Request for Rulemaking and Letters of Authorization

Under Section 101(a)(5)(A) of the Marine Mammal Protection Act

for the Take of Marine Mammals Incidental to Fisheries and Ecosystem Research Activities

conducted or funded by the

Alaska Fisheries Science Center

within the

Gulf of Alaska, Bering Sea/Aleutian Islands, and Chukchi Sea/Beaufort Sea Research Areas

June 2016

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TABLE OF CONTENTS

Appendices

Tables

Figures

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1.0 A DETAILED DESCRIPTION OF THE SPECIFIC ACTIVITY OR CLASS OF ACTIVITIES THAT CAN BE EXPECTED TO RESULT IN INCIDENTAL TAKING OF MARINE MAMMALS

This application, submitted to the National Marine Fisheries Service (NMFS) Office of Protected Resources, requests rulemaking and subsequent letters of authorization under the Marine Mammal Protection Act (MMPA) of 1972 for the incidental take of marine mammals during fisheries surveys and related research activities conducted by the Alaska Fisheries Science Center (AFSC), National Marine Fisheries Service (NMFS), NOAA. Management of certain protected species falls under the jurisdiction of the NMFS under the MMPA and Endangered Species Act (ESA). Mechanisms exist under both the ESA and MMPA to assess the effect of incidental takings and to authorize appropriate levels of take.

The Federal government has a trust responsibility to protect living marine resources in federal waters of the United States (U.S.). These waters generally lie 3-to-200 nautical miles from the shoreline [those waters 3-12 nautical miles offshore comprise territorial waters and those 12-to-200 nautical miles offshore and comprise the Exclusive Economic Zone (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 (i.e., the high seas). 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, 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 MMPA application to incidentally take marine mammals, the NMFS manages finfish and shellfish harvest under the provisions of several major statutes, including the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the MMPA, and ESA. Accomplishing the requirements of these statutes requires the close interaction of numerous entities in a sometimes complex fishery management process. In Alaska, the entities involved are a NMFS Regional Fisheries Science Center, NMFS Regional Office, NMFS Headquarters, one Fisheries Management Council, and three Fisheries Commissions, each described briefly below.

1.1 Fisheries Science Centers

Six Regional Fisheries Science Centers direct and coordinate the collection of scientific information needed to inform fisheries management decisions[1]. Each Fisheries Science Center is a distinct entity and is the scientific focal point for a particular region (Figure 1-1). The AFSC is the research arm of the NMFS in the Alaska Region and conducts research within three broad geographic research areas (RAs): the Gulf of Alaska (GOARA), the Bering Sea/Aleutian Islands (BSAIRA), and the Chukchi Sea/Beaufort Sea (CSBSRA) (Figure 1-2). The AFSC plans, develops, executes, and manages research foci that are grouped into four guiding themes. These themes encompass much of the work being done at the AFSC. The themes and foci are useful tools of research planning, and are linked to personnel, budget, project, data, and publication information through the AFSC Project Planning Database. The four guiding themes are as follows:

- Ecosystem approach to management for Alaska's large marine ecosystem
- Habitats to support sustainable fisheries and recovered populations

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

- Recovery, rebuilding, and sustainability of marine and anadromous species
- Oceans and human health

Since the 1970's, the AFSC has conducted research surveys throughout Alaska to monitor for important indicators of the overall health and status of the Region's fisheries resources, addressing the four main themes.

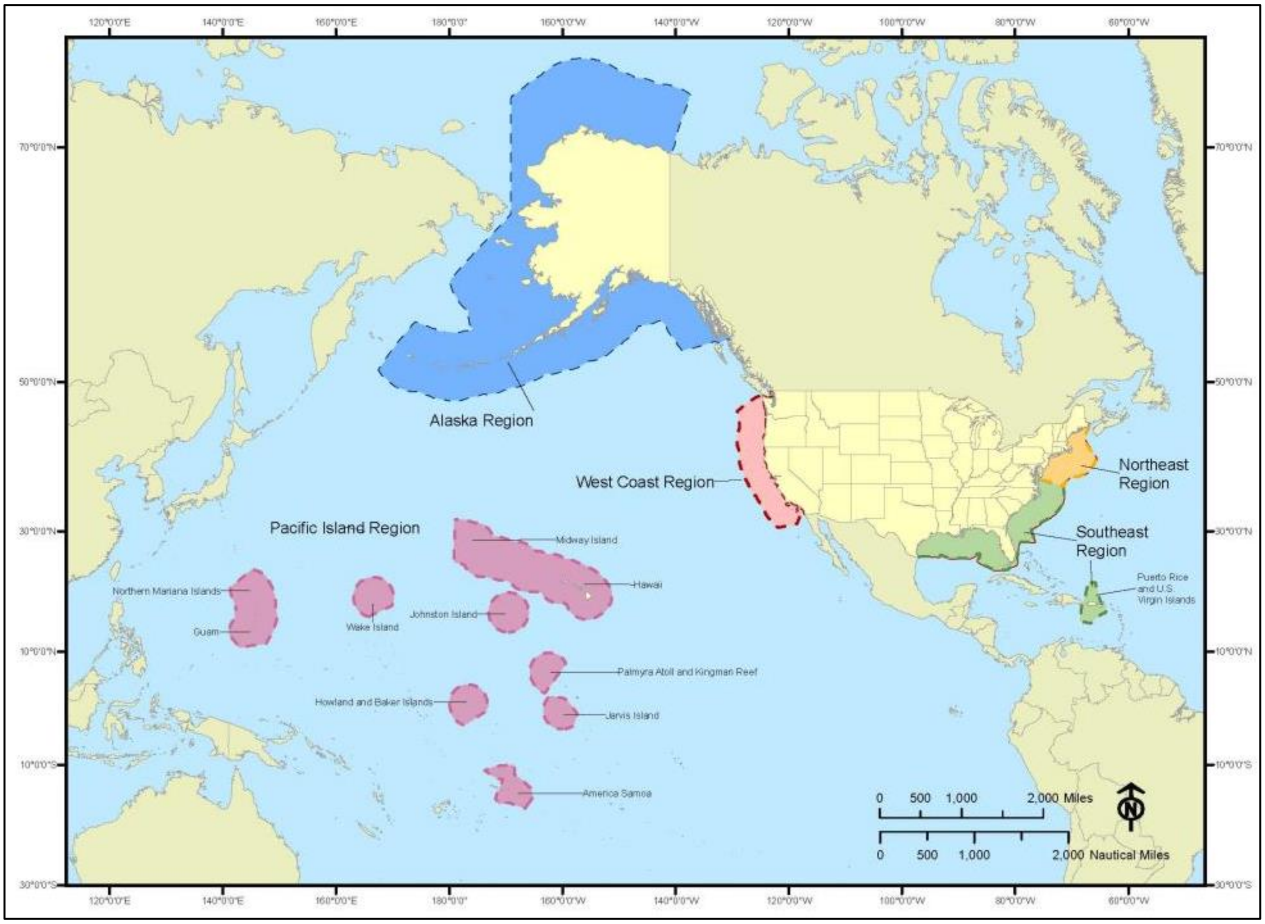

Figure 1-1 NMFS Fisheries Regions

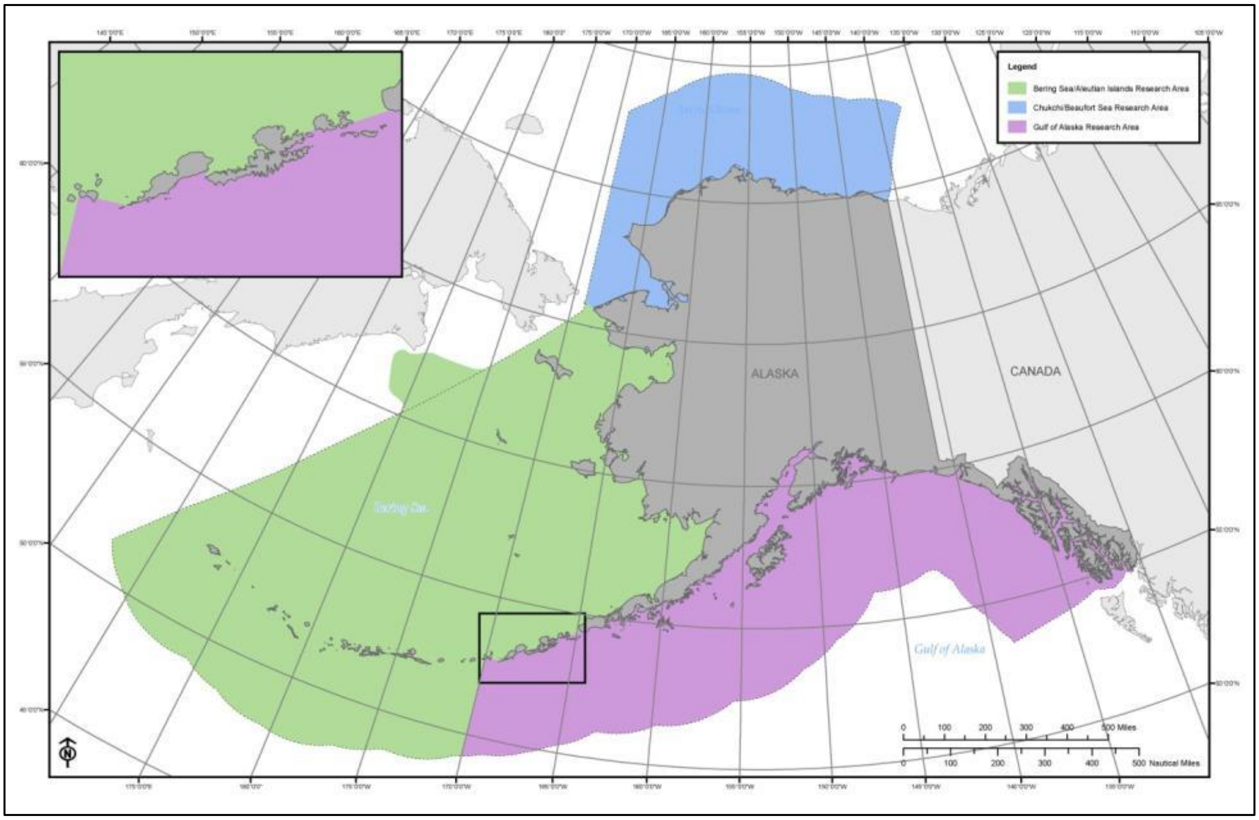

Figure 1-2 AFSC Fisheries Research Areas

Inset reflects boundaries of the Gulf of Alaska and Bering Sea Research Areas in the complex pass areas.

1.2 Domestic and International Fisheries Management Organizations and Agreements

The AFSC conducts fisheries research utilized for management of an array of species inhabiting a vast geographic region. Fisheries management of these species involves numerous domestic and international organizations with complex interrelationships and overlapping jurisdictions. These organizations include the North Pacific Fishery Management Council (NPFMC) which includes fishing industry representatives, fishers, scientists, government agency representatives, federal appointees, and others. Data collected by the AFSC are used to inform Fishery Management Plans (FMPs) developed by the NPFMC. In addition to providing information to domestic fisheries management councils, the AFSC provides scientific advice to support numerous international fisheries councils, commissions, and conventions including the Convention on the Conservation and Management of the Pollock Resources in the Central Bering Sea, the North Pacific Anadromous Fish Commission, the International Whaling Commission, and the International Pacific Halibut Commission. Coordinated international research efforts include those with the NOAA Fisheries Office of International Affairs and other organizations. Many details of these areas of responsibility along with maps of these operational areas are presented and discussed in depth in Chapter 1 in the Draft Programmatic Environmental Assessment (DPEA) that seeks coverage under the terms of the National Environmental Policy Act (NEPA) and is being prepared in connection with this application. To streamline review and to avoid redundancy, the reader is referred to that document for details.

1.3 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 are used to 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 NPFMC and the 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, the 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.
- Fishery-independent research directed by cooperating scientists (other agencies, academic institutions, and independent researchers) conducted on board non-NOAA vessels when the AFSC helps fund these types of research efforts.

The scope of this application covers the fisheries research activities of the AFSC or its research partners that:

- 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, 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. However, the research activities covered by this application involve only *incidental* interactions with marine mammals and not *intentional* interactions with those species.

1.4 Alaska Fisheries Science Center Research Divisions

Each of the AFSC's divisions provides science support for moving resource management toward a more holistic, ecosystem-based strategy. The AFSC's ecosystem approach promotes a shift away from management that previously focused in the short-term on a single species. The current approach focuses on interactions within and among ecosystems, offers long-term perspectives, and fully integrates analyses across a range of scientific disciplines. These functions are carried out through the coordinated efforts of nine research facilities located in Washington, Oregon, and Alaska. Included are the primary research center at the Western Regional Center Sand Point Facility in Seattle, Washington, a research laboratory at the Hatfield Marine Science Center in Newport, Oregon, and five research laboratories in Alaska – Little Port Walter Marine Station (Baranof Island), Auke Bay Laboratories (Auke Bay, Juneau), Ted Stevens

Marine Research Institute (Lena Point, Juneau), Kodiak Laboratory (Kodiak Island), and the Pribilof Islands Facilities (Figure 1-3).

Research programs at the AFSC are managed and conducted through the Resource Assessment and Conservation Engineering Division, Resource Ecology and Fisheries Management Division, Marine Mammal Laboratory, Fisheries Monitoring and Analysis Division, and Auke Bay Laboratories, in addition to the new Habitat and Ecological Processes Program, a unique cross-cutting program which focuses AFSC resources on interdisciplinary research topics. Additional details about the specific roles and responsibilities of each of these divisions are provided in the DPEA that supports this application.

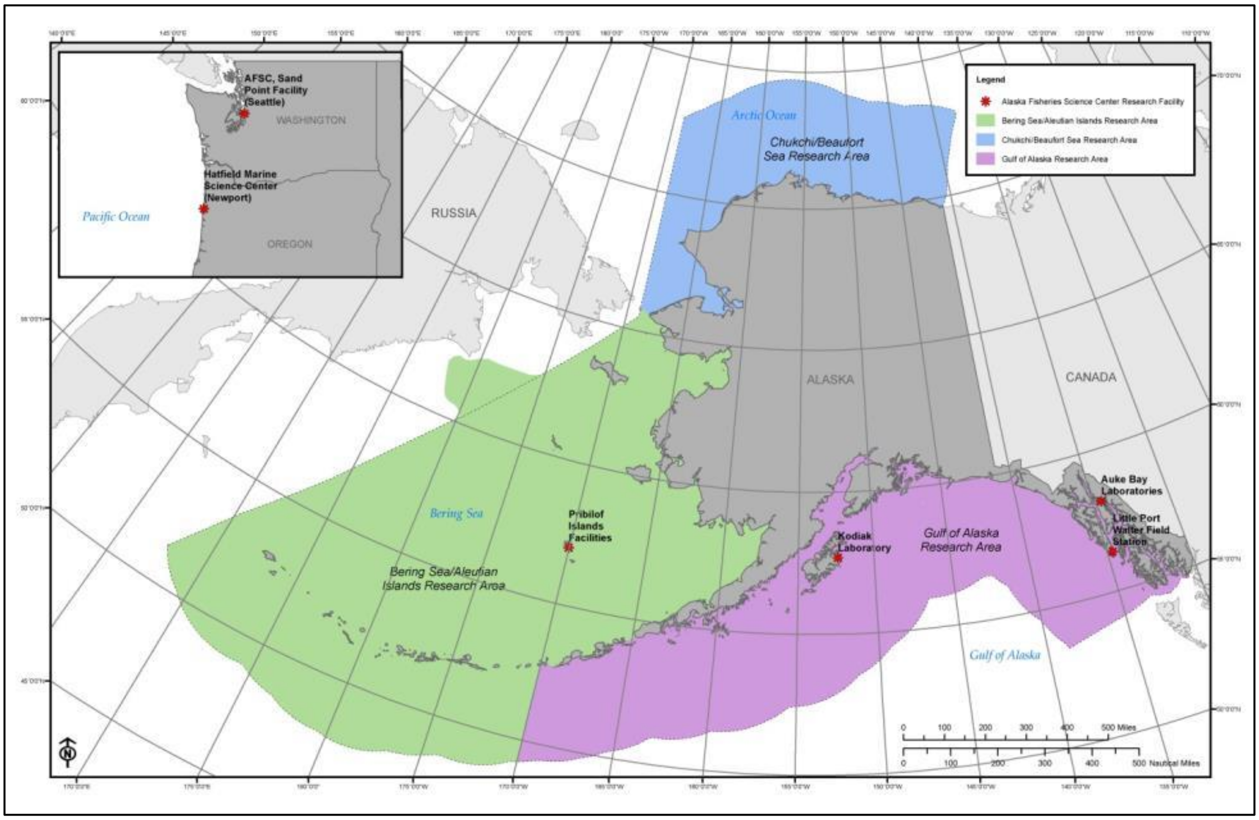

Figure 1-3 Map Showing the Locations of the AFSC Headquarters in Seattle, and the Research Facilities in Washington, Oregon, and Alaska

1.5 AFSC Fisheries and Ecosystem Research Activities

The AFSC conducts fisheries research and funds fisheries research conducted by its research partners that may incidentally take marine mammals. Detailed information describing the time of year projects are conducted, the regions of operations, the gear used, and methodological details of those fisheries research projects having such potential is presented in Table 1.1. The AFSC is requesting rulemaking and subsequent Letters of Authorization for these proposed activities. General descriptions of scientific gears, instruments, and vessels used are contained in Appendix A. Section 11 includes a description of mitigation measures used during research to minimize risk of marine mammal interactions. In general, all AFSC surveys are set in an ecological context. That is, the AFSC conducts concurrent hydrographic, oceanographic, ecosystem, and meteorological sampling in addition to the marine resource surveys. The AFSC anticipates that these research activities are likely to continue during the next five years, although not necessarily every year.

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Table 1-1 Summary Descriptions of Fisheries and Ecosystem Research Conducted or Funded by the AFSC

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. Mitigation measures are described in Section 11. Units of measurement are presented in the format data was collected. Abbreviations used in the table: ADCP = Acoustic Doppler Current Profiler; ADFG = Alaska Department of Fish and Game; AWT = Aleutian Wing Trawl; CTD = Conductivity Temperature Depth; DAS = days at sea; cm^2 = square centimeter; EcoFOCI = Ecosystem Fisheries-Oceanography Coordinated Investigations; ESA = Endangered Species Act; EVOSTC = Exxon Valdez Oil Spill Trustee Council; ft = feet; hr = hour; in = inch; kHz = kilohertz; km = kilometer; kts = knots; L = liter; m = meter; m^3 = cubic meter; max = maximum; MHz = megahertz; mi = miles; min = minutes; MM = marine mammals; 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; TSMRI = Ted Stevens Marine Research Institute; v = volt; 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							
Projects Using Trawl Gear							
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: Poly Nor'eastern bottom trawl (PNE) 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: 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
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
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 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 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.

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
					Midwater Trawl	Net type: Various Commercial midwater 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 31cm x 17cm x 14cm, 12 MHz	With tows
					Underwater camera in housing attached to net headrope	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.	With tows
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: bottom trawl to be determined 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: 12m 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 (<200m)	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	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

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
	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.				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
					Gillnet with pingers	Net type: scientific gillnet Net size: 10 m x 2 m Mesh size: variable Set duration: 30 min Pingers: 10 kHz, 132 dB re 1 µPa@1m; operating continuously during deployment, emission frequency every 4 s, duration 300 ms.	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
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
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 sampling 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 Marport headrope and wing sounders, 40 kHz	820 survey stations, 884 attempted 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
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 above Tow speed: 3-3.5 kn 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	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, 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.	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
					Mid-water Trawl with net sounders	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 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 Net size: Rigid square frame 2.3 m on each side, 2x3 mm mesh size in body, 1 mm mesh in codend. 1.8 m diheadral depressor to hold down frame. 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
					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
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

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
					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 Shumagins 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, 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
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
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 knot Tow duration: 15-45 min Depth: 1-200 m	64 samples 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
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: 50-200m 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							
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
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	Bottom 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
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 Seine or Gillnet Gear							
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, aircraft (occupied), travel on land	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 hours per set Pingers: 10 kHz, 132 dB re 1 µPa@1m; operating continuously during deployment.	50 sets
					Beach Seine	Net type: Nylon Net size: 150 ft length x 30 ft depth Mesh size: 1 in Set duration: Used intermittently July-August, 30 min per set	50 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
					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 hours per set	20 sets
					Fyke Net	Net type: Nylon Net size: 40 ft length Mesh size: ½ in Set duration: Used intermittently April-June, 4 hours per set	20 sets (in freshwater only)
					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: 1/4 in Set duration: Used intermittently Year round, 30 sec per set	>100 sets
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 during fieldwork conducted in FY13 (and beyond).	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
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 Ecoshounders; 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

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
					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
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
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; 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
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
					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
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 minutes	~150 per year
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

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 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: .25 m^2 Tow speed: 1.5 - 2.5 kts Tow duration: 10 min Depth: surface	150 tows
					CTD	Seabird 911	150 casts
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-hours/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: 1-2.5m Gangion spacing: 10-20m 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
***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 60Echosounders	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

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
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 31cm x 17cm x 14cm, 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)
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	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	5 seine hauls per sampling location (2) per sampling period (3) for a total of 25seine hauls
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
BERING SEA/ALEUTIAN ISLANDS RESEARCH AREA							
Projects 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

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
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/U.S. 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 minutes 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 minutes 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 knot Tow duration: 10 to 20 minutes Depth: surface to near bottom depth	75 tows
					SIMRAD EK60 echosounder	Freq: 38 kHz	Continuous
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

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
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 inch (forward sections) to 5.5 to 4 inch (aft sections). Footropes large bobbins or disks (18 – 24 inch 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
					Midwater Trawl	Midwater Trawl Net type: Various Commercial midwater 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 31cm x 17cm x 14cm, 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	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: bottom trawl to be determined, 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

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
	transport pathways from spawning to potential nursery locations for juveniles.				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 (<200m)	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
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 (<200m)	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 mins 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
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 Pribilofs 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

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
					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 knots Tow duration:	~ 100 hauls
Locating Essential Spawning Grounds for Red King Crab	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)
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 potenital 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

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 Summer Acoustic Trawl Survey - Bering Sea	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. 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. 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 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
					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.	Camera traps
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

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
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)
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
Projects 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
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; samples day and night	NOAA ship R/V *Fairweather*	Scientific Single Beam and Multibeam Ecoshounders; Side-scan Sonar	Frequencies used: Single beam echosounder (38 kHz); multi-beam ecohosounders (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

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
					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 (MOCNESS)	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: .25 m^2 Tow speed: 1.5 - 2.5 kts Tow duration: 10 min Depth: surface	150 tows
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)
CHUKCHI SEA/BEAUFORT SEA RESEARCH AREA							
Projects 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: Plumstaff Bean Trawl 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/U.S. 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 depth	70 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
					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 CS 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 Plumb Staff Beam Trawl (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
					Neuston Net	Net type: Plankton Net size: .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 Ecoshounders; Side-scan Sonar	Frequencies used: Single beam echosounder (38 kHz); multi-beam ecohosounders (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

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2.0 THE DATE(S) AND DURATION OF SUCH ACTIVITY AND THE SPECIFIC GEOGRAPHICAL REGION WHERE IT WILL OCCUR

2.1 Dates and Duration of Activities

Table 1-1 is a summary of regularly occurring AFSC fisheries and ecosystem research activities conducted on NOAA-owned and chartered vessels or research partner vessels. These surveys are likely to continue during the next five years, although not necessarily every year.

Some research projects last multiple years or may continue with modifications. Other projects only last one year and are not continued. Therefore, not all of the projects summarized in Table 1-1 are likely to continue in the future. Actual projects that will occur over the five-year application period depend on competitive grant processes and congressional funding levels for the AFSC, which are inherently uncertain.

- While some surveys are consistently conducted every year (Table 1-1), they are often based on randomized sampling designs so the exact location of survey effort varies year to year in the same general area.
- Some surveys are only conducted every two or three years or when funding is available. Timing of the surveys is a key element of their design but sea and atmospheric conditions as well as ship contingencies often dictate what can happen on any given day or whether scheduled surveys actually occur so there is variability inherent in even the most consistently conducted surveys.
- In addition, the research program is designed to provide flexibility on an annual basis in order to address issues as they arise. Competititve grants are often obtained for short duration (1-4 yr) projects that are specific to a particular research or management need.

In addition, the AFSC conducts cooperative research projects involving other enties; these go through an annual competitive selection process to determine which projects should be funded based on proposals developed by many independent researchers and fishing industry participants. Because the need for different kinds of fisheries information changes over time and overall funding levels vary with annual congressional appropriations, the priorities for funding different kinds of projects change regularly, which makes it difficult to know what will be funded in the next several years.

2.2 Geographic Regions Where the Activity Will Occur

AFSC research is conducted in three geographic areas that correspond to the Gulf of Alaska, the Bering Sea and Aleutian Islands, and the Chukchi Sea and Beaufort Sea (Figures 2-1, 2-2, and 2-3).

2.2.1 Gulf of Alaska

The Gulf of Alaska Research Area (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 2-1). The GOARA has approximately 160,000 km^2 of continental shelf and is a relatively open marine system.

