.8. Cumulative effects from, dredging, military operations, and geophysical exploration would be considered as part of the Federal permitting processes required for these activities. Contributions to cumulative effects from such activities would be limited by permit conditions and mitigation measures required by permitting agencies.

Adverse impacts from commercial and recreational fishing, especially those using bottom-contact fishing gear, could be substantial in heavily fished areas and could affect EFH and HAPC areas to various degrees. The cumulative effect from all external sources of disturbance to special resource areas is expected to be minor to moderate.

5.3.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on special resource areas are discussed in Sections 4.2.2, 4.3.2, and 4.4.2. When aggregated with the impacts of past, present, and RFFAs in the vicinity of the project, AFSC research activities would make a minor additive contribution to cumulative adverse impacts to special resource areas in the GOARA, BSAIRA, and CSBSRA under each of the three research alternatives. While there are no intentional discharges of pollutants from fisheries research vessels there is potential for accidental spills to occur. However, the magnitude of these potential spills is likely to be very small and the contribution of fisheries research to the cumulative effects of contamination is considered minor.

AFSC fisheries research programs contribute to understanding the status of special resource areas, including changes to EFH associated with climate change and ocean acidification. Continued fisheries research programs with long-term data sets are essential to understanding changes in the physical and biological environment within special resource areas, which by definition have special management needs. AFSC fisheries research therefore has a beneficial contribution to cumulative effects on special resource areas in addition to the minor adverse effects.

5.3.3 Contribution of the No Research Alternative

The No Research Alternative would result in elimination of any direct impacts from AFSC fisheries research to special resource areas that could potentially occur under each of the research alternatives.

However, the AFSC research activities proposed under the research alternatives would generate information important to resource managers to monitor species and habitat recovery, environmental changes, and the effectiveness of conservation measures for special resource areas. This type of information is especially important for management of special resource areas designated to protect and conserve natural resources that are susceptible to natural fluctuations and anthropogenic impacts. Although resource management agencies have other available data sources to support resource management decisions, the No Research Alternative is expected to result in increased uncertainty and changes in some management scenarios that may affect a few local areas. Through these indirect effects on future management decisions, the contribution of this alternative to cumulative impacts on special resource areas, including EFH, HAPC, and MPAs, would be minor adverse.

5.4 CUMULATIVE EFFECTS ON FISH

Activities external to AFSC fisheries research that could potentially affect fish species are generally similar among the three AFSC fisheries research areas with the exception of having no commercial fisheries in the CSBSRA. These external factors include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil and gas exploration, vessel traffic, other scientific research, military operations, climate change, and ocean acidification. These activities and potential effects are summarized in Table 5.1-1 and include:

- Injury or mortality due to directed catch or bycatch in commercial and recreational fisheries
- Habitat disturbances
- Changes in distribution and food availability due to climate change or habitat degradation

5.4.1 ESA-Listed Species

5.4.1.1 External Factors in the AFSC Research Areas

ESA-listed fish species in the AFSC research areas include multiple ESUs of Pacific salmon and multiple DPSs of steelhead. The past, present, and reasonably foreseeable future activities, external to AFSC fisheries research, that have or are likely to have the greatest effect on endangered fish in the region are intentional and incidental mortalities in commercial and recreational fisheries, dam construction on spawning streams and other habitat alterations, and periodic short-term and longer term climate changes.

Pacific salmon and steelhead populations have been historically strong in Alaska and remain so today. However, multiple factors including habitat degradation or loss from dams, construction, and dredging; pollutant discharges; and overfishing have contributed to large reductions in several spawning stocks of Pacific salmon or steelhead originating from freshwater habitat in Washington, Oregon, Idaho, and California and many of these are listed under the ESA. Coded wire tag retrieval data (Brase and Sarafin 2004) has shown that some of these fish migrate into marine waters off Alaska. However, it is not known what proportion of salmon are from ESA-listed stocks in any area of Alaska, especially as a function of season.

In Alaska, there are numerous commercial fisheries that target Pacific salmon or intercept them as bycatch. Guthrie et al. (2013) analyzed 240 samples of Chinook caught in GOARA commercial pollock trawl fisheries in 2011 and found that 26 percent of those were from West Coast Chinook populations. In the BSAIRA, 2,473 Chinook genetic samples were taken from commercial pollock trawls and the results indicated that approximately 6 percent of fish were from Washington, Oregon, Idaho, or California. Recent amendments to GOA and BSAI FMPs more closely monitor and reduce salmon bycatch in commercial fisheries; the effects of these efforts on salmonid bycatch rates, and by extension their potential impacts on ESA-listed stocks have been analyzed in EAs and in ESA Section 7 consultations.

The environmental effects of climate change could be extensive in geographic area and long-term in duration and could therefore have major cumulative effects on ESA-listed salmonids. Some fish species are likely to benefit from changes in the marine environment while others will experience adverse effects. Pink and chum salmon presence in the CSBSRA has been shown to be potentially significant (Moss et al. 2009) and these populations may be affected by impacts to the area through direct loss of ice habitat and ocean acidification which could influence survival and availability of prey. Related distribution changes and population declines are possible as noted in Grebmeier (2012) and Doney et al. (2012). Anadromous fish species e.g., Pacific salmonids may also be affected by changes in river ecology due to altered precipitation, sea-level rise, water temperature and other factors (see Beamish et al. 2009). The nature and magnitude of potential climate change effects are, however, very difficult to predict with certainty.

The activities external to AFSC fisheries research affecting ESA-listed fish will likely continue into the foreseeable future (Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.4.1.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on ESA-listed fish are discussed in Sections 4.2.3, 4.3.3, and 4.4.3. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The known take level of ESA-listed salmonids in AFSC fisheries research is exceedingly small (two fish from all AFSC surveys during the 2009-2013 survey period). When considered in conjunction with commercial and recreational fisheries, and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed fish in the AFSC Research Areas, the contribution of AFSC fisheries research activities to cumulative effects would be minor and adverse.

5.4.1.3 Contribution of the No Research Alternative

Under the No Research Alternative, the AFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in marine waters of the Gulf of Alaska, Bering Sea, Aleutian Islands, Chukchi Sea, and Beaufort Sea considered in the scope of this FPEA, so would not directly contribute to cumulative effects on ESA-listed species in these regions. Although directed research on ESA-listed species is not considered in the scope of this FPEA, the absence of AFSC research surveys on other fish stocks and environmental conditions important to ESA-listed species would have an adverse impact on the ability of resource managers to monitor the recovery of these species, track the health of their habitats, and implement effective fishery regulations and other conservation strategies for these species.

Ceasing or interrupting long-term data series on oceanography, abundance and distribution of various species, and diet studies (many surveys have roots in the early 1980s) would have long-term adverse effects on the ability of scientists to monitor and model effects of ecosystem changes important to ESA-listed species. The lack of information and increasing uncertainty about the status of fish stocks and their habitats would have serious implications for fisheries management. The indirect effects of the No Research Alternative could, therefore, impact ESA-listed species through a lack of information essential for informed decision making and conservation of the species, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on ESA-listed species is difficult to ascertain, but given the much greater importance of freshwater habitat issues on the West Coast for these stocks, will likely have minor adverse impacts on conservation management of these species.

5.4.2 Prohibited Species

5.4.2.1 External Factors in the AFSC Research Areas

Prohibited fish species (as defined in Section 3.2.1.2) that occur within AFSC research areas include Pacific halibut, Pacific herring and, as discussed earlier, Pacific salmon. The effects of AFSC research catches of Pacific salmon are described in the ESA-listed species section above; Pacific halibut and Pacific herring are discussed here. The past, present, and reasonably foreseeable future activities, external to AFSC fisheries research, that have or are likely to have the greatest effect on prohibited fish species in the region are intentional and incidental mortalities in commercial and recreational fisheries, habitat alterations, and periodic short-term and longer term climate changes.

Pacific halibut has been commercially fished in the Pacific Northwest, Canada, and Alaska since the 1880s (IPHC 2015). In the 1910s, a decline in the fishery was observed so the industry petitioned the governments of the U.S. and Canada to assist with management control. A treaty was signed in 1923 creating the organization now known as the IPHC, which manages the halibut fishery through regulation and quotas. The 2015 coast-wide quota in all halibut target sectors is 13,255 mt. Additional management measures, such as bycatch reductions in Bering Sea commercial groundfish fisheries (NPFMC 2015a) and catch sharing for guided sport fisheries (78 FR 75844) have been passed by the NPFMC in the last few years.

Pacific herring also represent a vibrant commercial fishery. All commercial fishing is done in Alaska state waters, primarily on fish returning to estuaries for spawning and management is partly based on the amount of spawning fish. The total commercial statewide 2013 quota of Pacific herring was 69,986 mt, small relative to the 2015 eastern Bering Sea biomass estimate of 217,153 mt (79 FR 72571). The prohibited species cap for herring in the BSAIRA groundfish fisheries is set at 1 percent of the annual BSAI herring biomass (2,172 mt in 2015, 79 FR 72571).

The effects of climate change could be extensive in geographic area and long-term in duration and could therefore have major cumulative effects on fish species. Some fish species are likely to benefit from changes in the marine environment while others will experience adverse effects. Anadromous fish species (e.g., Pacific salmon) may also be affected by changes in river ecology due to altered precipitation, sea-level rise, water temperature and other factors (see Beamish et al. 2009). The nature and magnitude of potential climate change effects are, however, very difficult to predict with certainty.

The activities external to AFSC fisheries research affecting prohibited fish species will likely continue into the foreseeable future (Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.4.2.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on prohibited Pacific herring and Pacific halibut are discussed in Sections 4.2.3, 4.3.3, and 4.4.3. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The known catch level of prohibited species in AFSC fisheries research is very small when considered in conjunction with commercial and recreational fisheries. When aggregated with other past, present, and reasonably foreseeable future activities affecting prohibited fish in the AFSC Research Areas, the contribution of AFSC fisheries research activities to cumulative effects would be minor and adverse.

5.4.2.3 Contribution of the No Research Alternative

Under the No Research Alternative, the AFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in marine waters of the BSAIRA and GOARA so would not directly contribute to cumulative effects on prohibited species in these regions. Although directed research on prohibited species is not considered in the scope of this FPEA, the absence of AFSC research surveys on other fish stocks and environmental conditions important to prohibited species would have an adverse impact on the ability of resource managers to monitor incidental catch rates of these species, track the health of their habitats, and implement effective fishery regulations and other conservation strategies for these species. Ceasing or interrupting long-term data series on oceanography, abundance and distribution of various species, and diet studies (many surveys have roots in the early 1980s) would have long-term adverse effects on the ability of scientists to monitor and model effects of ecosystem changes important to prohibited species. The lack of information and increasing uncertainty about the status of fish stocks and their habitats would have serious implications for fisheries management. The indirect effects of the No Research Alternative could, therefore, impact prohibited species through a lack of information essential for informed decision making and conservation of the species, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on prohibited species is difficult to ascertain, but will likely have moderate adverse impacts on conservation management of these species.

5.4.3 Target and Other Species

5.4.3.1 External Factors in the AFSC Research Areas

Target species are those managed for commercial fisheries, belong to a species category defined in the regional FMP, and are the subject of AFSC research surveys for stock assessment purposes. The other species considered here are generally not targeted by commercial or recreational fishers but may be caught in substantial numbers as bycatch. These recreational and commercial fisheries are the primary past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on these species external to AFSC fisheries research. The numerous target species in the GOARA and BSAIRA are managed by NMFS with directives from the NPFMC in compliance with their respective FMPs; those which are caught most frequently in AFSC research are shown in Table 3.2-2 and Table 3.2-3. There is a moratorium on commercial fisheries in the CSBSRA but a list of species caught in AFSC fisheries and ecosystem surveys is shown in Table 3.2-5. Other species that may be caught during AFSC research surveys are often monitored as part of ecosystem-based management efforts even if they are not subject to stock assessments. The analysis of effects in Chapter 4 focused on those species most frequently caught in AFSC research activities (Table 4.2-7, Table 4.2-8, and Table 4.2-9). The cumulative effects analysis will take a similar approach.

No target species encountered during AFSC surveys are considered overfished or approaching an overfished status (Table 3.2-2, Table 3.2-3, and Table 3.2-5; NMFS 2015g). However, multiple species and stocks are of unknown status.

Walleye pollock has been an important component of Alaska fisheries for over fifty years. A significant fishery targeted fish from the Bogoslof stock until an apparent decline in the 1980s led to a moratorium on fishing in the central Bering Sea in 1994 (Convention on the conservation and management of pollock resources in the Central Bering Sea 1994). Stocks within the U.S. EEZ since that point have remained stable and represent the largest single-species fishery in Alaska, with EBS catches greater than 1 million mt for all but four years since 1984 (NPFMC 2014d). Pollock is also a major fishery in the GOA with commercial landings greater than 50,000 mt for all but three years since 1974 (NPFMC 2014e). Other commercially important target species include Pacific cod, arrowtooth flounder, and rockfishes in the GOARA and Pacific cod, yellowfin sole, and rock soles in the BSAIRA. Stocks in both areas are considered healthy and not overfished.

The environmental effects of climate change could be extensive in geographic area and long-term in duration and could therefore have major cumulative effects on fish species. Some fish species are likely to benefit from changes in the marine environment while others will experience adverse effects. The nature and magnitude of potential climate change effects are, however, very difficult to predict with certainty.

The number of vessels traversing Arctic waters, including those used in research, offshore oil and gas exploration, military operations, and shipping, has increased in recent years and is projected to continue to increase (TRB 2008). Decreasing summer sea ice is increasing the likelihood of expanded trans-Arctic shipping routes in coming years (Smith and Stephenson 2013). Increased vessel traffic in the CSBSRA and poorly charted waters lead to increases in the risk of contaminant discharges.

Current and projected offshore oil and gas exploration and development in the Chukchi and Beaufort Seas could impact fish and ecosystem resources. Potential effects include vessel collisions, discharge of contaminants, and oil spills. Effects of oil spills on fish species can include displacement, impacts on prey resources, impacts on habitat, and impacts on animal health (e.g., survival, reproductive potential, and death).

The activities external to AFSC fisheries research affecting target species will likely continue into the foreseeable future (Table 5.1-1). The level of impact will depend on the application and efficacy of FMPs and habitat protection measures. Natural population fluctuations and periodic short-term and longer term climate changes also affect population viability and stock sizes. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.4.3.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on target and other fish are discussed in Sections 4.2.3, 4.3.3, and 4.4.3. Mortality of target and other species in the GOARA and BSAIRA due to AFSC fisheries research represents a small fraction of that allocated to commercial fisheries. The average annual catch of target species during AFSC research surveys (Table 4.2-7 and Table 4.2-8) is generally much less than one percent of the annual average commercial quotas of these species. In the CSBSRA, there is a moratorium on commercial fishing, so there are currently no sources for abundance and diversity data from the CSBSRA other than AFSC research surveys and existing data. Research surveys provide a reliable way to monitor both valuable and under-exploited species and can inform decisions about abundance.

The comparisons made in Table 4.2-7, Table 4.2-8, and Table 4.2-9 indicate that, while mortality to fish species is a direct effect of the AFSC fisheries and ecosystem surveys, the magnitude of this mortality is very small relative to other sources of mortality and the overall populations of these species.

When considered in conjunction with commercial fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting target and other fish species in the three AFSC research areas, the contribution of AFSC fisheries research activities to the adverse cumulative effects on these species would be minor adverse under all three research alternatives. The AFSC fisheries and ecosystem research program also makes a beneficial contribution to cumulative effects on fish through their role in providing scientific information to the commercial fisheries management process which strives to maintain sustainable populations. The beneficial value of fisheries research to a range of future management challenges from fishing to climate change is quite substantial and helps to address a range of adverse cumulative effects.

5.4.3.3 Contribution of the No Research Alternative

Under the No Research Alternative, the AFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in marine waters of Alaska, so would not directly contribute to cumulative effects on fish species in this region. In the absence of research surveys, important scientific information would not be collected about the status of fish stocks used for fisheries and conservation management, including trends in abundance, recruitment rates, and the amount of fish being harvested relative to overfishing metrics. These surveys provide scientific advice, data, and analyses directly to the NPFMC, information from which is used to develop and amend various FMPs. This lack of data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, and rebuild depleted stocks.

Ceasing or interrupting long-term data series on oceanography, abundance and distribution of various species, and diet studies (many surveys have roots in the early 1980's) would have long-term adverse effects on the ability of scientists to monitor and model effects of ecosystem changes. The lack of information and increasing uncertainty about the status of fish stocks and their habitats would have serious implications for fisheries management. The indirect effects of the No Research Alternative could, therefore, impact stocks of all fish species through a lack of information essential for prudent decision making and conservation of fish, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on target and other species is difficult to ascertain, but will likely have moderate adverse impacts on the long-term monitoring ability of NMFS or other agencies and the management capabilities for numerous economically and ecologically important species.

5.5 CUMULATIVE EFFECTS ON MARINE MAMMALS

Activities external to AFSC fisheries research that may potentially affect marine mammals in the GOARA, BSAIRA, and CSBSRA include commercial and recreational fisheries, vessel traffic, ocean discharges, dredging, geophysical activities, oil and gas exploration and extraction, other scientific research, military operations, subsistence harvests, conservation measures, and climate change. These activities and potential effects are summarized in Table 5.1.1 and include:

- Disturbance/behavioral changes or physical effects from anthropogenic noise (e.g., marine vessels of all types, military operations, navigational equipment, seismic surveys, construction)
- Injury or mortality due to vessel collisions, entanglement/hooking in fishing gear, subsistence harvests, and contamination of the marine environment
- Changes in food availability due to prey removal, ecosystem change, or habitat degradation

5.5.1 Gulf of Alaska Research Area

5.5.1.1 ESA-listed Species

<u>External Factors in the GOARA</u>

The endangered marine mammal species in the GOARA include the Cook Inlet DPS of beluga whales, sperm, humpback, blue, fin, sei, and North Pacific right whales, and the Western DPS of Steller sea lions. Threatened species include the Southwest Alaska DPS of the northern sea otter.

Commercial whaling was the single greatest historical source of mortality for the endangered whale species (except beluga whales) (Perry et al. 1999). Although right whales received legal protection from commercial whaling in 1935 (Perry et al. 1999), illegal whaling by the Soviet Union continued into the 1960s and nearly extirpated North Pacific right whales in the GOA (Wade et al. 2011a). Commercial harvests of sperm whales ended worldwide in 1986 (NMFS 2010b). Humpback whales and blue whales were protected in 1966 (NMFS 1998, Perry et al. 1999). The IWC banned hunting of fin whales throughout the North Pacific in 1976 (Perry et al. 1999). Hunting of sei whales in the eastern North Pacific ended after 1971 and after 1975 in the western North Pacific (Perry et al. 1999). Subsistence mortalities were the presumed cause of a 50% decline in Cook Inlet beluga abundance from 1994 to 1998. The population is not recovering despite harvest management measures implemented since1998 (Hobbs and Shelden 2008).

Commercial harvests of sea otters for their pelts during the 18th and 19th centuries nearly extirpated the species throughout its range. Sea otters received protection under the International Fur Seal Treaty of 1911 (USFWS 2010). The more recent cause for decline in southwest Alaska is uncertain.

Past, present, and reasonably foreseeable future conservation concerns and threats to recovery are outlined in the respective recovery plans for the ESA-listed species for which plans exist. Those for blue whales (NMFS 1998), humpback whales (NMFS 1991), sperm whales (NMFS 2010b), fin whales (NMFS 2010a), sei whales (NMFS 2011), North Pacific right whales (NMFS 2013b), Steller sea lions (NMFS 2008c), and the southwest Alaska DPS of the northern sea otter (USWFS 2010) were finalized or recently drafted or updated. The draft recovery plan for Cook Inlet beluga whales was published in May 2015 (NMFS 2015d). Noted conservation concerns and threats include vessel collisions, entanglement in fishing gear, anthropogenic noise, vessel/human disturbance, pollutants and pathogens, disease, habitat degradation, competition with fisheries for prey, subsistence harvest, and climate change.

Vessel collisions are considered potential threats for several endangered large whales. A variety of marine vessels traverse coastal and offshore waters of the GOA, including tankers, container ships, cargo ships, ferries, fishing boats, cruise ships, military and scientific vessels, whale-watching boats, and recreational boats. The two major ports in the GOA are in Anchorage and Valdez. The Port of Anchorage (POA) is the only intermodal deep-water port in Alaska, operates year-round, and provides dockage and services to a variety of ships, including bulk tankers, break bulk ships, tugs/barges, military vessels, container ships, and cruise ships. On average, there are 450 vessel-calls per year at the POA. (http://portofalaska.com/operations/facilities.html). The Valdez Marine Terminal is the southern end of the Trans-Alaska Pipeline System in Prince William Sound and was designed for both crude oil storage and for loading crude onto tankers (http://www.alyeska-pipe.com/TAPS/ValdezTerminalAndTankers).

Whale-vessel collisions occur in Alaskan waters, albeit infrequently. Neilson et al. (2012) summarized reported collisions in Alaska from 1978 to 2011. All but one unidentified whale was in the GOARA. Of the 89 definite and 19 probable ship strikes, 25 resulted in mortality. Nearly all (98%) collisions occurred during May to September and most frequently in southeastern Alaska. Most (86%) involved humpback whales, predominantly in southeastern Alaska where the number of collisions increased 5.8% per year, 1978-2011. Small vessel (<15 m) strikes were most common (60%), followed by medium (15–79 m, 27%) and large (≥80 m, 13%) vessels. Large vessels (190–294 m) were involved in fatal collisions for which vessel length was known and vessel speed was 12-19 knots in the three cases in which it was known. There were two reports of ship strikes of fin whales and none of blue or sperm whales in Alaskan waters between 2009-2013 (Muto and Angliss 2015). The western and central North Pacific stocks of humpback whales averaged 0.2 and 1.9 mortalities or serious injuries per year, respectively, due to ship strikes in Alaska during that same time period (Muto and Angliss 2015). Although there are no reports of vessel collisions, the possible impact of ship strikes on the recovery of North Pacific right whale populations is poorly understood. Ship strikes are a significant cause of injury and mortality for North Atlantic right whales, suggesting equal vulnerability of North Pacific right whales to such threats. However, their rare occurrence and scattered distribution make it impossible to adequately assess the threat of ship strikes to North Pacific right whales at this time (Muto and Angliss 2015, NMFS 2013b).