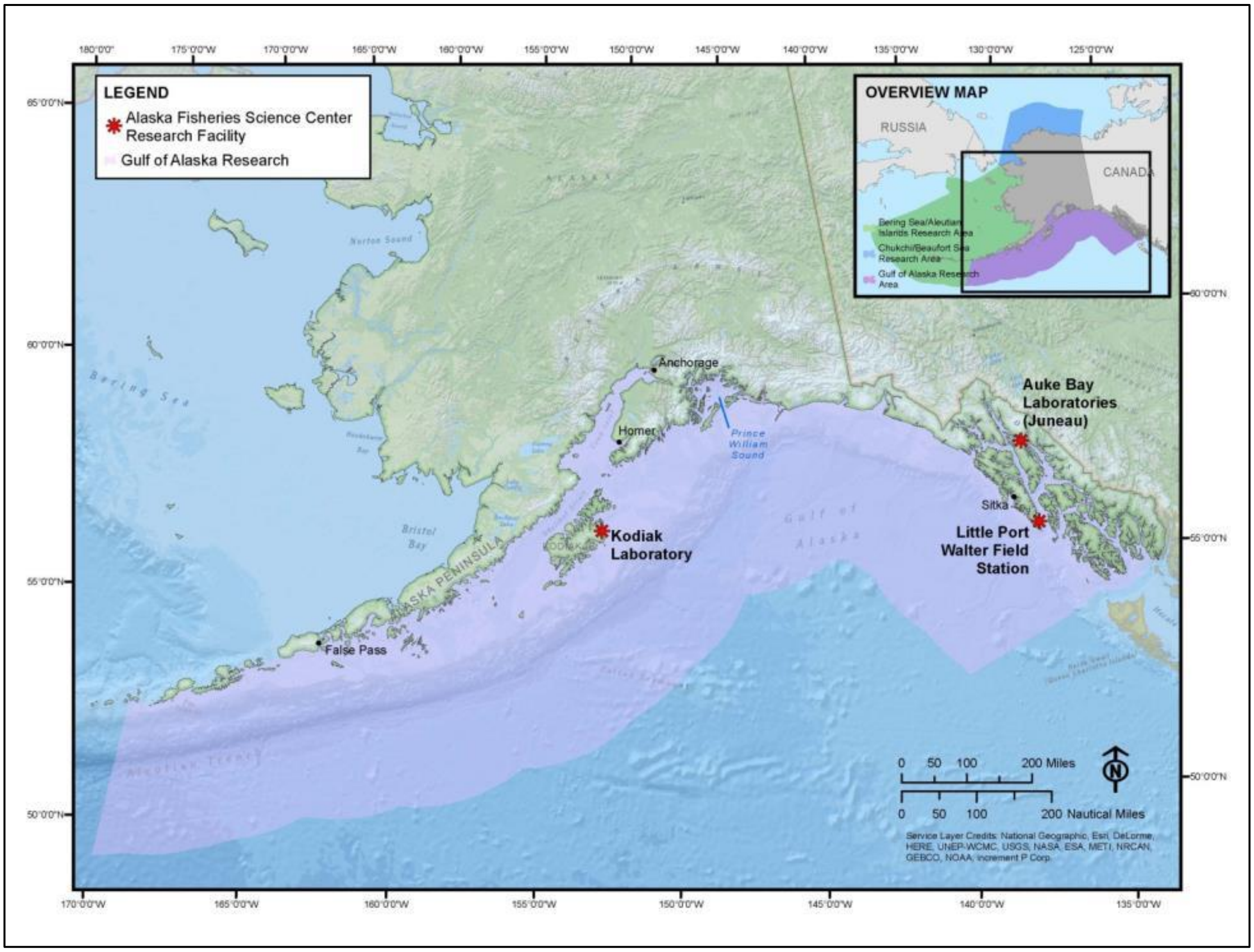

Figure 2-1 Gulf of Alaska Research Area and AFSC Research Facilities

2.2.2 Bering Sea and Aleutian Islands

The Bering Sea/Aleutian Islands Research Area (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 2-2). The surface area of this region is approximately 3.4 million km^2. This region includes the extremely wide, gradually sloping shelf of the Eastern Bering Sea, the narrow shelf and deep passes along the Aleutian Islands chain, the deep Aleutian Basin, Kamchatka Basin and Bowers Ridge. The Aleutian Islands archipelago includes approximately 150 islands extending about 2,260 km westward from the Alaska Peninsula to the Kamchatka Peninsula that create a partial geographic barrier to the exchange of northern Pacific marine waters with Eastern Bering Sea waters. The Aleutian Islands continental shelf is narrow, ranging in width on the north and south sides of the islands from about four km to 46 km, compared with the Eastern Bering Sea shelf, which ranges from 600-800 km from the shore to the shelf edge.

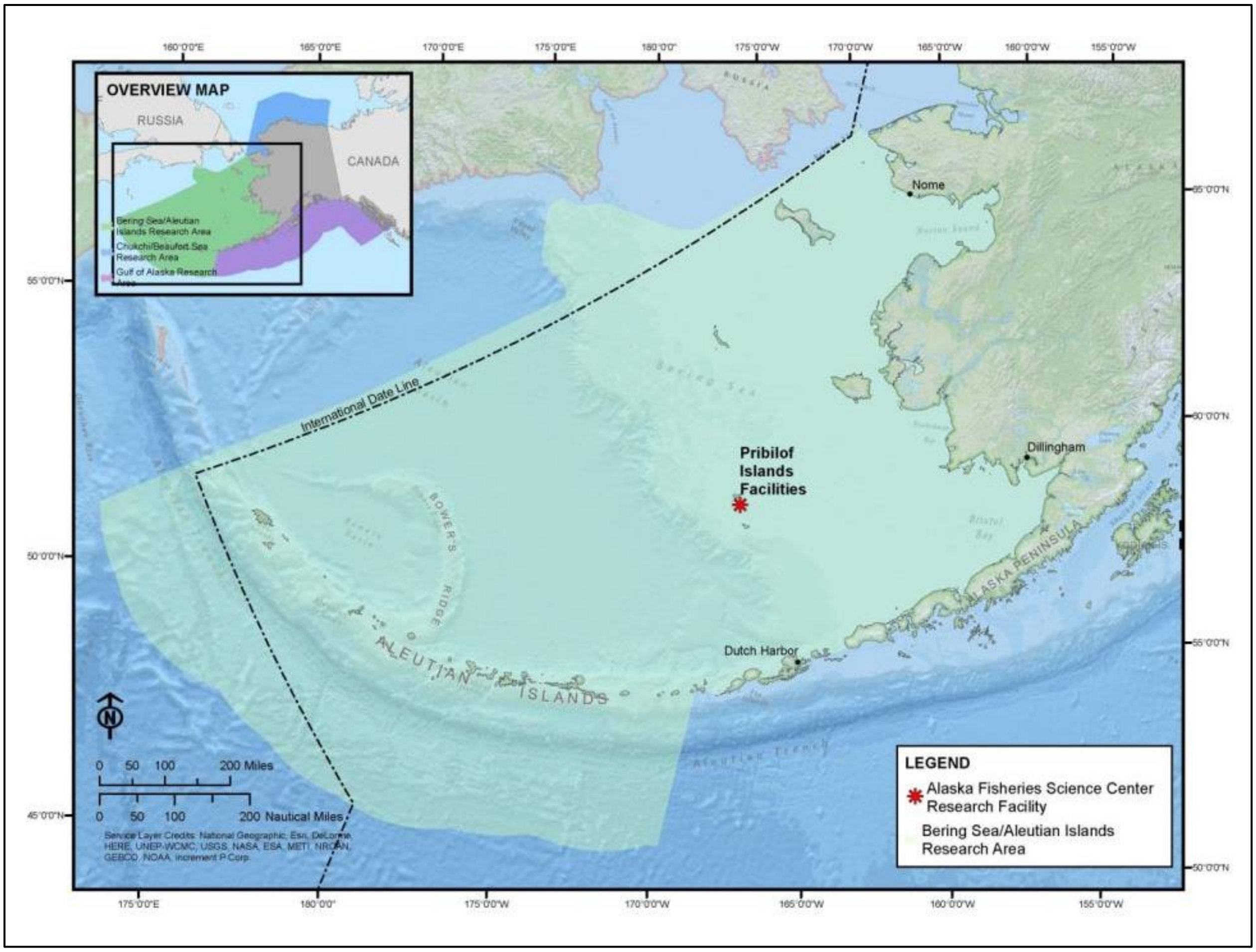

Figure 2-2 Bering Sea/Aleutian Islands Research Area and AFSC Research Facilities

2.2.3 Chukchi Sea and Beaufort Sea

The Chukchi Sea and Beaufort Sea Research Area (CSBSRA) includes waters of the Chukchi Sea east of the International Date Line and the Beaufort Sea west of the U.S.-Canada border within the U.S. Exclusive Economic Zone (EEZ) (Figure 2-2). The surface area of this region is approximately 1.5 million km^2. The region is a relatively shallow marginal sea with an extensive continental shelf and is characterized by the annual formation and deformation of sea ice. The ice-free zone of the summer is generally about 150-200 km wide. However, the Arctic climate is changing significantly and that one result of the change is a reduction in the sea ice extent in at least some regions of the Arctic (ACIA 2004, Johannessen et al. 2004, Doney et al. 2012, Melillo et al. 2014).

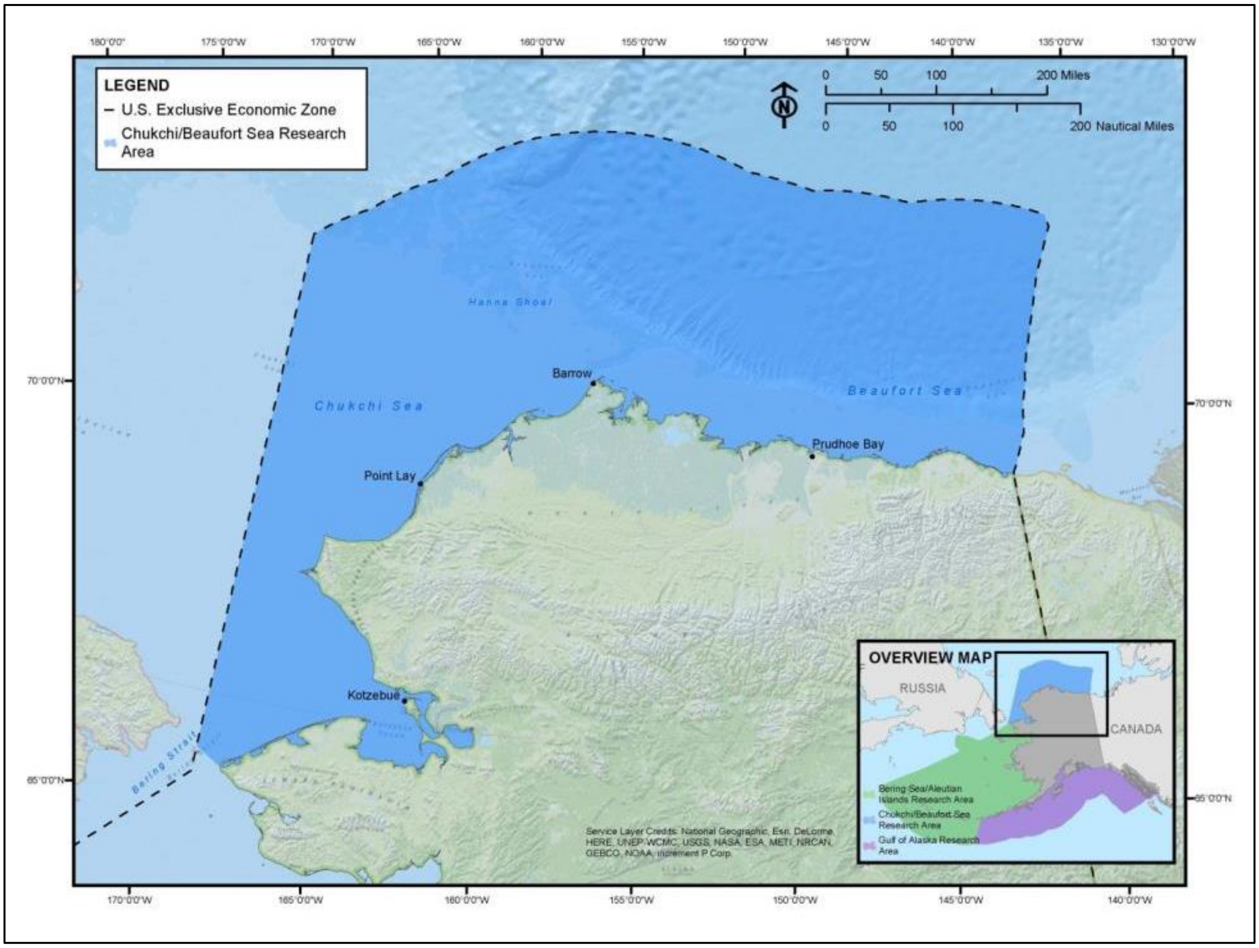

Figure 2-3 Chukchi Sea/Beaufort Sea Research Area

3.0 SPECIES AND NUMBERS OF MARINE MAMMALS LIKELY TO BE FOUND WITHIN THE ACTIVITY AREA

The species and approximate numbers of marine mammals likely to be found in the subject research areas are shown in Table 3-1. Marine mammal abundance estimates in this application represent the total number of individuals that make up a given stock or the total number estimated within a particular study area. NMFS stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. Survey abundance (as compared to stock or species abundance) is the total number of individuals estimated within the survey area, which may or may not align completely with a stock's geographic range as defined in the NMFS SARs (http://www.nmfs.noaa.gov/pr/sars/region.htm). These surveys may also extend beyond U.S. waters. Both stock abundance and survey abundance are used in this application when available to determine a density of marine mammal species within the survey area. Seasonal occurrence of these species within each research area is noted in Table 3-2.

Several species or stocks, such as narwhal, Western Pacific gray whales, and California sea lions, may occur in the AFSC research areas on rare occasions but are considered extralimital; they are included in Table 3-1 but are not likely to be 'taken' pursuant to the MMPA during survey operations. They are, therefore, not included in the take request and are not discussed below.

Table 3-1 lists the marine mammal species that occur in the waters of the Gulf of Alaska, Bering Sea/Aleutians Islands, and Chukchi Sea/Beaufort Sea Research Areas addressed by this application. The list includes nine cetacean species that are listed as endangered under the Endangered Species Act (ESA) (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, and Western North Pacific humpback whale, and the Cook Inlet stock of beluga whales), the Western DPS of Steller sea lion (listed as endangered), and two pinnipeds listed as threatened, the bearded seal and the ringed seal. One pinniped is designated as depleted under the MMPA (Pribilof Islands stock of Northern fur seal).

There are also three species of marine mammals under jurisdiction of the U.S. Fish and Wildlife Service (USFWS) that occur in the activity 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). However, a separate request for MMPA authorization for walrus, sea otters, and polar bears will be sent to the USFWS; these species will not be discussed further in this application.

For completeness and to avoid redundancy, the required information about all marine mammal species and numbers of species (insofar as it is known), are included in Section 4.

Table 3-1 Marine Mammals that Occur in the GOARA, BSAIRA, and CSBSRA, their Status under the ESA and MMPA, and Estimated Numbers[1]

Abbreviations: E = Endangered, T = Threatened, D = Depleted, S = Strategic, N/A = Not Available, U = Unknown, ND = Not Determined.

Common Name - Stock	Scientific Name	Federal ESA/ MMPA Status[2]	Population Estimate $N_{(best)}$	Minimum Population Estimate $N_{(min)}$
CETACEANS				
Beluga whale	*Delphinapterus leucas*			
Beaufort Sea			39,258	32,453

Common Name - Stock	**Scientific Name**	**Federal ESA/ MMPA Status[2]**	**Population Estimate $N_{(best)}$**	**Minimum Population Estimate $N_{(min)}$**
Eastern Chukchi Sea			3,710	U
Eastern Bering Sea			19,186	14,751[3]
Bristol Bay			2,877	2,467
Cook Inlet		E/D/S	312	280
Narwhal[4]	*Monodon monoceros*		N/A	N/A
Killer whale	*Orcinus orca*			
Eastern North Pacific Alaska Resident			2,347	2,347
Eastern North Pacific Northern Resident			261	261
Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient			587	587
AT1 Transient		D/S	7	7
West Coast Transient			243	243
Eastern North Pacific Offshore Stock			240	162
Pacific white-sided dolphin – Central North Pacific	*Lagenorhynchus obliquidens*		26,880	N/A
Harbor porpoise	*Phocoena phocoena*			
Southeast Alaska		S	11,146	N/A
Gulf of Alaska		S	31,046	N/A
Bering Sea		S	48,215	N/A
Dall's porpoise - Alaska	*Phocoenoides dalli*		83,400	N/A
Sperm whale – North Pacific	*Physeter macrocephalus*	E/D/S	N/A	N/A
Baird's beaked whale - Alaska	*Berardius bairdii*		N/A	N/A
Cuvier's beaked whale - Alaska	*Ziphius cavirostris*		N/A	N/A
Stejneger's beaked whale - Alaska	*Mesoplodon stejnegeri*		N/A	N/A
Gray whale	*Eschrichtius robustus*			
Eastern North Pacific			20,990	20,125
Western North Pacific[4]		E/D/S	140	135
Humpback whale	*Megaptera novaeangliae*			
Western North Pacific		E/D/S	893	836
Central North Pacific		E/D/S	10,252	9,896
Blue whale - Eastern North Pacific	*Balaenoptera musculus*	E/D/S	1,647	1,551
Fin whale – Northeast Pacific	*Balaenoptera physalus*	E/D/S	N/A	N/A
Sei whale - Eastern North Pacific	*Balaenoptera borealis*	E/D/S	126	83
Minke whale - Alaska	*Balaenoptera acutorostrata*		N/A	N/A
North Pacific right whale	*Eubalaena japonica*	E/D/S	31	25.7

Common Name - Stock	Scientific Name	Federal ESA/ MMPA Status[2]	Population Estimate $N_{(best)}$	Minimum Population Estimate $N_{(min)}$
Bowhead whale – Western Arctic	*Balaena mysticetus*	E/D/S	16,892	16,091
PINNIPEDS				
Steller sea lion	*Eumetopias jubatus*			
Eastern DPS		S	60,131-74,448	36,551
Western DPS		E/D/S	49,497	49,497
California sea lion[4]	*Zalophus californianus*		296,750	153,337
Northern fur seal – Eastern Pacific	*Callorhinus ursinus*	D/S	648,534	548,919
Harbor seal	*Phoca vitulina richardii*			
Aleutian Islands			6,431	5,772
Pribilof Islands			232	232
Bristol Bay			32,350	28,146
North Kodiak			8,321	7,096
South Kodiak			19,199	17,479
Prince William Sound			29,889	27,936
Cook Inlet/Shelikof Strait			27,386	25,651
Glacier Bay/Icy Strait			7,210	5,647
Lynn Canal/Stephens Passage			9,478	8,605
Sitka/Chatham Strait			14,855	13,212
Dixon/Cape Decision			18,105	16,727
Clarence Strait			31,634	29,093
Spotted Seal - Alaska	*Phoca largha*		460,268	391,000
Bearded seal - Alaska	*Erignathus barbatus*	D/S	N/A	N/A
Ringed seal - Alaska	*Phoca hispida*	T/D/S	N/A	N/A
Ribbon seal- Alaska	*Histriophoca fasciata*		184,000	163,086
Northern elephant seal - California breeding	*Mirounga angustirostris*		179,000	81,368

1. Sources: Allen and Angliss 2015, Muto and Angliss 2015, Carretta et al. 2015a, 2015b, and Shelden et al. 2015 for Cook Inlet beluga whale abundance estimates.
2. 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.
3. Data older than eight years; it is not considered a reliable minimum population estimate for calculating a PBR
4. Considered extralimital

Table 3-2 Timing of Occurrence for Marine Mammal Species and Stocks Encountered in AFSC Research Areas

Common Name - Stock	GOARA	BSAIRA	CSBSRA
Beluga whale			
Beaufort Sea	N/A	Winter	Spring/Summer/Fall

Common Name - Stock	GOARA	BSAIRA	CSBSRA
Eastern Chukchi Sea	N/A	Winter	Spring/Summer/Fall
Eastern Bering Sea	N/A	Year-round	N/A
Bristol Bay	N/A	Year-round	N/A
Cook Inlet	Year-round	N/A	N/A
Killer whale			
Eastern North Pacific Alaska Resident	Year-round	Year-round	N/A
Eastern North Pacific Northern Resident	Year-round	N/A	N/A
Eastern North Pacific Gulf of Alaska, Aleutian Islands, and Bering Sea Transient	Year-round	Year-round	Summer
AT1 Transient	Year-round	N/A	N/A
West Coast Transient	Year-round	N/A	N/A
Eastern North Pacific Offshore	Year-round	Year-round	N/A
Pacific white-sided dolphin – Central North Pacific	Year-round	Year-round	N/A
Harbor porpoise			
Southeast Alaska	Year-round	N/A	N/A
Gulf of Alaska	Year-round	N/A	N/A
Bering Sea	N/A	Year-round	Summer
Dall's porpoise - Alaska	Year-round	Year-round	N/A
Sperm whale – North Pacific	Year-round (more common in Summer)	Summer	N/A
Baird's beaked whale - Alaska	Year-round	Spring/Summer	N/A
Cuvier's beaked whale - Alaska	Year-round	Year-round	N/A
Stejneger's beaked whale - Alaska	Year-round	Year-round	N/A
Gray whale			
Eastern North Pacific	Spring/Summer/Fall	Spring/Summer/Fall	Summer
Western North Pacific[1]	Spring/Fall	Spring/Fall	N/A
Humpback whale			
Western North Pacific	Summer	Summer	Summer
Central North Pacific	Spring/Summer/Fall	Summer	N/A
Blue whale - Eastern North Pacific	Rare: Presumably Summer	Summer/Fall	N/A
Fin whale – Northeast Pacific	Summer/Fall (possible Year-round)	Summer/Fall (possible Year-round)	Summer
Sei whale - Eastern North Pacific	Summer	Summer	N/A
Minke whale - Alaska	Year-round?	Year-round?	Summer
North Pacific right whale	Spring/Summer/Fall	Spring/Summer/Fall	N/A

Common Name - Stock	GOARA	BSAIRA	CSBSRA
Bowhead whale – Western Arctic	N/A	Winter	Spring/Summer/Fall
Steller sea lion			
Eastern DPS	Year-round	N/A	N/A
Western DPS	Year-round	Year-round	N/A
Northern fur seal – Eastern Pacific	Winter/Spring	Summer/Fall	N/A
California sea lion – U.S.	Fall/Winter/Spring	Fall/Winter/Spring	N/A
Harbor seal			
Aleutian Islands	N/A	Year-round	N/A
Pribilof Islands	N/A	Year-round	N/A
Bristol Bay	N/A	Year-round	N/A
North Kodiak	Year-round	N/A	N/A
South Kodiak	Year-round	N/A	N/A
Prince William Sound	Year-round	N/A	N/A
Cook Inlet/Shelikof Strait	Year-round	N/A	N/A
Glacier Bay/Icy Strait	Year-round	N/A	N/A
Lynn Canal/Stephens Passage	Year-round	N/A	N/A
Sitka/Chatham Strait	Year-round	N/A	N/A
Dixon/Cape Decision	Year-round	N/A	N/A
Clarence Strait	Year-round	N/A	N/A
Spotted Seal - Alaska	N/A	Year-round	Summer/Fall
Bearded seal - Alaska	N/A	Year-round	Year-round
Ringed seal - Alaska	N/A	Winter/Spring	Year-round
Ribbon seal- Alaska	N/A	Year-round	Summer
Northern elephant seal - California breeding	Fall	Fall	N/A

1. 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).

4.0 STATUS, DISTRIBUTION AND SEASONAL DISTRIBUTION OF AFFECTED SPECIES OR STOCKS OF MARINE MAMMALS

The following information summarizes data on the affected species, by research area, their status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities, as available in published literature and reports, including marine mammal stock assessment reports. A brief synopsis of marine mammal acoustics and hearing precedes the species descriptions.

Marine mammals rely on sound production and reception for social interactions (e.g., reproduction, communication), to find food, to navigate, and to respond to predators. General reviews of cetacean and pinniped sound production and hearing may be found in Richardson et al. (1995), Edds-Walton (1997), Wartzok and Ketten (1999), and Au and Hastings (2008). Several recent studies on hearing in individual species or species groups of odontocetes and pinnipeds also exist (e.g., Kastelein et al. 2009, Kastelein et al. 2013, Ruser et al. 2014). Interfering with these functions through anthropogenic noise could result in potential adverse impacts.

Southall et al. (2007) provided a comprehensive review of marine mammal acoustics including designating functional hearing groups. Assignment was based on behavioral psychophysics (the relationship between stimuli and responses to stimuli), evoked potential audiometry, auditory morphology, and, for pinnipeds, whether they were hearing through air or water. Because no direct measurements of hearing exist for baleen whales, hearing sensitivity was estimated from behavioral responses (or lack thereof) to sounds, commonly used vocalization frequencies, body size, ambient noise levels at common vocalization frequencies, and cochlear measurements. NOAA modified the functional hearing groups of Southall et al. (2007) to extend the upper range of low-frequency cetaceans and to divide the pinniped hearing group into Phocid and Otariid hearing groups (NOAA 2015). Detailed descriptions of marine mammal auditory weighting functions and functional hearing groups are available in NOAA (2015). Table 4.1 presents the functional hearing groups and representative species or taxonomic groups for each that occur in the AFSC research areas. Most species found in the AFSC project areas are in the first two groups, low frequency cetaceans (baleen whales) and mid frequency cetaceans (odontocetes); both otariid and phocid pinnipeds occur in the project area as well.