Vessel traffic, via engine noise, propeller cavitation, and sonar equipment, also contributes to anthropogenic noise in the marine environment that may elicit changes in marine mammal behavior or interfere with communication through masking. Anthropogenic noise and acoustic disturbance are listed as potential threats to ESA-listed marine mammals in their respective Recovery Plans, although with unknown effects and a great deal of uncertainty. Potential impacts of anthropogenic noise are further discussed in Section 4.2.4.1.

Entanglement/hooking in fishing gear is another concern for several ESA-listed species. Overall, the level of take for ESA-listed marine mammals in the GOARA is relatively low. There are no commercial fisheries mortalities or serious injuries documented for blue, sei, North Pacific right whales, or Cook Inlet beluga whales in Alaska waters. A juvenile beluga whale entangled in a special use subsistence fishery salmon net in 2012 is the only known reported fisheries-related mortality of a Cook Inlet beluga whale in over ten years (Muto and Angliss 2015). One observed incidental mortality of a fin whale due to entanglement in ground tackle of a commercial mechanical jig fishing vessel occurred in 2012. This is the only known fisheries-related mortality in Alaska between 2009 and 2013, for an average of 0.2 takes per year (Muto and Allen 2015). There are no records of fin whale entanglement in fishing gear. Sperm whale depredation, well documented in the sablefish longline fishery and most prevalent from the central GOA to Southeast Alaska, leaves sperm whales vulnerable to entanglement (Sigler et al. 2008). The mean annual take of sperm whales by the Gulf of Alaska sablefish longline fishery was 0.8 from 2009 through 2013, based on four observed serious injuries (Muto and Angliss 2015). The estimated annual average mortality rate of Western North Pacific humpback whales incidental to U.S. commercial fisheries, 2009-2013, is 0.8 whales per year (0.6 in observed fisheries and 0.2 based on stranding database records). Since the observed takes occurred where the Western and Central North Pacific stocks overlap and stock identification is unknown, these mortalities and serious injuries are included in both stock assessments. For Central North Pacific humpback whales, the annual average mortality rate incidental to U.S. fisheries in Alaska for 2009-2013 is 6.3 whales per year (0.6 in observed BSAI fisheries, 5.5 in state-managed

Southeast Alaska salmon driftnet fishery, and 0.2 from strandings and reports in Alaska where a fishery is confirmed) (Muto and Angliss 2015). Fisheries and gear involved in humpback entanglements include the BSAI flatfish and pollock trawl fisheries, the Southeast Alaska salmon drift gillnet fishery, unspecified gillnet and pot gear, recreational shrimp pot gear, and unspecified crab pots and longlines (Muto and Angliss 2015). Studies in Southeast Alaska indicate that 71% of humpback whales have experienced non-lethal entanglements at some time during their lives (Neilson et al. 2009). The Western DPS of Steller sea lions experienced mortality or serious injury through interactions with commercial fisheries in the GOA, including the GOA Pacific cod longline (0.2 per year, 2009-2013), GOA Pacific cod trawl (0.2 per year, 2009-2013), GOA sablefish longline (1.1 per year, 2009-2013), and the Prince William Sound salmon drift gillnet (15 per year, 1990-1991) fisheries (Muto and Angliss 2015). Current estimates of sea otter bycatch in commercial fisheries are not available. Observer coverage in fisheries within the range of this stock is lacking or low for most fisheries, including those known to interact with sea otters, such as set and drift gillnet fisheries (USFWS 2014b).

The potential effects of commercial fisheries on prey availability are not clear. Direct competition with fisheries for prey is unlikely for blue, fin, sei, and right whales whose diet is 80-100% zooplankton, primarily krill or copepods (Barlow et al. 2008). Humpbacks consume roughly 50% large zooplankton, along with small pelagic and miscellaneous fish. Sperm whales consume about 60% large squid, and a mix of various fish, small squid, and benthic invertebrates. Krill is not commercially harvested, nor are most of the other prey items (Barlow et al. 2008). .

The potential for competition for prey exists for the Western DPS of Steller sea lions. Steller sea lions consume several commercially important species including Pacific whiting, walleye pollock, Atka mackerel, Pacific herring, capelin, Pacific sand lance, Pacific cod, arrowtooth flounder, rock soles, and salmon (Loughlin 2009, NMFS 2010c). The 2010 BiOp on the authorization of groundfish fisheries under the FMPs for groundfish of the Bering Sea and Aleutian Islands Management Area and Gulf of Alaska (NMFS 2010c) considered the "most notable indirect effect of commercial fisheries on Steller sea lions is the removal of prey species which could alter the animal's natural foraging patterns and their foraging success rate." An independent review determined there was insufficient scientific evidence to support this fishery-driven nutritional stress hypothesis (Bernard et al. 2011). Further discussion of and recent revisions to Steller Sea Lion Protection Measures can be found below in Section 5.5.2.1, ESA-listed species in the BSAIRA.

Subsistence harvests by Alaska Natives are another source of injury or mortality for several marine mammal species in Alaskan waters. Table 5.5-1 lists subsistence species and the AFSC research areas in which they are harvested. Refer to Section 3.3.4 for further details on subsistence harvests in AFSC research areas. Threatened and endangered species subject to subsistence harvest in the GOARA are the southwest Alaska DPS of northern sea otters and the Western DPS of Steller sea lions. The reported sea otter harvest from the southwest Alaska DPS is the lowest of the three stocks, averaging 76/year from 2006-2010. Eight-three percent of the harvest is from the Kodiak Archipelago (USFWS 2014b). Annual statewide data on community subsistence harvest of Steller sea lions are no longer collected as of 2009; data were collected for seven communities around Kodiak Island in 2011, where an estimated 20 adult Steller sea lions were harvested. The mean annual statewide subsistence take from this stock for all areas except St. Paul for 2004-2008 plus the annual take from St. Paul for 2008-2011 and 2013 was 199 Steller sea lions per year (Muto and Angliss 2015). Average annual M&SI levels from all sources, fisheries and subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

Table 5.5-1 Marine Mammal Species Harvested by Alaska Natives for Subsistence Purposes by AFSC Research Area

Species	GOARA	BSAIRA	CSBSRA
Beluga whale		X	X
Gray whale		X	X
Bowhead whale		X	X
Steller sea lion, Eastern DPS	X		
Steller sea lion, Western DPS	X	X	
Northern fur seal	X	X	
Harbor seal	X	X	
Spotted Seal		X	X
Bearded seal		X	X
Ringed seal		X	X
Ribbon seal		X	X
Pacific walrus		X	X
Northern sea otter	X	X	
Polar bear		X	X

Potential effects of oil and gas exploration and shipping in the GOARA, particularly in Cook Inlet and near the Port of Valdez in Prince William Sound, include acoustic disturbance, vessel collisions, discharge of contaminants, and oil spills. Effects of oil spills on marine mammals can range from displacement, impacts on prey resources, and minor skin irritations to loss of insulation and death. The latter leaves sea otters—reliant upon fur for insulation and buoyancy—particularly vulnerable, as demonstrated following the 1989 *Exxon Valdez* oil spill in Prince William Sound. Estimates of mortality of sea otters in the Prince William Sound area ranged from 500 to 5,000 (Garrott et al. 1993).

Military operations in the GOA are also potential sources of behavioral and habitat disturbance, injury, and mortality. The Department of Defense conducts joint training exercises with the Departments of Navy, Army, Air Force, and Coast Guard in the Joint Pacific Alaska Range Complex between April and October. The training area of concern to marine mammals is the Temporary Maritime Activities Area that encompasses 42,146 square nm (145,458 km^2) in the GOA. The Temporary Maritime Activities Area is south of Prince William Sound and east of Kodiak Island, is oriented northwest to southeast, and is approximately 300 nm long by 156 nm wide. Most Navy training activities occur in this area (DoN 2014). Current and proposed training activities include Anti-Air, Anti-Surface, and Anti-Submarine Warfare, Naval Special Warfare, Strike Warfare, and combat and support operations that involve gunnery, bombing, sinking, and tracking exercises. Sonar, active acoustic sources, airguns, weapons firing, explosives, and vessel and aircraft noise could result in Level A or Level B harassment of marine mammals (DoN 2014).

Climate change impacts on ESA-listed species are possible through changes in habitat, prey species, and food availability. Migration, feeding, and breeding locations influenced by ocean currents and water temperature could be impacted, which could, ultimately, affect productivity of ESA-listed species (NMFS 2010a, NMFS 2011, NMFS 2013b).

With the exception of the historical sources of population decline, all of the aforementioned effects are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on ESA-listed marine mammals are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. Although ESA-listed marine mammals continue to be affected by numerous factors external to AFSC fisheries research in the GOARA, and the resulting cumulative effects, contribution to these effects from AFSC fisheries research activities is comparatively small.

There have been no reported vessel collisions or entanglements of ESA-listed marine mammals involving AFSC vessels or gear, and the volume of ship traffic generated by AFSC fisheries research is miniscule compared to the number of other vessels transiting the area. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to ESA-listed species due to ship strikes is considered possible, but the potential risk is minor.

The potential effects from use of active acoustic devices for AFSC fisheries research activities would have rare or infrequent and temporary behavioral avoidance effects on ESA-listed marine mammals. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

There have been no adverse interactions or takes of ESA-listed marine mammals during AFSC fisheries research in the GOARA and, with one exception, takes of ESA-listed species are not anticipated. Based on one historical take of the analogous northern fur seal and takes in analogous commercial fisheries, the AFSC LOA application (Appendix C) estimated that Steller sea lions from the endangered Western DPS could be taken in the GOARA by trawl gear and longline gear (Table 4.2-13). The estimated average annual take requested by AFSC in the next five years is less than or equal to one percent of PBR for this stock, even when requested takes from the BSAIRA and "undetermined" pinniped species are included (Table 4.2-14). Given the existing and proposed additional mitigation measures, and the lack of historical takes of this species, it is unlikely that the requested level of take would be realized. The contribution of this requested take level to total M&SI from all known sources would be very small and would not exceed PBR (Table 5.5-2).

Although there is some overlap in prey of ESA-listed marine mammals in the GOARA and the species collected during AFSC fisheries and ecosystem research surveys, the total amount sampled is minimal compared to overall biomass and commercial fisheries removals (see Sections 4.2-3 and 4.3-3). In addition, the size classes of fish targeted in AFSC research are generally smaller than that preyed upon by marine mammals. The contribution of research catches to the cumulative effects on marine mammals through competition for prey is therefore considered minor for all ESA-listed species in the GOARA.

Incidental take in external commercial fisheries and the volume of ship strikes from external sources exceeds any known or potential takes of ESA-listed species by AFSC fisheries research. Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species, particularly the planktivorous species. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the GOARA, the contribution of AFSC fisheries research activities to cumulative effects on ESA-listed marine mammals would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on ESA-listed marine mammals in the GOARA. Indirectly, however, the loss of information obtained through this research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions and monitoring of ecological trends affecting marine mammal habitat. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact monitoring and management capabilities for marine mammals in the region. This may be particularly important for a heavily managed species such as the Western DPS Steller sea lion, where protection measures for critical habitat impact commercial fishing opportunities. Without the stock assessment information provided by AFSC fisheries research, the status of key prey species inside and outside of critical habitat boundaries would become more uncertain, which could have long-term impacts on fishery management decisions designed to protect Steller sea lions. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the GOARA, the contribution of the No Research Alternative to cumulative effects on ESA-listed marine mammals would be minor to moderate adverse.

5.5.1.2 Non-ESA-Listed Cetaceans

External Factors in the GOARA

The cetacean species included in this section are not listed as threatened or endangered. They are all subject to similar types of effects from external activities as described above for ESA-listed species. With the exception of minke whales and eastern North Pacific gray whales, the non-ESA listed cetaceans in the GOARA are odontocetes. Habitats are wide ranging, as are preferred prey items. Interactions with commercial fisheries are likely to have the greatest effect on most of these species and are generally well-documented. The gray whale is the only species included in this section that was subjected to large-scale commercial whaling, as well as historical and current hunting for subsistence purposes. The IWC banned commercial whaling of gray whales in the late-1940s and, after decades of recovery and population growth, the eastern North Pacific stock was removed from the List of Threatened and Endangered Wildlife in 1994. The U.S. and Russia share a combined harvest quota, with an average annual harvest allocation of 120 whales by the Russian Chukotka people and four whales by the Makah Indian Tribe. The average annual take by the Russian hunt was 123 whales from 2007 to 2011 (Carretta et al. 2014).

Interactions with commercial fisheries are a primary source of serious injury and mortality for Dall's porpoise, harbor porpoise, and Pacific white-sided dolphins. Pacific white-sided dolphins are known to interact with gillnet fisheries, yet there were no reported mortalities or serious injuries for this stock in commercial fisheries in Alaska between 2009 and 2013 (Muto and Angliss 2015). Harbor porpoise are known to interact with drift and set gillnet fisheries in Yakutat, Prince William Sound, Cook Inlet, and Kodiak. In the GOARA, Dall's porpoise historically interacted with the Alaska Peninsula/Aleutian Island salmon drift gillnet fishery and the Southeast Alaska salmon drift gillnet fishery, with estimated annual mortalities of 28 and 9 porpoises, respectively. PBR is unknown for all of these species (Muto and Angliss 2015). Average annual M&SI levels from all sources, fisheries and subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

Prey commonly consumed by these dolphin and porpoise species include schooling fish, such as herring, mesopelagic fish, and squid (Bjørge and Tolley 2009, Jefferson 2009). Some, like herring, are commercially valuable species in Alaska. It is, however, unlikely that commercial fisheries affect the availability of prey.

In addition, research conducted by the NWFSC and SWFSC may affect some of the same cetacean stocks for which AFSC (and IPHC) is requesting takes and is therefore considered in the set of external factors that contribute to cumulative effects in the GOARA. Table 5.5-2 includes takes from IPHC that would occur in conjunction with Alternative 2 (see Appendix E for details). The NWFSC and SWFSC have conducted their own NEPA and MMPA compliance process and requested authorization for incidental take of some of the same marine mammal stocks as the AFSC (see Final Rule for the SWFSC, 80 FR 58982, 30 September 2015). Table 5.5-2 indicates the requested takes by the AFSC (and IPHC), NWFSC, and SWFSC for all shared species or stocks of cetaceans. Note that these are conservative estimates of takes and the actual level of taking is likely to be much less than these requested takes.

For most of the cetacean stocks listed in Table 5.5-2, the total cumulative requested take from the AFSC (and IPHC), NWFSC and SWFSC, if they occurred, would represent less than ten percent of the stock's PBR and would be considered to have minor impacts on the stock. Requests may exceed 10% of the PBR only for some stocks with very small PBRs. Combined take requests for these stocks would be 58.3% (CA coastal bottlenose dolphin), 43.6% (CA/WA/OR offshore bottlenose dolphin), 13.0% (short-finned pilot whale), and 10.8% (Risso's dolphin) of each respective PBR and would be considered moderate in magnitude. However, the analysis in Table 5.5-2 assumes that all takes requested by these centers would occur in the same year and from the same stock (for bottlenose dolphins). These assumptions are very unlikely to actually occur, especially since the NWFSC has never taken any cetaceans other than Pacific white-sided dolphins and the IPHC has never taken any cetaceans. The SWFSC has historically taken a number of Pacific white-sided dolphins as well as one northern right whale dolphin (and pinnipeds). The NWFSC and SWFSC do not think that the number of requested takes will actually be taken in the next five years, but used a precautionary estimation procedure to ensure accounting for maximum level of potential take. According to the impact criteria described in Table 4.1-1, the level of mortality of the species considered here, if they occurred, would be considered minor to moderate in magnitude.

Climate change impacts are difficult to predict, but will likely affect non-ESA-listed cetaceans through changes in habitat and food availability. Some species may experience beneficial effects related to prey availability while others may experience adverse effects, which may not be consistent over time or space.

The activities external to AFSC fisheries research affecting cetaceans are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Table 5.5-2 Cumulative M&SI Compared to PBR with Requested Marine Mammal Takes from AFSC (and IPHC), NWFSC, and SWFSC

This table summarizes the known Mortality and Serious Injury (M&SI) from all sources (primarily subsistence harvests and commercial fishing) compared to PBR for each stock of marine mammals requested for incidental take by the AFSC during fisheries and ecosystem research in the GOARA, BSAIRA, and CSBSRA. The requested takes from the IPHC as described in Appendix E of this FPEA and in Appendix C of the LOA Application are also included here. The requested takes from the Northwest and Southwest Fisheries Science Centers for stocks shared with the AFSC requests are also shown. The Pacific Islands Fisheries Science Center did not request takes of any stocks shared with the AFSC. All population estimates, Potential Biological Removal (PBR) values, and total annual M&SI data are from the 2015 stock assessment reports (Allen and Angliss 2015, Muto and Angliss 2015, and Carretta et al. 2015a).

Common Name (Stock)	Minimum Population Estimate	PBR	Average Annual M&SI from All Sources[A]	Average Annual M&SI as % of PBR	IPHC Average Annual Take Request[C]	AFSC Average Annual Take Request	NWFSC Average Annual Take Request	SWFSC Average Annual Take Request	Total FSC and IPHC Average Annual Take Request	Total FSC and IPHC Average Annual Take Request as % of PBR
Beluga whale (Eastern Chukchi)	32,453	649	57.4	**8.8%**	0	0.2	0	0	0.2	**0.03%**
Beluga whale (Beaufort Sea)	Unknown	Undetermined	165.6	**N/A**	0	0.2	0	0	0.2	**N/A**
Killer whale (AK resident)	2,347	24	1	**4.2%**	0.2	0.2	0	0	0.4	**1.7%**
Sperm whale	Unknown	Undetermined	2.2	**N/A**	0.2	0.2	0	0	0.4	**N/A**
Short-finned pilot whale	465	4.6	0.0	**N/A**	0.2	0	0.2	0.2	0.6	**13.0%**
Bottlenose dolphin (California Coastal)	290	2.4	0.2	**1.7%**	0.2	0	0.4	0.8	1.4	**58.3%**
Bottlenose dolphin (CA/WA/OR offshore)	684	5.5	2.0	**36.4%**	0.2	0	0.4	1.8	2.4	**43.6%**
Pacific white-sided dolphin (North Pacific)	Unknown	Undetermined	0.0	**N/A**	0	1.2	0	0	1.2	**N/A**
Harbor porpoise (Southeast Alaska)	Unknown	Undetermined	34.2	**N/A**	0	0.4	0	0	0.4	**N/A**
Harbor porpoise (Gulf of Alaska)	Unknown	Undetermined	72	**N/A**	0	0.4	0	0	0.4	**N/A**

Common Name (Stock)	Minimum Population Estimate	PBR	Average Annual M&SI from All Sources [A]	Average Annual M&SI as % of PBR	IPHC Average Annual Take Request [C]	AFSC Average Annual Take Request	NWFSC Average Annual Take Request	SWFSC Average Annual Take Request	Total FSC and IPHC Average Annual Take Request	Total FSC and IPHC Average Annual Take Request as % of PBR
Harbor porpoise (Bering Sea)	Unknown	Undetermined	0.4	**N/A**	0	0.2	0	0	0.2	**N/A**
Risso's dolphin	4,913	39	1.6	**4.1%**	0.2	0	1.6	2.4	4.2	**10.8%**
Short-beaked common dolphin	343,990	3,440	64	**1.9%**	0.2	0	0.6	2.4	3.2	**0.09%**
Dall's porpoise (Alaska)	Unknown	Undetermined	38	**N/A**	0.2	2.6	0	0	2.8	**N/A**
California sea lion	153,337	9,200	331	**3.6%**	0.2	0	2	5	7.2	**0.08%**
Steller sea lion (Western DPS)	49,497	297	233.4	**78.6%**	1	2.6	0	0	3.6	**1.2%**
Steller sea lion (Eastern DPS)	36,551	1,645	92.3	**5.6%**	1	1.4	1.8	2.0	6.2	**0.38%**
Northern fur seal (Eastern Pacific)	548,919	11,802	439.3	**3.7%**	1	2.6	1 [B]	1 [B]	5.6	**.05%**
Northern fur seal (California)	6,722	403	2.6	**0.65%**	1	0.6	1 [B]	1 [B]	3.6	**0.9%**
Harbor seal (N. Kodiak)	7,096	298	37	**12.4%**	0.2	0.2	0	0	0.4	**0.1%**
Harbor seal (S. Kodiak)	17,479	314	127.9	**40.7%**	0.2	0.2	0	0	0.4	**0.1%**
Harbor seal (Prince William Sound)	27,936	838	279.4	**33.3%**	0.2	0.4	0	0	0.6	**0.07%**
Harbor seal (Cook Inlet/Shelikof Strait)	25,651	770	233.6	**30.3%**	0.2	0.2	0	0	0.4	**0.05%**
Harbor seal (Glacier Bay/Icy Strait)	5,647	169	104	**61.5%**	0.2	0.2	0	0	0.4	**0.2%**
Harbor seal (Lynn Canal/Stephens Passage)	8,605	155	50	**32.3%**	0.2	0.2	0	0	0.4	**0.2%**

Common Name (Stock)	Minimum Population Estimate	PBR	Average Annual M&SI from All Sources [A]	Average Annual M&SI as % of PBR	IPHC Average Annual Take Request [C]	AFSC Average Annual Take Request	NWFSC Average Annual Take Request	SWFSC Average Annual Take Request	Total FSC and IPHC Average Annual Take Request	Total FSC and IPHC Average Annual Take Request as % of PBR
Harbor seal (Sitka/Chatham Strait)	13,212	555	77	**13.9%**	0.2	0.4	0	0	0.6	**0.1%**
Harbor seal (Dixon/Cape Decision)	16,727	703	69	**9.8%**	0.2	0.2	0	0	0.4	**0.06%**
Harbor seal (Clarence Strait)	29,093	1,222	40.8	**3.3%**	0.2	0.2	0	0	0.4	**0.03%**
Harbor seal (Aleutian Islands)	5,772	173	90	**52.02%**	0.2	0.2	0	0	0.4	**0.2%**
Harbor seal (Pribilof Islands)	232	7	0	**0%**	0.2	0.2	0	0	0.4	**5.7%**
Harbor seal (Bristol Bay)	28,146	1,182	141.6	**11.98%**	0.2	0.2	0	0	0.4	**0.03%**
Harbor seal (California)[C]	27,348	1,641	30	**1.8%**	0.2	0	2.6	1.8	4.6	**0.28%**
Spotted seal (Alaska)	391,000	11,730	5,267.5	**44.9%**	0.2	0.4	0	0	0.6	**0.005%**
Bearded seal (Beringia DPS/Alaska)	Unknown	Undetermined	380.4	**N/A**	0	0.4	0	0	0.4	**N/A**
Ringed seal (Alaska)	Unknown	Undetermined	1044.1	**N/A**	0.6	0.6	0	0	1.2	**N/A**
Ribbon seal (Alaska)	163,086	9,785	3.8	**0.04%**	0	0.4	0	0	0.4	**0.004%**
Northern elephant seal	81,368	4,882	8.8	**0.2%**	0	0.2	0	0	0.2	**0.004%**

A – Total M&SI includes combined estimates of commercial and non-commercial fisheries interactions, ship strikes, and entanglements in unidentified gear. All estimates are considered smaller than actual M&SI due to unobserved fisheries and other uncertainties in detecting injured or killed animals.