Table 4-1 Summary of the Five Functional Hearing Groups of Marine Mammals[1]

Functional Hearing Group	Estimated Auditory Bandwidth	Species or Taxonomic Groups
Low frequency cetaceans (Mysticetes–Baleen whales)	7 Hz to 25 kHz (best hearing is generally below 1000 Hz, higher frequencies result from humpback whales)	All baleen whales
Middle frequency Cetaceans (Odontocetes)	150 Hz to 160 kHz (best hearing is from approximately 10-120 kHz)	Includes species in the following genera: *Lagenorhynchus,Orcinus, Physeter, Delphinapterus, Monodon, Ziphius, Berardius, Mesoplodon*
High frequency cetaceans (Odontocetes)	200 Hz to 180 kHz (best hearing is from approximately 10-150kHz)	Includes species in the following genera: *Phocoena, Phocoenoides*
Phocid pinnipeds (true seals)	75 Hz to 100 kHz (best hearing is from approximately 1-30 kHz)	All seals
Otariid pinnipeds (sea lions and fur seals)	100 Hz to 48 kHz (best hearing is from approximately 1-16 kHz)	All fur seals and sea lions

1. Based on Southall et al. 2007 and NOAA 2015

4.1 CETACEANS

4.1.1 Beluga Whale (*Delphinapterus leucas*) - Beaufort Sea, East Chukchi Sea, East Bering Sea, Bristol Bay, and Cook Inlet Stocks

Description: Beluga whales are medium sized toothed whale measuring 3.5 – 5.5 m in length and up to 1500 kg; males are up to 25 percent longer than females and are more robust (O'Corry-Crowe 2009). They have no dorsal fin but possess a prominent dorsal ridge that is used to break through thin sea ice. The cervical vertebrae are not fused allowing lateral flexibility of the head and neck, an unusual feature amongst cetaceans. They may live to 80 years of age. Neonates are born gray but become progressively lighter in color becoming pure white by about 14 years of age in females and 18 years of age in males (ibid).

Status and trends: Beluga whales belong to the Order Cetacea, Suborder Odontoceti, and Family Monodontidae. There are five management stocks in Alaska based on distributional separation, distinct population trends between regions occupied in summer, and genetic differences. These management stocks include the Beaufort Sea, Eastern Chukchi Sea, Eastern Bering Sea, Bristol Bay, and Cook Inlet (Figure 4-1).

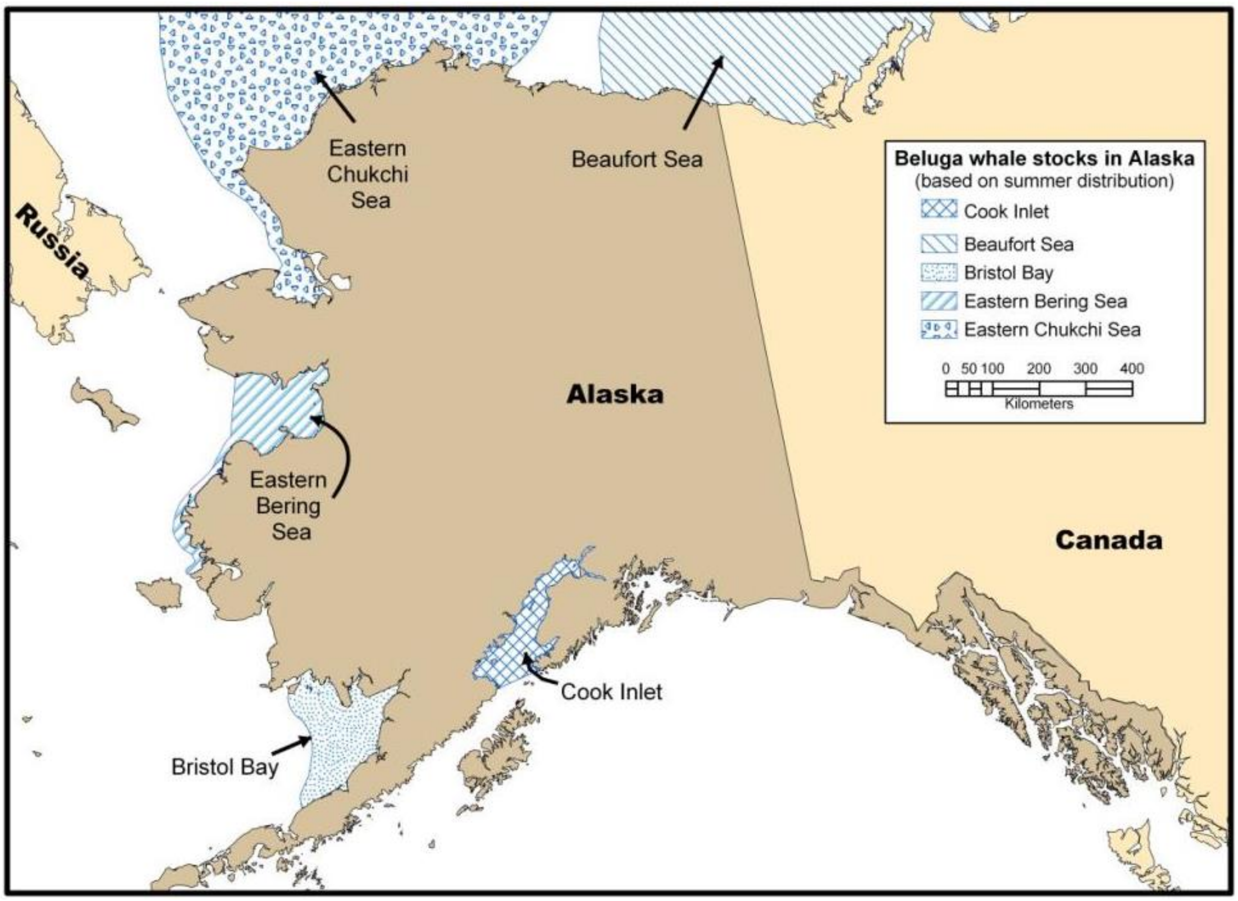

Figure 4-1 Summer Distribution of Beluga Whale Stocks in Alaska

Beaufort Sea stock: Based on 1992 aerial survey and extrapolation including a correction factor the population estimate for this stock is 39,258 whales (Allen and Angliss 2015). The minimum population estimate is 32,453 animals. 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 mortality and serious injury 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). Beaufort Sea beluga whales are not listed as “depleted” or as “strategic” under the MMPA or listed as threatened or endangered under the ESA.

Eastern Chukchi Sea stock: Eastern Chukchi Sea beluga whales move into coastal areas along Kasegaluk Lagoon in late June and animals are sighted in the area until about mid-July. Survey data are outdated for the eastern Chukchi Sea stock of beluga whales. 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). Eastern Chukchi Sea beluga whales are not listed as “depleted” or as “strategic” under the MMPA or listed as threatened or endangered under the ESA. Therefore, the eastern Chukchi Sea stock of beluga whales is not classified as a strategic stock.

Eastern Bering Sea stock: Aerial surveys of the Norton Sound/Yukon Delta region were conducted in 2000. Preliminary analyses indicate that the uncorrected estimate was 9,593 animals; when corrected for animals not visible at the surface, the estimated population size for Norton Sound is 19,186 (Allen and Angliss 2015). Based on this, the minimum population estimate would be 14,751 animals, but, because survey data are more than eight years old, it is not considered reliable for calculating PBR and the minimum estimate is considered unknown. More recent data are being analyzed (Allen and Angliss 2015). One beluga was reported entangled in a subsistence salmon gillnet in the eastern Bering Sea in 2010, leading to an average fisheries-related mortality and serious injury rate of 0.2 belugas for 2008-2012. A reliable estimate of mortality incidental to commercial fisheries is not available. Total estimated human-caused mortality is 181, 180.8 of which is from the subsistence harvest (Allen and Angliss 2015). Eastern Bering Sea beluga whales are not listed as “depleted” or as “strategic” under the MMPA or listed as threatened or endangered under the ESA. Therefore, the eastern Bering Sea beluga whale stock is not classified as strategic.

Bristol Bay stock: Summer movement patterns of Bristol Bay belugas include the shallow upper portions of Kvichak and Nushagak bays between May and August and they appear to remain in the nearshore waters of Bristol Bay through the months of September and October and perhaps some remain in the area through winter (Allen and Angliss 2011, and citations therein). Recent telemetry data indicate that the Bristol Bay stock of beluga whales is non-migratory and there is no evidence that members of the stock ever leave Bristol Bay (Citta et al. 2013). Beluga whale surveys in Bristol Bay in 1999, 2000, 2004 and 2005, resulted in maximum counts of 690, 531, 794, and 1,067. Using the correction factors and the maximum counts for 2004 and 2005 gives population estimates of 2,455 and 3,299 with an average of 2,877; the minimum population estimate for this stock is 2,467 beluga whales and the calculated PBR is 59 whales (Allen and Angliss 2015). It is unknown whether the U.S. commercial fishery-related mortality level is insignificant and approaching zero mortality and serious injury rate because a reliable estimate of the mortality rate incidental to commercial fisheries is currently unavailable. One beluga whale mortality in a subsistence salmon net was reported to the stranding network in 2009 resulting in a minimum annual fishery-related mortality rate of 0.2 for 2008-2012. This is likely an underestimate, since subsistence fisheries are not required to report marine mammal takes. The Alaska Native subsistence harvest from this stock averaged 24 belugas per year during 2008-2012 (Allen and Angliss 2015). Bristol Bay beluga whales are not listed as depleted under the MMPA or listed as threatened or endangered under the ESA. Based on currently available data, the estimated annual rate of human-caused mortality and serious injury is not known to exceed the PBR. Therefore, the Bristol Bay stock of beluga whales is not classified as a strategic stock. However, as noted previously, the estimate of fisheries-related mortality is unreliable and likely to be underestimated (Allen and Angliss 2015).

Cook Inlet stock: During spring and summer months, beluga whales in Cook Inlet are typically concentrated near river mouths in the northern Inlet. Although the exact winter distribution of this stock is unknown, there is evidence that some, if not all, of this population may inhabit Cook Inlet year-round (Allen and Angliss 2015, and citations therein). The 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 the PBR. NMFS cannot determine a maximum number that may be removed while allowing the population to achieve OSP, leaving the 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 rate due to subsistence fisheries from 2009 to 2013 is 0.2 beluga whales (Muto and Angliss 2015).

The stock is declining. Efforts to develop co-management agreements with Alaska Native organizations for several marine mammal stocks harvested by Native subsistence hunters across Alaska, including belugas in Cook Inlet, have been underway for several years. An umbrella agreement on co-management among the Indigenous People's Council for Marine Mammals, FWS, and NMFS was signed in August 1997, and an updated co-management agreement was signed in October 2006. During 1998, efforts were initiated to formalize a specific agreement between local Alaska Native organizations and NMFS regarding the management of Cook Inlet belugas, but without success. Federal legislation was implemented in May 1999, placing a moratorium on beluga hunting in Cook Inlet except under cooperative agreements between NMFS and affected Alaska Native organizations. Co-management agreements between NMFS and the Cook Inlet Marine Mammal Council were signed for 2000-2003 and 2005-2006 (Allen and Angliss 2011). Beginning in 2008, allowable harvest levels are based on the average abundance during the previous five-year period and the growth rate over the previous 10-year period; no harvest is allowed in the subsequent five years if the previous five-year average abundance is less than 350 whales. Since the population remains below 350, no harvest is allowed (Allen 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 2015).

Distribution and habitat preferences: Beluga whales inhabit cold waters of the Arctic and subarctic. The northernmost extent is off Alaska, northwest Canada, and off Ellesmere Island, West Greenland, and Svalbard (>80° N); the southern limit of distribution is in the St. Lawrence River in eastern Canada (47° – 49°N) (O'Corry-Crowe 2009). In Alaska beluga whales are distributed throughout seasonally ice-covered arctic and subarctic waters of the Northern Hemisphere, and are closely associated with open leads and polynyas in ice-covered regions (Allen and Angliss 2015, and references therein). Depending on season and region, beluga whales may occur in both offshore and coastal waters, with concentrations in Cook Inlet, Bristol Bay, Norton Sound, Kasegaluk Lagoon, and the Mackenzie Delta (ibid). 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). It is assumed that most beluga whales from these summering areas overwinter in the Bering Sea, excluding those found in the northern Gulf of Alaska (e.g., Cook Inlet). The general distribution pattern for beluga whales shows major seasonal changes. During the winter, they occur in offshore waters associated with pack ice. In the spring, they migrate to warmer coastal estuaries, bays, and rivers where they may molt and give birth to and care for their calves (ibid). Annual migrations may cover thousands of kilometers and varies by stock.

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 (Ibid). 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). Beluga whales equipped with satellite tracking equipment have moved over 1100 km from shore to the dense polar ice cap (Suydam et al. 2001). They 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 2010).

Acoustics and hearing: As summarized in O'Corry-Crowe (2009, and citations therein) beluga whales possess one of the most diverse vocal repertoires of any marine mammal and has long been called the 'sea canary' based on the myriad sounds produced. Calls and whistles are typically made at frequencies from 0.1 to 12 kHz and as many as 50 call types have been recognized. The echolocation system of belugas allows them to project and receive signals off the surface and to detect targets at high levels of ambient noise (O'Corry-Crowe 2009).

4.1.2 Killer Whale (*Orcinus orca*) - Alaska Resident; Northern Resident; GOA, AI, BS Transient; AT1 transient; West Coast Transient; Eastern North Pacific Offshore Stocks

Description: Killer whales are the largest member of the dolphin family attaining maximum body lengths of 9 m for males and 7.7 m for females (Ford 2009). Maximum measured weights for males is 5,568 kg and for females 3,810 kg (Ford 2009). Males develop larger appendages than females including the pectoral fins, tail flukes, and dorsal fin which is erect in shape and may be as high as 1.8 m in males. Directly behind the dorsal fin is a gray area of variable shape called the 'saddle patch'. Killer whales are generally black dorsally and white ventrally with a conspicuous elliptically shaped white patch behind the eye (post-ocular patch). Considerable variation exists in the shape and color of the post-ocular patch, saddle patch, and the size and shape of the dorsal fin such that they are used to identify individuals.

Status and trends: 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).

<u>Alaska Resident Stock:</u> 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 mortality and serious injury 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 mortality and serious injury (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).

<u>Northern Resident Stock:</u> As stated above, 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. The northern resident community is composed of three clans, A, G, and R with a total of 16 pods (Ford et al. 2000). The survey technique utilized for obtaining the abundance estimate of killer whales is a direct count of individually identifiable animals. Because this population has been studied for such a long time period, each individual is well documented and, except for births, no new individuals are expected to be discovered. Therefore, the estimated population size of 261 animals can also serve as a minimum count of the population, which includes animals found in Canadian waters (Allen and Angliss 2015). The calculated PBR is 1.96 killer whales and the stock appears to be increasing at about 2.5 percent per year (ibid).

The Northern Resident killer whale stock is not listed as depleted under the MMPA or listed as threatened or endangered under the ESA. In April 1999, the Committee on the Status of Endangered Wildlife in Canada voted to designate all resident killer whales in British Columbia as threatened. Based on currently available data, the estimated annual U.S. commercial fishery-related mortality level is zero, which does not exceed 10 percent of the PBR and therefore is considered to be insignificant and approaching zero mortality and serious injury rate. The estimated annual level of human-caused mortality and serious injury is not known to exceed the PBR. Therefore, the eastern North Pacific Northern Resident stock of killer whales is not classified as a strategic stock. Population trends and status of this stock relative to its OSP size are currently unknown (Allen and Angliss 2015).

Gulf of Alaska, Aleutian Islands, and Bering Sea Transient Stock: Within the transient ecotype, association data, acoustic data, and genetic data confirm that three communities of transient whales exist and represent three discrete populations: GOA, AI, and BS transients; AT1 transients; and West Coast transients (Allen and Angliss 2015, and citations therein). The GOA, AI, BS stock occurs mainly from Prince William Sound through the Aleutian Islands and Bering Sea. The minimum population estimate for this stock is 587 animals with a calculated PBR of 5.9 killer whales; reliable data on trends in population abundance for this stock are unavailable. The estimated annual level of human-caused mortality and serious injury (0.6 animals per year) in the Bering Sea-Aleutian Islands flatfish and rockfish trawl fisheries is less than the PBR, but equals 10 percent of PBR. Therefore, the Gulf of Alaska, Aleutian Islands, and Bering Sea transient stock of killer whales is not classified as a strategic stock and the estimated annual U.S. commercial fishery-related mortality level is considered insignificant and approaching a zero mortality and serious injury level. Population trends and status of this stock relative to its OSP level are currently unknown (Allen and Angliss 2015).

AT1 Transient Stock: AT1 transients have only been observed in Prince William Sound and in the Kenai Fjords region, and are partially sympatric with 'Gulf of Alaska' transients. The AT1 transients have a more limited geographic range than do other transients and have never been observed east of Prince William Sound or west of Kenai Fjords, Alaska, an apparent range of about 200 miles (Allen and Angliss 2015, and citations therein). The AT1 transient group consisted of 22 individuals when first documented in 1984. Since then, losses of nine individuals followed the *Exxon Valdez* spill in 1989, with two more losses soon thereafter. Only 11 whales were seen between 1990 and 1999. Four additional observed or presumed mortalities further diminished the population to a minimum of seven whales. The population counts have declined from a level of 22 whales in 1989 to seven whales in 2013, a decline of 68 percent. The estimated population size as of summer 2014 remains seven whales (Muto and Angliss 2015). No births have occurred in this population since 1984 (Matkin et al. 2012). The calculated PBR for this stock is zero and the estimated annual human-caused mortality and serious injury level is zero (Muto and Angliss 2015). This stock is designated as depleted under the MMPA and is classified as a strategic stock; it is not listed under the ESA.

West Coast Transient Stock: The West Coast Transient stock is a trans-boundary stock, including killer whales from British Columbia. It includes animals that occur in California, Oregon, Washington, British Columbia and southeastern Alaska. On many occasions, transient whales from the inland waters of southeastern Alaska have been seen in association with British Columbia/Washington State transients. On other occasions, some of those same British Columbia whales have been sighted with whales more frequently seen off California thus linking these whales by association. The minimum population estimate for this stock is 243 animals with a calculated PBR of 2.4 killer whales. The average annual population growth rate for the years 1999-2006 was 0.02 (95% CI 0.98-1.07) (Ford et al. 2007). The estimated annual human-caused mortality and serious injury level is zero (Allen and Angliss 2015, and citations therein). The West Coast Transient stock is not classified as a strategic stock. Status of this stock relative to its OSP level is currently unknown.

Eastern North Pacific Offshore Stock: Less is known about offshore killer whales, but their groupings are large, they range from California to Washington and, rarely, to Southeast Alaska, and their prey includes fish, particularly sharks (Carretta et al. 2014, Ford et al. 2000, Krahn et al. 2004, Ford et al. 2014). They apparently do not mix with the transient and resident killer whale stocks found in these regions No information is available regarding trends in abundance of Eastern North Pacific offshore killer whales. The minimum population estimate for this stock is 162 killer whales for the U.S. West Coast, from California to Washington, with a calculated PBR of 1.6 animals (Carretta et al. 2014, and citations therein).

Distribution and habitat preferences: Killer whales are found in all oceans and are second only to humans as the most widely spread of all mammals (Ford 2009). They are most commonly found in coastal and temperate waters of high productivity. Heimlich-Boran (1988) found that resident killer whales in the inland waters of the Pacific Northwest fed more in areas of high substrate topography along salmon migratory routes while transient whales fed in shallow protected areas around concentrations of their prey. The location of food resources and habitats suitable for prey capture appeared to be the prime determining factor in the behavioral ecology of killer whales.

Behavior and life history: Killer whales are very social and the basic social unit is based on matriline relationship and linked by maternal decent. A typical matriline is composed of a female, her sons and daughters, and the offspring of her daughters (Ford 2009). Females may live to 80-90 years so a female's line may contain four generations. The pod is the next level of organization which is a group of related matrilines that shared a common maternal ancestor. The next level of social structure is the clan, followed by a resident society.

Births may occur in any month but most are in October-March. Females give birth when between 11 and 16 years of age with a five-year interval between births. Gestation is 15-18 months and weaning is about 1-2 years after birth. Males attain sexual maturity at about 15 years of age. Life expectancy for females is about 50 years with a maximum of 80-90; males typically live to about 29 years of age (Ford 2009).

Resident ecotypes primarily feed on salmon, especially Chinook salmon, returning to rivers. This ecotype of killer whale exhibits cooperative food searching but perhaps not food capture (Hoelzel 1993). Transient killer whales feed on seals, sea lions, and young or smaller cetaceans (Ford 2009) with an optimal group size of at least three whales needed to efficiently chase and capture marine mammal prey (Baird and Dill 1996). Although killer whales regularly dive to greater than 150 m, there appears to be a trend toward a greater frequency of shallower dives and that males dive deeper than females (Krahn et al. 2004). Seven resident killer whales followed in 2002 were found to have dives that exceeded 228 m with an average maximum depth of 141 m (Baird et al. 2003). Dive rates (number of dives/hour) are similar for males and females and by age and among pods, but dive rates and swim speeds were greater during the day than at night (Baird et al. 2003). Killer whales have no natural predators other than humans but neonatal mortality is high with nearly 46 percent dying in the first 6 months (Ford 2009).

Acoustics and hearing: Killer whales, like most cetaceans, are highly vocal and use sound for social communication and to find and capture prey. The sounds include a variety of clicks, whistles, and pulsed calls (Ford 2009). As summarized in DON (2008b, and citations therein), the peak to peak source levels of echolocation signals range between 195 and 224 dB re 1 μPa-m. The source level of social vocalizations ranges between 137 to 157 dB re 1 μPa-m. Acoustic studies of resident killer whales in British Columbia have found that there are dialects, in their highly stereotyped, repetitive discrete calls, which are group-specific and shared by all group members (Ford 2009). These dialects likely are used to maintain group identity and cohesion, and may serve as indicators of relatedness that help in the avoidance of inbreeding between closely related whales (Ford 2009). The killer whale has the lowest frequency of maximum sensitivity and one of the lowest high frequency hearing limits known among toothed whales. The upper limit of hearing is 100 kHz for this species.

In contrast to resident whales, transient killer whales appear to use passive listening as a primary means of locating prey, call less often, and use high-amplitude vocalizations only when socializing, communicating over long distances, or after a successful attack. This probably results from the ability of other marine mammal species (their prey) to "eavesdrop" on killer whale sounds (DON 2008b).

4.1.3 Pacific White-Sided Dolphin (*Lagenorhynchus obliquidens*) - North Pacific Stock

Description: Pacific white-sided dolphins are a medium sized dolphin with adults ranging from 1.7 m to 2.5 m in length and weigh 75-198 kg; males are slightly larger than females (Black 2009). They are boldly marked with a dark gray or black dorsal surface, light gray sides and light gray 'suspender stripes' anterior. The dorsal fin is falcate to lobate with a rounded tip; it has a darker leading edge with light gray color covering two thirds of the posterior portion; the flukes are all dark (Black 2009). A few predominately white individuals with small patches of black pigmentation on the sides, heads, and fins have been identified in Monterey Bay.

Status and trends: Pacific white-sided dolphins belong to the Order Cetacea, Suborder Odontoceti, and Family Delphinidae. Although there is clear evidence that two forms of Pacific white-sided dolphins occur along the U.S. West Coast, there are no known differences in color pattern, and it is not currently possible to distinguish animals without genetic or morphometric analyses. Information is not sufficient to define stock structure throughout the North Pacific beyond the generalization that a northern form occurs north of about 33°N from southern California along the coast to Alaska, a southern form ranges from about 36° N southward along the coasts of California and Baja California while the core of the population ranges across the North Pacific to Japan at latitudes south of 45°N (Allen and Angliss 2015).

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 Gulf of Alaska (26,880 dolphins) serves as the minimum population estimate for this stock in the Gulf of Alaska region. The estimate of abundance for Pacific white-sided dolphins is now more than eight years old; Wade and Angliss (1997) recommend that abundance estimates older than eight years no longer be used to calculate a PBR level. Thus, the PBR for this stock is undetermined (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 2002 and 2006. 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 not listed as depleted under the MMPA or listed as threatened or endangered under the ESA. The level of human-caused mortality and serious injury (0) is not known to exceed the PBR, which is undetermined. Because the PBR for Pacific white-sided dolphin is undetermined, the level of annual U.S. commercial fishery related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The North Pacific stock of Pacific white-sided dolphins is not classified as a strategic stock. Population trends and status of this stock relative to OSP are currently unknown (Muto and Angliss 2015).

Distribution and habitat preferences: This dolphin is one of the most abundant pelagic species of dolphin found in cold-temperate North Pacific waters. In the eastern Pacific it occurs as far west as Amchitka Island in the central Aleutian Islands through the Gulf of Alaska and down to 20° N, just south of Baja California (Black 2009). They do not migrate but exhibit seasonal shifts in distribution related to oceanographic variability. As summarized in Carretta et al. (2011, and citations therein), Pacific white-sided dolphins are endemic to temperate waters of the North Pacific Ocean, and are common both on the high seas and along the continental margins. The species is common both on the high seas and along the continental margins and animals are known to enter the inshore passes of Alaska, British Columbia, and Washington (Ferrero and Walker 1996). They typically inhabit productive continental shelf and slope waters generally within 185 km of shore (Black 2009). They frequent some areas with complex bathymetry such as Monterey Bay, CA, and area where deep submarine canyons approach shore (ibid).

Behavior and life history: As summarized from Black (2009, and citations therein) calving occurs from May to September. Age and length of maturation varies by area with females becoming sexually mature at 8-11 years with a four to five year calving interval. These are highly social dolphins and are avid bow riders that commonly occur in groups of less than a hundred but can form herds of over a thousand animals. They often associate with other dolphins and porpoises and occasionally feed near humpback whales. Killer whales (Orcinus orca) appear to be a significant predator. Prey species include cephalopods (30 species known to be consumed) and schooling fishes (at least 60 species) (Black 2009). Pacific white-sided dolphins equipped with radio transmitters had mean dive duration of 24 seconds and a maximum dive time of 6.2 minutes (ibid).

Acoustics and hearing: As summarized in DON (2008b, and citations therein), vocalizations produced by Pacific white-sided dolphins include whistles and clicks. Whistles are in the frequency range of 2 to 20 Hz. Peak frequencies of the pulse trains for echolocation fall between 50 and 80 kHz; the peak amplitude is 170 dB re 1µPa-m. Underwater hearing sensitivity of the Pacific white-sided dolphin is from 75 Hz through 150 kHz. The greatest sensitivities were from 4 to 128 kHz. Below 8 Hz and above 100 kHz, this dolphin's hearing was similar to that of other toothed whales.