B – The NWFSC and SWFSC take requests for northern fur seals are for both stocks (Eastern Pacific and California) and does not differentiate between them in their respective take requests. To be conservative, take requests from NWFSC and SWFSC are added to the AFSC take requests for each stock.

C- Population estimate and PBR values are for the California stock of harbor seals only. There are no recent population estimates or PBR determinations for the Oregon/Washington Coast, Washington Northern Inland Waters, Southern Puget Sound, or Hood Canal stocks.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on non-ESA-listed cetaceans are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The contribution of AFSC fisheries research activities to cumulative effects on non-ESA-listed species is likely to be small.

There have been no reported vessel collisions with cetaceans involving AFSC vessels and the volume of ship traffic generated by AFSC fisheries research is miniscule compared to the number of other vessels transiting the area. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to non ESA-listed species due to ship strikes is considered possible, but the potential risk is minor.

Annual incidental take levels in external commercial fisheries exceed any known serious injury or mortality takes by AFSC fisheries research (Table 4.2-10). Dall's porpoise is the only cetacean species historically taken by AFSC. Requested takes of non-ESA listed cetaceans in the GOARA are based on being analogous to Dall's porpoise or on previous takes in analogous commercial fisheries. The estimated average annual take by AFSC in the next five years is likely well below 10 percent of PBR, despite PBR being unknown for all three non-ESA-listed cetacean species for which takes are requested (Table 4.2-14). Given the existing and proposed additional mitigation measures and the lack of historical takes for two of the three species for which takes are requested, it is unlikely that the requested level of take would be realized. The contribution of the requested AFSC takes, if they occurred, would be very small compared to other known sources of serious injury and mortality and to PBR (Table 5.5-2) and would be considered minor.

The potential effects from use of active acoustic devices for research activities would likely involve infrequent and temporary behavioral disturbance and avoidance effects, particularly for the mid- and high-frequency hearing odontocetes. Relative to the volume of other ship traffic and anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

Although there is some overlap in prey of non-ESA-listed cetaceans and the species collected during AFSC fisheries research surveys, the total amount sampled is minimal compared to overall biomass and commercial fisheries removals (see Sections 4.2-3 and 4.3-3). Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species. The contribution of research catches to the effects on cetaceans through competition for prey is therefore considered minor adverse.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the GOARA, the contribution of AFSC fisheries and ecosystem research to cumulative effects on cetaceans would be primarily through rare gear interactions and would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on non-ESA-listed cetaceans in the GOARA. Indirectly, however, the loss of information obtained through this research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions and monitoring of ecological trends affecting marine mammal habitat. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact monitoring and management capabilities for cetaceans in the region. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non ESA-listed cetaceans in the GOARA, the contribution of the No Research Alternative to cumulative effects on non-ESA-listed cetaceans would be minor adverse.

5.5.1.2 Non-ESA-Listed Pinnipeds

External Factors in the GOARA

The pinniped species included in this section are not listed as threatened or endangered. They are all subject to similar types of effects from external activities as described above for ESA-listed species. The five species of non-ESA-listed pinnipeds in the GOARA that may interact with AFSC research are the Eastern DPS of Steller sea lions, northern fur seals, harbor seal (several stocks), and northern fur seals.

Northern fur seals were heavily exploited through a commercial hunt until the hunt came under management of the International Fur Seal Treaty of 1911. A commercial harvest of adult female fur seals on the Pribilof Islands lasted from 1957 until 1973 on St. George Island and 1984 on St. Paul Island. A subsistence harvest of juveniles continues on both islands (Testa 2011) and is currently the primary source of human-caused mortality. The mean annual subsistence harvest on the Pribilof Islands (in the BSAI) was 432 fur seals from 2009-2013 (Muto and Angliss 2015). The average number of Eastern DPS Steller sea lions harvested or struck and lost in the Alaska Native subsistence hunt for 2005-2008 and 2012 is 11 sea lions per year. Data on community subsistence harvests have not been consistently collected since 2009 and no monitoring occurred in 2010 and 2011 (Allen and Angliss 2015). Subsistence harvest by Alaska Natives accounts for the largest source of mortality of harbor seals, as well. Subsistence harvest levels are estimated by the Alaska Native Harbor Seal Commission and ADFG. Since ADFG stopped collecting statewide community harvest information in 2009, 2004-2008 data are used for estimating annual harvest rates for most areas. Data shown for Kodiak Island, Prince William Sound, and Southeast Alaska are from 2011 and 2012 (Muto and Angliss 2015). Table 5.5-2 shows average annual subsistence harvest for each of the 12 stocks recognized in Alaska, nine of which are in the GOARA. Annual subsistence harvests in the GOARA range from 37 from the North Kodiak stock to 255 from the Prince William Sound stock (Muto and Angliss 2015).

Estimated incidental takes in commercial fisheries is relatively low for pinnipeds in the GOARA. No takes of Eastern DPS Steller sea lions were reported from 2008-2012 in any of the 22 federally-regulated commercial fisheries in Alaska. Reported takes of northern fur seals (1.1 per year) occurred in the BSAI flatfish and pollock trawl fisheries and the BSAI Pacific cod longline fishery; none occurred in the GOARA (Muto and Angliss 2015). Takes of harbor seals in observed commercial fisheries in the GOARA for 2009-2013 are shown in Table 5.5-1 and range from zero for several stocks to 24 for the Prince William Sound stock. The Prince William Sound drift gillnet fishery recorded 24 harbor seal mortalities in 1990-1991, the most recent year for which data are available. These takes were assigned to the Prince William Sound stock (Muto and Angliss 2015).

Other sources of mortality and injury, particularly for northern fur seals, include entanglement in marine debris (estimated 2.6 fur seals/year, 2009-2013) and mortality incidental to MMPA authorized research activities (0.6 per year for 2009-2013) (Muto and Angliss 2015). Strandings of Eastern DPS Steller sea lions with gunshot wounds and marine debris entanglements also occur. Of the 18 reported gunshot mortalities reported in Alaska from 2009-2012, 15 occurred in 2012 (Allen and Angliss 2015). Average annual M&SI levels from all sources, fisheries and subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

In addition, research conducted by the NWFSC and SWFSC may affect some of the same pinniped stocks affected by AFSC research, and is therefore considered in the set of external factors that contribute to cumulative effects in the GOARA and BSAIRA. The NWFSC and SWFSC have conducted their own

NEPA and MMPA compliance process and requested authorization for incidental take of some of the same marine mammal stocks as the AFSC (see Final Rule for the SWFSC, 80 FR 58982, 30 September 2015). Table 5.5-2 indicates the requested takes by the AFSC, NWFSC, and SWFSC for all shared species or stocks. Note that these are conservative estimates of takes and the actual level of taking is likely to be much less than these requested takes. For these pinniped stocks, the combined requested takes from NMFS fisheries research activities, if they occurred, would make a very small contribution to known sources of M&SI and would likely be very small relative to PBR for all stocks.

Northern fur seals prey primarily on schooling fish and gonatid squid (Sinclair et al. 1996). Sub-adult males and adult females at St. Paul Island commonly consume walleye pollock, Pacific salmon, Pacific herring, and cephalopods (Call and Ream 2012). Common prey items of Steller sea lions and harbor seals also include herring, pollock, salmon, cod, hake, flounders, squid, and crustaceans (Jemison 2001, Iverson et al. 1997, Tollit et al. 2015). Several of these are commercially important species. The contribution of AFSC fisheries research to cumulative effects on these fish and invertebrate species is very small (see Sections 4.2-3 and 4.2-7) and unlikely to have any effect on the availability of these species to pinnipeds.

Climate change impacts are difficult to predict, but may affect non ESA-listed pinnipeds through changes in habitat and food availability. Some species may experience beneficial effects related to prey availability while others may experience adverse effects, which may not be consistent over time or space.

The activities external to AFSC fisheries research affecting pinnipeds are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the AFSC research alternatives on pinnipeds are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The contribution of AFSC fisheries research activities to cumulative effects on pinnipeds is likely to be small.

There have been no reported vessel collisions with pinnipeds involving AFSC vessels and the volume of ship traffic generated by AFSC fisheries research is a very small fraction of the total number of other vessels transiting the area. Given the relatively slow speeds of research vessels, mitigation measures, and the low number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to non-ESA-listed pinnipeds due to ship strikes is possible, but the potential risk is minor.

The potential effects from use of active acoustic devices for research activities could infrequently and temporarily elicit behavioral avoidance effects on pinnipeds in the GOARA. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

Annual incidental take levels in external commercial fisheries exceed historical Level A takes of pinnipeds by AFSC fisheries research, which includes only one northern fur seal take (Table 4.2-10). Requested takes of other non-ESA-listed pinnipeds in the GOARA are based on being analogous to northern fur seals or on previous takes in analogous commercial fisheries. The estimated average annual take by AFSC in the next five years is less than 10 percent of PBR for all non-ESA-listed pinniped species for which takes are requested (Table 4.2-14). Given the existing and proposed additional mitigation measures and the lack of historical takes for all but one of these species and the very low take level for fur seals, it is unlikely that the requested level of take would be realized. The contribution of the requested AFSC takes, if they occurred, would be very small compared to other known sources of serious injury and mortality and to PBR (Table 5.5-2) and would be considered minor.

Although there is some overlap in prey of pinnipeds in the GOARA and the species collected during AFSC research surveys, the total amount sampled is minimal compared to overall biomass and commercial fisheries removals. The contribution of research catches to the effects on marine mammals through competition for prey is therefore considered minor adverse for cetaceans in the GOARA.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the GOARA, the contribution of AFSC fisheries and ecosystem research activities in the GOARA to cumulative effects on these species through disturbance, direct takes, and prey removal would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on non-ESA-listed pinnipeds in the GOARA. Indirectly, however, the loss of information obtained through this research on feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions regarding pinnipeds and monitoring of ecological trends affecting marine mammal habitat. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the GOARA, the contribution of the No Research Alternative to cumulative effects on non-ESA-listed pinnipeds would be minor adverse.

5.5.2 Bering Sea/Aleutian Islands Research Area

5.5.2.1 ESA-listed Species

External Factors in the BSAIRA

Endangered cetaceans that occur in the BSAIRA include sperm, humpback, fin, sei, North Pacific right, and bowhead whales and, on very rare occasions, blue whales and western North Pacific gray whales. Bowhead whales are in the western Bering Sea, along the ice edge, during winter months (November-April), so are unlikely to overlap with any AFSC fisheries research in the BSAIRA; refer to Section 5.5.3, CSBSRA, for further discussion of bowhead whales. ESA-listed pinnipeds in the BSAIRA include the endangered Western DPS of Steller sea lions, threatened ringed seals, and the Pacific walrus, which is a candidate for listing. The threatened listing of the Beringia DPS of bearded seals was vacated in 2014, following a decision in the U.S. District Court for the District of Alaska. The Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. While the appeal process is in progress, the Beringia DPS of bearded seals will retain consideration as an ESA-listed species in this FPEA. The Southwestern Alaska DPS of the northern sea otter, listed as threatened, also occurs in the BSAIRA.

Commercial whaling was the single greatest historical source of mortality for the whale species. Right whales received legal protection from commercial whaling in 1935 (Perry et al. 1999), but were illegally hunted by the Soviet Union into the 1960s (Wade et al. 2011a). Commercial harvests of sperm whales ended worldwide in 1986 (NMFS 2010b). Humpback whales and blue whales were protected in 1966 (NMFS 1998, Perry et al. 1999). The IWC banned hunting of fin whales throughout the North Pacific in 1976 (Perry et al. 1999). Hunting of sei whales in the eastern North Pacific ended after 1971 and after 1975 in the western North Pacific (Perry et al. 1999). Commercial harvests of sea otters for their pelts during the 18th and 19th centuries nearly extirpated the species throughout its range. Sea otters received protection under the International Fur Seal Treaty of 1911 (USFWS 2010). The more recent cause for decline is uncertain. Listing of the Western DPS of Steller sea lions followed a precipitous population decline between the 1970s and 1990s that was likely driven by several potential factors ranging from incidental mortality in commercial fisheries to nutritional stress (NMFS 2008c). Climate change and loss of sea-ice habitat are considered primary factors contributing to the listings of ringed and bearded seals (77FR76706, December 28, 2012; 77FR76740, December 28, 2012).

Past, present, and reasonably foreseeable future conservation concerns and threats to recovery are outlined in the respective recovery plans for the ESA-listed species for which plans exist. Those for blue whales (NMFS 1998), humpback whales (NMFS 1991), sperm whales (NMFS 2010b), fin whales (NMFS 2010a), sei whales (NMFS 2011), North Pacific right whales (NMFS 2013b), Steller sea lions (NMFS 2008c), and the southwest Alaska DPS of the northern sea otter (USWFS 2010) were finalized or recently drafted or updated. Other species currently lack such plans. Noted conservation concerns and threats include vessel collisions, entanglement in fishing gear, anthropogenic noise, vessel/human disturbance, pollutants and pathogens, disease, habitat degradation, competition with fisheries for prey, subsistence harvest, and climate change.

Numerous marine vessels traverse coastal and offshore waters of the BSAIRA including tankers, container ships, cargo ships, fishing vessels, military ships, ferries, cruise ships, and scientific research vessels. The Aleutian Islands lie along the North Pacific Great Circle Route, the shortest shipping route for vessels traveling between northwestern North America and Asia. More than 4500 large commercial ships pass through Unimak Pass in the eastern Aleutians each year. The number of vessels that travel that route and into the Arctic has increased in recent years and is likely to continue to do so (TRB 2008). The Port of Dutch Harbor on Unalaska Island is the largest port in the region, with five marine facilities that provide dockage and services for vessels including small boats, cargo ships, the USCG, and a large and active fishing fleet (NEI 2009b). Vessel collisions are considered potential threats for several endangered large whales. Other potential threats associated with vessel traffic include acoustic disturbance, spills, and discharges.

On December 8, 2004, the Malaysian freighter, *Selendang Ayu*, ran aground in Skan Bay on the west coast of Unalaska Island. The freighter broke in half and spilled an estimated 321,052 gallons of Intermediate Fuel Oil, 14,680 gallons of marine diesel fuel, and 60,000 tons of soybeans as freight. At least 1,600 dead birds and six dead sea otters were collected or documented during the initial response and several harbor seals were noted to have been oiled (Brewer 2006).

Whale-vessel collisions occasionally occur in Alaskan waters. Neilson et al. (2012) summarized reported collisions in Alaskan waters from 1978 to 2011. Of the 89 definite and 19 probable ship strikes, only one—an unidentified whale—was in the BSAIRA. There were two reports of ship strikes of fin whales (near Kodiak) and none of blue or sperm whales in Alaskan waters between 2009 and 2013 (Muto and Angliss 2015). The western and central North Pacific stocks of humpback whales averaged 0.2 and 1.9 mortalities or serious injuries per year, respectively, due to ship strikes in Alaska during that same time period; most reported collisions occurred in Southeast Alaska, with additional reports from south-central and Kodiak areas of Alaska (Muto and Angliss 2015). Although there are no reports of vessel collisions, ship strikes are a significant cause of injury and mortality for North Atlantic right whales, suggesting equal vulnerability of North Pacific right whales to such threats. Their rarity and scattered distribution, however, make it difficult to adequately assess the threat of ship strikes to North Pacific right whales (Muto and Angliss 2012, NMFS 2013b).

Vessel traffic, via engine noise, propellers, and sonar equipment, also contributes to anthropogenic noise in the marine environment that may elicit changes in marine mammal behavior or interfere with communication through masking. Anthropogenic noise and acoustic disturbance are listed as potential threats to ESA-listed marine mammals in their Recovery Plans, although with unknown effects and a great deal of uncertainty. Potential impacts of anthropogenic noise are further discussed in Section 4.2.4.1.

Entanglement in fishing gear is another concern for several ESA-listed species, although the level of take in the BSAIRA is relatively low for most species. There are no fisheries mortalities or serious injuries documented for blue, sei, and North Pacific right whales in Alaska waters. There was one observed incidental mortality of a fin whale due to entanglement in ground tackle of a commercial mechanical jig fishing vessel in 2012. This is the only known fisheries-related mortality of fin whales in Alaska between 2009 and 2013, for an average of 0.2 takes per year (Muto and Allen 2015). The mean annual take of sperm whales by the Gulf of Alaska sablefish longline fishery was 0.28 from 2007 through 2011, based on one observed serious injury in 2007; there were no observed takes from 2009 through 2013 and no takes in the BSAIRA (Muto and Angliss 2015). The estimated annual average mortality rate of Western North Pacific humpback whales incidental to U. S. commercial fisheries, 2009-2013, is 0.8 whales per year (0.6 in observed fisheries and 0.2 based on stranding database records). Since the observed takes occurred where the Western and Central North Pacific stocks overlap and stock identification is unknown, these mortalities and serious injuries are included in both stock assessments. For Central North Pacific humpback whales, the annual average mortality rate incidental to U. S. fisheries in Alaska for 2009-2013 is 6.3 whales per year (0.6 in observed Bering Sea/Aleutian Islands fisheries, 5.5 in state-managed Southeast Alaska salmon driftnet fishery, and 0.2 from strandings and reports in Alaska where a fishery is confirmed) (Muto and Angliss 2015). Fisheries and gear involved in humpback entanglements include the BSAI flatfish and pollock trawl fisheries, the Southeast Alaska salmon drift gillnet fishery, unspecified gillnet and pot gear, recreational shrimp pot gear, and unspecified crab pots and longlines (Muto and Angliss 2015). Studies in Southeast Alaska indicate that 71% of humpbacks whales have experienced non-lethal entanglements at some time during their lives (Neilson et al. 2009). The Western DPS of Steller sea lions experienced a mean annual mortality of 14 sea lions through interactions with commercial fisheries in the BSAI, including the BSAI Atka mackerel, flatfish, Pacific cod, and pollock trawl fisheries from 2009 through 2013. Most (13) occurred in the pollock and flatfish trawl fisheries. Bearded seals were also taken, at an average rate of 1.83 per year, in the BSAI pollock and flatfish trawl fisheries and ringed seals experienced and average annual mortality of 4.12 seals in the BSAI flatfish, pollock, and Pacific cod trawl fisheries, and the Pacific cod longline fishery (Muto and Angliss 2015). Between 2006 and 2010, an average of two Pacific walrus per year was taken incidental to the BSAI flatfish trawl fishery (USFWS 2014a). Current estimates of sea otter bycatch in commercial fisheries are not available. Observer coverage in fisheries within the range of this stock is lacking or low for most fisheries, including those known to interact with sea otters, such as set and drift gillnet fisheries (USFWS 2014b).

The potential effects of commercial fisheries on prey availability are not clear. Direct competition with fisheries for prey is unlikely for blue, fin, sei, bowhead, and right whales whose diet is 80-100% zooplankton, primarily krill or copepods. Humpbacks consume roughly 50% large zooplankton, along with small pelagic and miscellaneous fish. Sperm whales consume about 60% large squid, and a mix of various fish, small squid, and benthic invertebrates. Walrus prey primarily on benthic organisms. Krill is not commercially harvested, nor are most of the other prey items. Northern sea otters are unlikely to directly interact or compete for resources with commercial groundfish fisheries, since fishing areas and preferred prey do not overlap (NMFS 2013c).