4.1.4 Harbor Porpoise (*Phocoena phocoena*) - Southeast Alaska, Gulf of Alaska, and Bering Sea Stocks

Description: Harbor porpoise are one of the smaller porpoises and have a short, stocky body. On average females reach 1.6 m in length and 60 kg while males reach 1.4 m and 50 kg (Bjørge and Tolley 2009). The body is dark gray dorsally with the chin and ventral surfaces a contrasting white which sweeps up the mid flanks (ibid). They have a small triangular dorsal fin that facilitates recognition when swimming but they also known to lie on the surface (ibid). Harbor porpoise tend to avoid ships and rarely bow ride.

Status and trends: Harbor porpoise belong to the Order Cetacea, Suborder Odontoceti, and Family Phocoenidae. There are three management stocks in Alaska based on arbitrary boundaries, the Southeast Alaska stock, the Gulf of Alaska stock, and the Bering Sea stock.

Southeast Alaska stock: This stock ranges from the northern border of British Columbia to Cape Suckling, Alaska. 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 mortality and serious injury 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).

Gulf of Alaska stock: This stock ranges from Cape Suckling to Unimak Pass. The most recently available abundance estimate of 31,046 porpoises for the Gulf of Alaska stock is based on surveys conducted in 1998 (Hobbs and Waite 2010). Therefore, the minimum population estimate is considered unreliable and the PBR undeterminable. Average annual mortality in observed fisheries (1990-2005) is 71.4 harbor porpoise. All takes were in drift or set gillnets (Allen and Angliss 2015).

Bering Sea stock: This stock ranges from throughout the Aleutian Islands and all waters north of Unimak Pass. 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, 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 mortality and serious injury 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 porpoises due to subsistence fishery interactions. Total mean annual mortality and serious injury 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 Endangered Species Act (ESA). At present, U.S. commercial fishery-related annual mortality levels (i.e., 10 percent of PBR) can be considered insignificant and approaching zero mortality and serious injury rate. The estimated level of human-caused mortality and serious injury for these stocks does not exceed the PBR. 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 (Allen and Angliss 2015).

Distribution and habitat preferences: Harbor porpoises are distributed throughout the coastal waters of North Pacific, North Atlantic, and Black Sea. In the eastern North Pacific they occur from Point Conception, California to Alaska and across to Russia (Allen and Angliss 2015). Harbor porpoise along the west coast of North America are not panmictic or migratory, and movement is sufficiently restricted that genetic differences have evolved. Recent preliminary genetic analyses of samples ranging from Monterey Bay, California to Vancouver Island, British Columbia indicate that there is small-scale subdivision within the U.S. portion of this range. They are typically found in small groups of one to three individuals often consisting of a female-calf pair, but larger groups are not uncommon (Bjørge and Tolley 2009). The species frequents inshore areas, shallow bays, estuaries, and harbors. Harbor porpoises are found almost exclusively shoreward of the 200 m contour line, with the vast majority found inside the 50 m curve (Gearin and Scordino 1995, Osmek et al. 1996). A radio-tagged animal remained over deep water of the southern Strait of Georgia (200 m) and movements were confined to a 65 square kilometer area of the capture site off Orcas Island, Washington (Hanson et al. 1999).

Behavior and life history: Harbor porpoises calve and breed throughout the range, and they generally give birth in summer from May through July. Calves remain dependent for at least six months (Leatherwood et al. 1982). Harbor porpoise are usually shy and avoid vessels; thus, they are difficult to approach. Harbor porpoise often feed near bottom in waters less than 200 m deep on bottom-dwelling fishes and small pelagic schooling fishes with high lipid content; herring and anchovy are common prey (Bjørge and Tolley 2009, Leatherwood and Reeves 1986).

Acoustics and hearing: The harbor porpoise has the highest upper-frequency limit of all odontocetes investigated. Kastelein et al. (2002) found that the range of best hearing was from 16 to 140 kHz, with a reduced sensitivity around 64 kHz. Maximum sensitivity (about 33 dB re 1 μPa) occurred between 100 and 140 kHz. This maximum sensitivity range corresponds with the peak frequency of echolocation pulses produced by harbor porpoises (120–130 kHz). Harbor porpoise are in the high-frequency functional hearing group, whose estimated auditory bandwidth is 200 Hz to 180 kHz (Southall et al. 2007). Their vocalizations range from 110 to 150 kHz (DON 2008a) (Table 4-1).

4.1.5 Dall's Porpoise (*Phocoenoides dalli*) - Alaska Stock

Description: Dall's porpoises are a stocky, medium sized porpoise with a wide-based dorsal fin which is topped with white pigment. The tail stock is deepened and there is a noticeable beak; the flippers and fluke are small (Jefferson 2009). Males are somewhat larger than females but both may reach a length of about 2.2 m and weigh about 150 kg or more. The body is black with a large white flank patch that extends to the level of the dorsal fin. They are extremely fast in the water and are often misidentified as 'baby killer whales' (Osborne et al. 1988).

Status and trends: Dall's porpoise belong to the Order Cetacea, Suborder Odontoceti, and Family Phocoenidae. Up to ten populations or stocks are recognized, one of which is the Alaska stock. 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 eight years. By regulation, abundance estimates older than eight 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 mortality and serious injury 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). This level is not known to exceed the currently undetermined PBR. Because the PBR is undetermined, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. The Alaska stock of Dall's porpoise is not classified as a strategic stock (Muto and Angliss 2015).

Distribution and habitat preferences: The species is found only in temperate waters of the North Pacific and adjacent seas (Jefferson 2009).The southern end of this population's range is not well-documented, but they are commonly seen off Southern California in winter, and during cold-water periods they probably range into Mexican waters off northern Baja California. Dall's porpoises occur in small groups, although aggregations of at least 200 individuals have been reported. Dall's porpoise occur only rarely in groups of mixed species, although they are sometimes seen in the company of harbor porpoises and gray whales (Jefferson 2009). It 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. There are seasonal inshore-offshore and north-south movements, but these movements are poorly understood (Jefferson 2009). Hanson (2007) described movements of radio-tagged Dall's porpoise from the San Juan Islands to the outer coast coincident with the timing of development of the Juan de Fuca eddy in two consecutive years. Their departure is consistent with the breakdown of this feature.

Behavior and life history: Calves are born in summer, and gestation is thought to be about one year (Osborne et al. 1988, Jefferson 2009). Dall's porpoises apparently feed at night. Prey species in the inland waters of British Columbia and Puget Sound include squid and schooling fishes (Walker et al. 1998). Dall's porpoise equipped with dive recorders dove to about 94 m in water that exceeded 200 m while feeding in Puget Sound inland waters. Dive duration was about 1.3 minutes (Baird and Hanson 1996).

Acoustics and hearing: Only short duration pulsed sounds have been recorded for Dall's porpoise; this species apparently does not whistle often (Richardson et al. 1995). Dall's porpoises produce short-duration (50 to 1,500 μs), high-frequency, narrow band clicks, with peak energies between 120 and 160 kHz. There are no published data on hearing ability of this species (DON 2008b).

4.1.6 Sperm Whale (*Physeter macrocephalus*) - North Pacific Stock

Description: The sperm whale is the largest toothed whale species and the most sexually dimorphic cetaceans in body length and weight (Whitehead 2009). Adult females can reach 12 m in length, while adult males measure as much as 18 m in length (Jefferson et al. 1993). The head is large (comprising about one-third of the body length) and squarish. The lower jaw is narrow and under slung. The blowhole is located at the front of the head and is offset to the left. Sperm whales are brownish gray to black in color with white areas around the mouth and often on the belly. The flippers are relatively short, wide, and paddle-shaped. There is a low rounded dorsal hump and a series of bumps on the dorsal ridge of the tailstock and the surface of the body behind the head tends to be wrinkled (Whitehead 2009).

Status and trends: Sperm whales belong to the Order Cetacea, Suborder Odontoceti, and Family Physeteridae. Whaling removed at least 436,000 sperm whales from the North Pacific between 1800 and the end of commercial whaling (summarized in Carretta et al. 2011 and references therein). Of this total, an estimated 33,842 were taken by Soviet and Japanese pelagic whaling operations in the eastern North Pacific from the longitude of Hawaii to the U.S. West coast, between 1961 and 1976, and approximately 1,000 were reported taken in land-based U.S. West coast whaling operations. There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped earlier, in 1980. As a result of this whaling, sperm whales are formally listed as "endangered" under the ESA, and consequently the Alaska stock is automatically considered as a "depleted" and "strategic" stock under the MMPA.

A 1998 analysis by Japanese scientists suggested that there were 102,112 sperm whales in the western North Pacific (Kato and Miyashita 1998, cited in Allen and Angliss 2015). Current and historical abundance estimates are, however, 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 mortality and serious injury 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 mortality and serious injury rate is unknown (Muto and Angliss 2015).

Distribution and habitat preferences: With the exception of humans and killer whales, few animals on earth are as widely distributed as the sperm whale (Whitehead 2009). 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° N) to the Pribilof Islands; the majority are thought to be south of 40° N in winter. As summarized in Allen 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 Gulf of Alaska, Bering Sea, and waters around the Aleutian Islands. Sightings surveys conducted in the summer months between 2001 and 2006 have found sperm whales to be the most frequently sighted large cetacean in the coastal waters around the central and western Aleutian Islands. Acoustic surveys detected the presence of sperm whales year-round in the Gulf of Alaska although they appear to be more common in summer than in winter (Mellinger et al. 2004).

Discovery Mark data from the days of commercial whaling (260 recoveries with location data) show extensive movements from U.S. and Canadian coastal waters into the Gulf of Alaska and Bering Sea (Allen and Angliss 2015, and citations therein). U.S. scientists marked 176 sperm whales during U.S. cruises from 1962-1970, mostly between 32° and 36° N off the California coast. Seven of those marked whales in locations ranging from offshore California, Oregon, and British Columbia waters to the western Gulf of Alaska. A whale marked by Canadian researchers moved from near Vancouver Island, British Columbia to the Aleutian Islands near Adak. A whale marked by Japanese researchers moved from the Bering Sea just north of the Aleutians to waters off Vancouver Island, British Columbia. Based on these data, there appear to be movements along the U.S. West Coast into the Gulf of Alaska and Bering Sea/Aleutian Islands region.

Behavior and life history: Females reach sexual maturity at about age 9 when roughly 9 m long and they give birth about every five years; gestation is 14-16 months (Whitehead 2009). Males are larger during the first 10 years and continue to grow well into their 30s finally reaching physical maturity at about 16 m (ibid). The sperm whale consumes numerous varieties of deep water fish and cephalopods. Sperm whales forage during deep dives that routinely exceed a depth of 400 m and duration of 30 min (Watkins et al. 2002). They are capable of diving to depths of over 2,000 m with durations of over 60 min. Sperm whales spend up to 83 percent of daylight hours underwater. 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 hrs daily) without foraging (Whitehead 2009). An average dive cycle consists of about a 45 min dive with a 9 min surface interval. The average swimming speed is estimated to be 2.5 km/hr.

Acoustics and hearing: As summarized in DON (2008a, and citations therein), Sperm whales typically produce short-duration (less than 30 ms), repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges. When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Whitehead 2009). Codas are shared between individuals of a social unit and are considered to be primarily for intra-group communication. Neonatal clicks are of low directionality, long duration (2 to 12 ms), low frequency (dominant frequencies around 0.5 kHz) with estimated source levels between 140 and 162 dB re 1 μPa-m rms. Source levels from adult sperm whales' highly directional (possible echolocation), short (100 μs) clicks have been estimated up to 236 dB re 1 μPa-m rms. Creaks (rapid sets of clicks) are heard most frequently when sperm whales are engaged in foraging behavior in the deepest portion of their dives with intervals between clicks and source levels being altered during these behaviors. In summary, sperm whales are in the mid-frequency functional hearing group, with an estimated auditory range of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations, including echolocation clicks, range from 100 Hz to 30 kHz (DON 2008a) (Table 4-1).

4.1.7 Baird's Beaked Whale (*Berardius bairdii*) - Alaska Stock

Description: Baird's beaked whales are one of the largest members of the family Ziphiidae. The entire body is dark brown with the ventral side paler with irregular white patches; tooth marks of conspecifics are numerous on the back, particularly on adult males (Kasuya 2009). The body is slender with a small head, low falcate dorsal fin and small flippers that fit into depressions on the body. The melon is small and its front surface is almost vertical with a slender projecting rostrum (ibid). Mean body length of whales 15 years or older are 10.5 m in females and 10.1 m in males.

Status and trends: Baird's beaked whales belong to the Order Cetacea, Suborder Odontoceti, and Family Ziphiidae. Because the distribution of Baird's beaked whale varies and animals probably spend time outside the U.S. EEZ. Unfortunately reliable estimates of abundance for this stock are currently unavailable and as such it is not possible to produce a reliable minimum population estimate or to calculate a PBR for this stock. Also, reliable data on trends in population abundance are unavailable (Allen and Angliss 2015).

The status of Baird's beaked whales in Alaskan waters relative to OSP is not known, and there are insufficient data to evaluate trends in abundance (Allen and Angliss 2015). No habitat issues are known to be of concern for this species, but in recent years, questions have been raised regarding potential effects of human-made sounds, such as shipping noise and military sonar, onbeaked whales. Little is known about effects of noise on beaked whales in Alaska (Allen and Angliss 2015 and citations therein). They are not listed as "threatened" or "endangered" under the Endangered Species Act nor as "depleted" under the MMPA. Baird's beaked whales are not classified as a "strategic" stock under the MMPA. The total fishery mortality and serious injury for this stock is zero and can be considered to be insignificant and approaching zero (Allen and Angliss 2015).

Distribution and habitat preferences: Baird's beaked whale is distributed throughout deep waters and along the continental slopes of the North Pacific Ocean (Kasuya 2009). In the eastern North Pacific the northern limits are Cape Navarin (62° N) in the Bering Sea south to just north of northern Baja California. They have been harvested and studied in Japanese waters, but little is known about this species elsewhere. The range of the species in Alaska extends north from Cape Navarin (62° N) and the central Sea of Okhotsk (57° N) to St. Matthew Island, the Pribilof Islands in the Bering Sea, and the northern Gulf of Alaska (Allen and Angliss 2015, and citations therein). An apparent break in distribution occurs in the eastern Gulf of Alaska, but from the mid-Gulf to the Aleutian Islands and in the southern Bering Sea there are numerous sighting records. In the Bering Sea, Baird's beaked whales arrive in April-May, are numerous during the summer, and decrease in October. During this time they are rarely found in offshore waters and their winter distribution is unknown (Kasuya 2009). They are the most commonly seen beaked whales within their range, perhaps because they are relatively large and gregarious, traveling in schools of a few to several dozen, making them more noticeable to observers than other beaked whale species. Baird's beaked whales are migratory, arriving in continental slope waters during summer and fall months when surface water temperatures are the highest.

Along the U.S. West Coast, Baird's beaked whales have been seen primarily along the continental slope from late spring to early fall. They have been seen less frequently and are presumed to be farther offshore during the colder water months of November through April (Carretta et al. 2011). Baird's beaked whale probably is a slope-associated species. As a result, the area of highest utilization for this whale in the eastern North Pacific is in waters deeper than 500 m. The area of lower utilization is between 200 m to 500 m water depth. There is a rare occurrence in waters shallower than 200 m.

Behavior and life history: Baird's beaked whales occur in relatively large groups of 6 to 30, and groups of 50 or more sometimes are seen (Kasuya 2009). Sexual maturity occurs at about 8 to 10 years, and the calving peak is in March and April (Kasuya 2009). Mating generally occurs in October and November but little else is known of their reproductive behavior (Kasuya 2009). They feed mainly on benthic fish and cephalopods, but prey also includes pelagic fish such as mackerel, sardine, and saury (Walker et al. 2002). Baird's beaked whales in Japan prey primarily on deepwater gadiform fishes and cephalopods, indicating that they feed primarily at depths ranging from 800 to 1,200 m (Walker et al. 2002). Baird et al. (2006) reported on the diving behavior of four Blaineville's beaked whales (a similar species) off the west coast of Hawaii. The four beaked whales foraged in deep ocean areas with a maximum dive to 1,407 m. Dives ranged from at least 13 min to a maximum of 68 min (Baird et al. 2006).

Acoustics and hearing: DON (2008b) reviewed the literature on beaked whale acoustics and reported that beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. Both whistles and clicks have been recorded from Baird's beaked whales in the eastern North Pacific Ocean. Whistles had fundamental frequencies between 4 and 8 kHz, with two to three strong harmonics within the recording bandwidth. Pulsed sounds (clicks) had a dominant frequency around 23 kHz, with a second frequency peak around 42 kHz. Baird's beaked whales are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). There is no information on the hearing abilities of Baird's beaked whale.

4.1.8 Cuvier's Beaked Whale (*Ziphius cavirostris*) - Alaska Stock

Description: Cuvier's beak whale resembles other beaked whales in that it has a robust, cigar-shaped body with a smallish falcate dorsal fin set about two thirds back; the small flippers fit into a slight depression as with other beaked whales (Heyning and Mead 2009). The head is blunt with a small poorly defined rostrum that grades into a generally sloping melon region (Heyning and Mead 2009). Minimum length at sexual maturity is 5.3 m for females and 5.3 m for males.

Status and trends: Cuvier's beaked whales belong to the Order Cetacea, Suborder Odontoceti, and Family Ziphiidae. Reliable estimates of abundance for this stock in Alaska are currently unavailable and as such it is not possible to produce a reliable minimum population estimate or to calculate a PBR. Also, reliable data on trends in population abundance are unavailable (Allen and Angliss 2015). Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Cuvier's beaked whale is not classified as strategic. Cuvier's beaked whales are not listed as depleted under the MMPA or listed as threatened or endangered under the ESA. (Allen and Angliss 2015).

Distribution and habitat preferences: Cuvier's beaked whale is distributed in all oceans and seas except the high polar regions. In the North Pacific they range as far north as the Gulf of Alaska, Aleutian Islands, and Commander Islands. Cuvier's beaked whale generally is sighted in waters >200 m deep, and is frequently recorded at depths >1,000 m. They are commonly sighted around seamounts, escarpments, and canyons (Heyning and Mead 2009). In Hawaii, Cuvier's beaked whales showed a high degree of site fidelity in a study spanning 21 years and showed that there was a offshore population and an island associated population (McSweeney et al. 2007). The site fidelity in the island associated population was hypothesized to take advantage of the influence of islands on oceanographic conditions that may increase productivity (McSweeney et al. 2007). Waters deeper than 1,000 m are the area of highest utilization for the Cuvier's beaked whale in the Northeast Pacific with water depths between 500 m and 1,000 m are less utilized. Occurrence in waters shallower than 500 m is rare (DON 2008b).

Behavior and life history: Little is known of the feeding preferences of Cuvier's beaked whale. They may be mid-water and bottom feeders on cephalopods and, rarely, fish. There is little information on beaked whale reproductive behavior. Recent studies by Baird et al. (2006) show that Cuvier's beaked whales dive deeply (maximum of 1,450 m) and for long periods (maximum dive duration of 68.7 min) but also spent time at shallow depths. Tyack et al. (2006) has also reported deep diving for Cuvier's beaked whales with mean depth of 1,070 m and mean duration of 58 min.

Acoustics and hearing: DON (2008b) reviewed the literature on beaked whale acoustics and reported that beaked whales use frequencies of between 300 Hz and 129 kHz for echolocation, and between 2 and 10 kHz, and possibly up to 16 kHz, for social communication. Cuvier's beaked whale echolocation clicks were recorded at frequencies from 20 to 70 kHz. There is no information on the hearing abilities of Cuvier's beaked whale. Cuvier's beaked whales are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations ranges are similar at 300 Hz to 135 kHz (DON 2008a) (Table 4-1).

4.1.9 Stejneger's Beaked Whale (*Mesoplodon stejnegeri*) - Alaska Stock

Description: At least six species in this genus have been recorded off the U.S. West Coast, but due to the rarity of records and the difficulty in identifying these animals in the field, virtually no species-specific information is available (Carretta et al. 2011). Of the six species known to occur in the North Pacific Ocean only one occurs in Alaska, Stejneger's beaked whale (M. stejnegeri) (also known as the Bering Sea beaked whale and saber-toothed beaked whale). Insufficient sighting records exist to determine any possible spatial or seasonal patterns in the distribution of these beaked whales. Although they are fairly common in some parts of the ocean, because of their shyness around vessels and unobtrusive behavior, they are rarely observed (Pitman 2009). They have a single tooth in the front to the middle of the jaw. They are relatively small whales with an average length of about 5.7 m (Pitman 2009). The body is spindle shaped with a small, usually triangular dorsal fin located approximately two-thirds of the way back on the body. The flippers are small and narrow and fit into pigmented depressions in the body.

Status and trends: Mesoplodont beaked whales belong to the Order Cetacea, Suborder Odontoceti, and Family Ziphiidae. The Alaska stock of Stejneger's beaked whales is considered separate from *Mesoplodon* spp. off California, Oregon, and Washington. Reliable estimates of abundance for this stock are currently unavailable, so it is not possible to produce a reliable minimum population estimate or to calculate a PBR. Also, reliable data on trends in population abundance are unavailable (Allen and Angliss 2015). There were zero serious injuries or mortalities of Stejneger's beaked whales incidental to observed commercial fisheries reported from 2007 to 2011. Because the PBR is unknown, the level of annual U.S. commercial fishery-related mortality that can be considered insignificant and approaching zero mortality and serious injury rate is unknown. However, the estimated annual rate of human-caused mortality and serious injury seems minimal for this stock. Thus, the Alaska stock of Stejneger's beaked whale is not classified as strategic. Stejneger's beaked whales are not listed as depleted under the MMPA or listed as threatened or endangered under the ESA (Allen and Angliss 2015).

Distribution and habitat preferences: *Mesoplodon* beaked whales are distributed throughout deep waters and along the continental slopes of the North Pacific Ocean. World-wide, beaked whales normally inhabit continental slope and oceanic waters that are deeper than 200 m (Pitman 2009). Occurrence often has been linked to the continental slope, canyons, escarpments, and oceanic islands (MacLeod and D'Amico 2006). As summarized in Allen and Angliss (2015, and citations therein), the range of Stejneger's beaked whale extends along the coast of North America from Cardiff, California, north through the Gulf of Alaska to the Aleutian Islands, into the Bering Sea to the Pribilof Islands and Commander Islands, and, off Asia, south to Akita Beach on Noto Peninsula, Honshu, in the Sea of Japan. Near the central Aleutian Islands, groups of 3-15 Stejneger's beaked whales have been sighted on a number of occasions. The species is not known to enter the Arctic Ocean and is the only species of *Mesoplodon* known to occur in Alaska waters. The distribution of *M. stejnegeri* in the North Pacific corresponds closely, in occupying the same cold-temperate niche and position, to that of *M. bidens* in the North Atlantic. It lies principally between 50° and 60° N and extends only to about 45° N in the eastern Pacific, but to about 40° N in the western Pacific.

Behavior and life history: Little is known of Stejneger's beaked whale behavior but perhaps it can be generalized from that of other Mesoplodont beaked whales. They occur alone or in groups of up to 15, and probably calve in the summer. They may be both a mid-water and bottom feeder on squid and fish (Pitman 2009). Analysis of stomach contents from captured and stranded individuals suggests that beaked whales are deep-diving animals, feeding by suction (Heyning and Mead 1996). Baird et al. (2006) reported on the diving behavior of four Blaineville's beaked whales (M. densirostris) off the west coast of Hawaii. The four beaked whales foraged in deep ocean areas (690-3,000 m) with a maximum dive to 1,408 m. Dives ranged from at least 13 min to a maximum of 68 min (Baird et al. 2006).

Acoustics and hearing: *Mesoplodon* spp. beaked whales are in the mid-frequency functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al. 2007). Vocalizations ranges are similar at 300 Hz to 135 kHz (DON 2008a) (Table 4-1).

4.1.10 Gray Whale (*Eschrichtius robustus*) - Eastern North Pacific and Western North Pacific Stocks

Description: The gray whale is a robust, slow-moving whale recognized by a mottled gray color with numerous light patches scattered along the body and lack of a dorsal fin (Jones and Swartz 2002). They have more external parasites and epizoites than any other cetacean (Jones and Swartz 2009). Instead of a dorsal fin, they have a low hump, followed by a series of 10 or 12 knobs along the dorsal ridge of the tail, which are easily seen when the animal arches to dive. The baleen is short (5-40 cm), thick, and coarse and is cream-white to yellow. The upper jaw has 130-180 baleen plates (Jones and Swartz 2009). Adults are 10-15 m long and weigh between 16 and 45 tons. At birth, the calves are 5 m long and weigh close to 450 kg. Both male and female gray whales reach sexual maturity when they are between five and 11 years old, with the average being eight years (Rice 1986).

Status and trends: Gray whales belong to the Order Cetacea, Suborder Mysticeti, and Family Eschrichtius. There are two populations, the Western North Pacific (WNP) population that migrates along Asia and into the Okhotsk Sea, and the Eastern North Pacific (ENP) population which migrates along the coasts of eastern Siberia, North America, and Mexico. On June 16, 1994, the Eastern North Pacific gray whale population was formally removed from the List of Endangered and Threatened Wildlife, as it was no longer considered "endangered" or "threatened" under the ESA. The stock is stable or increasing. The most recent abundance estimates are based on counts made during the 2007/2008, 2009/2010, and 2010/2011 southbound migrations. The most recent estimate of abundance, from the 2010/2011 southbound survey is 20,990 whales, with a minimum population estimate of 20,125; the calculated PBR for this stock is 624 gray whales (Carretta et al. 2015a).

The total estimated annual level of human-caused mortality and serious injury for ENP gray whales, 2008-2012, was 133 and includes Russian harvest (127), mortality from commercial fisheries (4.45), and ship strikes (2.0) Since this level does not exceed the PBR (624), the ENP stock of gray whales is not classified as a "strategic" stock. Levels of human-caused mortality and serious injury resulting from commercial fisheries and ship strikes for ENP whales represent minimum estimates as recorded by stranding networks or at-sea sightings (Carretta et al. 2015a).

The presence of individuals from the WNP stock of gray whales in the AFSC research areas is considered extralimital. During summer and fall, the WNP stock feeds in the Okhotsk Sea, Russia. Historically, wintering areas included waters off Korea, Japan, and China. Recent tagging, photo-identification, and genetics studies revealed that some WNP gray whales migrate to the eastern North Pacific (ENP) in winter, including waters off Canada, the U.S., and Mexico (Lang et al. 2011, Mate et al. 2011, Weller et al. 2012, Urbán et al. 2013). Combined, these studies include 27 individual WNP gray whales in the ENP

(Carretta et al. 2015a). 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).

The WNP stock is listed as endangered under the ESA, as well as depleted and strategic under the MMPA. Based on photo-identification studies off Sakhalin Island, Russia, estimated abundance is 140, with a minimum estimate of 135 WNP gray whales off Sakhalin (Carretta et al. 2015a and citations therein). The calculated PBR of 0.06 WNP gray whales per year includes multipliers that account for an estimated proportion of the population that uses the U.S. EEZ (0.575) and the proportion of the year those whales are in the U.S. EEZ (3 months, or 0.25 years) (Carretta et al. 2015a).

Distribution and habitat preferences: The gray whale migration covers 8,000 - 10,000 km each way (Rugh et al. 1999), perhaps the longest migration of any mammalian species. Most ENP gray whales spend the summer in the shallow waters of the northern and western Bering Sea and in the adjacent waters of the Arctic Ocean; however some remain throughout the summer and fall along the Pacific coast as far south as southern California. These whales are designated as the Pacific Coast Feeding Aggregation and have been shown by photo-identification studies to 1) move widely within and between areas on the Pacific coast to feed in the summer and fall, 2) are not always observed in the same area each year, and 3) may have several year gaps between resightings in studied areas (Quan 2000). Gray whales are by far the most coastal of all the great whales, and inhabit primarily inshore or shallow, offshore continental shelf waters of the North Pacific. They tend to be nomadic, highly migratory, and tolerant of climate extremes (Jones and Swartz 2009).

Behavior and life history: Female gray whales usually breed once every two years. The breeding season is limited primarily to a three-week period in late November and early December near the start of the southward migrations. However, if no conception occurs at that time, a second estrus cycle can occur within 40 days (Rice and Wolman 1971), such that a few females may breed as late as the end of January on the winter grounds (Jones and Swartz 2009). Gray whale calves are born in the winter after a gestation period of about 13.5 months. Killer whale predation may be the most significant cause of mortality (ibid). Gray whales are the most coastal of all the large whales and inhabit primarily inshore or shallow, offshore continental shelf waters (Jones and Swartz 2009). Gray whales are suction-feeders and prey primarily on benthic amphipods, decapods, and other invertebrate species.

Acoustics and hearing: As summarized in Jones and Swartz (2009) and DON (2008b, and references therein), gray whales produce broadband signals ranging from 100 Hz to 4 kHz (and up to 12 kHz). The most common sounds on the breeding and feeding grounds are knocks which are broadband pulses from about 100 Hz to 2 kHz and most energy at 327 to 825 Hz (Richardson et al. 1995). The source level for knocks is approximately 142 dB re 1 μPa-m. During migration, individuals most often produce low-frequency moans. The structure of the gray whale ear is evolved for low-frequency hearing. Gray whale responses to noise include changes in swimming speed and direction to move away from the sound source; abrupt behavioral changes from feeding to avoidance, with a resumption of feeding after exposure; changes in calling rates and call structure; and changes in surface behavior, usually from traveling to milling.

4.1.11 Humpback Whale (*Megaptera novaeangliae*) - Western North Pacific and Central North Pacific Stocks

Description: As summarized by Clapham (2009, and citations therein), humpback whales are large baleen whales with females slightly larger than males. Adult lengths are 16-17 m and calves are about 4 m. Humpback whales are easily recognized at close range by their extremely long flippers, which may me one-third the length of the body. The flippers are white on the bottom and may be white or black on top, depending on the population. The body is black on top with variable coloration ventrally and on the sides. The head and jaws have numerous knobs which are diagnostic for the species. The dorsal fin is small and variable in shape. The underside of the tail exhibits a pattern of white to black that is individually identifiable. The baleen is primarily black and occurs in 270-400 plates on each side of the mouth.

Status and trends: The humpback whale belongs to the Order Cetacea, Suborder Mysticeti, and Family Balaenopteridae. No subspecies are recognized. The species is listed as endangered throughout its range. Critical habitat has not been designated for humpback whales in the North Pacific. Three relatively distinct stocks migrate between their summer/fall feeding areas and winter/spring calving and mating areas: 1) the California/Oregon/Washington and Mexico stock, consisting of winter/spring populations in coastal Central America and coastal Mexico which migrate to the coast of California to southern British Columbia in summer/fall; 2) the Central North Pacific stock, consisting of winter/spring populations of the Hawaiian Islands which migrate primarily to northern British Columbia/Southeast Alaska, the Gulf of Alaska, and the Bering Sea/Aleutian Islands; and 3) the Western North Pacific stock, consisting of winter/spring populations off Asia which migrate primarily to Russia and the Bering Sea/Aleutian Islands. Humpback whales from the Western and Central North Pacific stocks mix to a limited extent on summer feeding grounds ranging from British Columbia through the central Gulf of Alaska and up to the Bering Sea (Allen and Angliss 2015, and citations therein).

Humpback whales are listed as endangered under the ESA and designated as depleted under the MMPA (Allen 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 distinct population segments (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).

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 Gulf of Alaska combined ranged from 6,000 to 19,000 or 2,889 to 13,594 whales for the Aleutian Islands and Bering Sea and 2,845 to 5,122 whales for the Gulf of Alaska (Allen and Angliss 2015). Due to range overlap, these estimates likely include whales from both the Western and Central North Pacific stocks.

<u>Western North Pacific Stock:</u> 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 level 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 mortality and serious injury 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 (0.4) exceeds 10 percent of PBR and cannot be considered insignificant and approaching a zero mortality rate (Muto and Angliss 2015). The Western North Pacific stock of humpback whales is classified as a strategic stock. The status of this stock relative to its OSP size is currently unknown (Muto and Angliss 2015).

Central North Pacific Stock: The winter distribution of the Central North Pacific stock is primarily in the Hawaiian archipelago. In recent studies sampling occurred on Kauai, Oahu, Penguin Bank (off the southwest tip of the island of Molokai), Maui and the island of Hawaii (the Big Island). Interchange within Hawaii was extensive. Although most of the Hawaii identifications came from the Maui sub-area, identifications from the island of Hawaii and Kauai at the eastern and western end of the region showed a high rate of interchange with Maui. In summer the majority of whales from the Central North Pacific stock are found in the Aleutian Islands, Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia.

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 Gulf of Alaska, 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 mortality and serious injury 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 mortality and serious injury rate (Muto and Angliss 2015). Since this stock is listed as endangered under the ESA and depleted under the MMPA, it is classified as a strategic stock (Muto and Angliss 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). North Pacific humpback whales are distributed primarily in four more-or-less distinct wintering areas: the Ryukyu and Ogasawara (Bonin) Islands (south of Japan), the Hawaiian Islands, the Revillagigedo Islands off Mexico, and along the coast of mainland Mexico (Calambokidis et al. 2008). There is known to be some interchange of whales among different wintering grounds, and matches between Hawaii and Japan and Hawaii and Mexico have been found (Calambokidis et al. 2008). However, it appears that the overlap is relatively small between the Western North Pacific humpback whale population and Central North Pacific and Eastern North Pacific populations (Calambokidis et al. 2008). 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 Aleutian Islands, Kamchatka Peninsula, and the Bering and Chukchi seas. The U.S./Canada border is an approximate geographic boundary between the California and Alaska feeding groups (Carretta et al. 2011). There is much interchange of whales among different feeding grounds, although some site fidelity occurs.

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 2015). 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. 2013a). 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).

During the winter, humpbacks generally migrate to the tropics and subtropics where they can be found around islands, over shallow banks, and along continental coasts, where calving and breeding occur. Humpbacks have one of the longest migrations known for any mammal with individuals traveling nearly 4,320 nm (8,000 km) between feeding and breeding areas (Clapham 2009). Most humpback whale sightings are in nearshore and continental shelf waters; however, humpback whales frequently travel through deep water during migrations such as the route to and from the Hawaiian Islands. 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 likely feed independently after 6 months (Clapham 2009). As summarized in Clapham (2009, and citations therein) and DON (2008b, and citations therein), humpback whale dives in summer last less than five min; those exceeding 10 min are atypical. In winter (December through March), dives average 10 to 15 min. Although humpback whales have been recorded to dive as deep as about 500 m, on the feeding grounds they spend the majority of their time in the upper 122 m of the water column. On the wintering grounds they dive deeper to 176 m or greater. Like other large mysticetes, they are a "lunge feeder" taking advantage of dense prey patches and engulfing as much food as possible in a single gulp. They also blow nets, or curtains, of bubbles around or below prey patches to concentrate the prey in one area, then lunge with mouths open through the middle. Humpback whales feed on euphausiids and various schooling fishes, including herring, capelin, sand lance, and mackerel (Clapham 2009).

Acoustics and hearing: Humpback whales are known to produce three classes of vocalizations: (1) "songs" in the late fall, winter, and spring by solitary males; (2) sounds made within groups on the wintering (calving) grounds; and (3) social sounds made on the feeding grounds (Richardson et al. 1995). The main energy of humpback whale songs lies between 0.2 and 3.0 kHz, with frequency peaks at 4.7 kHz. Feeding calls, unlike song and social sounds, are highly stereotyped series of narrow-band trumpeting calls. They are 20 Hz to 2 kHz, less than 1 sec in duration, and have source levels of 175 to 192 dB re 1 μPa-m. The fundamental frequency of feeding calls is approximately 500 Hz (summarized in DON 2008b, and citations therein). Thus, humpback whales are in the low-frequency functional hearing group, with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Their vocal repertoire ranges from 20 Hz to greater than 10 kHz (DON 2008a) (Table 4-1).

4.1.12 Blue Whale (*Balaenoptera musculus*) - Eastern North Pacific Stock

Description: The blue whale is the largest animal to have ever existed on earth and is found world-wide ranging into all oceans. The largest recorded blue whale from the northern hemisphere was a 28.1 m female; females tend to be larger than males, and southern hemisphere blue whales are larger than those in the north (Sears and Perrin 2009). They have a tapered, elongated shape with a huge broad, relatively flat, U-shaped head. The baleen is black (ibid). The dorsal fin is proportionately smaller than in other baleen whales and varied in shape, ranging from a small nubbin to triangular and falcate positioned far back on the body (Ibid). Underwater they are slate blue; above water they appear mottled light and dark shades of gray.

Status and trends: The blue whale belongs to the Order Cetacea, Suborder Mysticeti, and Family Balaenopteridae. The International Whaling Commission (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 Gulf of Alaska 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 Gulf of Alaska (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 Gulf of Alaska and the south side of the Aleutian Islands (Rankin et al. 2006). **S**ightings 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 Gulf of Alaska 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 Gulf of Alaska (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 mortality and serious injury 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 mortality and serious injury 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. They undertake seasonal migrations and were historically hunted on their summer, feeding areas. It is assumed that blue whale distribution is governed largely by food requirements and that populations are seasonally migratory. Pole-ward movements in spring allow the whales to take advantage of high zooplankton production in summer. Movement toward the subtropics in the fall allows blue whales to reduce their energy expenditure while fasting and to avoid ice entrapment. In Alaska, blue whales occur in the Gulf of Alaska during fall and winter months. The Eastern North Pacific Stock of blue whales includes animals found in the eastern North Pacific from the northern Gulf of Alaska to the eastern tropical Pacific (Carretta et al. 2011). This definition is consistent with both the distribution of the northeastern call type and with the known range of photographically identified individuals. Based on locations where the northeastern call type has been recorded, some individuals in this stock may range as far west as Wake Island and as far south as the Equator. The U.S. West Coast is certainly one of the most important feeding areas in summer and fall, but, increasingly, blue whales from this stock have been found feeding to the north and south of this area during summer and fall. 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. Given that these migratory destinations are areas of high productivity and given the observations of feeding.

Behavior and life history: Blue whales reach sexual maturity at 5-15 years of age; length at sexual maturity in the Northern Hemisphere for females is 21-23 m and for males it is 20-21 m (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 (ibid). Blue whales occur primarily in offshore deep waters (but sometimes near shore, e.g. the deep waters in Monterey Canyon, CA) 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 min when foraging and to 68 m and for 4.9 min when not foraging. Data from southern California and Mexico showed that whales dove to > 100 m for foraging. Calambokidis et al. (2003) deployed tags on blue whales and collected data on dives as deep as about 300 m.

Acoustics and hearing: Blue whales, along with other mysticetes, are in the low-frequency functional hearing group, with an estimated auditory range of 7 Hz to 22 kHz (Southall et al. 2007). Their vocalizations range from 12 Hz to 400 Hz, with a dominant range of 12-25 Hz (DON 2008a) (Table 4-1).

4.1.13 Fin Whale (*Balaenoptera physalus*) - Northeast Pacific Stock

*Descriptio*n: Fin whales are sexually dimorphic with females about 10-15 percent longer than males; in the Northern Hemisphere female length is about 22.5 m and for males 21 m (Aguilar 2009). Fin whales are a slender with a narrow rostrum, a falcate fin located at 75 percent of total length; it is higher than the blue whale but lower than the sei whale (ibid). The ventral grooves are numerous and extend from the chin to the umbilicus. The pigmentation of the head region is strikingly asymmetrical whereas the left side, dorsal and ventral, is dark slate and the right side dorsal is light gray and the right ventral is white (ibid). The pigmentation also is shown in the baleen plates which are gray and yellowish.

Status and trends: The fin whale belongs to the Order Cetacea, Suborder Mysticeti, and Family Balaenopteridae. For management purposes, three stocks of fin whales are currently recognized in U.S. waters: 1) Alaska (Northeast Pacific), 2) California/Washington/Oregon, and 3) Hawaii. 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, of a mean annual mortality of 0.4 whales. Total estimated annual human-caused mortality and serious injury for this stock is 0.6 fin whales (Muto and Angliss 2015).

Fin whales in the entire North Pacific were estimated to be at less than 38 percent (16,625 out of 43,500) of historic carrying capacity (Mizroch et al. 1984). The initial abundance has never been estimated separately for the "West Coast" stock, but this stock was also probably depleted by whaling. Approximately 47,000 fin whales were taken from the North Pacific by commercial whalers between 1947 and 1987. Approximately 5,000 fin whales were taken from the west coast of North America from 1919 to 1965. Fin whales in the North Pacific were given protected status by the IWC in 1976. Fin whales are formally listed as "endangered" under the ESA, and consequently the Alaska (Northeast Pacific) stock is automatically considered as a "depleted" and "strategic" stock under the MMPA.

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 Gulf of Alaska 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. 2013a, 2013b). 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. Reproductive occurs primarily in the winter. Gestation lasts about 11 months and nursing occurs for 6 to 11 months (Aguilar 2009). Fin whales typically dive for 5 to 15 min, separated by sequences of 4 to 5 blows at 10 to 20 sec intervals. Goldbogen et al. (2006) reported that fin whales in California made foraging dives to a maximum of 228-271 m and dive durations of 6.2-7.0 min. Fin whale dives likely coincide with the diel migration of krill. Fin whales feed on planktonic crustaceans, including *Thysanoessa* sp. and *Calanus* sp., as well as schooling fish including herring, capelin, and mackerel (Aguilar 2009).

Acoustics and hearing: Fin whales are in the low-frequency functional hearing group, with an estimated auditory range of 7 Hz to 22 kHz (Southall et al. 2007). They also vocalize at low frequencies of 15-30 Hz (DON 2008a) (Table 4-1).

4.1.14 Sei Whale (*Balaenoptera borealis*) - Eastern North Pacific Stock

Description: The sei whale is a typical sleek rorqual and is the third largest whale (behind blue and fin) reaching a maximum length of about 20 m and weighing 20 tons; the dorsal fin is larger than that of the blue and fin but all three species may be confused at sea (Horwood 2009). There is a single prominent ridge on the rostrum and a slightly arched rostrum with a downturned tip. They are dark gray dorsally and on the ventral surfaces of the flukes and flippers (ibid). There is no whitening of the lower lip as in fin whales and the baleen is dark gray, often with a yellowish-blue hue; but some white baleen may occur in some individuals (ibid).

Status and trends: The sei whale belongs to the Order Cetacea, Suborder Mysticeti, and Family Balaenopteridae. The Eastern North Pacific stock of sei whales is not often encountered in Alaskan waters but does occur infrequently in the Bering Sea and Gulf of Alaska in summer (NMML data archives). 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.

Previously, sei whales were estimated to have been reduced to 20 percent (8,600 out of 42,000) of their pre-whaling abundance in the North Pacific. The initial abundance has never been reported separately for the eastern North Pacific stock, but this stock was also probably depleted by whaling. The reported take of North Pacific sei whales by commercial whalers totaled 61,500 between 1947 and 1987. Of these, at least 410 were taken by-shore-based whaling stations in central California between 1919 and 1965. There has been an IWC prohibition on taking sei whales since 1976, and commercial whaling in the U.S. has been prohibited since 1972. Sei whales are formally listed as "endangered" under the ESA, and consequently the eastern North Pacific stock is automatically considered as a "depleted" and "strategic" stock under the MMPA.

Distribution and habitat preferences: As summarized in Horwood (2009) and DON (2008a,b), sei whales have a worldwide distribution but are found primarily in cold temperate to subpolar latitudes rather than in the tropics or near the poles (Horwood 2009). Sei whales spend the summer months feeding in subpolar higher latitudes and return to lower latitudes to calve in the winter. There is some evidence from whaling catch data of differential migration patterns by reproductive class, with females arriving at and departing from feeding areas earlier than males. For the most part, the location of winter breeding areas is unknown.

Behavior and life history: Sei whales mature at about 10 years for both sexes. They are most often found in deep, oceanic waters of the cool temperate zone. 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). In the North Pacific, sei whales feed along the cold eastern currents (Perry et al. 1999). 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.

Acoustics and hearing: Sei whales are in the low-frequency hearing group, along with other baleen whales, with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). There are few recordings of sei whale vocalizations in the North Pacific, where the sweep frequency ranged from 1.5 to 3.5 kHz (DON 2008a) (Table 4-1).

4.1.15 Minke Whale (*Balaenoptera acutorostrata scammoni*) - Alaska Stock

Description: As summarized by Perrin and Brownell (2009, and citations therein), the North Pacific minke whale is the second smallest baleen whale with females somewhat larger than males. Females have been measured at 8.5 m and males at 7.9 m and weigh about 10 tons. The body is dark gray to brownish dorsally and white to cream ventrally; the flipper has a white chevron that is diagnostic. The baleen is white and short and numbers between 230-360 plates; the dorsal fin is relatively tall and falcate and located forward on the posterior one-third of the body. The rostrum is very narrow and pointed (thus the species name *acutorostrata*).

Status and trends: The common minke whale belongs to the Order Cetacea, Suborder Mysticeti, and Family Balaenopteridae. They are widely distributed in all oceans with three recognized subspecies, one in the North Atlantic (*B. a. acutorostrata*), one in the southern hemisphere (*B. a. bonaerensis*), and one in the North Pacific (*B. a. scammoni*). There is presently discussion among taxonomists as to whether the southern hemisphere subspecies is a separate species (Perrin and Brownell 2009). The two stocks of North Pacific minke whales recognized in U.S. waters are the Alaska stock and the California/Washington/Oregon stock (Allen and Angliss 2015).

No abundance estimates exist for minke whales in the entire North Pacific, although some information is available on the numbers of minke whales in some areas off Alaska. Visual surveys for cetaceans conducted on the eastern Bering Sea shelf in 2002, 2008, and 2010, in cooperation with commercial fisheries' research, provide provisional abundance estimates of 389 (CV = 0.52), 517 (CV = 0.69), and 2,020 (CV = 0.73) minke whales on the eastern Bering Sea shelf, respectively (Friday et al. 2013). These estimates are considered provisional because they have not been corrected for animals missed on the trackline, animals submerged when the ship passed, or responsive movement. Line-transect surveys were also conducted in shelf and nearshore waters (within 30-45 nm of land) in 2001-2003 from the Kenai Fjords in the Gulf of Alaska to the central Aleutian Islands, where minke whale abundance was estimated to be 1,233 (CV = 0.34) (Zerbini et al. 2006). This estimate has also not been corrected for animals missed on the trackline. Most of the sightings were in the Aleutian Islands, not in the Gulf of Alaska. These estimates cannot be used as an estimate of the entire Alaska stock of minke whales since only a portion of the stock's range was surveyed (Muto and Angliss 2015). There are insufficient data to estimate minimum population or PBR for this stock (Muto and Angliss 2015). No mortalities or serious injuries due to interactions with U.S. commercial fisheries were reported for this stock from 2009 to 2013. The total mean annual mortality due to human-related causes based on stranding data is zero for this five-year period. Minke whales are not designated as "depleted" or "strategic" under the MMPA or listed as "threatened" or "endangered" under the ESA (Muto and Angliss 2015).

Distribution and habitat preferences: Minke whales are common and the most numerous baleen whales found throughout the world. In the Northeast Pacific Ocean, minke whales range from the Chukchi Sea south to Baja California (Perrin and Brownell 2009). The minke whale generally occupies waters over the continental shelf, including inshore bays and estuaries (ibid). However, based on whaling catches and surveys worldwide, there is also a deep-ocean component to the minke whale's distribution. Minke whales are relatively common in the Bering and Chukchi seas and in the inshore waters of the Gulf of Alaska, but are not considered abundant elsewhere in the eastern Pacific (Leatherwood et al. 1982, Friday et al. 2012, Clarke et al. 2013b). Minke whales occur throughout the Bering Sea, but most sightings of minke whales in the central-eastern Bering Sea occurred along the upper slope in waters 100-200 m deep (Moore et al. 2002); sightings in the southeastern Bering Sea occurred along the north side of the Alaska Peninsula and were associated with the 100 m contour near the Pribilof Islands (Moore et al. 2002). Friday et al. (2013) found minke whales scattered throughout the eastern Bering Sea shelf in all oceanographic domains (coastal, middle shelf, and outer shelf/slope) in 2002 and 2008, but concentrated on the outer shelf and slope in 2010. Recent visual and acoustic data found minke whales in the Chukchi Sea north of Bering Strait in July and August (Clarke et al. 2013a, 2013b), and minke whale "boing" sounds have been detected in the northeast Chukchi Sea in August, October, and November (Delarue et al. 2013).

Behavior and life history: Little is known of the natural history of minke whales. They are assumed to breed in winter in warm waters of low latitudes, give birth to a single calve every other year, and reach sexual maturity when 7-9 m long (Osborne et al. 1988, Perrin and Brownell 2009). Minke whales in the

North Pacific typically prey on euphausiids, Japanese anchovy, Pacific saury, walleye pollock, small fish, and squid (Perrin and Brownell 2009). There are no data on dive depth for minke whales. General surfacing pattern of minke whales consisting of about four surfacing interspersed by short-duration dives averaging 38 sec have been recorded. After the fourth surfacing, there was a longer duration dive ranging from approximately 2 to 6 min. Minke whales are lunge-feeding "gulpers," like most other rorquals. (DON 2008b). Minke whales are predated upon by killer whales.

Acoustics and hearing: Minke whales are in the low-frequency functional hearing group with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Vocalizations range from 60 Hz to 20 kHz (DON 2008a) (Table 4-1).

4.1.16 North Pacific Right Whale (*Eubalaena japonica*) - Eastern North Pacific Stock

Description: Right whales are extremely robust, bordering on rotund, with a thick blubber layer and the girth at times exceeding 60 percent of total body length (Kenney 2009, and citations therein). The head is relatively large comprising one fourth to one third of the total body length (ibid). The upper jaw is arched and the margin or the lower lip forms a pronounced curve; there are 200-270 baleen plates on each side. The body is mostly black, sometime with irregular white ventral patches; there is no dorsal fin and the large pectoral fins retains a five digits, are broad, large, and blunt (ibid). The flukes are broad (up to 40 percent body length), deeply notched, and black on both surfaces. North Pacific right whales are up to 18 m in length and 100 metric tons, larger than the two other right whale species (Atlantic *E. glacialis* and southern *E. australis*).

Status and trends: North Pacific right whales belong to the Order Cetacea, Suborder Mysticeti, and Family Balaenidae. 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 Gulf of Alaska 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 Gulf of Alaska 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 for the year 2008 (Allen 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 mortality and serious injury is considered to be insignificant and approaching a zero mortality and serious injury rate (Muto and Angliss 2015).The right whale is listed as endangered under the ESA, and therefore designated as depleted and strategic under the MMPA. 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 Gulf of Alaska, 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). Recently reported telemetry data indicates that Critical Habitat designated by the NMFS encompasses the main feeding range of North Pacific right whales in the Bering Sea (Zerbini et al. 2015). 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. 2000, 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 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 Gulf of Alaska 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). 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). Satellite telemetry studies in 2008 and 2009 show tagged whales remained within the Bering Sea critical habitat corroborating the importance of this region to right whales during the feeding season (Clapham et al. 2012, 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. Long-term acoustic recorders across the Bering Sea shelf further elucidate this site fidelity within the northeastern portion of the critical habitat, with seasonal presence extending from July through January (Clapham et al. 2012).