The potential for competition for prey exists for the Western DPS of Steller sea lions. Steller sea lions consume several commercially important species including Pacific whiting, walleye pollock, Atka mackerel, Pacific herring, capelin, Pacific sand lance, Pacific cod, arrowtooth flounder, rock soles, and salmon (Loughlin 2009, NMFS 2010c, Sinclair et al. 2013). Atka mackerel dominates the diet west of Samalga Pass and walleye pollock dominates east of Samalga Pass (Sinclair et al. 2013). The 2010 BiOp on the authorization of groundfish fisheries under the Fisheries Management Plans for groundfish of the Bering Sea and Aleutian Islands Management Area and the Gulf of Alaska (NMFS 2010c) considered the "most notable indirect effect of commercial fisheries on Steller sea lions is the removal of prey species which could alter the animal's natural foraging patterns and their foraging success rate." An independent review determined there was insufficient scientific evidence to support this fishery-driven nutritional stress hypothesis (Bernard et al. 2011).

Since listing Steller sea lions under the ESA, NMFS has revised and implemented numerous management measures, known as Steller sea lion protection measures. These measures aim to protect Steller sea lion prey from potential effects of groundfish fishing by temporally and geographically dispersing commercial catches through a variety of harvest limitations and closure areas. Many of these measures apply specifically to Atka mackerel, Pacific cod, and pollock, which are important prey for Steller sea lions. The 2014 Final Rule (79 FR 70286, November 25, 2014) implements a comprehensive suite of management measures for the Atka mackerel, Pacific cod, and pollock fisheries, primarily in the Aleutian Islands. To protect Steller sea lion prey availability, this final rule maintains a precautionary approach to the management of Steller sea lion prey species by spatially and temporally dispersing catch, particularly in critical habitat, to prevent localized prey depletion. The protection measures regulate fishing through a combination of closed areas, harvest limits, and seasons that reduce fishery competition for Steller sea lion prey when and where Steller sea lions forage. In addition, this final rule removes restrictions on fishing implemented by the 2010 Interim Final Rule (75 FR 77535, December 13, 2010; corrected 75 FR 81921, December 29, 2010) that have been determined to be unnecessary.

Subsistence harvest by Alaska Natives is an important source of injury or mortality for several marine mammal species in Alaskan waters. Table 5.5-1 lists subsistence species and the AFSC fisheries research areas in which they are harvested. Threatened and endangered species subject to subsistence harvest in the BSAIRA are the Western DPS of Steller sea lions, Pacific walrus, ringed and bearded seals, and the southwest Alaska DPS of northern sea otters. Annual statewide data on community subsistence harvest of Steller sea lions are no longer collected as of 2009. The mean annual subsistence take of western Steller sea lions for all areas except St. Paul during 2004-2008, combined with the mean annual take for St. Paul in 2008-2011 and 2013, was 199 Steller sea lions per year (Muto and Angliss 2015). Pacific walrus are harvested in both the U.S. and Russia, with an estimated total mean annual harvest for 2006-2010 of 4,852; total harvest includes those struck and lost. The mean annual harvest for U.S. (Alaska Native) subsistence hunters was 1,782 walrus for the same time period (USFWS 2014a). Ringed and bearded seals are also important subsistence species for Alaska Natives. Only 11 of the 64 coastal communities known to harvest bearded seals and ringed seals were surveyed from 2009 to 2013, so statewide harvest estimates are not available. Based on available data, a minimum estimate of the average annual bearded seal and ringed seal harvests for 2009-2013 are 379 and 1,040 seals per year, respectively (Muto and Angliss 2015). Walrus and ringed and bearded seal harvests include harvests from villages and communities in the BSAIRA and in the CSBSRA. The reported sea otter harvest from the southwest Alaska DPS is the lowest of the three stocks, averaging 76 per year from 2006-2010. Eight-three percent of the harvest is from the Kodiak Archipelago (USFWS 2014b). Average annual M&SI levels from all sources, fisheries and subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

Climate change impacts on ESA-listed species are possible through changes in habitat, prey species, and food availability. Migration, feeding, and breeding locations influenced by ocean currents and water temperature could be impacted, which could, ultimately, affect productivity of ESA-listed species (NMFS 2010a, NMFS 2011, NMFS 2013b). Ice-obligate species, such as walrus, bearded seals, and ringed seals, are intricately tied to and heavily dependent upon sea ice and particularly vulnerable to climate changes. The likelihood of sea-ice habitat modification due to climate change and marine habitat modification due to ocean acidification were the bases for the determinations to list ringed and bearded seals as threatened species under the ESA (77 FR 76706, December 28, 2012; 77 FR 76740, December 28, 2012).

With the exception of the historical sources of population decline, all of the aforementioned effects are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation and management measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on ESA-listed marine mammals are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species.

There have been no reported vessel collisions or entanglements of ESA-listed marine mammals involving AFSC vessels or gear in the BSAIRA. The level of ship traffic resulting from AFSC fisheries research is miniscule compared to the number of other vessels transiting the Bering Sea and Aleutian Islands region. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to ESA-listed species due to ship strikes is low and the potential risk is minor.

The potential effects from use of active acoustic devices for research activities could elicit rare or infrequent and temporary behavioral avoidance effects on ESA-listed marine mammals. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

There have been no known adverse interactions or takes of ESA-listed marine mammals during AFSC fisheries research in the BSAIRA. The AFSC is, however, requesting takes of six Western DPS of Steller sea lion, and one each of bearded seal and ringed seal in trawl gear in the BSAIRA over the five-year authorization period based on historical takes in commercial fisheries. The estimated average annual take requested for western Steller sea lions is less than one percent of PBR, even when requested takes from the GOARA and "undetermined" pinniped species are included (Table 4.2-14). PBR is undetermined for both bearded and ringed seals, but the requested takes in trawl gear in are likely sufficiently small to be considered minor in magnitude for both species. Given the existing and proposed additional mitigation measures, and the lack of historical takes of this species, it is unlikely that the requested level of take would be realized. The contribution of the requested AFSC takes, if they occurred, would be very small compared to other known sources of serious injury and mortality and to PBR for the Western DPS of Steller sea lions, bearded seals, and ringed seals (Table 5.5-2) and would be considered minor.

Prey removal during fisheries research (see Sections 4.2.3 and 4.2.7) is very small and likely inconsequential to prey availability for ESA-listed marine mammal species in the BSAIRA. AFSC fisheries research removals of Steller sea lion prey species within and outside of critical habitat areas are very small (less than 0.1 percent) relative to harvest limits for key species under the Steller sea lion protection measures and are unlikely to have any measurable effect on the availability of prey to sea lions (Section 4.2.4.7, Tables 4.2-16 and 4.2-17). These AFSC fisheries research surveys play a key role in helping fisheries managers to monitor the abundance and distribution of sea lion prey species in critical habitat areas and the effectiveness of the protection measures. When considered in conjunction with commercial fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the BSAIRA, the contribution of AFSC fisheries research activities to cumulative effects on ESA-listed marine mammals would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on ESA-listed marine mammals in the BSAIRA. Indirectly, however, the loss of information obtained through this research on feeding ecology of ESA-listed marine mammals, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions and analysis of ecological trends affecting marine mammal habitats. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact monitoring and management capabilities for ESA-listed species in the region. This may be particularly important for a heavily managed species such as the Western DPS Steller sea lion, where protection measures for critical habitat impact commercial fishing opportunities. Without the stock assessment information provided by AFSC fisheries research, the status of key prey species inside and outside of critical habitat boundaries would become more uncertain, which could have long-term impacts on fishery management decisions designed to protect Steller sea lions. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the AFSC research areas, the contribution of the No Research Alternative to cumulative effects on ESA-listed marine mammals in the BSAIRA would be minor to moderate adverse.

5.5.2.2 Non-ESA-Listed Cetaceans

External Factors in the BSAIRA

The cetaceans included in this section are not ESA-listed, although they are subject to similar types of effects from external activities as described above for ESA-listed species. Baleen whales most common in the BSAIRA are minke whales and eastern North Pacific gray whales. Most non-ESA listed cetaceans in the BSAIRA are odontocetes, including those for which takes are requested—harbor and Dall's porpoises. The gray whale is the only species included in this section that was subjected to large-scale commercial whaling, as well as historical and current hunting for subsistence purposes. Details are as described above for the GOARA in Section 5.5.1.2.

Interactions with commercial fisheries are a primary source of serious injury and mortality for Dall's porpoise and harbor porpoise. There were, however, no mortalities of Bering Sea harbor porpoise reported in observed commercial fisheries during 2009 to 2013. One harbor porpoise was reportedly entangled in a commercial salmon gillnet in Kotzebue in 2013 resulting in a minimum average annual M&SI rate of 0.2 Bering Sea harbor porpoise in commercial fisheries in 2009 to 2013. A harbor porpoise was also entangled in a subsistence gillnet in 2012, for a mean annual mortality of 0.2 porpoise in subsistence fisheries (Muto and Angliss 2015). The average estimated serious injury and mortality of Dall's porpoise was 38 per year from observed commercial fisheries during 2009-2013. Fisheries with reported mortalities include the BSAI pollock trawl (0.2) and Pacific cod longline fisheries (0.3). Most (28) of the mortalities included in the annual estimated take were in the Alaska Peninsula/Aleutian Islands salmon drift gillnet fishery in 1990. PBR is undetermined for both harbor and Dall's porpoises (Muto and Angliss 2015). Average annual M&SI levels from all sources, fisheries and subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

Prey commonly consumed by these dolphin and porpoise species include schooling fish, such as herring, mesopelagic fish, and squid (Bjørge and Tolley 2009, Jefferson 2009). Some, like herring, are commercially valuable species in Alaska. It is, however, unlikely that commercial fisheries affect the availability of prey.

Climate change impacts are difficult to predict, but will likely affect non-ESA listed cetaceans through changes in habitat and food availability. Some species may experience beneficial effects related to prey availability while others may experience adverse effects, which may not be consistent over time or space.

The activities external to AFSC fisheries research affecting non-ESA-listed cetaceans are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on non-ESA-listed cetaceans are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The contribution of AFSC fisheries research activities to cumulative effects on non-ESA-listed cetaceans is likely to be small.

There have been no reported vessel collisions with cetaceans involving AFSC vessels and the volume of ship traffic generated by AFSC fisheries research is miniscule compared to the number of other vessels transiting the area. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to non ESA-listed cetaceans due to ship strikes is considered possible, but the potential risk is minor.

Dall's porpoise and harbor porpoise are the only non-ESA-listed cetaceans for which takes are requested by the AFSC in the BSAIRA. Annual incidental take levels in external commercial fisheries exceed any known Level A takes by AFSC fisheries research for Dall's porpoises and equals that requested for harbor porpoise in the BSAIRA (Table 4.2-13). PBR is undetermined for both porpoise species, but the requested level of take, were it to occur, is small and likely inconsequential on the population level. These estimates are based on historical takes of similar species in analogous commercial fisheries. The AFSC does not think that number will actually be taken in the next five years, but used a conservative estimation procedure to ensure accounting for the maximum amount of potential take. The contribution of the requested AFSC takes, if they occurred, would be very small compared to other known sources of serious injury and mortality (Table 5.5-2) and would be considered minor.

The potential effects from use of active acoustic devices for research activities would likely involve infrequent and temporary behavioral disturbance and avoidance effects (Level B harassment), particularly for the mid- and high-frequency hearing odontocetes, such as harbor and Dall's porpoises. Relative to the volume of other ship traffic and anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

Although there is some overlap in prey of non-ESA-listed cetaceans and the species collected during AFSC research surveys, surveys generally focus on younger age-classes than consumed by cetaceans and the total amount sampled is minimal compared to overall biomass and commercial fisheries removals (see Sections 4.2.3 and 4.2.7). Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species. The contribution of research catches to the effects on cetaceans through competition for prey is therefore considered minor adverse.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the BSAIRA, the contribution of the three research alternatives to cumulative effects on these species through disturbance and prey removal would be minor adverse.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on non-ESA-listed cetaceans in the BSAIRA. Indirectly, however, the loss of information obtained through this research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions and monitoring of ecological trends affecting marine mammal habitat. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact monitoring and management capabilities for cetaceans in the region. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non ESA-listed cetaceans in the BSAIRA, the contribution of the No Research Alternative to cumulative effects would be minor adverse.

5.5.2.3 Non-ESA Listed Pinnipeds

External Factors in the BSAIRA

The pinniped species included in this section are not listed as threatened or endangered. They are all subject to similar types of effects from external activities as described above for ESA-listed species. The five species of non-ESA-listed pinnipeds in the BSAIRA that may interact with AFSC research: northern fur seal, harbor seal (three stocks), spotted seal, and ribbon seal.

Northern fur seals were heavily exploited through a commercial hunt until the hunt came under management of the International Fur Seal Treaty of 1911. A commercial harvest of adult female fur seals on the Pribilof Islands lasted from 1957 until 1973 on St. George Island and 1984 on St. Paul Island. A subsistence harvest of juveniles continues on both islands (Testa 2011) and is currently the primary source of human-caused mortality. The mean annual subsistence harvest on the Pribilof Islands was 432 fur seals from 2009-2013 (Muto and Angliss 2015). Subsistence harvest by Alaska Natives also accounts for the largest source of mortality of harbor, spotted, and ribbon seals. Subsistence harvest levels of harbor seals are estimated by the Alaska Native Harbor Seal Commission and ADFG. Since ADFG stopped collecting statewide community harvest information in 2009, 2004-2008 data are used for estimating annual harvest rates for several areas. Table 5.5-2 shows average annual subsistence takes for each of the 12 stocks recognized in Alaska, three of which are in the BSAIRA. Annual subsistence takes were 90 from the Aleutian Islands stock, 141 from the Bristol Bay stock, and zero from the Pribilof Islands stock (Muto and Angliss 2015). The most recently available statewide harvest data for spotted seals is from 2000, when the estimated number harvested annually was 5,265. In 2008, six coastal villages in northern Bristol Bay reported harvesting 271 spotted seals for subsistence. Only 11 of the 64 coastal communities known to harvest ribbon seals were surveyed between 2009 and 2013, so statewide harvest estimates are not available. Based on these limited data, a minimum estimate of the average annual ribbon seal harvest for 2009-2013 is 3.2 seals per year (Muto and Angliss 2015). Alaska Native subsistence hunters primarily harvest ribbon seals from villages along the Bering Strait and, to a lesser degree, the Chukchi Sea coast (Allen and Angliss 2015).

Estimated incidental takes in commercial fisheries is relatively low for pinnipeds in the BSAIRA. Reported takes of northern fur seals (1.1 per year) occurred in the BSAI flatfish and pollock trawl fisheries and the BSAI Pacific cod longline fishery (Muto and Angliss 2015). Takes of harbor seals in observed commercial fisheries in the BSAIRA for 2009-2013 are shown in Table 5.5-2 and range from zero takes for the Aleutian Islands and Pribilof Islands stocks to 0.6 per year for the Bristol Bay stock. Reported harbor seal takes in the BSAI were in the BSAI flatfish trawl fishery. Incidental take of spotted seals was reported in the BSAI flatfish trawl and pollock trawl fisheries and in the BSAI cod longline fishery between 2008 and 2012 for a minimum average mortality of 1.52 seals per year. Mortalities of ribbon seals were reported in the BSAI flatfish, Atka mackerel, and pollock trawl fisheries between 2009 and 2013, for an estimated mean annual mortality of 0.6 seals (Muto and Angliss 2015).

Other sources of mortality and injury, particularly for northern fur seals, include entanglement in marine debris (estimated 2.6 fur seals/year, 2009-2013) and mortality incidental to MMPA authorized research activities (0.6 per year, 2008-2012) (Muto and Angliss 2015). Average annual M&SI levels from all sources, fisheries and subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

In addition, research conducted by the Northwest and Southwest Fisheries Science Centers (NWFSC and SWFSC) may affect some of the same pinniped stocks affected by AFSC research, and is therefore considered in the set of external factors that contribute to cumulative effects in the GOARA and BSAIRA. The NWFSC and SWFSC have conducted their own NEPA and MMPA compliance process and requested authorization for incidental take of some of the same marine mammal stocks as the AFSC (see Proposed Rule for the SWFSC, 80 FR 8166, 13February 2015). Table 5.5-2 indicates the requested takes by the AFSC, NWFSC, and SWFSC for all shared species or stocks, of which there are only two in the BSAIRA. Note that these are conservative estimates of takes and the actual level of taking is likely to be much less than these requested takes.

Northern fur seals prey primarily on schooling fish and gonatid squid (Sinclair et al. 1996). Sub-adult males and adult females at St. Paul Island commonly consume walleye pollock, Pacific salmon, Pacific herring, and cephalopods (Call and Ream 2012). Common prey items of harbor seals also include herring, pollock, salmon, cod, squid, and crustaceans (Jemison 2001, Iverson et al. 1997). Several of these are commercially important species.

Climate change impacts are difficult to predict, but may affect non ESA listed pinnipeds through changes in habitat and food availability. Climate change impacts on sea-ice are of primary concern for ribbon and spotted seals. Their dependence on sea-ice habitat for at least part of their life history leaves them particularly vulnerable to effects of diminishing sea-ice (Boveng et al. 2008, 2009). On a global scale, both spotted and ribbon seals are likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate (Laidre et al. 2008).

The activities external to AFSC fisheries research affecting pinnipeds are likely to continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the AFSC research alternatives on pinnipeds are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species. The contribution of AFSC fisheries research activities to cumulative effects on pinnipeds is likely to be small.

There have been no reported vessel collisions with pinnipeds involving AFSC vessels in the BSAIRA and the volume of ship traffic generated by AFSC fisheries research is a very small fraction of the total number of other vessels transiting the area. Given the relatively slow speeds of research vessels, mitigation measures, and the low number of research cruises, the likelihood of fisheries research vessels causing serious injury or mortality to non-ESA-listed pinnipeds due to ship strikes is possible, but the potential risk is minor.

The potential effects from use of active acoustic devices for research activities could infrequently and temporarily elicit behavioral avoidance effects on pinnipeds in the BSAIRA. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

Annual incidental take levels in external commercial fisheries exceed any known or potential Level A takes of most non-ESA listed pinnipeds by AFSC fisheries research. There have been no historical takes of any marine mammals in AFSC fisheries research in the BSAIRA; requested takes are based on historical takes in analogous commercial fisheries. The estimated average annual take by AFSC in the next five years is well below 10 percent of PBR for all non-ESA listed pinniped species for which takes are requested. The AFSC does not think that number will actually be taken in the next five years, but used a conservative estimation procedure to ensure accounting for the maximum amount of potential take. Given existing and proposed additional mitigation measures and the lack of historical takes, it is unlikely that the requested levels of take would be realized. The contribution of the requested AFSC takes, if they occurred, would be very small compared to other known sources of serious injury and mortality and to PBR (Table 5.5-2) and would be considered minor.

Although there is some overlap in prey of non ESA-listed pinnipeds in the BSAIRA and the species collected during AFSC research surveys, surveys generally focus on younger age-classes than consumed by pinnipeds and the total amount sampled is minimal compared to overall biomass and commercial fisheries removals (see Sections 4.2.3 and 4.2.7). Prey removal during fisheries research is very small and likely inconsequential to prey availability for any marine mammal species. The contribution of research catches to the effects on marine mammals through competition for prey is therefore considered minor adverse for pinnipeds in the BSAIRA.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the BSAIRA, the contribution of the AFSC fisheries research in the BSAIRA to cumulative effects on these species through disturbance, direct takes, and prey removal would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on non-ESA-listed pinnipeds in the BSAIRA. Indirectly, however, the loss of information obtained through this research on feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions regarding pinnipeds and monitoring of ecological trends affecting marine mammal habitat. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting pinnipeds in the BSAIRA, the contribution of the No Research Alternative to cumulative effects on non-ESA-listed pinnipeds would be minor adverse.

5.5.3 Chukchi Sea/Beaufort Sea Research Area

5.5.3.1 ESA-listed Species

External Factors in the CSBSRA

The endangered marine mammal species in the CSBSRA include bowhead, fin, and humpback whales. Threatened species include ringed seals and polar bears. The threatened listing of the Beringia DPS of bearded seals was vacated in 2014, following a decision in the U.S. District Court for the District of Alaska. The Department of Justice, on behalf of NOAA Fisheries, filed a notice of appeal of this court decision. While the appeal process is in progress, the Beringia DPS of bearded seals will retain consideration as an ESA-listed species in this FPEA. Walrus are candidate species for listing. Commercial whaling was the single greatest historical source of mortality for the cetacean species, resulting in substantial population declines through overexploitation (Perry et al. 1999). The commercial harvest of bowhead whales ended in the early part of the twentieth century. Humpback whales were protected in 1966 and fin whales in the North Pacific in 1976 (Perry et al. 1999). Climate change and loss of sea-ice habitat are considered primary factors contributing to the listings of the others (73FR28212, May 15, 2008; 77FR76706, December 28, 2012; 77FR76740, December 28, 2012).

Past, present, and reasonably foreseeable future conservation concerns and threats to recovery are outlined in recovery plans for ESA-listed species. Those for humpback whales (NMFS 1991) and fin whales (NMFS 2010a) are finalized. In 2015, the USFWS released a Draft Conservation Management Plan for polar bears (USFWS 2015b). The other species currently lack recovery plans. Conservation concerns and threats listed in the various plans include vessel collisions, entanglement in fishing gear, anthropogenic noise, vessel/human disturbance, pollutants and pathogens, disease, habitat degradation, subsistence harvest, and sea-ice loss and climate change.

The number of vessels traversing Arctic waters, including those for research, offshore oil and gas exploration, military operations, and shipping, has increased in recent years and is projected to continue to increase (TRB 2008). Decreasing summer sea ice is increasing the likelihood of expanded trans-Arctic shipping routes in coming years (Smith and Stephenson 2013). Vessel activity in the U.S. Arctic increased from 120 vessels in 2008 to 250 in 2012. Projections for 2025 range from 420 to 1,262 vessels, with a mid-range of 640 vessels transiting U.S. Arctic waters (ICCT 2015). Increased vessel traffic in the CSBSRA may result in increased incidence of whale-vessel collisions, acoustic disturbance, and haul-out disturbance of walruses and ice seals.