Behavior and life history: Breeding, mating, and calving of North Atlantic and Southern Hemisphere right whales occurs 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 grounds for the eastern North Pacific population is unknown. Right whales are observed to frequently perform highly energetic behaviors at or above the surface including breaching, and lobtailing (Kenney 2009). 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 (ibid).

There is almost nothing known of North Pacific right whale diving abilities. Dives of 5 to 15 minutes or even longer have been reported for North Atlantic right whales. Observations of North Atlantic right whales found that the average depth dive was strongly correlated with both the average depth of peak copepod abundance and the average depth of the bottom mixed layer’s upper surface. North Atlantic right whale feeding dives are characterized by a rapid descent from the surface to a particular depth between 80 and 175 m, remarkable fidelity to that depth for 5 to 14 min, and then rapid ascent back to the surface (DON 2009). Longer surface intervals have been observed for reproductively active females and their calves.

Acoustics and hearing: North Pacific right whale calls are classified into five categories: (1) up, (2) down-up, (3) down, (4) constant, and (5) unclassified. The "up" call is the predominant type and is typically a signal sweeping from about 90 to 150 Hz in 0.7 sec. Right whales commonly produce calls in a series of 10 to 15 calls lasting 5 to 10 min, followed by silence lasting an hour or more. Some individuals do not call for periods of at least 4 hours. Morphometric analyses of the inner ear of right whales resulted in an estimated hearing frequency range of approximately 0.01 to 22 kHz (DON 2009). These whales are in the low-frequency functional hearing group with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007).

4.1.17 Bowhead Whale (*Balaena mysticetus*) - Western Arctic Stock

Description: These whales are readily identified by their large size, rotund shape, lack of a dorsal fin, dark color, white chins, triangular head, and neck (Rugh and Shelden 2009). They are predominately black but have white patterns on their chins, undersides, around the tail stock, and on their flukes, all of which can be used for individual identification (ibid). These patterns distinguish them from North Pacific right whales which are similar in appearance. These are large whales weighing up to 75-100 tons; males grow to 14-17 m in length and females 16-18 m, perhaps as long as 20 m; calves are about 4 m long at birth (ibid). The head constitutes over a third of the bulk of the body and baleen may reach lengths of 4 m with 230-260 plates on each side (ibid).

Status and trends: Bowhead whales belong to the Order Cetacea, Suborder Mysticeti, and Family Balaenidae. For management purposes, five stocks of bowhead whales have been recognized worldwide by the International Whaling Commission. The only stock found within U.S. waters is the Western Arctic stock, also known as the Bering- Chukchi-Beaufort stock (Allen and Angliss 2015, and citations therein).

The most recent population estimate for the Western Arctic stock, derived from an ice-based census in 2011, was 16,892 bowhead whales (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; however 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 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 (Allen 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 mortality and serious injury 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 mortality and serious injury (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 of the Arctic and near-Arctic, generally north of 60° N and south of 75° N in the western Arctic Basin (Braham 1984). 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 2008, 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 they are capable of breaking through ice up to 60 cm thick to manufacture breathing holes. They feed throughout the water column at the surface and on the bottom; the most prevalent prey are copepods, euphausiids, mysids, and gammarid amphipods. They may stay submerged for over an hour (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 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).

Acoustics and hearing: Acoustics probably play a vital role in reproduction of bowhead whales because they are vocally active during the mating season and can hear each other 5-10 km away (Rugh and Shelden 2009). Bowhead whale calls are directional with received levels of whale calls about 4.8 dB higher ahead of the whale versus behind the whale (Blackwell et al. 2012). Bowhead whales are in the low-frequency functional hearing group with an estimated auditory bandwidth of 7 Hz to 22 kHz (Southall et al. 2007). Bowhead whale vocalizations likely have a similar range as North Pacific right whales described below with a range from 60 Hz to 20 kHz (DON 2008c, 2009) (Table 4-1).

4.2 PINNIPEDS

4.2.1 Steller Sea Lion (*Eumetopias jubatus*) - Western Distinct Population Segment (DPS) and Eastern DPS

Description: Steller sea lions exhibit significant sexual dimorphism with males larger than females. Average length of males is 2.8 m and of females 2.4 m (maximum of about 3.3 m and 2.9 m, respectively). Estimated average weight of males is 566 kg and of females 263 kg (maximum of about 1,120 kg and 350 kg, respectively). Pup weight at birth is 16-23 kg and may be slightly larger in the western part of their range. Pups are born with a wavy, chocolate brown fur that molts after 3-6 months of age. Adult fur color varies between a light buff to reddish brown with most of the under parts and flippers a dark brown to black; naked parts of the skin are black. Both sexes become blonder with age. Adult males have long, coarse hair on the chest, neck, and shoulders which are massive and muscular (Loughlin 2009).

Status and trends: Steller sea lions belong to the Order Carnivora, Suborder Pinnipedia, Family Otariidae. As the result of an analysis by Loughlin (1997) two separate stocks of Steller sea lions were recognized within U.S. waters: an eastern U.S. stock, which includes animals east of Cape Suckling, Alaska (144°W), and a western U.S. stock, which includes animals at and west of Cape Suckling. All genetic analyses and other data confirm a strong separation between western and eastern stocks such that the IUCN and the Society for Marine Mammalogy support elevating the two recognized stocks to the subspecies level in which case the vernacular name for the Eastern DPS/subspecies may become Loughlin's northern sea lion (*Eumetopias jubatus monteriensis*, Phillips et al. 2009); the Western DPS/subspecies is to remain as Steller sea lion. However, as the vernacular designation of the Eastern DPS/subspecies as Loughlin's northern sea lion is new, the designation of Eastern DPS of Steller sea lion will be used in this document.

In November 1990, NMFS listed Steller sea lions as threatened under the ESA (55 FR 49204). In 1997, when the two stocks were formally recognized (Loughlin 1997), the Western DPS was listed as endangered (62 FR 24345, June 1997), while the Eastern DPS retained a threatened classification. In 2013, NOAA delisted the Eastern DPS, by removing it from the ESA list of threatened and endangered species. The endangered status for the Western DPS remains unchanged (78 FR 66140, November 4, 2013). Delisting the Eastern DPS 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). NMFS solicited public comment in 2014 and is currently conducting a review to determine if revision of the existing critical habitat is warranted.

<u>Western DPS:</u> Western DPS 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 mortality and serious injury of Western DPS Steller sea lions in U.S. waters include the Bering Sea/Aleutian Islands Atka mackeral, flatfish, Pacific cod, and pollock trawl fisheries, the Gulf of Alaska 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 mortality and serious injury rate. Additional sources of mortality and serious injury include 1.2 sea lions per year in unknown fisheries and marine debris, 199 per year in Alaska Native 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 under the MMPA and considered a strategic stock.

Eastern DPS: Based on extrapolations from non-pup and pup surveys, 2009-2013, the total population of the Eastern DPS 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 mortality and serious injury 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). Although no longer listed under the ESA, Eastern DPS Steller sea lions are considered depleted and, as a result, classified as a strategic stock.

Distribution and habitat preferences: Steller sea lions occur throughout the North Pacific Ocean rim from Japan to southern California. They abound on numerous breeding sites (rookeries) in the Russian Far East, Alaska, and British Columbia with fewer numbers in Oregon and California. Seal Rocks in Prince William Sound, Alaska is the northernmost (60° 09' N) rookery and Año Nuevo Island, California, the southernmost (37° 06' N) (Loughlin et al. 1987, Loughlin 2009). Both subspecies occur year around in Alaska, with peak numbers in late summer, fall, and winter (Allen and Angliss 2015).

Unlike their more gregarious cousin the California sea lion, Steller sea lions tend to avoid people and prefer isolated offshore rocks and islands to breed and rest. Although rookeries and rest sites occur in many areas, principally on exposed rocky shorelines and wave-cut platforms, the locations used are specific and change little from year to year. Steller sea lions tend to return to their birth island as adults to breed, but they range widely (some yearlings have been seen > 1,000 km from their birth rookery) during their first few years and during the non-breeding season (Loughlin 2009).

Steller sea lions exhibit two general types of distribution at sea: 1) less than 20 km from rookeries and haulout sites for adult females with pups, pups, and juveniles, and 2) larger areas (greater than 20 km) where these and other animals may range to find optimal foraging conditions once they are no longer tied to rookeries and haulout sites for nursing and reproduction (Call and Loughlin 2005). Telemetry studies show that in winter adult females may travel far out to sea into water greater than 1,000 m deep (Merrick and Loughlin 1997), and juveniles less than 3 years of age travel nearly as far (Loughlin et al. 2003). Sea lions commonly occur near and beyond the 200 m depth contour. Some individuals may enter rivers in pursuit of prey.

Behavior and life history: Steller sea lions breed from late May to early July throughout the range at rookeries located on remote islands and rocks. One pup is born annually after a 9 month gestation period. As with most pinnipeds embryo implantation typically is delayed 3 months. 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 (ibid). 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).

Acoustics and hearing: Steller sea lions have similar hearing thresholds in-air and underwater to other otariids. Hearing in air ranges from 0.250–30 kHz, with a region of best hearing sensitivity from 5–14.1 kHz (Muslow and Reichmuth 2010). The underwater audiogram shows the typical mammalian U-shape. The range of best hearing was from 1 to 16 kHz. Higher hearing thresholds, indicating poorer sensitivity, were observed for signals below 16 kHz and above 25 kHz (Kastelein et al. 2005b). Like other otariids, Steller sea lions have an estimated auditory bandwidth of 100 Hz to 40 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from <4 to 120 kHz (DON 2008a) (Table 4-1).

4.2.2 Northern Fur Seal (*Callorhinus ursinus*) - Eastern Pacific and California Stocks

Description: The northern fur seal is a moderate sized pinniped and shows a marked difference in size with males two to three times larger than females. Northern fur seal males weigh 200-250 kg and are up to 1.9 m long; females weigh up to 45 kg and are 1.3 m long. Pups are black, weigh about 10 kg and are about 0.6 m long at birth (Gentry 2009). The under-fur is brown, very dense, and covered by coarser guard hair that in males varies from black to reddish, with a mane over the shoulders that is often a different color; females are typically brown to gray and lack the mane.

Status and trends: Fur seals belong to the Order Carnivora, Suborder Pinnipedia, Family Otariidae. The genus *Callorhinus* contains one species, the northern fur seal, *C. ursinus*. Northern fur seals are divided into two stocks in U.S. waters: Eastern Pacific stock (Pribilof Islands and Bogoslof Island) and California stock (includes San Miguel Island and Farallon Islands). The Eastern Pacific stock of northern fur seal was designated as “depleted” pursuant to the Marine Mammal protection Act on 17 June 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 the late 1950s (NMFS 2007). The stock is, therefore, also classified as strategic.

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 mortality and serious injury 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 PBRand considered to be insignificant and approaching a zero mortality and serious injury rate (Muto and Angliss 2015).

Distribution and habitat preferences: NMFS (2007) summarized northern fur seal distribution. They 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. The largest breeding colonies are located on St. Paul and St. George islands in the Pribilof Islands and compose 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 that compose 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. The subpolar continental shelf and shelf break from the Bering Sea to California are feeding grounds while fur seals are at sea. Highest fur seal densities in the open ocean occur in association with major oceanographic frontal features such as sea mounts, valleys, canyons and along the continental shelf break (NMFS 2007). Northern fur seals are primarily pelagic in the winter months, but occasionally haul-out onto land for brief periods.

Behavior and life history: Northern fur seals are the most pelagic of pinnipeds with females spending all but 35 days per year at sea and males 45 days (Gentry 2009). From November to March they remain north of about 35° N latitude without coming ashore. In March and April they gather along continental shelf breaks and begin to migrate to their respective breeding islands (Gentry 2009). Males come ashore and acquire breeding territories in late May and June and most pups are born in July, nursed for about four months and weaned in October or November. They are a highly migratory species and typically return to their natal sites to breed.

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 remains found in scat on the Pribilof Islands during the breeding season showed complete dietary niche overlap between subadult males and adult females; they each consumed primarily walleye pollock, Pacific salmon, Pacific herring and cephalopods but the size of prey of each group differed (Call and Ream 2012). Dive behavior of northern fur seals is well studied and shows that females from the Pribilof Islands often dive to 200 m or more for at least 5-6 minutes with some to 11 minutes (Gentry 2009).

Acoustics and hearing: Like other otariids, northern fur seals have an estimated auditory bandwidth of 100 Hz to 40 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from <4 to 120 kHz (DON 2008a) (Table 4-1).

4.2.3 Harbor Seal (*Phoca vitulina richardsi*) - Aleutian Islands, Pribilof Islands, Bristol Bay, North Kodiak, South Kodiak, Prince William Sound, Cook Inlet/Shelikof, Glacier Bay/Icy Strait, Lynn Canal/Stephens, Sitka/Chatham, Dixon/Cape Decision, and Clarence Strait Stocks

Description: Harbor seals are relatively small pinnipeds compared to sea lions and elephant seals. Males tend to be slightly larger than females. Bothe sexes weigh about 90-120 kg but can be as large as 180 kg and can be 1.2 - 1.8 m long (Burns 2009). They are covered with short, stiff hair with variable color pattern and two basic color phases. Background color ranges from yellowish (light phase) to black (dark phase) which is then covered with dark spots and light rings (Burns 2009).

Status and trends: Harbor seals belong to the Order Carnivora, Suborder Pinnipedia, Family Phocidae. There are five presently recognized subspecies of harbor seal; *P.v. richardsi* occurs along the west coast of North America (Burns 2009). In 2010, the NMFS and the Alaska Native Harbor Seal Commission defined twelve separate stocks of harbor seals in Alaska based largely on their genetic structure, along with population trends, movements, and traditional Alaska Native use areas (Muto and Angliss 2015, O'Corry-Crowe et al. 2003). The twelve stocks of harbor seals currently recognized in Alaska are 1) the Aleutian Islands stock, 2) the Pribilof Islands stock, 3) the Bristol Bay stock, 4) the North Kodiak stock, 5) the South Kodiak stock, 6) the Prince William Sound stock, 7) the Cook Inlet/Shelikof Strait stock, 8) the Glacier Bay/Icy Strait stock, 9) the Lynn Canal/Stephens Passage stock, 10) the Sitka/Chatham Strait stock, 11) the Dixon/Cape Decision stock, and 12) the Clarence Strait stock. None of these 12 stocks are considered to be "depleted" under the MMPA or listed as threatened or endangered under the ESA. 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). The status of all 12 stocks relative to their OSP size is unknown.

Aleutian Islands stock: This stock is estimated to number 6,431 seals with a minimum population estimate of 5,772 seals; PBR for this stock is 173 seals.

Pribilof Islands stock: This stock is estimated to number 232 seals with a minimum population estimate of 232 seals; the calculated PBR for this stock is 7 harbor seals; population trend is unknown.

Bristol Bay stock: This stock is estimated to number 32,350 seals with a minimum population estimate of 28,146 seals; the calculated PBR for this stock is 1,182 harbor seals; population trend appears to be increasing.

North Kodiak stock: This stock is estimated to number 8,321 seals with a minimum population estimate of 7,096 seals; the calculated PBR for this stock is 298 harbor seals; population trend is unknown.

South Kodiak stock: This stock is estimated to number 19,199 seals with a minimum population estimate of 17,479 seals; the calculated PBR for this stock is 314 harbor seals; population trend is unknown but may be stabilizing after significant declines in abundance.

Prince William Sound stock: This stock is estimated to number 29,899 seals with a minimum population estimate of 27,936 seals; the calculated PBR for this stock is 838 harbor seals; population trend is unknown.

Cook Inlet/Shelikof Strait stock: This stock is estimated to number 27,386 seals with a minimum population estimate of 25,651 seals; the calculated PBR for this stock is 770 harbor seals; population trend is unknown.

Glacier Bay/Icy Strait stock: This stock is estimated to number 7,210 seals with a minimum population estimate of 5,647 seals; the calculated PBR for this stock is 169 harbor seals; population trend is unknown but appears to be declining in Glacier Bay.

Lynn Canal/Stephens Passage stock: This stock is estimated to number 9,478 seals with a minimum population estimate of 8,605 seals; the calculated PBR for this stock is 155 harbor seals; population trend is unknown.

Sitka/Chatham Strait stock: This stock is estimated to number 14,855 seals with a minimum population estimate of 13,212 seals; the calculated PBR for this stock is 555 harbor seals; population trend is unknown.

Dixon/Cape Decision stock: This stock is estimated to number 18,105 seals with a minimum population estimate of 16,727 seals; the calculated PBR for this stock is 703 harbor seals; population trend is either stable or increasing.

Clarence Strait stock: This stock is estimated to number 31,634 seals with a minimum population estimate of 29,093 seals; the calculated PBR for this stock is 1,222 harbor seals; population trend is either stable or increasing.

A reliable estimate of the total mortality and serious injury rate incidental to commercial fisheries is not available due to the lack of observer coverage in salmon gillnet fisheries known to interact with several harbor seal stocks. Therefore, mean annual mortality and serious injury rates are assigned to the following stocks based on the location of takes in observed fisheries in 2009-2013: Bristol Bay stock (0.6 from the BSAI flatfish trawl fishery); South Kodiak stock (0.6 from the GOA Pacific cod trawl fishery and 1.3 from the GOA flatfish trawl fishery); Cook Inlet/Shelikof Strait stock (0.4 from the GOA flatfish trawl fishery). The latter seal could have been from either the South Kodiak or Cook Inlet/Shelikof Strait stock, so mortality is assigned to both stocks. 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 (Allen and Angliss 2015), the current estimates are less than 10 percent of PBR for all 12 stocks and, therefore, considered insignificant and approaching a zero mortality and serious injury rate. Total human-caused mortality and serious injury is less than PBR for all stocks (Muto and Angliss 2015).

Distribution and habitat preferences: The species is widespread in temperate and arctic waters of the northern hemisphere of both the Atlantic and Pacific Oceans; it is the most widespread of any pinniped. They occur principally in the near shore zone. Harbor seals use hundreds of sites to rest or haulout along the coast and inland waters, including intertidal sand bars and mudflats in estuaries, intertidal rocks and reefs, 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).

Behavior and life history: Harbor seals are considered a non-migratory species, breeding and feeding in the same area throughout the year. They give birth on shore and nurse their single pup for four to five weeks. After the pups are weaned, they disperse widely in search of food. Breeding occurs in the water shortly after the pups are weaned. 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, crustaceans, sole, flounder, sculpin, hake, and octopus (Orr et al. 2004, Jemison 2001, Iverson et al. 1997). Harbor seals can dive to over 400 m and stay submerged over 20 minutes, but the average depth is less than 100 m and about two minute duration (Eguchi and Harvey 2005).

Acoustics and hearing: Harbor seals are assigned to functional hearing group that includes phocid pinnipeds, or true seals, with an estimated auditory bandwidth of 75 Hz to 100 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from 25 Hz to 4 kHz (DON 2008a) (Table 4-1).

4.2.4 Spotted Seal (*Phoca largha*) - Alaska Stock

Description: Spotted seals older than weaned pups are not readily distinguishable from harbor seals. Body size of spotted seals falls within the range of that for all but the largest harbor seals (Burns 2009). The pelage pattern of spotted seals tends to be more uniform than that of harbor seals in color and pattern and resembles the light-phase of harbor seals (ibid). However there are genetic, ecological, and behavioral differences between spotted and harbor seals.

Status and trends: Spotted seals belong to the Order Carnivora, Suborder Pinnipedia, Family Phocidae. Until recently it was considered a subspecies of harbor seal. The spotted seal population includes three Distinct Population Segments (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 1.52 seals per year. 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 mortality and serious injury does not exceed PBR for this stock (Allen and Angliss 2015).

The Alaska stock (Bering DPS) of spotted seals is not listed as “depleted” under the MMPA or listed as threatened or endangered under the ESA. The Alaska stock is not considered strategic. NMFS received a petition on 28 May 2008 to list spotted seals under the ESA due to loss of sea ice habitat caused by climate change in the Arctic. NMFS published a Federal Register notice indicating that there were sufficient data to warrant a review of the status of the species (73 FR 51615, 4 September 2008). Upon completion of the status review (Boveng et al. 2009), NMFS determined that listing the Bering and Okhotsk DPSs was not warranted. The Southern DPS was, however, proposed for listing under the ESA (74 FR 53683, 20 October 2009). NMFS issued a final rule listing the Southern DPS as "threatened" on 22 October 2010 (75 FR 65239).

Distribution and habitat preferences: Spotted seal distribution in the breeding season is the temperate-subarctic boundary region; they are common on the 'front' and broken ice zones of seasonal ice (Burns 2009). They occur in the Bering, Chukchi (summer), Beaufort Sea (summer), and Okhotsk seas, Tartar Strait, the Sea of Japan, and Northern Yellow Sea (ibid). 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. 1976b). As seasonal ice recedes and disintegrates, spotted seals expand their range and haul out on land and may occur as far north as Point Barrow (Burns 2009). Spotted seals in the eastern Bering Sea use coastal haul-out sites from Kuskokwim Bay to the Bering Strait from May to July. They are known to occur around the Pribilof Islands, Bristol Bay, and the eastern Aleutian Islands. Spotted seals are closely related to and often confused with Pacific harbor seals, especially where their ranges overlap in the southern part of the Bering Sea (Quakenbush 1988).

Behavior and life history: Spotted seals are annually monogamous and territorial. They begin to form pairs prior to the female estrous and once pupping and mating have occurred they form triads of female and pup with attending adult male. Pups are born on the ice and spend the first 2-3 weeks there exposed to the elements (ibid). In areas where spotted and harbor seals occur together, spotted seals breed about 2 months earlier than harbor seals (Burns 2009). Spotted seals are generalist feeders 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). In the Bering Sea during spring, the main food items were pollock, arctic cod, sand lance, and capelin (Burns 2009).

Acoustics and hearing: Spotted seals, like harbor seals, are assigned to a functional hearing group that includes phocid pinnipeds, or true seals, with an estimated auditory bandwidth of 75 Hz to 100 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from 25 Hz to 4 kHz (DON 2008a) (Table 4-1).

4.2.5 Bearded Seal (*Erignathus barbatus*) - Alaska Stock

Description: Bearded seals are the largest of the northern phocids with adults measuring 2-2.5 m long and weighing 250-33 kg; females are somewhat larger and can weigh in excess of 425 kg (Kovacs 2009). The sexes are not easily distinguished; both are gray brown in color with some individuals having irregular light-colored patches (ibid). Their body shape is rectangular and their heads appear small compared their body size. The fore flippers are square shaped (with the longest toe being the middle) with strong claws. They have extremely elaborate, smooth, facial whiskers that tend to curl when dry resulting in the common name of bearded seals (ibid). The extreme development of the sensitivity of the whiskers is presumably an adaptation to their benthic feeding habit (ibid).

Status and trends: Bearded seals belong to the Order Carnivora, Suborder Pinnipedia, Family Phocidae. 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).

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 mortality and serious injury 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 Endangered Species Act, with the final rule taking effect on February 26, 2013 (77 FR 76740). On December 28, 2012, NMFS issued a final determination to list the Beringia and Okhotsk DPSs of bearded seals as threatened under the Endangered Species Act, 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 this document, despite current removal from the list.

Distribution and habitat preferences: As summarized in Allen and Angliss (2011, and citations therein) and Bengtson et al. (2005), bearded seals are circumpolar in their distribution, extending from the Arctic Ocean (85° N) south to Hokkaido (45° N) in the western Pacific. 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: These seals are largely solitary but they do haul out in small groups along ice leads and at holes in the ice. Peak breeding occurs between March and 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). They are not deep divers; they feed in shallow coastal areas and typically not required to dive more than 100 m and about 10 minutes in duration, although some dives last 20-25 min (Bengtson et al. 2005, Kovacs 2009). Pups may dive to >450 m but dives become shallower with maturity as the animals begin foraging in shallower waters (ibid).

Acoustics and hearing: Bearded seals perform vocal displays under water to attract females during the breeding season (Kovacs 2009). The underwater songs are composed of downward spiraling trills that can be heard for many kilometers; the onset of this behavioral trait occurs with the onset of sexual maturity. The calls exhibit geographic variation in call dialects (ibid). . As above for harbor seals bearded seals are assigned to a functional hearing group that includes phocid pinnipeds, or true seals, with an estimated auditory bandwidth of 75 Hz to 100 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from 25 Hz to 4 kHz (DON 2008a) (Table 4-1).

4.2.6 Ringed Seal (*Phoca hispida*) - Alaska Stock

Description: The ringed seal is among the smallest of pinnipeds with adults reaching a maximum length of 1.3-1.5 m and weighing up to 100 kg (Hammill 2009). Males and females are about the same size with males slightly larger. The ventral surface is typically light gray and the dorsum is black with whitish-silvery rings or silver gray with black spots (ibid). The claws on the front flippers are rugged and are used to open and maintain holes in the ice.

Status and trends: Ringed seals belong to the Order Carnivora, Suborder Pinnipedia, Family Phocidae. 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 one 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).

Surveys and telemetry studies in the Chukchi Sea (Bengtson et al. 2005) showed that ringed seals were relatively common in nearshore fast ice and pack ice, with lower densities in offshore pack ice. The average density of ringed seals was 1.91 seals per km^2 in 1999 (range 0.37–16.32) and 1.62 seals per km^2

in 2000 (range 0.42–19.4), with the highest densities of ringed seals found in coastal waters south of Kivalina and near Kotzebue Sound.

In the absence of reliable estimates of minimum population size, PBR cannot be determined. Interactions between U.S. commercial fisheries and ringed seals in Bering Sea/Aleutian Islands flatfish, pollock, and Pacific cod trawl and Pacific cod longline fisheries from 2008 to 2012 resulted in an annual average of 4.12 mortalities. Ringed seals are an important subsistence resource for Alaska Native communities. The most recent statewide estimate of the annual harvest was of 9,567 ringed seals in 2000 (Allen 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. On December 28, 2012, NMFS issued a final determination to list the Arctic, Okhotsk, and Baltic subspecies of ringed seal as threatened, and the Ladoga subspecies as endangered under the ESA, with the final rule taking effect on February 26, 2013 (77 FR 76706). As a result of the ESA listing, the stock is also designated as depleted under the MMPA and considered a strategic stock. NMFS proposes to designate critical habitat for the Arctic ringed seal in future rulemaking.

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. 2010). The Arctic subspecies typically hauls out exclusively on sea ice for resting, pupping, and molting (Kelly and Quakenbush 1990, Kelly et al. 2010).

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 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) 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 white-coated pup in a subnivean lair during March-April which is weaned after about 40 days; mating occurs soon thereafter. They remain in contact with ice most of the year. Males emit a strong pungent odor during the breeding season produced by modified sebaceous glands concentrated in the facial region (Hammill 2009). Over 30 different food species have been identified as ringed seal prey, including fish and invertebrates. Dominant prey includes Arctic cod, capelin, redfish, snailfish, Greenland halibut, and sculpins (Hammill 2009). Information on foraging behavior is unavailable. Telemetry studies of haulout patterns indicated that ringed seals transitioned to basking behavior in late May and early June, and that the largest proportion of seals (60–68 percent) was hauled out between 0830 and 1530 local solar time (Bengtson et al. 2005).

Acoustics and hearing: Acoustics of ringed seals are likely similar to other Phocine seals. As above for harbor seals they are assigned to a functional hearing group that includes phocid pinnipeds, or true seals, with an estimated auditory bandwidth of 75 Hz to 100 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from 25 Hz to 4 kHz (DON 2008a) (Table 4-1).

4.2.7 Ribbon Seal (*Histriophoca fasciata*) - Alaska Stock

Description: Adult ribbon seals are generally 1.5-1.75 m long and weigh 70-110 kg; they are considerably more slender than other northern ice-inhabiting seals (Lowry and Boveng 2009). Ribbon seals are distinctly marked. Older seals have a dark background with a set of light bands circling the head, posterior trunk, and each front flipper. In males the background color is nearly black and the bands almost white; females have a similar pattern with less contrast (ibid). Pups pelage is white at birth which sheds to silver-gray to a dark blue-black back before turning to the adult pelage (ibid).

Status and trends: Ribbon seals belong to the Order Carnivora, Suborder Pinnipedia, Family Phocidae. 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 (Allen 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 this 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). Due to a very low level of interactions between U.S. commercial fisheries and ribbon seals, the Alaska stock of ribbon seals is not considered a strategic stock.

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.

Distribution and habitat preferences: 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 suggest ribbon seals disperse widely. Ten seals tagged in 2005 near the eastern coast of Kamchatka spent the summer and fall throughout the Bering Sea and Aleutian Islands; eight of the 26 seals tagged in 2007 in the central Bering Sea moved to the Bering Strait, Chukchi Sea, or Arctic Basin as the seasonal ice retreated (Boveng et al. 2008).

Behavior and life history: As summarized by Lowry and Boveng (2009), ribbon seals give birth on the ice front during March-April. Adult males do not accompany females during the early part of the nursing period, and little is known of their breeding structure. The peak of breeding occurs in late April and early May and seals molt shortly thereafter. Sexual maturation occurs at 3-5 years of age. Ribbon seals primarily consume pelagic and nektobenthic 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).

Acoustics and hearing: Two kinds of underwater sounds were recorded from ribbon seals in the ice near St. Lawrence Island. One was described as a ‘puffing’ sound and the other a ‘downward sweeping’ sound (Lowry and Boveng 2009). Little is known of the acoustics of ribbon seals but they are likely similar to other Phocine seals. As above for harbor seals they are assigned to a functional hearing group that includes phocid pinnipeds, or true seals, with an estimated auditory bandwidth of 75 Hz to 100 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from 25 Hz to 4 kHz (DON 2008a) (Table 4-1).

4.2.8 Northern Elephant Seal (*Mirounga angustirostris*) - California Breeding Stock

Description: Northern elephant seals are the largest pinniped in Alaska, with the walrus a close second. The species is sexually dimorphic with males weighing about 1,800 kg with a length of 4.8 m; females weigh about 900 kg and are about 2.5 m in length (Hindell and Perrin 2009). Males have a large inflatable proboscis and a pronounced chest shield associated with fighting with other males on land to acquire females. Females lack the proboscis and chest shield (ibid). Both males and females are gray to brown in color.

Status and trends: Northern elephant seals belong to the Order Carnivora, Suborder Pinnipedia, Family Phocidae. Elephant seals occur in the eastern Bering Sea and Gulf of Alaska during fall but typically in low numbers, typically seen resting at Steller sea lion or harbor seal haulout sites. There are no estimates of the number of elephant seals in Alaska but the number is likely in the low hundreds. The primary population is located south of Alaska in the California Current Ecosystem where the 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 mortality and serious injury 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 or strategic under the MMPA.

Distribution and habitat preferences: 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 Gulf of Alaska and Aleutian Islands; adult females typically feed in the western North Pacific (Carretta et al. 2015a). Northern elephant seals breed at about 15 colonies 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 tend to 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). However it is not uncommon to see male and female northern elephant seals hauled out on land alongside harbor seals, California and Steller sea lions, and northern fur seals throughout the North Pacific.

Behavior and life history: Adult breeding males enter the rookeries in November; adult females arrive in December and a single pup is born about 2-5 days later. Elephant seals are highly polygynous with large dominant males presiding over large aggregations of females, known as harems consisting of up to 100 animals (Hindell and Perrin 2009). Males feed near the eastern Aleutian Islands and in the Gulf of Alaska, and females typically feed south of 45° N latitude. Elephant seals prey on deepwater 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).

Acoustics and hearing: Like other phocid pinnipeds, elephant seals are assigned to a functional hearing group with an estimated auditory bandwidth of 75 Hz to 100 kHz (Southall et al. 2007, NOAA 2013). Vocalizations range from <4 to 120 kHz (DON 2008a) (Table 4-1).

5.0 TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

The promulgation of regulations and subsequent issuance of annual Letters of Authorization (LOA) for the incidental taking of marine mammals is requested pursuant to Section 101 (a)(5)(A) of the Marine Mammal Protection Act (MMPA). The request is for a five-year period commencing upon issuance of the permit.

The term "take", as defined in Section 3 (16 U.S. Code [U.S.C.] 1362 of the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal." "Harassment" was further defined in the 1994 amendments to the MMPA, which provided two levels of "harassment," Level A (potential to injure) and Level B (potential to disturb).

The AFSC requests the promulgation of regulations and subsequent issuance of an LOA to authorize potential lethal and non-lethal incidental takes during its planned scientific operations. The requested numbers of authorized lethal and serious injury takes and non-serious injury "Level A" and "Level B" harassment takes per year are discussed in Section 6. Mortality and serious injury and Level A harassment takes are combined for the purposes of take requests. Although serious injury or mortality are rare during AFSC research activities, the AFSC requests that the LOA 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 Sections 11, 13, and 14.

<u>Potential "Level A" harassment/mortality and serious injury takes</u>: AFSC fisheries and ecosystem research surveys use a variety of trawl, gillnet, and longline gear that has the potential to take marine mammals by two mechanisms: (1) take by accidental entanglement or hooking that may cause mortality and serious injury, and (2) take by accidental entanglement or hooking that may cause non-serious injury ("Level A" harassment take). The surveys using these gears are conducted to assess groundfish and an assortment of other finfish as well as commercially important invertebrate species and numerous ecosystem components.

<u>"Level B" harassment takes:</u> The "Level B" take by harassment may occur as the result of acoustic gear used during survey operations in all three research regions surveyed by the AFSC. The take may be manifested as a temporary threshold shift (Southall et al. 2007) within the zone of audibility where the received levels of sound exposure are high enough that a marine mammal can hear it, or in the zone of responsiveness where the received level is such that the animal responds via behavioral modifications (Holt 2008). No hearing loss or physiological damage (permanent threshold shift, Southall et al. 2007) is expected to occur to marine mammals by the acoustic gear or vessel movements during AFSC surveys in any of the three research areas.

Level B harassment takes also may occur to Steller sea lions (Western DPS) and harbor seals within the Bering Sea/Aleutian Islands and Gulf of Alaska research areas due to the physical presence and passage of researchers near haulouts. AFSC researchers in these regions are very aware of this situation and take precautions to minimize the frequency and scope of potential disturbances, including choosing travel routes away from hauled out pinnipeds and by moving sample site locations to avoid consistent haulout areas wherever doing so does not compromise required data collection. It is possible that in some areas within the GOARA and BSAIRA, passage of fisheries research vessels may occur within 3 nm or less of pinniped haulout sites. As a result some airborne sounds from research vessel engines or gear deployments may result in disturbance to Steller sea lions or harbor seals on some haulouts. The alternative of complete avoidance is complicated by the fact that pinnipeds may haul out in new locations on a regular basis, making it essentially impossible for researchers to completely avoid disturbing pinnipeds as they move throughout the region.

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6.0 THE NUMBER OF MARINE MAMMALS THAT MAY BE TAKEN BY EACH TYPE OF TAKING, AND THE NUMBER OF TIMES SUCH TAKINGS BY EACH TYPE OF TAKING ARE LIKELY TO OCCUR

6.1 Estimated Number of Potential Marine Mammal Takes by Mortality/Serious Injury or 'Level A' Harassment and Derivation of the Number of Potential Takes

6.1.1 Introduction

As stated in Section 5 above, potential take during AFSC fisheries and ecosystem research surveys using surface trawls, mid-water trawls, bottom trawls, longline gear, and gillnets may occur in two forms: (1) take by accidental entanglement or hooking that may cause mortality and serious injury, and (2) take by accidental entanglement or hooking that may cause non-serious injury ("Level A" harassment take). Because there is a very fine line between the two take categories (mortality and serious injury and Level A harassment) and insufficient data exist to understand the circumstances that lead to one outcome or the other after capture in fisheries research gear, the AFSC believes it would be unjustified to estimate potential takes in each category based only on historic interactions in that category; a Level A harassment take could easily have been a serious injury or mortality under a slightly different set of circumstances and vice versa. The AFSC incidental take request is therefore described in terms of the combined Level A harassment and mortality and serious injury (M&SI) takes for the five-year authorization period. These combined takes will hereafter be referred to as M&SI/Level A takes.

The justification for requesting incidental takes of marine mammal species and the estimated mortalities and injuries is discussed below. A phased approach was taken to develop the incidental take requests. First, the historical interactions of marine mammals with AFSC research gear was considered as the most direct information for estimating potential takes for species that have been encountered. Second, the historical information on species and numbers taken was used to estimate takes for analogous species in the research area where research takes have occurred. And finally, species takes from commercial fisheries operating in Alaska were considered as analogues to comparable research gears used by the AFSC.

6.1.2 Use of Historical Interactions as a Basis for M&SI/Level A Take Estimates

It is anticipated that all species that interacted with AFSC fisheries research gear historically could potentially be taken in the future. For the duration of the regulations, we estimated the numbers of marine mammals that may be caught during AFSC fisheries research based on historic interaction data for a species. Historical interactions with marine mammals during AFSC fisheries and ecosystem research (Table 6-1, Figure 6-1) were input into NOAA's Protected Species Incidental Take (PSIT) database, a real-time internal monitoring tool for reporting interactions with marine mammals.

The AFSC considered all historic marine mammal interactions available from 2004 through 2015 to calculate the total take request over the five-year authorization period. The discussion that follows describes how 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. For species that have not been caught in AFSC research gear in the past, and for which there is a reasonable chance that they may be taken in the future, the methodology for estimating take requests for these species are explained in more detail in sections 6.1.7 and 6.1.8.

Table 6.1 Historical M&SI/Level A 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 Alive[1]	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
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"
3. Based on location, take was most likely from the Southeast Alaska DPS.

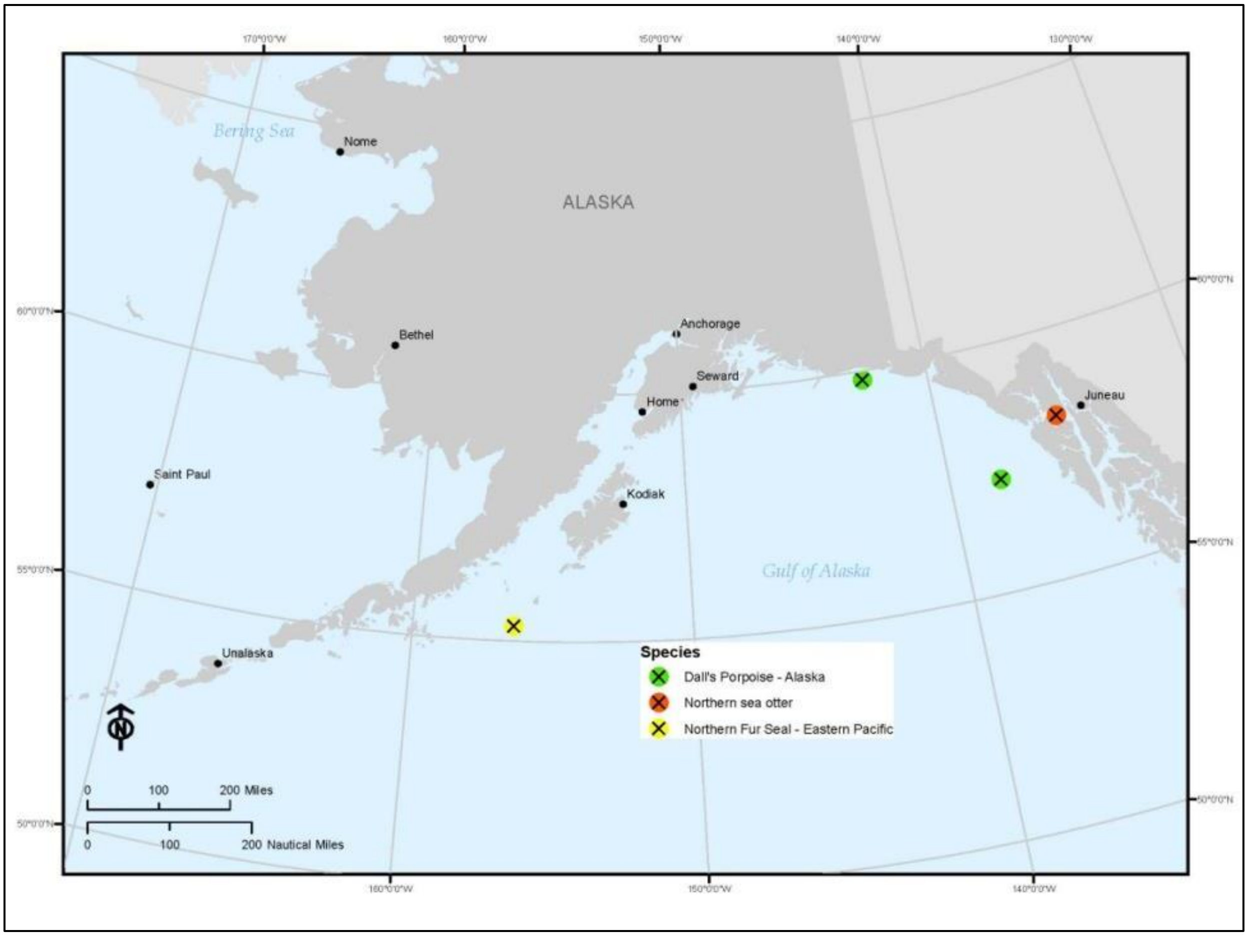

Figure 6-1 Locations and Species Taken Historically in AFSC Fisheries Research Activities

6.1.3 Historical Interaction: Summary of Potential Trawl Survey Efforts

Marine mammals have the potential to be caught in bottom, surface, mid-water, and beam trawl nets. These nets are used in the rockfish, groundfish, pollock, and of finfish species assessments throughout Alaska annually during all seasons (Table 1-1). The tows are conducted at a variety of depths depending on the research target species, from near the surface down to the bottom, during all hours of the day using charter vessels or NOAA vessels (Table 1-1). From 2004 through 2015, at least 1,250 tows per year using these trawl nets and only four marine mammals were captured and killed during this period, all in the Gulf of Alaska. These mortalities included two Dall's porpoise captured in midwater and surface trawls, one northern fur seal captured in a bottom trawl, and a sea otter in a Nordic 264 surface trawl (Table 6-1, Figure 6-1). (As this request addresses only NMFS managed species, the sea otter take will not be considered in this document. NMFS will consider this take within the context of the USFWS MMPA consultation.) It should be noted that several mitigation measures intended to further minimize potentially adverse interactions with marine mammals during AFSC fisheries research were initiated after 2008. The AFSC predicts that about the same number of tows will be deployed using these nets over the duration of the authorization period.

As noted above, the species that have been historically caught in these trawl nets include Dall's porpoise and a northern fur seal. Given the timing and geographic scope of its trawl surveys, the AFSC believes it could take any age class of marine mammal for which it estimates potential take. Northern fur seals are designated as depleted and strategic; they pup and breed during July-September at the Pribilof Islands and

Bogoslof Island in the Bering Sea and animals caught near these locations may be part of the breeding population (section 4.2). The location of the captured northern fur seal (2009) is in the zone occupied by the Eastern Pacific stock, and not likely that of the California stock, which only occurs in the eastern GOARA (Robert DeLong, NOAA Fisheries, personal communication). Dall's porpoise calve during summer months (section 4.14) so animals caught during this period may be part of the Alaska stock and actively engaged in breeding activities. In addition to these species, which AFSC has historically captured, other species AFSC requests to take in the course of this research have similar distributions, life histories and/or vulnerabilities to these gears, so it follows that multiple age classes of these species could be susceptible to take.

6.1.4 Historical Interactions in Other Gear

The AFSC has not incidentally caught marine mammals in any other gear during its fisheries research activities. However the AFSC is requesting authorization for incidental take in other gear because similar gear has been involved in incidental catch at other NMFS Fisheries Science Centers or in commercial fisheries. The species that may be taken and the gear used will be discussed below.

6.1.5 Approach for Estimating M&SI/Level A Takes of Species Captured Historically

To date, interactions of trawl gear with marine mammals have only occurred in the Gulf of Alaska. Historically, there have been no marine mammal interactions with AFSC bottom trawls in the Bering Sea, Chukchi Sea, or Beaufort Sea. The AFSC interaction rates in the GOARA have exhibited some inter-annual variation in numbers, possibly due to changing marine mammal densities and distributions and dynamic oceanographic conditions. Occurrences of multiple marine mammals being caught per year during survey operations are possible, as in 2011, but are rare.

The AFSC take estimates (for Level A harassment and serious injury/mortality combined) for the two species captured historically were determined by rounding the annual average take for a particular species up to the nearest whole number (to reflect a value that was representative of an entire animal) and multiplying by five to account for the five-year authorization period (Table 6-2). For example, if a species interacted with AFSC mid-water trawl gear 0.2 times per year, on average, this number was rounded up to one and then multiplied by five to determine a take request of five. Based on past experience, the AFSC expects there to be some variability in the actual number of annual gear interactions. By using an average based approach, it is expected to capture the variability that may occur on an annual basis over the period of this authorization. Furthermore, mitigation measures have been developed and implemented subsequent to some of the years upon which the take estimates are based, further reducing the likelihood that these estimates would be exceeded.

Over the 2004-2015 period, the AFSC interacted with marine mammals in trawl surveys in the Gulf of Alaska, including: two Dall's porpoise and one northern fur seal in trawl gear. As described above, an average based approach (Level A and serious injury/mortality combined) for each species in each gear was used as a basis for estimating potential take (Table 6-2). Since both species occur throughout the GOARA and BSAIRA and AFSC research activities using trawl gear are distributed throughout both research areas, the request for these two stocks is the same for each research area. The five-year take request for Alaskan waters is as follows: five Dall's porpoise and five northern fur seal (Eastern Pacific stock) in trawls in both the GOARA and BSAIRA.

Although the AFSC take estimates for species captured historically are based on the average taken during 2004-2015, it should be emphasized that there is still an inherent level of uncertainty in estimating potential take both in terms of numbers and species of marine mammals that may actually be taken. Further, the AFSC continues to invest significant resources in better understanding the factors that contribute to interactions and developing mitigation measures and evaluating its operations to minimize these occurrences in the future.

Table 6-2 Requested Incidental Marine Mammal M&SI/Level A Takes Based on Historical Takes in AFSC Research Trawls

This table summarizes the AFSC request for combined potential takes by Mortality and Serious Injury (M&SI) and Level A harassment for species that have been taken in AFSC research bottom and surface trawls from 2004-2015 (Table 6-1).

Species	Average Annual Requested Take (animals per year)	Requested M&SI and Level A Take for the Five-year Authorization Period
Dall's porpoise	1 in GOARA and 1 in BSAIRA	5 in GOARA and 5 in BSAIRA
Northern fur seal (Eastern Pacific stock)	1 in GOARA and 1 in BSAIRA	5 in GOARA and 5 in BSAIRA

6.1.6 Approach for Estimating M&SI/Level A Takes of Species Analogous to those Historically Taken by the AFSC

In addition to the two NMFS species the AFSC has historically caught in trawl nets, the AFSC believes it is appropriate to include estimates for future incidental takes of a number of species that have not been taken historically but inhabit the same areas and show similar types of behaviors and vulnerabilities to such gear as the "reference" species taken in the past. The AFSC believes the potential for take of these other "analogous" species would be low and would occur rarely, if at all, based on lack of takes since 2004.

The approach outlined below reflects: (1) concern that some species with which we have not had historical interactions may interact with these gears, (2) acknowledgment of variation between sets, and (3) understanding that many marine mammals are not solitary, so in many cases if a set results in take, the take could be greater than one animal, particularly with trawl gear. The approach takes into account the possibility that additional species could interact with AFSC surveys, while also reflecting that, absent significant range shifts or changes in habitat usage, such events would likely remain rare occurrences. 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.

In the GOARA, several species were deemed to have a similar vulnerability to trawl gear as Dall's porpoise and northern fur seal. A number of factors were taken into account to determine whether another species may have a similar vulnerability to fisheries research gear (e.g., density, abundance, behavior, feeding ecology, travel in groups, prior interactions with similar gear in other NMFS Fisheries Science Center research). For these analogous species the AFSC estimates the annual take to be equal to the maximum interactions per any given set of a similar species that was historically taken during 2004-2015 (Table 6-1). The Pacific white-sided dolphin was deemed to have similar vulnerability to trawl gear as the Dall's porpoise with both being oceanic and shelf species. The analogous take for Pacific white-sided dolphins was estimated at one per year or five over the five-year period (Table 6-3). Harbor porpoise was not a complete analog to the Dall's porpoise since the harbor porpoise tends to inhabit inshore and coastal waters. The AFSC requests one potential take by trawls over the authorization period for each GOARA stock of harbor porpoise (Table 6-3). Steller sea lion was considered analogous to northern fur seal and one take per year is requested for each stock with five takes for each stock over the five-year authorization period. The take of a northern fur seal from the Eastern Pacific stock establishes an analogy for the California stocks of northern fur seal which only occurs in the eastern GOARA. Since only half of this stock of approximately 13,000 individuals ranges to the eastern GOARA, the chance of take in AFSC research gear is small and the take request is for one animal over the five-year authorization period. The more inshore harbor seal was not a complete analog to the more oceanic and shelf inhabiting northern fur seal. However, AFSC fisheries research occurs in areas within the range of each stock so one take for each GOARA harbor seal stock is requested during the authorization period. All requested takes are for research trawls in the GOARA because that is the only research area where the AFSC has historically caught marine mammals. Estimated takes in other research areas are considered in the following sections.

The AFSC is not requesting the take of large whales and several other cetaceans (e.g. Cook Inlet and Bristol Bay stocks of beluga whales) by trawl gear due to lack of historical interactions with analogous species and/or the low probability of take in a fisheries research trawl due to several biological factors (e.g., density, abundance, behavior, etc.) and/or limited overlap with AFSC research activities.

Table 6-3 Requested Incidental Marine Mammal M&SI/Level A Takes in the GOARA in Trawl Gear Based on Analogy to Species Taken Historically in AFSC Fisheries Research Trawls

This table summarizes the AFSC request for combined potential takes by Mortality and Serious Injury (M&SI) and Level A harassment for species that are considered analogous to species that have been taken in AFSC fisheries research trawls from 2004-2015 (Table 6-1).

Species (Stocks)	Average Annual Requested Take (animals per year)	Requested M&SI and Level A Take Total for Five-year Period
Pacific white-sided dolphin	1	5
Harbor porpoise (Southeast Alaska stock)	0.2	1
Harbor porpoise (Gulf of Alaska stock)	0.2	1
Steller sea lion (Western DPS)	1	5
Steller sea lion (Eastern DPS)	1	5
Northern fur seal (California stock)	0.2	1
Harbor seal (N. Kodiak)	0.2	1
Harbor seal (S. Kodiak)	0.2	1
Harbor seal (Prince William Sound)	0.2	1
Harbor seal (Cook Inlet/Shelikof)	0.2	1
Harbor seal (Glacier Bay/Icy Strait)	0.2	1
Harbor seal (Lynn Canal/Stephens)	0.2	1
Harbor seal (Sitka/Chatham)	0.2	1
Harbor seal (Dixon/Cape Decision)	0.2	1

Harbor seal (Clarence Strait)	0.2	1

6.1.7 Approach for Estimating M&SI/Level A Takes of Species Analogous to those Taken in Commercial Fisheries

In addition to species that are considered analogous to species that have been captured historically in AFSC research gear, the AFSC is requesting potential takes of several species that have been caught incidental to commercial fisheries in the AFSC research areas (based on the 2016 List of Fisheries [LOF], NMFS 2016) using gears that are similar to fisheries research gear but recognizing that commercial gears are often substantially larger than research gears (Appendix A). We reviewed the 2016 LOF and identified commercial fisheries that used gear similar to ours. We did not consider frequency of use of the commercial gear or aspects of their spatial and temporal use. We examined the incidental capture of marine mammals by these commercial fisheries and focused on the species they captured as opposed to the abundance of each species. Species that were previously caught (as outlined in the 2016 LOF) in what were deemed analogous commercial fisheries were considered to have a higher probability of potential take in AFSC fisheries research gear and were considered, but not necessarily included, for requested take by the AFSC based on an evaluation of the similarities and differences of how and where commercial fisheries are prosecuted and AFSC fisheries research activities are conducted.