Incidence of vessel collisions with bowhead whales appears to be low. Two to three percent of harvested whales examined from 1988 to 2007 had ship or propeller injuries (Reeves et al. 2012). This low incidence could be due to either collisions resulting in death (and not accounted for) or minimal co-occurrence of ships and bowhead whales (George et al. 1994).

The Chukchi and Beaufort Seas are closed for commercial fishing in U.S. waters (NPFMC 2009a). Serious injury or mortality associated with commercial fisheries is, therefore, currently attributable to interactions with fisheries in the Bering Sea and, for fin and humpback whales, interactions are also possible in other regions frequented in the North Pacific. Refer to Sections 5.5.1.1 and 5.5.2.1 for details on vessel strikes and fisheries interactions for fin and humpback whales, Pacific walrus, and ringed and bearded seals in other areas of Alaska.

Scarring attributed to ropes or fishing gear entanglements have been observed on approximately 10 percent of bowhead whales harvested from 1988 to 2008 (Reeves et al. 2012). Stranding reports from 2001 to 2005 included a bowhead whale observed near Point Barrow with fishing net and line around the head (Allen and Angliss 2012). A dead bowhead whale found floating in Kotzebue Sound in July 2010 was entangled in crab pot gear similar to that used in the Bering Sea crab fishery (Suydam et al. 2011). Based on the 2010 entanglement, the average annual commercial fisheries-related mortality for 2008-2012 is 0.4 bowhead whales (Allen and Angliss 2015).

Subsistence harvest by Alaska Natives is an important source of injury or mortality for several marine mammal species in Alaska. Table 5.5-1 lists subsistence species and the AFSC research areas in which they are harvested. Threatened and endangered species subject to subsistence harvest in the CSBSRA are bowhead whales, ringed seals, bearded seals, Pacific walrus, and polar bears. The subsistence harvest by Alaska Natives is the single greatest source of human-caused mortality of the Western Arctic stock of bowhead whales. The subsistence harvest has been regulated by a quota system under the IWC since 1977 and for 2013-2018 a block quota of 306 landed bowheads is allotted, of which 67 can be harvested annually (Muto and Angliss 2015). Alaska Natives struck 57 and landed 46 bowhead whales during the 2013 subsistence hunt, which is higher than the ten-year (2003-2012) average of 40.5 landed whales (Suydam et al. 2014). The average annual combined take by subsistence hunters in Alaska, Russia, and Canada was 44 from 2009 through 2013 (Muto and Angliss 2015). Most bowhead are harvested in the Chukchi and Beaufort Seas in spring and fall hunts, with small numbers taken during spring by the villages of Gambell and Savoonga on St. Lawrence Island in the Bering Sea (Suydam et al. 2012). Only 11 of the 64 coastal communities known to harvest bearded seals and ringed seals were surveyed from 2009 to 2013, so statewide harvest estimates are not available. Based on available data, a minimum estimate of the average annual bearded seal and ringed seal harvests for 2009-2013 are 379 and 1,040 seals per year, respectively (Muto and Angliss 2015). Pacific walrus are harvested in both the U.S. and Russia, with an estimated total mean annual harvest for 2006-2010 of 4,852; total harvest includes those struck and lost. The mean annual harvest for U.S. (Alaska Native) subsistence hunters was 1,782 walrus for the same time period (USFWS 2014a). The average annual subsistence harvest of polar bears in Alaska from 2003-2007 was 37 for the Chukchi/Bering seas stock and 33 for the Southern Beaufort Sea stock. The average annual subsistence harvest for the Southern Beaufort Sea stock in Alaska and Canada combined was 53.6 bears per year (Allen and Angliss 2012). Average annual M&SI levels from all sources, subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

Current and projected offshore oil and gas exploration and development in the Chukchi and Beaufort Seas could impact threatened and endangered marine mammals in the area. Potential effects include acoustic disturbance, vessel collisions, discharge of contaminants, and oil spills. Effects of oil spills on marine mammals can range from displacement, impacts on prey resources, and minor skin irritations to loss of insulation and death (NMFS 2013d).

Climate change may profoundly impact marine mammals in the Arctic. Impacts on ESA-listed species are possible through direct loss of habitat for feeding, breeding, pupping, and resting, as well as changes in prey composition and availability. Ice-obligate species, such as walrus, ringed seals, bearded seals, and polar bears are particularly vulnerable to climate changes, as they are intricately tied to and heavily dependent upon sea ice. Concern over habitat loss through diminishing and degrading sea-ice loss due to climate change prompted petitions to list these species under the ESA (73 FR 28212, May 15, 2008; 77 FR 76706, December 28, 2012; 77 FR 76740, December 28, 2012). Polar bears and ringed seals are now listed as threatened, while walrus are candidate species for listing. Recent shifts in distribution and habitat use by polar bears and walrus in the Beaufort and Chukchi seas are likely attributable to loss of sea ice habitat (Fischbach et al. 2007, 2009). Bowhead whales may be sensitive to current and ongoing effects of climate change, although it is not currently possible to reliably predict effects of changes in weather, sea surface temperatures, or sea ice extent on bowheads. Research and models suggest that, at least in the short term, reduced sea ice cover may actually increase prey availability for bowhead whales and result in improved body condition (George et al. 2015, Moore and Laidre 2006).

The activities external to AFSC fisheries research affecting ESA-listed marine mammals in the CSBSRA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on ESA-listed marine mammals in the CSBSRA are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species.

There have been no reported vessel collisions or entanglements of ESA-listed marine mammals involving AFSC vessels or gear in the CSBSRA. The level of ship traffic resulting from AFSC fisheries research is small compared to the number of other vessels transiting the Chukchi and Beaufort seas. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels contributing to serious injury or mortality to ESA-listed species due to ship strikes is low and the potential risk is minor.

The potential effects from use of active acoustic devices for research activities could elicit rare or infrequent and temporary behavioral avoidance effects on ESA-listed marine mammals. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

There have been no known adverse interactions or takes of ESA-listed marine mammals during AFSC fisheries research in the CSBSRA. The AFSC is, however, requesting a take of one bearded seal and one ringed seal in trawl gear in the CSBSRA over the five-year authorization period (or an average of 0.2 per year) based on the geographic and temporal overlap of AFSC fisheries research activities and marine mammal species' ranges. PBR is undetermined for both bearded and ringed seals, but the requested takes in trawl gear are sufficiently small to be considered minor in magnitude for both species, even when requested takes in the BSAIRA and "undetermined" pinniped species takes are considered. Given the existing and proposed additional mitigation measures, and the lack of historical takes of these species, it is unlikely that the requested level of take would be realized. The contribution of the requested AFSC takes of bearded seals and ringed seals, if they occurred, would be very small compared to other known sources of serious injury and mortality and to PBR (Table 5.5-2) and would be considered minor. No takes are requested of other ESA-listed species in the CSBSRA.

Prey removal during fisheries research is very small (see Sections 4.2.3 and 4.2.7) and likely inconsequential to prey availability for ESA-listed marine mammal species in the CSBSRA.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the CSBSRA, the contribution of AFSC fisheries research activities to cumulative effects on ESA-listed marine mammals would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on ESA-listed cetaceans in the CSBSRA. Indirectly, however, the loss of information obtained through this research, either directly or indirectly, on marine mammal feeding ecology, oceanographic components of their habitat, and status of prey stocks could have minor adverse impacts on management decisions and monitoring of ecological trends affecting marine mammal habitat. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact monitoring and management capabilities for marine mammals in the region. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting ESA-listed marine mammals in the CSBSRA, the contribution of the No Research Alternative to cumulative effects would be minor adverse.

5.5.3.2 Non-ESA-Listed Cetaceans

External Factors in the CSBSRA

The cetaceans included in this section are not ESA-listed, although they are subject to similar types of effects from external activities as described above for ESA-listed species. The non-ESA-listed cetaceans that occur in the CSBSRA include two stocks of beluga whales, harbor porpoise, minke whales, and eastern North Pacific gray whales. The gray whale is the only species included in this section that was subjected to large-scale commercial whaling. Gray whales and beluga whales were historically and are currently hunted for subsistence purposes.

The IWC banned commercial whaling of gray whales in the late-1940s and, after decades of recovery and population growth, the eastern North Pacific stock was removed from the List of Threatened and Endangered Wildlife in 1994. The U.S. and Russia share a combined harvest quota, with an average annual harvest allocation of 120 whales by the Russian Chukotka people and four whales by the Makah Indian Tribe. The average annual take by the Russian hunt was 123 whales from 2007 to 2011 (Carretta et al. 2014).

Beluga whales in western and northern Alaska are co-managed by NMFS and the Alaska Beluga Whale Committee, whose members include representatives from 28 coastal villages from Bristol Bay to Kaktovik, the North Slope Borough, ADFG, and NMFS. The average annual subsistence harvest of belugas from the Eastern Chukchi Sea stock by Alaska Natives was 57.4 whales for the years 2008 to 2012. The Beaufort Sea stock of beluga whales are harvested for subsistence purposes in both Alaska and Canada. The mean annual number landed by Alaska Natives is 66 (2008-2012) and is 100 in Canada (2005-2009) for a total average annual subsistence take of 166 from this stock (Allen and Angliss 2015).

Subsistence harvests are the primary source of injury or mortality for beluga whales in the CSBSRA. There are no reports of mortality incidental to commercial fisheries and total fishery-related M&SI is estimated to be zero for both stocks. Average annual M&SI levels from all sources, subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

The number of vessels traversing Arctic waters from the Bering Strait to the Beaufort Sea has increased in recent years and is projected to continue to increase (TRB 2008). Decreasing summer sea ice is facilitating the likely expansion of trans-Arctic shipping routes in coming years (Smith and Stephenson 2013). Vessel activity in the U.S. Arctic increased from 120 vessels in 2008 to 250 in 2012, and is projected to increase further to 420 to 1,262 vessels by 2025 (ICCT 2015). Increased vessel traffic in the CSBSRA may result in increased incidence of vessel collisions, contaminant spills, and acoustic disturbance of marine mammals.

Current and projected offshore oil and gas exploration and development in the Chukchi and Beaufort Seas could also impact marine mammals in the area through acoustic disturbance, vessel collisions, discharge of contaminants, and oil spills. Effects of oil spills on marine mammals can range from displacement, impacts on prey resources, and minor skin irritations to loss of insulation and death (NMFS 2013d).

Climate change may profoundly impact marine mammals in the Arctic. Impacts are possible through changes in habitat and prey composition and availability. Range expansion of sub-arctic or temperate water species could result in increased competition for resources or, in the case of killer whales, possible increases in predation. Data are currently insufficient to reliably predict impacts of climate change on non-ESA-listed cetaceans in the CSBSRA.

The activities external to AFSC fisheries research affecting ESA-listed marine mammals in the CSBSRA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on non-ESA-listed cetaceans in the CSBSRA are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species.

There have been no reported vessel collisions of non-ESA-listed cetaceans involving AFSC vessels or gear in the CSBSRA. The level of ship traffic resulting from AFSC fisheries research is small compared to the number of other vessels transiting the Chukchi and Beaufort seas. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels contributing to serious injury or mortality of non-ESA-listed species due to ship strikes is low and the potential risk is minor.

The potential effects from use of active acoustic devices for research activities could elicit rare or infrequent and temporary behavioral avoidance effects on non-ESA-listed cetaceans. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

There have been no known adverse interactions or takes of non-ESA-listed cetaceans during AFSC fisheries research in the CSBSRA. The AFSC is, however, requesting a take of one beluga whale from the Eastern Chukchi stock and one from the Beaufort stock in trawl gear in the CSBSRA over the five-year authorization period (or an average of 0.2 per year from each stock) based on the geographic and temporal overlap of AFSC fisheries research activities and the stocks' ranges. This level of take, were it to occur, would be well below one percent of PBR for the Eastern Chukchi Sea stock; PBR is undetermined for the Beaufort Sea stock, but the total annual average estimated take of 0.2 belugas is sufficiently small to be considered minor in magnitude, even in the absence of a PBR determination. There are no requested takes of other species or of either stock in other gear types. The contribution of the requested AFSC takes, if they occurred, would be very small compared to other known sources of serious injury and mortality and to PBR (Table 5.5-2) and would be considered minor.

Prey removal during fisheries research is very small (see Sections 4.2.3 and 4.2.7) and likely inconsequential to prey availability for non-ESA listed cetaceans in the CSBSRA.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed cetaceans in the CSBSRA, the contribution of AFSC fisheries research activities to cumulative effects on non-ESA-listed cetaceans would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on non-ESA-listed cetaceans in the CSBSRA. Indirectly, however, the loss of physical and biological information obtained through this research, either directly or indirectly, could have minor adverse impacts on management decisions and monitoring of ecological trends affecting marine mammal habitat. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact monitoring and management capabilities for cetaceans in the region. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA listed cetaceans in the CSBSRA, the contribution of the No Research Alternative to cumulative effects would be minor adverse.

5.5.3.3 Non-ESA Listed Pinnipeds

External Factors in the CSBSRA

The pinnipeds included in this section are not ESA-listed, although they are subject to similar types of effects from external activities as described above for ESA-listed species. The non-ESA-listed pinnipeds that occur in the CSBSRA and that may interact with AFSC fisheries research include spotted seals and ribbon seals.

Subsistence harvests by Alaska Natives are the primary cause of injury or mortality of ribbon and spotted seals in the CSBSRA. The most recently available statewide harvest data for spotted seals is from 2000, when the estimated number harvested annually was 5,265. Only 11 of the 64 coastal communities known to harvest ribbon seals were surveyed between 2009 and 2013, so statewide harvest estimates are not available. Based on these limited data, a minimum estimate of the average annual ribbon seal harvest for 2009-2013 is 3.2 seals per year (Muto and Angliss 2015). Alaska Native subsistence hunters primarily harvest spotted seals in the Bering Strait and Yukon-Kuskokwim areas and ribbon seals from villages along the Bering Strait and, to a lesser degree, the Chukchi Sea coast (Allen and Angliss 2015). Average annual M&SI levels from all sources, subsistence harvests included, and PBR for species for which the AFSC is requesting takes are shown in Table 5.5-2.

The number of vessels traversing Arctic waters from the Bering Strait to the Beaufort Sea has increased in recent years and is projected to continue to increase (TRB 2008). Decreasing summer sea ice is facilitating the likely expansion of trans-Arctic shipping routes in coming years (Smith and Stephenson 2013). Vessel activity in the U.S. Arctic increased from 120 vessels in 2008 to 250 in 2012, and is projected to increase further to 420 to 1,262 vessels by 2025 (ICCT 2015). Increased vessel traffic in the CSBSRA may result in increased incidence of vessel collisions, contaminant leaks or spills, and acoustic and behavioral disturbance of pinnipeds.

Current and projected offshore oil and gas exploration and development in the Chukchi and Beaufort Seas could also impact marine mammals in the area through acoustic disturbance, vessel collisions, discharge of contaminants, and oil spills. Effects of oil spills on marine mammals can range from displacement, impacts on prey resources, and minor skin irritations to loss of insulation and death (NMFS 2013d).

Climate change may profoundly impact marine mammals in the Arctic. Altered sea-ice is a primary concern for ribbon and spotted seals. Their dependence on sea-ice habitat for at least part of their life history leaves them particularly vulnerable to effects of diminishing sea-ice (Boveng et al. 2008, 2009). On a global scale, both spotted and ribbon seals are likely to be moderately sensitive to climate change based on an analysis of various life history features that could be affected by climate (Laidre et al. 2008).

The activities external to AFSC fisheries research affecting non-ESA-listed pinnipeds in the CSBSRA will likely continue into the foreseeable future (see Table 5.1-1). The level of impact will depend on the application and efficacy of current and proposed mitigation measures. The potential effects of climate change are unpredictable, but are also likely to continue into and beyond the foreseeable future.

Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on non-ESA-listed pinnipeds in the CSBSRA are discussed in Sections 4.2.4, 4.3.4, and 4.4.4. The three research alternatives considered in this FPEA include similar scopes of research. The primary differences lie in the number and types of associated mitigation measures for protected species.

There have been no reported vessel collisions of non-ESA-listed pinnipeds involving AFSC vessels or gear in the CSBSRA. The level of ship traffic resulting from AFSC fisheries research is small compared to the number of other vessels transiting the Chukchi and Beaufort seas. Given the relatively slow speeds of research vessels, mitigation measures, and the small number of research cruises, the likelihood of fisheries research vessels contributing to serious injury or mortality of non-ESA-listed species due to ship strikes is low and the potential risk is minor.

The potential effects from use of active acoustic devices for research activities could elicit rare or infrequent and temporary behavioral avoidance effects on non-ESA-listed pinnipeds. Relative to the volume of other ship traffic and other anthropogenic sources of acoustic disturbance, the contribution of noise from AFSC research would be minor.

There have been no known adverse interactions or takes of non-ESA-listed pinnipeds during AFSC fisheries research in the CSBSRA. The AFSC is, however, requesting a take of one ribbon seal and one spotted seal in trawl gear in the CSBSRA over the five-year authorization period (or an average of 0.2 per year for each species) based on the geographic and temporal overlap of AFSC fisheries research activities and the stocks' ranges. These potential takes, even if combined with the requested take level in the BSAIRA and "undetermined" pinniped species takes, would be less than one percent of PBR for spotted seals and ribbon seals. Given the lack of pinniped interactions that have occurred in the past and the implementation of current mitigation measures, future mortalities of pinnipeds would likely be rare or infrequent events. The contribution of the requested AFSC takes, if they occurred, would be very small compared to other known sources of serious injury and mortality and to PBR (Table 5.5-2) and would be considered minor.

Prey removal during fisheries research is very small (see Sections 4.2.3 and 4.2.7) and likely inconsequential to prey availability for non-ESA-listed pinnipeds in the CSBSRA.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed pinnipeds in the CSBSRA, the contribution of AFSC fisheries research activities to cumulative effects on non-ESA-listed pinnipeds would be minor adverse under all three research alternatives.

Contribution of the No Research Alternative

Under the No Research Alternative, AFSC would no longer conduct or fund the fisheries and ecosystem research considered in the scope of this FPEA, so would not directly contribute to cumulative effects on non-ESA-listed pinnipeds in the CSBSRA. Indirectly, however, the loss of physical and biological information obtained through this research, either directly or indirectly, could have minor adverse impacts on management decisions and monitoring of ecological trends affecting marine mammal habitat. The indirect contribution of the No Research Alternative to cumulative effects is difficult to ascertain for individual species, but could impact monitoring and management capabilities for cetaceans in the region. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting non-ESA-listed pinnipeds in the CSBSRA, the contribution of the No Research Alternative to cumulative effects would be minor adverse.

5.6 CUMULATIVE EFFECTS ON BIRDS

Activities external to AFSC fisheries research that could potentially affect birds in the AFSC research areas may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, hunting, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Mortality from by-catch in fisheries and hunting
- Collisions with ships
- Alteration or reduction of prey resources
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance
- Loss or injury due to contamination of habitat or prey
- Loss or injury from collision with offshore structures

5.6.1 Gulf of Alaska Research Area

5.6.1.1 External Factors

Seabirds in the GOARA are affected by numerous past and present human-caused and natural factors.

Anthropogenic factors include: mortality in longline, trawl, pot, and gillnet fisheries, ingestion of plastic debris, human use and development of nesting habitat, oil spills, attraction to and disorientation by artificial lights leading to exhausted birds landing in dangerous situations and colliding with power lines and other structures, habitat destruction, pollution, competition with fisheries for prey species, underwater explosions from industrial and military operations, entanglement in debris, ingestion of marine debris, introduction of mammalian predators to nesting islands, vessel collisions, and hunting. Some seabird species travel long distances over the ocean and have many potentially adverse interactions with humans and their activities around the globe. Human activities on land can also affect them at sea or at inland nest sites, such as oil and gas exploration, coastal development and transportation, dock construction, marine pollution, and dredging, as well as runoff contamination and land clearing for resource development. Climate change is also likely having effects on seabirds through changes in their prey abundance and distribution, although climate change may have adverse effects on some species while others may actually benefit.

Natural factors include: threats to their nesting habitat, predation on adults, eggs, and young by birds and mammals, and habitat loss. Natural factors such as changes in ocean currents, prey availability, and severe weather can drive population fluctuations for many species (Ainley and Hyrenbach 2007).

The factors that have affected seabirds in the GOARA in the past are likely to do so in the future. RFFAs include continuation and possible expansion of fisheries activities, mining, military operations, oil and gas exploration and production, marine vessel traffic, ocean disposal and discharge, climate change, and ocean acidification.

For some species (e.g., ESA-listed species), cumulative effects resulting from external anthropogenic factors (past actions) have caused declines in populations that are considered major conservation concerns. For many other species, population trends are not well known and most populations tend to fluctuate normally due to natural factors. Cumulative effects on these species from anthropogenic sources and climate change could be moderate to minor.

5.6.1.2 Contribution of the Research Alternatives

None of the three action alternatives are likely to contribute more than minor effects to the cumulative effects on seabirds. One species, black-footed albatross, have been caught on an infrequent but regular basis (average about three birds per year) in AFSC fisheries research longline gear in the GOARA, in spite of seabird mitigation measures being implemented on all longline sets. Past levels of bycatch for this species are expected to continue under all research alternatives and contribute to bycatch of this species in other fisheries throughout its range, many of which are not subject to independent observation and for which no bycatch estimates are available. The Alaska groundfish fisheries have an Observer Program and, based on that data, are estimated to have caught black-footed albatross at an average rate of 160 birds per year in the GOA demersal longline fishery (plus about 8 birds per year in the BSAI longline fisheries and 9 birds per year in all GOA/BSAI trawl fisheries combined) (NMFS 2014b). The contribution of AFSC fisheries research to cumulative black-footed albatross mortality in bycatch is therefore very small. The cumulative number of albatross caught each year in all fisheries is unknown and remains a conservation concern for this species. However, mandatory requirements for seabird mitigation measures in various commercial fisheries in the past 15 years has decreased the rate of albatross bycatch and nesting populations of the species appear to be stable (Arata et al. 2009). Very few other seabirds have been caught incidentally in AFSC fisheries surveys and the contribution of AFSC research to cumulative bycatch is minimal for all other species. No ESA-listed species are expected to be caught in the GOARA by AFSC fisheries research in the future.

The contribution of AFSC fisheries research to cumulative effects on seabird prey availability or contamination of the marine environment is negligible. In contrast, ecosystem research conducted by the AFSC has beneficial contributions to seabirds by providing scientific information important to seabird conservation and management. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting seabirds in the GOARA, the contribution of AFSC fisheries research to the cumulative effects on seabirds in the GOARA is considered minor adverse for all species.

5.6.1.3 Contribution of the No Research Alternative

The lack of research under this alternative would eliminate any contribution of AFSC fisheries research to direct effects on seabirds in the GOA. However, many of the AFSC projects that would be eliminated under this alternative generate a great deal of information on the ecology of the GOA. The loss of this information could indirectly affect resource management decisions concerning the conservation of seabirds. There are too many unknown variables to estimate the level of impact this lack of information would have on any particular species of seabirds but the contribution of this alternative to cumulative impacts on seabirds would likely be minor adverse.

5.6.2 Bering Sea/Aleutian Islands Research Area

5.6.2.1 External Factors

Seabirds in the BSAIRA are being affected by the same types of anthropogenic and natural factors described above in the GOARA section, and are likely to be affected by the same types of RFFAs. The cumulative effects on seabirds in the BSAIRA resulting from external anthropogenic factors (past actions, present actions, and RFFAs) are considered major (for some ESA-listed species) to minor for other species.

5.6.2.2 Contribution of the Action Alternatives

None of the three action alternatives are likely to contribute more than minor effects to the cumulative effects on seabirds. Just three seabirds have ever been caught incidentally in AFSC fisheries surveys in the BSAIRA, and the risk is expected to continue to be very low in the future. The contribution of AFSC research to cumulative bycatch is therefore minimal for all species. No ESA-listed species are expected to be caught in the BSAIRA by AFSC fisheries research in the future.

The contribution of AFSC fisheries research to cumulative effects on seabird prey availability or contamination of the marine environment is negligible. In contrast, ecosystem research conducted by the AFSC has beneficial contributions to seabirds by providing scientific information important to seabird conservation and management. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting seabirds in the BSAIRA, the contribution of AFSC fisheries research to the cumulative effects on seabirds in the BSAIRA is considered minor adverse for all species.

5.6.2.3 Contribution of the No Research Alternative

As described above in the GOARA section, the contribution of this alternative to cumulative impacts on seabirds would be minor through the loss of ecological information used for the management and conservation of seabirds.

5.6.3 Chukchi Sea/Beaufort Sea Research Area

5.6.3.1 External Factors

Seabirds in the CSBSRA are being affected by some of the same types of anthropogenic and natural factors described above, as well as substantial ecological changes occurring in this region due to loss and thinning of sea ice in a rapidly warming Arctic, and are likely to be affected by the same types of RFFAs Although commercial fishing has not been a factor affecting seabirds in this area in the past, the warming of the Arctic and seasonal loss of sea ice may increase opportunities for fishing in this region in the future (NMFS 2009b). Oil exploration and development in offshore arctic waters has recently been reduced as a potential factor although that may change again in the future. The cumulative effects on seabirds in the CSBSRA resulting from external anthropogenic factors (past actions, present actions, and RFFAs) and climate change are considered major (for some ESA-listed species) to minor for other species.

5.6.3.2 Contribution of the Action Alternatives

None of the three action alternatives are likely to contribute more than minor effects to the cumulative effects on seabirds. No seabirds have ever been caught incidentally in AFSC fisheries surveys in the CSBSRA and the risk is very low in the future. The contribution of AFSC fisheries research to cumulative effects on seabird prey availability or contamination of the marine environment is negligible. In contrast, ecosystem research conducted by the AFSC has beneficial contributions to seabirds by providing scientific information important to seabird conservation and management. When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting seabirds in the CSBSRA, the contribution of AFSC fisheries research to the cumulative effects on seabirds in the CSBSRA is considered minor adverse for all species.

5.6.3.3 Contribution of the No Research Alternative

As described above in the GOARA section, the contribution of this alternative to cumulative impacts on seabirds would be minor through the loss of ecological information used for the management and conservation of seabirds.

5.7 CUMULATIVE EFFECTS ON SEA TURTLES

Sea turtles not present in the Chukchi Sea/Beaufort Sea Research Area, so this analysis will focus on cumulative effects in the GOA and Bering Sea. Factors external to AFSC fisheries research that could potentially affect sea turtles within the GOA may include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these factors are summarized in Table 5.1-1 and may include:

- Mortality and injury from by-catch in fisheries
- Collisions with ships
- Alteration or reduction of prey resources through fisheries and climate change
- Loss or injury due to ingestion of or entanglement in marine debris
- Behavioral disturbance from marine vessels and coastal development

5.7.1 External Factors in the Gulf of Alaska and Bering Sea/Aleutian Islands

Sea turtles are susceptible to impacts resulting from natural and anthropogenic factors, both on land and in the water (Table 5.1-1). All four species of sea turtles that occur in the AFSC research areas are threatened or endangered, and have therefore been subject to major population-level cumulative effects, outside of Alaska. Factors affecting sea turtles in Alaska include incidental bycatch in fisheries, entanglement in other lines, vessel collisions, ingestion of floating plastics, and exposure to spills (ADFG 2005), as well as mortality due to cold-stunning associated with rapid temperature declines in the fall (ANHP 2012). It is not known whether or not climate change may increase the rate of sea turtle occurrences in Alaska (Ream 2015).

Multiple past and present actions have affected sea turtles both inside and outside of Alaska and many of these factors are likely to continue for the foreseeable future.

5.7.2 Contribution of the Research Alternatives

Fisheries research activities conducted and funded by the AFSC have had no recorded interactions with any sea turtles and removal of potential sea turtle prey is very small and localized. None of the research alternatives are likely to contribute more than negligible adverse effects to the cumulative effects on these species. When considered in conjunction with commercial and recreational fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting sea turtles in Alaska, the contribution of AFSC fisheries research to the cumulative effects on sea turtles in the GOA and Bering Sea research areas is considered negligible for all species.

5.7.3 Contribution of the No Research Alternative

The No Research Alternative would eliminate any direct impacts to sea turtles that could potentially occur under the research alternatives. However, the elimination of AFSC fisheries research would also substantially reduce the collection of oceanographic and fisheries data important for monitoring the ecological status of the environment important to sea turtles. However, there are other sources of information on the marine environment than the AFSC fisheries research so the No Research Alternative would have a negligible contribution to adverse cumulative impacts to sea turtles in Alaska through indirect effects on management decisions important to the conservation and recovery of these species.

5.8 CUMULATIVE EFFECTS ON INVERTEBRATES

Activities external to AFSC fisheries research that could potentially affect invertebrate species are generally similar among the three AFSC fisheries research areas (except for the lack of commercial fisheries in the CSBSRA) and include commercial and recreational fisheries, ocean disposal and discharges, dredging, coastal development, oil and gas exploration, vessel traffic, other scientific research, military operations, climate change, and ocean acidification. These activities and potential effects are summarized in Table 5.1-1 and include:

- Injury or mortality due to directed catch or bycatch in commercial and recreational fisheries
- Habitat disturbances
- Changes in distribution and food availability due to climate change or habitat degradation

5.8.1 External Factors in the AFSC Research Areas

Commercial and recreational fisheries are significant external factors in the GOARA and BSAIRA while subsistence fishing is also a factor in the CSBSRA. There are currently no significant fisheries in the CSBSRA due to the indefinite prohibition on commercial fishing as outlined in the August 2009 Arctic FMP, and no timeline has been set for a fishery opening to occur (NPFMC 2009a). In the GOARA and BSAIRA, there are multiple fisheries and multiple invertebrate target species. By definition, target species are those managed for recreational and commercial fisheries, are defined as belonging to a management group defined in the regional FMP, and are the subject of AFSC research surveys for stock assessment purposes. The other species considered here are generally not targeted by commercial or recreational fishers but may be caught in substantial numbers as bycatch. These fisheries are the primary past, present, and reasonably foreseeable future activities that have or are likely to have the greatest effect on these species in the GOARA and BSAIRA external to AFSC fisheries research.

The numerous target species in the GOARA and BSAIRA are managed by NMFS or by the ADFG with directives from the NPFMC in compliance with their respective FMPs; those which are most frequently caught in AFSC research are shown in Table 3.2-13. Other species that may be caught during research surveys are often monitored as part of ecosystem-based management efforts even if they are not subject to stock assessments; these are shown in Table 3.2-14. The analysis of effects in Chapter 4 focused on those species most frequently caught in AFSC research activities and species that are considered overfished or where overfishing is occurring (Tables 4.2-20, 4.2-21, and 4.2-22). The cumulative effects analysis will take a similar approach.

Only Pribilof Islands blue king crab are considered overfished or approaching an overfished status (Table 3.2-13 and NMFS 2015g). A directed fishery on this stock of blue king crab was open from 1973 to 1988, with catches ranging up to 5 million pounds (NPFMC 2014f). In 1988, the fishery was closed, reopened from 1995 to 1999, and declared overfished in 2002. Other commercially important target species include snow crab, red king crab, southern Tanner crab and weathervane scallops. These stocks are considered healthy and not overfished.

The environmental effects of climate change could be extensive in geographic area and long-term in duration and could therefore have major cumulative effects on invertebrate species. Impacts are possible through direct loss of habitat (including sea ice habitat) for feeding, spawning, and rearing; ocean acidification; and changes in prey composition and availability. Some species are likely to benefit from changes in the marine environment while others will experience adverse effects, such as the effects of ocean acidification on crab shell or coral building (Mathis et al. 2014). Distribution changes and population declines related to climatic changes are possible (see Grebmeier 2012, and Doney et al. 2012). The nature and magnitude of potential climate change effects are, however, very difficult to predict with certainty.

The number of vessels traversing waters in AFSC research areas, including those for research, offshore oil and gas exploration, military operations, and shipping, has increased in recent years and is projected to continue to increase (TRB 2008). Decreasing summer sea ice in the CSBSRA is increasing the likelihood of expanded trans-Arctic shipping routes in coming years (Smith and Stephenson 2013). Increased vessel traffic in the AFSC research areas leads to increases in the risk of contaminant discharges.

Current and projected offshore oil and gas exploration and development in the Chukchi and Beaufort Seas could impact invertebrate and ecosystem resources. Potential effects include vessel collisions, discharge of contaminants, and oil spills. Effects of oil spills on invertebrate species can include displacement, impacts on prey resources, impacts on habitat, animal illness, and mortality.

The activities external to AFSC fisheries research affecting invertebrate species will likely continue into the foreseeable future (Table 5.1-1). The level of impact from fishing will depend on the application and efficacy of FMPs and habitat protection measures. Natural population fluctuations and periodic short-term and longer term climate changes also affect population viability and stock sizes. The potential effects of increased industrial use of Alaska waters and of climate variability are unpredictable, but are also likely to continue into and beyond the foreseeable future.

5.8.2 Contribution of the Research Alternatives

Direct and indirect effects of the research alternatives on invertebrates are discussed in Sections 4.2.7, 4.3.7, and 4.4.7. Mortality of target and non-managed species due to AFSC fisheries research would be similar under all three research alternatives and represents a small fraction of harvest levels allocated to commercial fisheries. The average annual catch of invertebrate species during AFSC research surveys (Tables 4.2-20, 4.2-21, and 4.2-22) is generally much less than 2 percent of commercial quotas of these species. There is a moratorium on commercial fishing in the Arctic, so there are currently no sources for abundance and diversity data other than research surveys and existing data for the CSBSRA. Research surveys provide a reliable way to monitor both valuable and under-exploited species and can inform decisions about abundance.

The comparisons made in Table 4.2-20 and Table 4.2-21 indicate that, while mortality to invertebrate species is a direct effect of the AFSC fisheries surveys, the magnitude of this mortality is very small relative to other sources of mortality and the overall populations of these species.

When considered in conjunction with commercial fisheries and aggregated with other past, present, and reasonably foreseeable future activities affecting managed and non-managed invertebrate species in the GOA and BSAI, the contribution of AFSC fisheries research activities to the adverse cumulative effects on these species would be minor under all three research alternatives. The AFSC fisheries and ecosystem research program also makes a beneficial contribution to cumulative effects on managed species through their role in providing scientific information to the commercial fisheries management process which strives to maintain sustainable populations. The beneficial value of fisheries research to a range of future management challenges from fishing to climate change is quite substantial and helps to address a range of adverse cumulative effects.

5.8.3 Contribution of the No Research Alternative

Under the No Research Alternative, the AFSC would no longer conduct or fund fieldwork for fisheries and ecosystem research in marine waters of the BSAIRA and GOARA so would not directly contribute to cumulative effects on invertebrate species in this region. In the absence of research surveys, important scientific information would not be collected about the status of managed invertebrate stocks used for fisheries and conservation management, including trends in abundance, recruitment rates, and the amount of invertebrates being harvested relative to overfishing metrics. This lack of data would make it much more difficult for fisheries managers to effectively monitor the status of stocks, develop fishery regulations, and rebuild depleted stocks. Ceasing or interrupting long-term data series on oceanography, abundance and distribution of various species, and diet studies (many surveys have roots in the early 1980's) would have long-term adverse effects on the ability of scientists to monitor and model effects of ecosystem changes. The lack of information and increasing uncertainty about the status of invertebrate stocks and their habitats would have serious implications for fisheries management. The indirect effects of the No Research Alternative could, therefore, impact invertebrate stocks through a lack of information essential for prudent decision making and conservation of invertebrates, their prey, and their habitats. The indirect contribution of the No Research Alternative to cumulative effects on target and other species is difficult to ascertain, but would likely have moderate adverse impacts on the long-term monitoring ability of NMFS or other agencies and the management capabilities for numerous economically and ecologically important species.

5.9 CUMULATIVE EFFECTS ON THE SOCIAL AND ECONOMIC ENVIRONMENT

This section describes the contribution of AFSC research activities to cumulative effects on the social and economic environment from past, present, and RFFAs. The intent of this section is to describe the contribution of AFSC fisheries research activities to the social and economic environment of fishing communities throughout the North Pacific and Alaska Region. Activities external to AFSC fisheries research that could potentially affect the social and economic environment in the GOARA, BSAIRA, and CSBSRA may include commercial, recreational, and subsistence fisheries, shipping, coastal development, oil extraction, other scientific research, military operations, climate change, and ocean acidification. The potential effects of these activities are summarized in Table 5.1-1 and may include:

- Provision of jobs and economic opportunity
- Changes in commercial fishing opportunities
- Changes in and contributions to management of subsistence resources
- Economic costs of changes in resource availability due to climate change and ocean acidification

5.9.1 External Factors on Social and Economic Resources

Many Alaskan coastal communities are centered on a subsistence economy and culture. Even in the larger coastal communities with substantial industry, resident Alaska Natives often participate in subsistence harvests and cultural traditions of sharing such resources. Climate change and other natural environmental trends are likely to have the greatest potential to affect subsistence resources and associated subsistence harvest activities. Changes in the distribution and characteristics of sea ice and changes in the distribution of fish and wildlife resources with warming ocean temperatures are major drivers. In addition, potential impacts associated with marine shipping and offshore resource development could also have an effect on subsistence. Subsistence resources within the AFSC research areas, such as salmon and marine mammals, are also influenced by external factors and the contribution to cumulative effects from AFSC fisheries research as described in Section 5.4 (Cumulative Effects on Fish) and Section 5.5 (Cumulative Effects on Marine Mammals). The ability of subsistence users to purchase vehicles, supplies, and fuel to support their subsistence activities is often dependent on a cash economy that may be related to commercial or recreational fisheries. Subsistence activities may also be influenced by cumulative effects on the fishing economy, as described below.

The cumulative effects of AFSC fisheries research are closely related to socioeconomic conditions in Alaska and the North Pacific with regard to commercial and recreational fisheries, although the importance of federally managed fisheries in the social and cultural environment in these communities varies substantially from place to place. Overall, as stated in Section 3.3.2, in 2012 Alaska's seafood industry generated $4.2 billion in sales impacts, $1.8 billion in income impacts, and approximately 56,000 full-time and part-time jobs (NMFS 2012). The strength of the fisheries-related economy closely parallels the health of fish and invertebrate populations, which are subject to their own cumulative effects (Section 5.4 and 5.8 respectively).

In regard to marine fishing opportunities, cumulative fishing and non-fishing industry actions would be more noticeable in coastal communities. Specific fisheries management decisions, to which the AFSC research program contributes, could also have an effect over time. Reductions in certain stocks as a result of ocean ecosystem changes, or overfishing, which results in commercial or recreational fishing area closures, would result in noticeable changes in the socioeconomic status of many communities.

RFFAs that could contribute to cumulative effects on the social and economic environment of Alaska and the North Pacific include new conservation measures for ESA-listed species (e.g., Steller sea lions) and depleted fishery resources (e.g., Pacific halibut and Chinook salmon) that may come into effect. Conservation efforts could include measures that would lead to increased costs for fishermen through required gear modifications or extensive time and/or area closures. These types of conservation measures could have long-term effects if fishing fleets cannot adapt their fishing techniques to reduce unwanted bycatch or find alternative fishing locations. The potential effects of climate change and ocean acidification on fisheries stocks and distribution is another RFFA of concern.

Existing fisheries regulations within the Alaska Region have already contributed to effects on the social and economic environment through numerous regulatory regimes affecting levels of effort for both commercial and recreational fishing. Most fishermen can understand the need to protect different marine species. However, depending on locations of closed areas or the level of specificity in regulations, fishermen could feel varying levels of effects on their daily operations from these regulations.

5.9.2 Contribution of the Research Alternatives

The contribution of AFSC fisheries and ecosystem research to cumulative effects on subsistence resources and the ability of Alaska Natives to harvest those resources would be minimally adverse under all three research alternatives. Capture of subsistence fish species in AFSC fisheries research is very small relative to commercial fisheries metrics and even smaller relative to population levels and unlikely to have any effect on the availability of those species for subsistence. Incidental capture of marine mammals in AFSC fisheries research are anticipated to remain very rare events under the three research alternatives and the risk of interference with subsistence harvests is minimal and should be mitigated with a new AFSC communication plan.

The fundamental purpose of fisheries management is to ensure the continued productivity of fisheries resources and the accomplishment of other fisheries objectives through the formulation, implementation, and enforcement of regulations or rules which govern fisheries activities. This process takes into account the cumulative effects on fish stocks from past, present, and reasonably foreseeable actions. Through information gathering, analysis, planning, consultation, allocation of resources, and decision making, AFSC fisheries and ecosystem research is one of the most effective mechanisms to monitor the status of fish stocks and changes in the marine environment, providing substantial beneficial contributions to cumulative effects through scientific input to fishery management and other environmental decision-making processes to ensure the continued productivity of the resources. Continuation of this research would provide consistent data to allow evaluation of fish stock trends and the effects of actions not related to fishing.

In all research alternatives, at-sea and laboratory research conducted or funded by the AFSC would continue. This would help promote sustainable fish populations and have substantial benefits for local economies dependent on stable fishing opportunities. Long-term sustainable catches would be promoted, increasing stability in fishing communities and reducing boom and bust cycles related to over-exploitation of target species. In addition, research results that identify effects not related to commercial or recreational fishing that could threaten species recoveries and sustainable yield levels could be identified in sufficient time to take corrective action before population level effects would be noticed by fishers in the form of reduced abundance and lower catches.

The socioeconomic effects of non-fishing industry actions are likely to dominate any cumulative effects on the socioeconomic environment of Alaska and the North Pacific. The research alternatives would contribute minor to moderate beneficial effects to the cumulative effects because the AFSC research provides a substantial portion of the information needed to determine if fisheries management actions are successful, and therefore balance the needs for stock recovery and sustainable catch quotas that minimize impacts to fishing communities. Likewise, AFSC research activities provide information essential to the sustainable management of ecosystems that support culturally important marine resources. The at-sea surveys also provide a means to detect the cumulative effects contributed by non-fishing industries and climate change.

When considered in conjunction with other past, present, and reasonably foreseeable future activities affecting the socioeconomic environment in Alaska and the North Pacific, the contribution of the research alternatives to cumulative effects on the socioeconomic environment and cultural resources would be minor to moderate and beneficial in that AFSC research reduces the potential for negative cumulative effects on commercial, and recreational fisheries, as well as potential impacts to subsistence resources and users.

5.9.3 Contribution of the No Research Alternative

Under the No Research Alternative, the AFSC would not contribute to the information base needed for sustainable management of fisheries and important subsistence resources. Fisheries research activities conducted by the State of Alaska and private organizations are not likely to be sufficient to identify trends in target fish stocks and set sustainable fishery harvest limits without the contribution from the AFSC research program. Some commercially and culturally important species could receive attention from state and private research efforts, so potential adverse effects would not likely be uniform across the fishing communities. Some fishers that target commercially important species may continue to benefit from sustainable fisheries management without the contribution from AFSC activities, but others may be affected by lack of information on their target species. Lack of consistent data input into the fisheries management process would have major adverse effects on the quality of the management analyses, and subsequently to the value of the management process. This lack of consistent data input would also result in potentially adverse effects to the management of subsistence resources, as well as decreased levels of information potentially useful to sustain the preservation of such resources. Elimination of AFSC at-sea operations would reduce science-based input into fisheries management decisions, which could increase the potential for negative cumulative effects on socioeconomic and subsistence resources.

The No Research Alternative would contribute moderate adverse effects to the cumulative effects on socioeconomic and subsistence environment through widespread impacts on the fisheries management system. This is due to the discontinuance of at-sea research efforts of the AFSC, many of which are designed to detect and anticipate cumulative effects on fisheries resources. These activities are important for fisheries management decisions that strongly influence the socioeconomic conditions of fishing communities, as well as the preservation of subsistence resources.

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6.1 THE MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

In 1976, Congress passed the MSA (16 U.S.C. 1801, *et seq.*). This law authorizes the U.S. to manage its fishery resources in an area extending from the seaward boundary of a state's territorial sea (generally 3 nm [5.6 km] from shore) out to 200 nm (370 km) from shore. This area is termed the Exclusive Economic Zone (EEZ).

Two of the main purposes of the MSA are to promote domestic commercial and recreational fishing under sound conservation and management principles, and to provide for FMPs. The FMPs are intended to achieve and maintain, on a continuing basis, the optimum yield from each fishery. The MSA standards require that FMPs contain certain conservation and management measures. The standards include measures necessary to prevent overfishing; rebuilding overfished stocks; ensuring conservation; facilitating long-term protection of EFH; and realizing the full potential of the nation's fishery resources. Furthermore, the MSA also declares that the National Fishery Conservation and Management Program must utilize the best scientific information available; involves, and is responsive to the needs of interested and affected states and citizens; considers efficiency; and draws upon federal, state, and academic capabilities in carrying out research, administration, management, and enforcement.

Certain stocks of fish in the U.S. have declined to the point where their survival is impacted, and other stocks of fish have been substantially reduced in number such that they could become similarly affected as a consequence of (a) increased fishing pressure, (b) the inadequacy of fishery resource conservation and management practices and controls, or (c) direct and indirect habitat losses which have resulted in a diminished capacity to support existing fishing levels.

The resource and research surveys conducted by the AFSC are designed to meet the requirements of the MSA by providing the best scientific information available to fishery conservation and management scientists and managers. This supports a management program that is able to respond to changing ecosystem conditions, and manages risk by developing science-based decision tools.

The U.S. Commission on Ocean Policy has identified the need for more holistic assessments of the status of marine ecosystems. The President's Ocean Action Plan has endorsed the concept of marine Ecosystem-Based Management. Sustained ecosystem monitoring programs are essential for tracking the health of marine ecosystems as part of this overall approach. The individual AFSC surveys comprise a broader ecosystem monitoring program that meets this emerging critical need. The potential effects of survey activities must be weighed against the risk of in-adequately characterizing the state of the ecosystem and potential human impacts on the system.

The EFH provisions of the MSA require federal agencies to consult with NMFS when their actions or activities may adversely affect habitat identified by regional fishery management councils or NMFS as EFH. In addition, NMFS must provide recommendations for conserving and enhancing EFH, which is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". There is no EFH-specific permit or authorization process; EFH consultations can be combined with existing environmental review procedures, where appropriate, and are often combined with NEPA. The AFSC has had discussions with the Alaska Regional Office EFH Coordinator regarding assessment of impacts from AFSC fisheries research activities on EFH.

On November 30, 2017, AFSC requested concurrence from the NMFS Assistant Regional Administrator for Habitat Conservation on its determination that proposed research actions by AFSC will have effects; however, these are determined to be minimal and temporary in nature and will not adversely affect EFH identified for federally-managed species. On December 19, 2017 the NMFS Assistant Regional Administrator for Habitat Conservation conferred with the AFSC that their determination was supported that the fisheries research, research gear, and associated research platforms (e.g., research vessels) will not adversely affect EFH because the research activities will have not more than minimal and temporary effects on marine resources and habitats. Section 404 of the MSA requires the Secretary of Commerce to initiate and maintain, in cooperation with the Fishery Management Councils, a comprehensive program of fishery research to carry out and further the purposes, policy, and provisions of the MSA. Substantial parts of the proposed action meet the MSA's definition of scientific research activity, and the proposed action is part of a comprehensive program to address this requirement. The MSA does not include scientific research as part of the definition of "fishing" regulated by the MSA.

The Sustainable Fisheries Act of 1996 (Public Law 104-297) is also an amendment to the MSA. Sections 104 and 105 clarify issues surrounding highly migratory fish, and the international agreements that govern fisheries. Among the topics covered by these sections are fishing in international waters of the Atlantic and Pacific oceans; fishing in the Bering Sea, shared with Russia; and congressional rules setting time limits on approval of international fishing treaties. Sections 116 to 406 of the Sustainable Fisheries Act describe the management measures and research necessary to implement the act. These sections specify the agencies responsible for research and the nature of the research to be conducted in each of several specific fishing areas, including the Pacific Ocean.

The 1996 amendments to the MSA require assessment, specification, and description of the effects of conservation and management measures on participants in fisheries, and on fishing communities:

> *Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.*

This FPEA provides an analysis of impacts to the socioeconomic environment from the SEFSC-affiliated fisheries and ecosystem research program as required by the MSA

6.2 MARINE MAMMAL PROTECTION ACT

Section l0l(a) of the Marine Mammal Protection Act, as amended (MMPA; 16 United States Code (U.S.C.) §§ 1631 et seq.) prohibits persons or vessels subject to the jurisdiction of the United States from taking any marine mammal in waters or on lands under the jurisdiction of the United States or on the high seas (16 U.S.C. 1372(a)(1), (a)(2)). Sections 101(a)(5)(A) and (D) of the MMPA provide exceptions to the prohibition on take, which give us the authority to authorize the incidental but not intentional take[13] of small numbers of marine mammals, provided certain findings are made and statutory and regulatory procedures are met. Incidental Take Authorizations (ITAs) may be issued as either (1) regulations and the associated Letter of Authorization (LOA) or (2) an Incidental Harassment Authorization (IHA). The U.S. Fish and Wildlife Service (USFWS) and NMFS jointly administer the MMPA.

NMFS promulgated regulations to implement the provisions of the MMPA governing the taking and importing of marine mammals (50 Code of Federal Regulations (CFR) Part 216) and published application instructions that prescribe the procedures necessary to apply for incidental take authorization. U.S. citizens seeking to obtain authorization for the incidental take of marine mammals under NMFS'

[13] The term "take" means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. §1362(3)(13)). The incidental take of a marine mammal falls under three categories: mortality, serious injury or harassment (i.e., injury and/or disruption of behavioral patterns). Harassment, as defined in the MMPA for non-military readiness activities (Section 3(8)(A), is any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment) or any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns (Level B harassment). Disruption of behavioral patterns includes, but is not limited to, migration, breathing, nursing, breeding, feeding or sheltering.

jurisdiction must comply with these regulations and application instructions in addition to the provisions of the MMPA. Information about the MMPA and 50 CFR 216 is available at https://www.fisheries.noaa.gov/topic/laws-policies#marine-mammal-protection-act. Information on the application process is available at https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act and the application along with detailed instructions is available at https://www.fisheries.noaa.gov/national/marine-mammal-protection/apply-incidental-take-authorization.

Like NMFS, USFWS implements a process for incidental take authorizations. U.S. citizens seeking to obtain authorization for the incidental take of marine mammals under USFWS' jurisdiction[14] must comply with USFWS implementing regulations (50 CFR Part 18) and procedures and application instructions in addition to the provisions of the MMPA. Information about USFWS implementing regulations, procedures and applications is available at https://www.fws.gov/ecological-services/species/ITA.html and https://www.fws.gov/permits/ApplicationMain.html.

Once NMFS Office of Protected Resources (OPR) (or USFWS) determines an application is adequate and complete, NMFS OPR and USFWS have a corresponding duty to determine whether and how to authorize take of marine mammals incidental to the activities specified in the application. To authorize the incidental take of marine mammals, NMFS OPR (or USFWS) evaluates the best available scientific information to determine whether the take would have a negligible impact on the affected marine mammal species or stocks and an unmitigable impact on their availability for taking for subsistence uses. NMFS OPR (or USFWS) must also prescribe the "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, and on the availability of those species or stocks for subsistence uses, as well as monitoring and reporting requirements. The following subsections explain the MMPA authorization process with NMFS and USFWS, respectively.

6.2.1 Authorization with NMFS OPR

In accordance with the requirements noted above, the AFSC submitted an initial LOA application in 2016 to NMFS OPR requesting take of small numbers of marine mammals incidental to conducting fisheries and ecosystem research activities and a revised LOA application in 2017[15] to include fishery-independent research activities conducted International Pacific Halibut Commission (IPHC) in U.S. waters, which the AFSC sponsors. The IPHC, established by a convention between the governments of Canada and the United States, is an international fisheries organization mandated to conduct research on, and management of, stocks of Pacific halibut (*Hippoglossus stenolepis*) within the Convention waters of both nations. The Northern Pacific Halibut Act of 1982 (16 U.S.C. 773), which amended the Northern Pacific Halibut Act of 1937, is the enabling legislation that gives effect to the Convention in the United States. Although operating in U.S. waters (and, therefore, subject to the prohibition on ''take'' of marine mammals), the IPHC is not appropriately considered to be a U.S. citizen (as defined by the MMPA) and cannot be issued an incidental take authorization. Therefore, in their revised 2017 LOA application, the AFSC added the IPHC fishery-independent research activities that may result in unintentional take of marine mammals. Fishery-independent data, which is necessary to the management of halibut stocks, is collected using longline gear aboard chartered commercial vessels within multiple IPHC regulatory areas, including within U.S. waters of the Bering Sea, Gulf of Alaska, and off the U.S. west coast. Detailed information and analyses of IPHC fishery-independent activities, including location, time of year, equipment and gear used is presented in Appendix E.

As indicated in Chapter 3 of this FPEA, several marine mammal species occur in the waters of the Gulf of Alaska, Bering Sea/Aleutians Islands, and Chukchi Sea/Beaufort Sea. This includes nine ESA-listed cetacean species (i.e., the North Pacific sperm whale, Western North Pacific gray whale, Eastern North

[14] USFWS has jurisdiction for polar bears, walruses, sea otters and manatees.
[15] The revised LOA application incorporates the IPHC fishery-independent research activities sponsored by AFSC.

Pacific blue whale, Northeast Pacific fin whale, Eastern North Pacific sei whale, Western Arctic bowhead whale, North Pacific right whale, Western North Pacific humpback whale, and the Cook Inlet stock of beluga whales), the Western DPS of Steller sea lion (listed as endangered), two ESA-listed pinnipeds (i.e., the bearded seal and ringed seal) and one pinniped designated as depleted under the MMPA (i.e., Pribilof Islands stock of Northern fur seal). AFSC also identified other species or stocks, such as narwhal, Western Pacific gray whales and California sea lions that may occur in the AFSCs proposed action areas on rare occasions, however, AFSC did not request take for these species because they were considered extralimital. As explained in Chapter 4 of this FPEA, the research activities conducted or sponsored by AFSC involving the use of research gear and active acoustic sources have the potential to cause marine mammals within or near AFSCs proposed Research Action Areas to be behaviorally disturbed or result in Level A harassment, serious injury or mortality and, therefore, requires an incidental take authorization from NMFS.

Based on AFSCs revised 2017 LOA application, NMFS OPR prepared and published a proposed rule which established a framework under the authority of the MMPA to allow for the authorization of take of small numbers of marine mammals incidental to the AFSC's fisheries and ecosystem research activities and the IPHC fishery-independent activities as specified in the LOA application (see Appendix C). The proposed rule addressed AFSC proposal to conduct fisheries and ecosystem research using trawl gear used at various levels in the water column, hook-and line gear (including longlines with multiple hooks), gillnets, and other gear. If a marine mammal interacts with gear deployed by AFSC, the outcome could potentially be Level A harassment, serious injury or mortality. Regarding the potential for serious injury or mortality, although any given gear interaction could result in an outcome less severe than serious injury or mortality, NMFS does not have sufficient information to parse out these potential outcomes from the total number of take estimates. Therefore, AFSC presented a pooled estimate of the number of potential incidents of gear interaction and, for analytical purposes under the MMPA, NMFS OPR assumed gear interactions would result in serious injury or mortality. AFSC also uses various active acoustic devices and use of these devices has the potential to result in Level B harassment of marine mammals. Level B harassment to pinnipeds hauled out may also occur as a result of visual disturbance from vessels during the conduct of AFSC fisheries and ecosystem research activities and IPHCs fishery-independent research activities. Refer to the "Description of Marine Mammals in the Area of the Specified Activity" and the "Potential Effects of the Specified Activity on Marine Mammals and their Habitat" sections of the proposed rule for details[16] about the analysis and determinations under the MMPA regarding serious injury or mortality, Level A harassment, and Level B harassment. The corresponding information associated with the impacts to marine mammal species in the FPEA is in Chapters 3-4.

The final rule, if issued, will authorize take of individuals of 19 marine mammal species by Level A harassment, serious injury or mortality and take of individuals of 25 marine mammal species by Level B harassment incidental to the AFSC's proposed fisheries and ecosystem research and IPHC's fisheries-independent research in the Gulf of Alaska, Bering Sea and Arctic Ocean. In compliance with the MMPA, the final rule and LOA will also set forth specific findings and requirements (e.g., no unmitigable adverse impact on the availability of a species or stock for subsistence uses, negligible impact on a species or stock, and mitigation, monitoring, and reporting requirements) and the mitigation measures to avoid and minimize impacts to marine mammals to the level of least practicable adverse impact.

6.2.2 Authorization with USFWS

There are three species of marine mammals under jurisdiction of the USFWS that occur in the three Research Areas. These include the Pacific walrus, sea otter, (Southwest Alaska stock listed as threatened),

[16] The final rule, if issued, will incorporate the same details.

and polar bear (Chukchi/Bering Sea and Southern Beaufort Sea stocks listed as threatened). A request for MMPA authorization for Pacific walrus, sea otters, and polar bears was sent to the USFWS.

On May 25, 2017, the AFSC, requested that the USFWS Marine Mammals Management Office (MMM) concur with the AFSC's determinations regarding interactions with polar bears, Pacific walruses, and northern sea otters associated with Fisheries and Ecosystem Research conducted and funded by the AFSC. On August 4, 2017, the AFSC requested a similar Letter of Concurrence under the ESA for potential AFSC research impacts on the threatened polar bear and northern sea otter, and spectacled and Steller's eiders. The AFSC determined that its research activities 'may affect but are not likely to adversely affect' threatened species under the terms of Section 7 of the ESA. The AFSC also concluded that the activities 'may affect but are not likely to adversely affect designated critical habitats, identified principal constituent elements (PCEs), and the species that depend upon them.' The USFWS concurred with the AFSC's determination by letter dated September 1, 2017 that proposed research activities are not likely to adversely affect spectacled eider, Steller's eider, polar bear, northern sea otter, or their designated critical habitats.

By letter dated September 28, 2017, the AFSC requested that the IPHC's research surveys be included in the AFSC's previous Section 7 consultation for research surveys for the 2017 to 2021 field seasons. By e-mail dated October 24, 2017, the AFSC clarified this request related only to those IPHC surveys and research activities conducted in Alaska's waters. The majority of the IPHC survey effort is the Fishery-independent Setline Survey. This survey is conducted annually, with some modifications as stations may be added or removed or effort (number of skates fished) at each station adjusted. The IPHC also uses existing AFSC trawl surveys to collect information on small Pacific halibut that are not yet vulnerable to the gear used for the IPHC Fishery-independent Setline Survey or commercial fishery, and as an additional data source and verification tool for stock analysis. This survey is led and conducted by AFSC. The mitigation measures previously proposed by the AFSC for their research surveys will be implemented during IPHC surveys and research operations, as well, to avoid effects to listed or otherwise protected species. In addition, the AFSC and IPHC proposed the following additional mitigation measures to mitigate potential interactions with seabirds, including protected species, during research activities:

1) All IPHC survey vessels will use seabird avoidance gear (i.e., tori lines) while setting the longline gear.
2) Vessels fishing in Alaska must have a written Seabird Avoidance Plan as required by NMFS regulations.
3) All seabird avoidance gear are to be deployed so that the line enters the water no less than a distance of 40 meters aft of the vessel stern (if the vessel is greater than 100 ft the minimum distance is 60 meters).
4) IPHC longline survey protocols specifically prohibit chumming before or during the longline setting operations (i.e., releasing additional bait to attract target species to the gear). However, longline surveys are conducted on contracted commercial fishing catcher vessels and fish are processed as the longline is retrieved. Spent bait and processing offal are discarded away from the longline retrieval area which often serves to attract seabirds and marine mammals away from the longline. Due to the volume of fish caught with each set and the length of time it takes to retrieve the longline, the retention of spent bait and offal until the gear is completely retrieved is not possible.

In a letter of concurrence on November 3, 2017 the USFWS noted that after reviewing the IPHC's proposed research activities and additional mitigation measures, the USFWS agreed that the addition of the IPHC's surveys and research activities to the AFSC's Section 7 consultation was consistent with the effects previously analyzed, and did not change the USFWS concurrence with the AFSC's previous consultation. Therefore, the USFWS concurred with the AFSC's determination that proposed AFSC and

AFSC-directed IPHC research activities are not likely to adversely affect spectacled eider, Steller's eider, polar bear, northern sea otter, or their designated critical habitats and that based on the AFSC request and the USFWS response, requirements of Section 7 of the ESA have been satisfied.

On March 19, 2018, the USFWS MMM agreed with the AFSC's determinations that the likelihood of the proposed fisheries research contributing to serious injury, mortality, or biologically significant changes to behavior of any of these species is extremely low. The USFWS also agreed that the AFSC does not need MMPA incidental take authorization at this time for the proposed research activities. To reduce the potential for incidental interactions from the specified fisheries and ecosystem research activities, AFSC is implementing a suite of mitigation and monitoring measures for marine mammals and other protected species; these are discussed in detail in Sections 2.3.1 and 2.3.2 of the Final PEA and in the final rule. These measures are intended to reduce the potential for protected species interactions and increase the chances of survival for animals that do interact. In addition, AFSC is also implementing a number of data collection requirements to enable further analysis of the efficacy of these measures and to facilitate feedback and adaptive management of its research activities as it relates to impacts to protected species.

6.3 ENDANGERED SPECIES ACT

The Endangered Species Act (ESA) establishes a national policy for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. An endangered species is a species in danger of extinction throughout all or a significant portion of its range, and a threatened species is one that is likely to become endangered within the near future throughout all or in a significant portion of its range. The U.S. USFWS and NMFS jointly administer the ESA and are responsible for listing a species as either threatened or endangered, as well as designating critical habitat where applicable, developing recovery plans for these species, and undertaking other conservation actions pursuant to the ESA. The ESA generally prohibits the take[17] of an ESA species listed as endangered unless an exception or exemption applies. NMFS has extended the "take" prohibition to ESA-listed threatened species under its jurisdiction through promulgation of protective rules. However, as discussed below, Federal agencies and applicants for Federal permits generally receive exemption from incidental take through the Section 7 consultation process.

Section 7(a)(2) of the ESA requires federal agencies to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with NMFS (or the USFWS) for actions that may affect species listed per Section 4 of the ESA as threatened or endangered or critical habitat designated for such species. Formal consultation with NMFS (or USFWS) is required unless exceptions per 50 CFR 402.14(b) apply.

When a Federal action agency determines, through a biological assessment or other review, that an action is likely to adversely affect a listed species or result in the destruction or adverse modification of critical habitat, the Federal action agency initiates the formal consultation process by submitting a request for formal consultation to the consulting agency (see 50 CFR 402.14). Section 7(b)(3) of the ESA requires that at the conclusion of formal consultation, the consulting agency provides an opinion stating whether the federal action agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. A similar opinion is included for proposed species or proposed critical habitat if either or both were part of the consultation. If the consulting agency determines the action is likely to jeopardize ESA-listed species or destroy or adversely modify critical habitat, they then provide a reasonable and prudent alternative that allows the action to proceed in compliance with Section 7(a)(2) of the ESA. If incidental take will be caused by the action and is reasonably certain to occur and certain

[17] Take, as defined in Section 3 of the ESA, means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

conditions are met, Section 7(b)(4) requires the consulting agency to provide an incidental take statement that specifies the impact of any incidental taking and includes mandatory reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures. An agency or applicant's compliance with these measures exempts the incidental take from the ESA's take prohibition.

As provided in 50 CFR 402.14(b), if a federal action agency determines an action "may affect, but is not likely to adversely affect" listed species or designated critical habitat and the consulting agency concurs with that determination, consultation concludes informally per 50 CFR 402.13. Informal consultation is an optional process that includes all discussions and correspondence between the consulting agency and the Federal action agency designed to assist the Federal action agency in determining whether formal consultation or a conference is required. If during informal consultation it is determined by the Federal action agency, with the written concurrence of the consulting agency, that the action is not likely to adversely affect listed species or critical habitat, the consultation process is terminated, and no further action is necessary. During informal consultation, the consulting agency may suggest modifications to the proposed action that the Federal action agency and any applicant could implement to avoid the likelihood of adverse effects to listed species or critical habitat. (See 50 CFR 402.13 (a) – (b))

To initiate formal consultation under Section 7 per the ESA, in conjunction with the development of the DPEA, AFSC prepared a Biological Assessment (BA) for proposed fisheries and ecosystem research and IPHC fishery-independent activities that may affect listed species or critical habitat. However, prior to initiating formal consultation, the AFSC engaged in early coordination with USFWS and NMFS to seek technical assistance and input regarding the analyses of impacts for threatened or endangered species during the development of the draft BA. The following subsections explain the ESA Section 7 consultations with NMFS and USFWS, respectively. However, details about the consultation history and the analyses of impacts to threatened or endangered species is provided in the AFSC BA and the NMFS/USFWS final Biological Opinions. The final Biological Opinions are available for review at https://www.fisheries.noaa.gov/resources/documents.The corresponding information associated with the impacts to listed species in the FPEA is in Chapters 3-4.

6.3.1 Consultation with NMFS Alaska Protected Resources Division

There are 12 listed marine mammal species under the jurisdiction of NMFS with confirmed or possible occurrence in the Research Action Areas. These include the North Pacific sperm whale, Western North Pacific gray whale, Eastern North Pacific blue whale, Northeast Pacific fin whale, Eastern North Pacific sei whale, Western Arctic bowhead whale, North Pacific right whale, Western North Pacific humpback whale, and the Cook Inlet stock of beluga whales, the Western DPS of Steller sea lion, the bearded seal and ringed seal.

The AFSC determined that the proposed fisheries and ecosystem research and fishery-independent research activities (primary action) will likely adversely affect ESA-listed marine mammals and fish, and may affect, but is not likely to adversely affect ESA-listed sea turtles. In addition, NMFS OPRs issuance of regulations and LOA (secondary action) is federal action also subject to the requirements of Section 7 of the ESA. Therefore, on January 16, 2018, the AFSC initiated formal consultation with the Alaska Regional Protected Resources Division and requested a programmatic Biological Opinion for AFSC ecosystem research, IPHC research for NMFS OPRs issuance of regulations and a LOA.

The formal consultation concluded and a final Biological Opinion was issued on April 5, 2019. As explained in the BiOp, the Alaska Regional Protected Resources Division found that AFSC proposed fisheries and ecosystem research and IPHCs fishery-independent research is not likely to jeopardize the continued existence or recovery of the listed marine mammal species. This determination was made based on review of the status of the listed marine mammal species, the environmental baseline within the action area, and the effects of the proposed action as well as effects of interrelated and interdependent actions and cumulative effects. Furthermore, Alaska Regional Protected Resources Division found that AFSC proposed fisheries and ecosystem research is also not likely to adversely affect designated critical habitat; thus, no destruction or adverse modification of designated critical habitat for these species is anticipated.

6.3.2 Consultation with USFWS

There are 3 listed marine mammal species under the jurisdiction of the USFWS with confirmed or possible occurrence in the Research Action Areas. These include the Pacific walrus, sea otter, (Southwest Alaska stock listed as threatened), and polar bear (Chukchi/Bering Sea and Southern Beaufort Sea stocks listed as threatened). Bird species of the under jurisdiction of the USFWS include spectacled eider, Steller's eider and short-tailed albatross.

Therefore, the AFSC requested formal consultation with the USFWS on September 12, 2017 pursuant to Section 7 of the ESA with the USFWS, Endangered Species Branch, Anchorage, Alaska, on the effects of the AFSC research activities in Alaska including the Bering, Chukchi and Beaufort seas; Gulf of Alaska and Aleutian Islands. As described in the Biological Assessment (2017b) although the potential for gear interactions does exist due to the use of longline gear and attraction of tubenoses to such fishing activities AFSC anticipated that research activities will result in the taking of significant numbers of short-tailed albatross. As a precautionary measure, however, three takes for short-tailed albatross were requested over a five-year period in the event unexpected circumstances occur during planned activities.

In a Letter of Concurrence on November 3, 2017 the USFWS noted that after reviewing the IPHC's proposed research activities and additional mitigation measures, the USFWS agreed that the addition of the IPHC's surveys and research activities to the AFSC's Section 7 consultation was consistent with the effects previously analyzed, and did not change the USFWS concurrence with AFSC's previous consultation. Therefore, the USFWS concurred with the AFSC's determination that proposed AFSC and AFSC-directed IPHC research activities are not likely to adversely affect spectacled eider, Steller's eider, polar bear, northern sea otter, or their designated critical habitats and that based on the AFSC request and the USFWS response, requirements of Section 7 of the ESA have been satisfied.

On March 29, 2018 the USFWS transmitted a Biological Opinion (USFWS 2018) that evaluated the continuation of the AFSC's fisheries research activities on the short-tailed albatross during the next five years, and is limited to those AFSC and IPHC research activities that would be conducted within the waters of the State of Alaska, including those conducted in the Gulf of Alaska, the Bering Sea and Aleutian Islands, and the Chukchi and Beaufort Seas Research Areas. As explained in the BiOp USFWS found that after reviewing the current status of the short-tailed albatross, the environmental baseline for the action area, the effects of the proposed AFSC and IPHC continued fisheries research, and the cumulative effects, it is the USFWS' biological opinion that the continuation of AFSC's and IPHC's fisheries research, as proposed, is not likely to jeopardize the continued existence of the short-tailed albatross,

6.4 MIGRATORY BIRD TREATY ACT

The Migratory Bird Treaty Act (MBTA) protects approximately 836 species of migratory bird species from any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof, unless permitted by regulations (i.e., for hunting and subsistence activities). Additional protection is allotted under the Bald and Golden Eagle Protection Act for the identified species. Compliance with the MBTA does not require a permit or authorization; however, the USFWS often requests that other agencies incorporate MBTA mitigation measures as stipulations in their permits. The AFSC has been working in close collaboration with the USFWS since the 1970s to address seabird bycatch issues in the Alaska commercial fisheries. Based in part on this productive cooperative relationship, a Draft Memorandum of Understanding (MOU) between NMFS and USFWS focuses on avoiding and minimizing, to the extent practicable, adverse impacts on migratory birds through enhanced interagency collaboration. As a continuation of this long collaboration and in compliance with the MOU, the AFSC has identified and evaluated the impacts of the proposed actions on migratory birds.

6.5 FISH AND WILDLIFE COORDINATION ACT

The Fish and Wildlife Coordination Act (FWCA) requires USFWS and NMFS to consult with other state and federal agencies in a broad range of situations to help conserve fish and wildlife populations and habitats in cases where federal actions affect natural water bodies (16 U.S.C. 661 1934). Specific provisions involve conservation or expansion of migratory bird habitats related to water body impoundments or other modifications. FWCA requires consultation among agencies and the incorporation of recommended conservation measures if feasible, but does not involve a separate permit or authorization process. NMFS will provide a copy of this FPEA to the state fish and wildlife agencies in every state affected by the fisheries research activities examined in this FPEA. NMFS will consider all comments from these agencies and take steps to comply with FWCA as necessary.

6.6 NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the National Historic Preservation Act (NHPA) requires review of any project funded, licensed, permitted, or assisted by the federal government for impact on significant historic properties. Federal agencies must allow the State Historic Preservation Officer (SHPO) and the Advisory Council on Historic Preservation, a federal agency, to comment on a project. NMFS provided a copy of the DPEA and will provide the FPEA to the SHPOs in every state affected by the fisheries research activities examined in this FPEA.

The AFSC initiated consultation with the State of Alaska SHPO regarding compliance with the NHPA on January 29, 2018. On February 9, 2018 the SHPO concurred with a finding of no adverse effect for the AFSC Fisheries Research Program. This completed the AFSC NHPA consultation with the Alaska SHPO. In a letter from the AFSC to the SHPO on May 14, 2018 to ensure that the program is in compliance with Section 106 of the NHPA and avoids adverse impacts to historic properties the AFSC stated it would avoid manmade obstacles through use of on-board sonar, actively avoid known obstacles during sampling, and will implement a plan to report any potential historic properties encountered during research activities to the Alaska SHPO. To facilitate compliance, AFSC proposes to prepare an annual work plan for submittal to the Office of History and Archaeology (OHA), documenting proposed research activities with the potential for encountering historic properties. The work plan will describe the nature and location of those activities and a summary of potential historic properties located within the vicinity of the proposed research activities, based on a review of OHA's Alaska Heritage Resources Survey (AHRS) database and supplemented with information from the Bureau of Ocean Energy Management (BOEM) Alaskan Shipwreck table. The annual plan will also include measures for avoiding any historic properties identified during review of these databases, as well as an Inadvertent Discovery Plan (IDP) to address inadvertent discoveries that may occur during research activities.

6.7 EXECUTIVE ORDER 13158, MARINE PROTECTED AREAS

The purpose of this order is to strengthen and expand the Nation's system of MPAs to enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for future generations. The order encourages federal agencies to use science-based criteria and protocols to identify and prioritize natural and cultural resources in the marine environment that should be protected to secure valuable ecological services and to monitor and evaluate the effectiveness of MPAs. Each federal agency whose actions affect the natural or cultural resources that are protected by an MPA shall identify such actions. To the extent permitted by law and to the maximum extent practicable, each federal agency, in taking such actions, shall avoid harm to the natural and cultural resources that are protected by an MPA. The AFSC has considered its potential effects on MPAs in this FPEA and found that the impacts are minor.

There are no national marine sanctuaries (NMSs) in Alaska. For the IPHC and the West Coast of the United States, IPHC has received a five year permit for the Olympic Coast NMS and obtains annual permits from the California NMSs and AFSC is complying with the need for NMS concurrence on a sanctuary by sanctuary basis.

6.8 EXECUTIVE ORDER 12989, ENVIRONMENTAL JUSTICE

Executive Order 12898 directs federal agencies to take the appropriate and necessary steps to identify and address disproportionately high and adverse effects of federal projects on the health or environment of minority and low-income populations to the greatest extent practicable and permitted by law. No such effects are identified in this FPEA.

6.9 EXECUTIVE ORDER 13112, INVASIVE SPECIES

This order (64 CFR 6183, February 3, 1999) directs federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. The Executive Order established the National Invasive Species Council. The proposed AFSC research activities are not reasonably expected to result in the spread or introduction of non-indigenous species due to compliance with regulations for appropriate ballast water management and other discharge processes for NOAA and charter vessel operations.

6.10 EXECUTIVE ORDER 13175, GOVERNMENT TO GOVERNMENT CONSULTATION

Executive Order 13175 requires federal departments and agencies to consult with federally recognized Indian tribal governments when considering policies that would impact tribal communities. NOAA 13175 Policy establishes procedures for Government–to-Government to Consultation with federally recognized Indian tribes and Alaska Native corporations established under the Alaska Native Claims Settlement Act (ANCSA) of 1971. NMFS has had a long history of engaging Alaska Native stakeholders in Alaska with regard to co-management, policy actions, evaluation of permit applications, and preparation of Environmental Impact Assessments/Statements.

In August 2013, the AFSC embarked on identifying potentially affected federally recognized tribal governments, regional and village Alaska Native ANCSA corporations, and Alaska Native co-management groups. Given the wide geographic extent of AFSC fisheries research activities, over 200 separate organizations were identified for outreach and consultation under NOAAA 13175 Policy guidance. NMFS sent letters to these organizations in October 2013, notifying them of the "Evaluation of Potential Impacts of Fisheries Research Activities Conducted by NMFS' Alaska Fisheries Science Center on Subsistence Resources and Activities", and requesting assistance in identifying any additional subsistence use areas that may overlap with AFSC fisheries research activities in time and space, and concerns about the AFSC fisheries research efforts and its impacts on specific maritime historic or culturally significant sites in their areas that should be addressed in the programmatic EA.

In June 2016 over 150 thumb drives were sent containing the Draft EA and Draft NMFS LOA application to Alaskan Native representatives and entities. This was at the beginning of the public comment period, and AFSC provided an additional 30 days (total of 60 days) for Alaskan native governments to respond. The result of this consultation was one response from Alaskan native organizations was received indicating a preference for the selection of Alternative and was reviewed with other comments submitted on the DPEA.

6.11 PACIFIC INTERNATIONAL CONVENTIONS, TREATIES, AND LAW

The AFSC participates in international forums for the assessment of the status of some stocks in accordance with the relevant rules of international law. NMFS, working through the AFSC, conducts research to support U.S. commitments to international fisheries management, including provision of stock assessment and management advice for the conventions and treaties outlined below.

6.11.1 Tunas Convention Act

The Tunas Convention Act of 1950 (16 U.S.C. 951-961; Act of September 7, 1950, as amended) addresses and codifies the obligations of the U.S. under the Inter-American Tropical Tuna Commission (IATTC) and authorizes the Secretary of Commerce to issue regulations for implementing recommendations of the Commission. The act permits limiting the size and quantity of catches and limiting or prohibiting incidental catch of regulated species.

The IATTC was established in 1949 to monitor the long-term conservation and sustainable use of tunas, billfish, dolphins, turtles, non-target finfish, sharks, and others) that may be affected either directly or indirectly by fishing operations. In 2003, the Convention's scope was broadened, and is now known as the Antigua Convention. The Antigua Convention applies to waters of the Pacific Ocean including areas off California, Oregon and Washington, and encompasses significant U.S. fisheries, such as the troll fishery targeting albacore. The IATTC is currently made up of 21 nations and fishing entities. The Secretary of Commerce has directed NMFS to conduct research and provide scientific input into stock assessments and conservation and management recommendations for target and non-target stocks in the convention area.

The International Scientific Committee for Tuna and Tuna-like Species (ISC) in the North Pacific Ocean was established in 1995 for the purpose of enhancing scientific research and cooperation for conservation and rational utilization of tuna and tuna-like species of the North Pacific Ocean. Through a MOU, the ISC provides scientific support for the work of the Northern Committee of the WCPFC. As a member, the U.S. supports obligations to the Committee through scientific research conducted by NMFS.

6.11.2 Pacific Salmon Treaty Act

The Pacific Salmon Treaty Act [Public Law 99–5, Approved Mar. 15, 1985, 99 Stat. 7, amended through Public Law 111–8, Enacted March 11, 2009] was established to balance fishing and conservation interests between the US and Canada to prevent overfishing and provide for optimum production. It was also designed to benefit both countries in receiving benefits of salmon originating in their respective waters. The Pacific Salmon Commission was established to implement the Treaty, and is composed of federal and state officials; Washington, Idaho, Alaska, and Oregon residents, and tribal representatives.

6.11.3 International Whaling Commission

The International Convention for the Regulation of Whaling was established in 1946. The IWC is composed of members of 89 countries. In 1986 the Commission introduced zero catch limits for commercial whaling, which remains to present. The Commission sets catch limits for aboriginal subsistence whaling. It also addresses the conservation or whales, and promotes the recovery of depleted whale populations by reviewing ship strikes or entanglement events, habitat, and protocols for whale watching. The Whaling Convention Act of 1949 (16 U.S.C. 916-9161; Act of August 9, 1950, as amended) authorizes the secretary of commerce via NOAA and NMFS to provide and collect scientific data, and enforce the provisions of the International Convention for the Regulation of Whaling and to issue regulations necessary for this purpose.

6.11.4 North Pacific Anadromous Stocks Act

The North Pacific Anadromous Stocks Act of 1992 established an Advisory Panel to the United States Section of the North Pacific Anadromous Fish Commission (NPAFC). The Advisory Panel shall be composed of: (1) the Commissioner of the Alaska Department of Fish and Game; (2) the Director of the Washington Department of Fisheries and Wildlife; (3) one representative of the Pacific States Marine Fisheries Commission; and (4) 11 members (six residents of the State of Alaska and five residents of the State of Washington) appointed by the Secretary of State, in consultation with the Secretary of Commerce, from among a slate of 12 persons nominated by the Governor of Alaska and a slate of 10 persons nominated by the Governor of Washington. There must be at least one representative of commercial salmon fishing interests and one representative of environmental interests on each of the Governors' slates. As is the case with NPAFC Commissioners, Advisors must be knowledgeable of North Pacific anadromous stocks and ecologically related species. Advisors serve for a term not to exceed four years, and may not serve more than two consecutive terms. The terms of the most recent Advisory Panel members have expired. The Secretary of State is in the process of appointing a new roster of Advisors.

The NPAFC serves as a forum for promoting the conservation of anadromous stocks and ecologically-related species, including marine mammals, sea birds, and non-anadromous fish, in the high seas area of the North Pacific Ocean. This area, as defined in the Convention, is "the waters of the North Pacific Ocean and its adjacent seas, north of 33° North Latitude beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured." In addition, the NPAFC serves as the venue for coordinating the collection, exchange, and analysis of scientific data regarding the above species within Convention waters. It also coordinates high seas fishery enforcement activities by member countries (the Convention prohibits directed fishing for salmonids and includes provisions to minimize the incidental take of salmonids in other fisheries in the Convention area).

6.11.5 International Pacific Halibut Commission

Pacific halibut has been fished for hundreds of years by native peoples of the west coast of North America, and the North American commercial fishery began in 1888. By the 1910s it became evident that the Pacific halibut stocks were suffering from over-fishing and members of the halibut fishing industry asked the governments of both the United States and Canada for international management of the resource.

The United States and Canada signed a Convention (treaty) in 1923, which was ratified in 1924. From that Convention, the International Fisheries Commission (later to become the International Pacific Halibut Commission) was formed. The Convention was modified a number of times in subsequent years. The current iteration of the treaty that governs the IPHC is the “Protocol Amending the Convention between Canada and the United States of America for the Preservation of the Halibut Fishery of the Northern Pacific Ocean and Bering Sea” of 1979 (Convention) (McCaughran and Hoag 1992). The key responsibility of the IPHC is to develop the stocks of Pacific halibut in the Convention waters to those levels which will permit the optimum yield from the fishery and to maintain the stocks at those levels. All Pacific halibut in Canada and the United States is under the jurisdiction of the IPHC.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) governs U.S. federal fisheries management, and Title II of the MSA, “Foreign Fishing and International Fishery Agreements,” recognizes that management of fishing for some species is covered by international agreements. Thus, the IPHC’s authority for the preservation and management of the Pacific halibut resource in the United States comes from the Convention rather than the MSA. The Northern Pacific Halibut Act of 1982 (Halibut Act), which amended the earlier Northern Pacific Halibut Act of 1937, is the enabling legislation that gives effect to the Convention in the United States. It governs U.S. participation in the IPHC and specifies how IPHC regulations are carried out in the United States (McCaughran and Hoag 1992).

The IPHC began its management of the halibut resource in 1924 with a three-month winter closure to fishing. By 1932, it was evident that further action was needed and the first catch limit was set. Over the next two decades, the fleet grew and the fishers became more skilled, resulting in progressively shorter seasons to avoid exceeding the catch limit. By 1953, the season length was less than two months, so the Convention was modified to allow the setting of seasons by area.

The U.S. MSA and the Canadian Coastal Fisheries Protection Act extended each country’s fishery jurisdiction to 200 nautical miles (370.4 km) from shore beginning in 1977. In 1979, the Protocol to the Convention of 1953 signed by the two countries brought an end to U.S. fishing in Canadian waters in 1979 and Canadian fishing in U.S. waters in 1981. The 1979 Protocol also enabled each government to make regulations pertaining to its own fleet as long as they were not in conflict with IPHC regulations. Figure C-1 shows the IPHC’s Regulatory Areas with the seaward boundary marking the 200 nautical mile zone (370.4 km) of the U.S. and Canada.

The U.S. fishery remained open access, and as the need for allocative measures became clear, the U.S. government began considering options for limiting access. The U.S. regional councils (the North Pacific Fishery Management Council (NPFMC) in Alaska and the Pacific Fishery Management Council [PFMC] on the west coast) were given the authority in 1982 to establish limited-access regulations, and allocative authority was shifted from the IPHC to the Councils in 1987.

6.12 TRIBAL CONSULATION

Tribal entities in Alaska were contacted by letter in September and October 2013 notifying them that AFSC was undertaking the PEA of AFSC's fisheries and ecosystem research programs. In June 2016 over 150 thumb drives were sent containing the Draft EA and Draft NMFS LOA to Alaskan Native representatives and entities. This was at the beginning of the public comment period, and AFSC provided an additional 30 days (total of 60 days) for Alaskan native governments to respond. The result of this consultation was one response from Alaskan native organizations was received indicating a preference for the selection of Alternative and was reviewed with other comments submitted on the DPEA. Another result is that a new communication plan to facilitate pre-survey and in-season communication with Alaska Native subsistence communities and co-management organizations intended to reduce the chance that AFSC fisheries research activities might interfere with subsistence activities. As a result of consultation several initiatives have been ongoing including:

- Providing an AFSC research prospectus before the beginning of the field season as a tool for altering both Alaska Native and non-native entities as to the scope of AFSC research.
- AFSC continues to use the NOAA website and media channels to alert communities of upcoming research and ongoing research results.
- AFSC has been engaged with Alaska Native communities in communicating research plans and results and developing cooperative research activities with Alaska Native communities.
- AFSC has developed a three-tiered communications plan for communicating with Alaska Native and coastal communities in areas where there is the potential to overlap with subsistence hunting and fishing activities prior to the start of surveys, during and following the surveys to provide results and;
- Meeting with representatives of Kawerak, Inc to discuss ways to implement cooperative research including projects that operationalize co-production of knowledge.

6.13 COORDINATION WITH OTHER FEDERAL AGENCIES

In November 2018 the National Park Service (NPS) asked to review the Draft PEA regarding AFSC and IPHC research activities in Glacier Bay National Park. An invitation to be a cooperating agency in the adoption of the PEA for Fisheries and Ecosystem Research Conducted and Funded by the AFSC was sent to NPS on December 17, 2018. The NPS became a cooperating agency on this PEA on December 19, 2018. A portion of the IPHC proposed research project would occur within the boundaries of Glacier Bay National Park where National Park Service has jurisdiction. The IPHC plans to conduct expansion stations of their regular longline survey within the boundaries of Glacier Bay National Park. Expansion stations are not a part of the core IPHC survey station but provide information on relative abundance and distribution in areas that are not surveyed every year. This activity will consist of deploying the standard IPHC longline with baited hooks which will be set at three to four stations within the park boundaries. This activity will be occasionally conducted during future summer months within the park at infrequent annual intervals, in coordination with park staff. As a result of this coordination NPS will use this FPEA to issue research permits to IPHC for activities in Glacier Bay National Park.

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[Note: This work was initiated by consultants from URS Corporation in Anchorage, Alaska. In October 2014, URS was purchased by AECOM, Inc. and later stages of the project were completed by many of the listed personnel as AECOM staff, although the service contract remained under the URS name.]

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