After making this comparison, the AFSC considers several marine mammal species to have a reasonable chance of being caught in AFSC fisheries research gear in the future (Table 6-4). The AFSC believes that any incidental takes would likely be rare occurrences based on their lack of historical captures in research gear and mitigation measures in place to reduce the risk of incidental capture. The AFSC is not requesting any takes of large whales in trawls or gillnets as AFSC research gear and fishing methodology is not analogous to that used in commercial fisheries known to have taken large cetaceans (e.g., fin, humpback, sei, sperm, killer whales).

Adaptive management measures to reduce incidental take would be employed as necessary should it turn out that catch rates are higher than have been recorded; such measures would be especially important to implement in the case of any takes from the Western DPS of Steller sea lions, an endangered species. These are discussed in sections 11 and 13 of this application.

GOARA

The Gulf of Alaska pollock trawl fishery has taken Dall's porpoise, northern elephant seal, and Steller sea lion (Western DPS); the Alaska Gulf Pacific cod trawl fishery has taken Steller sea lion (Western DPS). Northern elephant seal has been taken in the AK Gulf of Alaska flatfish trawl fishery (NMFS 2014). Thus, AFSC requests authorization to take one northern elephant seal in fisheries research trawls over the five-year period from the GOARA (Table 6-4). Takes of Dall's porpoise and Western DPS Steller sea lions are already requested based on historical takes and analogy (above).

Whales, particularly killer whales in the Bering Sea and sperm whales in the Gulf of Alaska, are commonly attracted to longline fishing operations and have learned how to remove fish from longline gear as it is retrieved. Such depredation of fish off the longline by whales can significantly affect catch rate and species composition data collected by the survey. The effect of depredation activity on survey results has been a research subject for many years and many aspects are therefore recorded as part of normal survey protocols, including the amount of catch depredated (percent of empty hooks or damaged fish), number of whales visible, behavior of whales, whale proximity to the vessel, and any whale/vessel interactions. Sperm whale depredation can be difficult to determine because they can alternate between diving deep to depredate the line and swimming at the surface eating offal (see below). The presence of sperm whales at the surface does not mean they are actively depredating the line.

Marine mammals have never been caught or entangled in AFSC longline research gear; if interactions occur, marine mammals depredate caught fish from the gear, but leave the hooks attached and unaltered. They have never been hooked nor had hooks taken off gear during depredation. However, such gear could be considered analogous to potential commercial longline surveys that may be conducted elsewhere (e.g., Garrison 2007, Roche et al. 2007). Thus in the GOARA, some pinniped species may be vulnerable to longline gear in Alaska. Steller sea lions have previously been taken in the Gulf of Alaska Pacific cod longline fisheries. California sea lions have interacted with the longline gear used in California by the SWFSC but never more than one time in a single set during the previous five years. Because it is assumed that no more than one pinniped would likely be caught at a time on longline gear in Alaska, the AFSC requests one potential take in longline gear for each of the Western and the Eastern DPS of Steller sea lions in the GOARA (Table 6-4). While northern fur seals have not been caught by commercial longline gear in the GOARA, this species has been caught in Pacific cod longline fisheries in the BSAI. Therefore, one take each of the Eastern Pacific and California stock is requested for research longline gear in the GOARA. The AFSC also requests the take of one Dall's porpoise by longline since commercial longline fisheries in the BSAI have taken this species.

AFSC conducts one project in Prince William Sound having a small gillnet component (EVOSTEC). The Prince William Sound salmon set gillnet has reported takes of Dall's porpoise (AK stock), harbor porpoise (GOA stock), Pacific white-sided dolphin, harbor seal (Prince William Sound stock), northern fur seal (Eastern Pacific stock), and Steller sea lion (Western DPS). Fisheries research at the Little Port Walter facility also has a small gillnet component conducted in the summer as salmon move upstream to spawn. Even though underwater pingers (10 kHz, 132 dB ref 1 µPa@1m; operating continuously during deployment) are used on these gillnets in the inner bay around hatchery net pens to prevent interactions and tangling of local harbor seals, it is possible, although unlikely, that a harbor seal could become entangled in these nets. No other marine mammal species (other than sea otters) occur in these nearshore waters by the Little Port Walter facility. While harbor seals and other marine mammals have been taken in various Southeast Alaska commercial gillnet fisheries (NMFS 2014), the AFSC is not requesting any other takes by gillnet in this area because no other fisheries research using gillnets occurs in Southeast Alaska. Therefore, the AFSC is requesting one take each of Dall's porpoise (AK stock), harbor porpoise (GOA and Southeast Alaska stocks), Pacific white-sided dolphin, northern fur seal (Eastern Pacific and California stocks), and Steller sea lion (Eastern and Western DPSs), and one take of harbor seal from each of the Prince William Sound and Sitka/Chatham stocks in fisheries research gillnets in the GOARA over the five-year period of this application (Table 6-4).

BSAIRA

The 2016 LOF reports the following trawl fisheries have taken marine mammals in the BSAIRA: Bering Sea-Aleutian Islands flatfish trawl, pollock trawl, Atka mackerel trawl, and Pacific cod trawl. While the tow duration and net dimensions of AFSC research trawls are much less than commercial fishing and no marine mammals have been historically taken by AFSC fisheries research trawls in the BSAIRA, there is potential for a rare incidental take by analogy and due to physical presence of marine mammals within the area where AFSC conducts research. Therefore, the AFSC requests one take each of the following species in research trawls in the BSAIRA over the five-year period of authorization: spotted seal, ribbon seal, ringed seal, bearded seal, harbor porpoise (Bering Sea stock), and each of the BSAI harbor seal stocks (Aleutian, Bristol Bay, and Pribilof Islands) (Table 6-4). Because Steller sea lions (Western DPS) are taken by commercial fisheries and by analogy with AFSC research trawls in the GOARA, the AFSC is requesting one take per year or five takes over five-year authorization period for this species, consistent with the request in the GOARA. Takes of northern fur seals (Eastern Pacific) and Dall's porpoises in BSAIRA trawls are made based on historical takes (above).

The Bering Sea-Aleutian Islands Pacific cod longline fishery has taken Dall's porpoise (AK stock), northern fur seal, Steller sea lion (Western DPS), and ringed seal (AK stock). Therefore, the AFSC requests one take each of Dall's porpoise, northern fur seal (Eastern Pacific), Steller sea lion (Western DPS), and ringed seal in longlines over the five-year authorization period in the BSAIRA (Table 6-4).

Even though marine mammals in this region have been taken in commercial fisheries using other types of fishing gear (e.g., gillnets and purse seines), the AFSC is not requesting takes based on these fisheries because the AFSC does not use analogous gears for fisheries research in the BSAIRA.

CSBSRA

As there has been no commercial fishing in this region, no takes by analogy with CSBSRA fisheries are requested. The take request for this research area is based on other factors (see Section 6.1.8).

Table 6-4 Requested Incidental Marine Mammal M&SI/Level A Takes Based on Analogy to Species Taken in Commercial Fisheries

This table summarizes the AFSC request for combined potential takes by Mortality and Serious Injury (M&SI) and Level A harassment for species that are considered analogous (i.e., similar in vulnerability to take in the given research area and fishing gears) as species that have been taken in commercial fisheries using gears similar to those used in AFSC fisheries research.

Species (Stocks)	Requested M&SI and Level A Take for Five-year Period Based on Analogy to Commercial Fisheries Takes					Total for Five-year Period
	GOARA			BSAIRA		
	Trawl	Longline	Gillnet	Trawl	Longline	
Pacific white-sided dolphin (North Pacific)	0	0	1	0	0	1
Harbor porpoise (Southeast Alaska)	0	0	1	0	0	1
Harbor porpoise (Gulf of Alaska)	0	0	1	0	0	1
Harbor porpoise (Bering Sea)	0	0	0	1	0	1
Dall's porpoise (Alaska)	0	1	1	0	1	3
Steller sea lion (Western DPS)	0	1	1	5	1	8
Steller sea lion (Eastern DPS)	0	1	1	0	0	2
Northern fur seal (Eastern Pacific)	0	1	1	0	1	3
Northern fur seal (California)	0	1	1	0	0	2
Harbor seal (Prince William Sound)	0	0	1	0	0	1
Harbor seal (Sitka/Chatham Strait)	0	0	1	0	0	1

Species (Stocks)	Requested M&SI and Level A Take for Five-year Period Based on Analogy to Commercial Fisheries Takes					Total for Five-year Period
	GOARA			BSAIRA		
	Trawl	Longline	Gillnet	Trawl	Longline	
Harbor seal (Aleutian Islands)	0	0	0	1	0	1
Harbor seal (Pribilof Islands)	0	0	0	1	0	1
Harbor seal (Bristol Bay)	0	0	0	1	0	1
Bearded seal	0	0	0	1	0	1
Ribbon seal	0	0	0	1	0	1
Ringed seal	0	0	0	1	1	2
Spotted seal	0	0	0	1	0	1
Northern elephant seal	1	0	0	0	0	1

6.1.8 Incidental Marine Mammal M&SI/Level A Takes in the CSBSRA Based on Spatial-Temporal Overlap of Species Occurrence and Fisheries Research Effort

Because there has been no historic incidental catch in fisheries research and commercial fisheries have not been authorized in the Chukchi Sea/Beaufort Sea Research Area, it was not possible to use the "by analogy" process employed above to inform our request for possible incidental take of marine mammals in fisheries research activities for this region. Therefore the AFSC examined the potential for this type of take by evaluating the areas of overlap between our proposed fisheries research activities and the distribution of marine mammal species endemic to the area. This analysis considered the seasonality of both our fisheries research activities and the species distributions as well as other factors that may influence the degree of potential overlap such as sea and shorefast ice occurrence (AFSC fisheries research typically avoids working in areas where sea ice is present).

In considering the possible take of beluga whales in the CSBSRA, the AFSC considered that beluga whales show behavior similar to large dolphins and porpoises. While no belugas have been taken in AFSC research or Alaska commercial fisheries, there have been takes of large dolphins elsewhere in trawls. Beluga whales may occur in summer periods within the Chukchi and Beaufort Sea regions where the AFSC may be conducting trawl surveys. Thus to be pre-cautionary, AFSC has included one take each from two stocks of beluga whale (Eastern Chukchi stock and Beaufort Sea stock) in fisheries research trawl surveys in the CSBSRA over the five-year authorization period (Table 6-5).

Additionally as a result of this review, the AFSC requests the take of one each of the following species in fisheries research trawl surveys in the CSBSRA over the five-year authorization period of the following pinnipeds: spotted seal, bearded seal, ringed seal, and ribbon seal (Table 6-5).

Table 6-5 Requested Incidental Marine Mammal M&SI/Level A Takes in Trawl Gear Based on Spatial-Temporal Overlap of Species Occurrence and Fisheries Research Effort in the CSBSRA

This table summarizes the AFSC request for combined potential takes by Mortality and Serious Injury (M&SI) and Level A harassment for species in the CSBSRA. All requested takes are in fisheries research trawls.

Species (Stocks)	Average Annual Requested Take (animals per year)	Requested M&SI and Level A Take Total for Five-year Period
Beluga whale (Eastern Chukchi stock)	0.2	1
Beluga whale (Beaufort Sea stock)	0.2	1
Spotted seal	0.2	1
Bearded seal	0.2	1
Ringed seal	0.2	1
Ribbon seal	0.2	1

6.1.9 Undetermined Species

There are situations when a caught animal cannot be identified to species with certainty. For example, such a case might occur if a young female Steller sea lion was caught in longline gear or trawl gear and freed itself before it could be identified. A number of otariids or large phocids are very difficult to differentiate at sea in poor lighting, making exact identification difficult if it escapes or is freed before it can be brought onboard. Similarly some cetacean species are difficult to identify to species under poor field conditions. In addition, for those takes based on analogy with commercial fisheries, observer reports may not have provided detailed species identifications, simply identifying takes by broad taxa. Thus, to address these situations, the AFSC requests a small number of potential takes of undetermined pinniped and small cetacean species that have been identified as having some risk of interaction with research gears (Tables 6-4 and 6-5). For the GOARA the AFSC requests one undetermined dolphin or porpoise take each in research trawls and research gillnet studies and one undetermined pinniped take in each of research trawl and longline studies over the five-year authorization period (Table 6-6). For the BSAIRA, the AFSC requests one undetermined dolphin or porpoise take in research trawls and one undetermined pinniped take in research trawls and longline studies over the five-year period (Table 6-6). For the CSBSRA, the AFSC requests one take of undetermined pinniped species in research trawls over the five year period (Table 6-6).

The AFSC requests a small number of takes of "undetermined species" to account for those rare, but potential events where an animal may be caught and escape prior to identification or in cases where species is taken contrary to our ability to make predictions based on historic data and the best available science.

Table 6-6 Requested Incidental Marine Mammal M&SI/Level A Takes of Undetermined Species for the Three AFSC Fisheries Research Areas

Species (stock)	Requested M&SI and Level A Take for Five-year Period						Total for Five-year Period
	GOARA			BSAIRA		CSBSRA	
	Trawl	Longline	Gillnet	Trawl	Longline	Trawl	
Undetermined dolphin or porpoise	1	0	1	1	0	0	3

Undetermined pinniped	1	1	0	1	1	1	5

6.1.10 Gear Types for which AFSC Anticipates No Level A, Serious Injury or Mortality Takes

The AFSC is requesting incidental takes of marine mammals in various types of trawl nets, longline gear, and gillnet gear. These are large gears and have either demonstrated Level A or M&SI takes or are similar to commercial gears that have had Level A or M&SI takes. A number of surveys and research activities covered in this LOA application do not use any of the sampling gear covered under the AFSC incidental take request because they are much smaller, are under direct human observation and control, and have not had any observed M&SI/Level A takes. These surveys and research activities use a variety of other gears and equipment to sample the marine environment (see Table 1-1 for project descriptions) that are not expected to result in Level A harassment, serious injury, or mortality interactions with marine mammals, including:

- Various plankton nets
- Various echosounders and sonars
- CTD profilers/Drop cameras
- Towed cameras/AUVs/ROVs
- Continuous water samplers
- Video camera sleds/beam trawls
- Fish pots/holding pens
- SCUBA divers
- VR2 passive acoustic receivers
- Beach seines and pole seines
- Predator exclusion cages
- Benthic settling plates
- Fyke nets
- Epibenthic tow sleds
- Electro-fishing gear
- Remote PIT detectors
- Water quality instruments

6.1.11 Mitigation and Minimization of Takes

Because of the suite of mitigation measures AFSC has implemented, it expects the total number of M&SI/Level A takes of marine mammals in these gears to decrease in the future and be substantially less than the estimated level of take when summed across all species. Current mitigation includes using marine mammal watches, a move-on rule to minimize chances for gear to be deployed with marine mammals nearby, and modified net retrieval procedures if marine mammals are sighted while gear is in the water (see Section 11 for additional information on mitigation and Section 13 for information on monitoring and reporting interactions). The AFSC continues to look for additional ways to minimize marine mammal takes during the course of its fisheries research, such as experimenting with new sampling methods that eliminate the possibility of marine mammal mortalities (e.g. video and acoustic sampling to replace fishing gear). The results of these studies are expected to influence future sampling protocols and gear development.

6.1.12 Conclusion

The AFSC has used its historical interactions with marine mammals in fisheries research surveys as a basis for estimating potential M&SI/Level A takes of these species and of other species it has not interacted with, but which it believes shares similar vulnerabilities to trawl, gillnet, and longline gear used in commercial fisheries that have caught marine mammals. In those cases where a species has been identified as historically taken, and/or taken by analogy to species historically taken, or taken in commercial fisheries using similar gear, the AFSC is only requesting take based on one type of analogy. For example, Dall's porpoise have been historically taken by AFSC research trawls in the GOARA; they were also identified as having been taken in analogous commercial trawl fisheries in the GOARA. The final AFSC request in trawls is only for the five animals over the five-year authorization period based on the historic take, not some additive number of the two analogy types. Table 6-7 provides a summary for all AFSC requested takes for marine mammals in all gears and research areas as described in sections 6.1.6 through 6.1.8 and Tables 6-2, 6-3, 6-4, 6-5, and 6-6.

Because of the relatively low level of survey effort, historical interactions, and predicted takes (mortality, serious injury, and Level A harrassment combined) relative to population size, and the fact that take will likely be minimized through the implementation of the AFSC mitigation measures, the AFSC believes that its activities will have a negligible impact on marine mammals in Alaskan waters. The basis for this statement is discussed in greater detail in Section 7 of this application.

Further, the AFSC notes that, despite its best efforts to estimate realistic potential marine mammal M&SI/Level A takes, it believes 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 here 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. Our understanding of the potential effects of AFSC activities on marine mammals is continually evolving. Reflecting this, the AFSC proposes to include an adaptive management component within the application (see Section 13 of this application). This allows the AFSC, in concert with NMFS Office of Protected Resources, to consider, on a case-by-case basis, new data to determine whether mitigation should be modified.

Table 6-7 Requested M&SI/Level A Marine Mammal Takes in the Three AFSC Research Areas by Gear Type

This table summarizes the AFSC request for combined potential takes by Mortality and Serious Injury (M&SI) and Level A harassment for the requested five-year authorization period using trawls, longline gear, and gillnets. Takes shown for species and stocks include those for undetermined species. See Section 7 for discussion of potential impacts to these species.

Species (Stock)	Requested M&SI/Level A Takes 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 stock)	0	0	0	0	0	1	1	0	0	1
Beluga whale (Beaufort Sea stock)	0	0	0	0	0	1	1	0	0	1
Pacific white-sided dolphin (North Pacific stock)	5[3]	0	1	0	0	0	5	0	1	6
Harbor porpoise (Southeast Alaska stock)	1[3]	0	1	0	0	0	1	0	1	2
Harbor porpoise (Gulf of Alaska stock)	1[3]	0	1	0	0	0	1	0	1	2
Harbor porpoise (Bering Sea stock)	0	0	0	1	0	0	1	0	0	1
Dall's porpoise (Alaska stock)	5[4]	1	1	5[4]	1	0	10	2	1	13
Undetermined dolphin or porpoise	1	0	1	1	0	0	2	0	1	3
Steller sea lion (Western DPS)	5[3]	1	1	5[3]	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[4]	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

Species (Stock)	Requested M&SI/Level A Takes 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 (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
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 CSBSRA, 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.

6.2 Estimated Number of Potential Marine Mammal Takes by Acoustic 'Level B' Harassment and Derivation of the Number of Potential Takes

Estimating sound exposures leading to behavioral effects of intermittent high frequency sounds from active acoustic devices used in fisheries research is challenging for a variety of reasons. Among these are the wide variety of operating characteristics of these devices, variability in sound propagation conditions throughout the typically large areas in which they are operated, uneven (and often poorly understood) distribution of marine species, differential (and often poorly understood) hearing capabilities in marine species, and the uncertainty in the potential for effects from different acoustic systems on different species. The AFSC took a dual approach in assessing the impacts of high-frequency active acoustic sources used in fisheries research in the three areas where AFSC conducts fisheries research (GOARA, BSAIRA, and CSBSRA) and, where appropriate within each area, to appropriately address species occurrence within the geographical areas where it operates these devices within two depth strata: 0-200 meter depth and >200 meter depth.

The first approach was a qualitative assessment of potential impacts across species and sound types. This analysis considers a number of relevant biological and practical aspects of how marine mammals likely receive and may be impacted by these kinds of sources. This assessment (described in greater detail in Section 7.2 below) considered the best available current scientific information on the impacts of noise exposure on marine life and the potential for the types of acoustic sources used in AFSC surveys to have behavioral and physiological effects. The results indicate that a subset of the sound sources used are likely to be entirely inaudible to all marine mammals, that some of the lower frequency and higher power systems may be detectable over moderate ranges for some species (although this depends strongly on inter-specific differences in hearing capabilities). As discussed in more detail (see Section 7.2), current scientific information supports the conclusion that direct physiological harm is quite unlikely but behavioral avoidance may occur to varying degrees in different species. Consequently, any potential direct injury (as defined by NMFS relative to the MMPA as Level A harassment and currently estimated as 180 and 190 dB root mean square (rms) received levels respectively for cetaceans and pinnipeds) from these fisheries research acoustic sound sources was deemed highly unlikely and were not directly calculated.

Building on this assessment to attempt to quantify behavioral impacts, an analytical framework was derived and applied to estimate potential Level B harassment by acoustic sources (as defined relative to the MMPA). This analysis used characteristics of active acoustic systems, their expected patterns of use in the AFSC research areas, and characteristics of the marine mammal species that may interact with them to estimate Level B harassment of marine mammals. This approach is relatively straightforward and (although certain adaptations enable a more realistic spatial depiction of exposed animals in the water column) relies on average density values of marine species. While the AFSC believes this quantitative assessment benefits from its simplicity and consistency with the current NMFS guidelines regarding estimates of Level B harassment by acoustic sources, based on a number of deliberately precautionary assumptions, the resulting take estimates should be seen as a likely overestimate of behavioral harassment from the operation of these systems. Additional details on the approach used and the assumptions made that result in a conservative estimate of the number of exposures at received levels identified as Level B harassment) are described in Section 6.2.7.

6.2.1 Framework for Quantitative Estimation of Potential Acoustic Harassment Takes

The discussion in section 7.2 considers the differential frequency bands of hearing in marine animals in deriving a qualitative assessment of the probable risk of particular acoustic impacts from general categories of active acoustic sources, and is likely a more appropriate means of assessing their overall impact from a limited set of deployments given the level of scientific uncertainty in a variety of areas.

However, in order to meet the compliance requirements for assessing the potential environmental impact of AFSC fisheries research, in this case acoustic impacts, a quantitative estimate of potential incidents of Level B harassment is required.

Different sound exposure criteria are typically used for impulsive and continuous sources (Southall et al. 2007). Under the current NMFS guidelines for calculating Level B harassment, an animal is considered taken if it is exposed to continuous sounds at a received level of 120 dB rms or impulsive sounds at a received level of 160 dB rms. These are simple step-function thresholds that do not consider the repetition or sustained presence of a sound source. Sound produced by the fisheries acoustic sources here are very short in duration (typically on the order of milliseconds), intermittent, have high rise times, and are operated from moving platforms. They are consequently considered most similar to impulsive sources, which are subject to the 160 dB rms criterion. A mathematical method for estimating exposures according to this step-function was derived and applied in each of the three AFSC research areas where active acoustic gear is used (GOARA, BSAIRA, CSBSRA).

The assessment paradigm for active acoustic sources used in AFSC fisheries research is relatively straightforward and has a number of key simplifying assumptions, most of which are deliberately precautionary given the known areas of uncertainty. These underlying assumptions (described in greater detail in 6.2.6, below) very likely lead to an overestimate of the number of animals that may be exposed at the 160 dB rms level in any one year on average for each area. Conceptually, Level B harassment may occur when a marine mammal interacts with an acoustic signal and exhibits a behavorial response. Estimating the number of exposures at the specified received level requires several determinations, each of which is described sequentially below:

1. A detailed characterization of the acoustic characteristics of the effective sound source or sources in operation;
2. The operational areas exposed to levels at or above those associated with Level B harassment when these sources are in operation;
3. A method for quantifying the resulting sound fields around these sources; and
4. An estimate of the average density for marine mammal species in each research area.

Quantifying the spatial and temporal dimensions of the sound exposure footprint of the active acoustic devices in operation on moving vessels and their relationship to the average density of marine mammals enables a quantitative estimate of the number of individuals for which sound levels exceed NMFS Level B Harassment threshold for each area. Because depths range dramatically along the margin of the continental slope that define the outer edge of the survey areas, the depth range for determining volumes was set at 500 m for deep diving species because deeper surveyed depths rarely range over 500 m. Therefore, the number of Level B harassment events is ultimately estimated as the product of the volume of water insonified to 500 m and at sound intensities greater than 160 dB rms and the volumetric density of animals determined from simple assumptions about their vertical stratification in the water column. Specifically, reasonable assumptions based on what is known about diving behavior and onshore and offshore distributions among different marine mammal species were made to segregate those that predominately remain in the upper 200 meters versus those that regularly dive deeper during foraging and transit and for those animals that reside in inshore-shelf waters and shelf and offshore waters. Methods for estimating each of these calculations are described in greater detail in the following sections, along with the simplifying assumptions made, and followed by the take estimates for each of the three research areas where the AFSC conducts fisheries research.

6.2.2 AFSC Sound Source Characteristics

An initial characterization of the general source parameters for the primary AFSC vessels operating active acoustic sources was conducted (Table 6-8). This process enabled a full assessment of all sound sources, including those within the category 1 sources (discussed in Section 7.2 below) that are entirely outside the range of marine mammal hearing (not shown here). This auditing of the active sources also enabled a determination of the predominant sources that, when operated, would have sound footprints exceeding those from any other simultaneous sources. These sources were effectively those used directly in acoustic propagation modeling to estimate the zones within which the 160 dB rms received level would occur.

The full range of sound sources used in fisheries acoustic surveys were considered. Many of these sources can be operated in different modes and with different output parameters. In modeling their potential impact areas for these vessels when used and also when they are operated from non-NOAA vessels used for AFSC survey operations, those features among those given below that would lead to the most precautionary estimate of maximum received level ranges (i.e. largest insonified area) were used (e.g., lowest operating frequency). These operating characteristics of each of the predominant sound sources were used in the calculation of effective line km (Section 6.2.3) and area of exposure (Section 6.2.6) specific to each source in each survey.

Sources operating at frequencies above the functional hearing range of any marine mammal (typically above 180 kHz; see section 7.2) were excluded from quantitative analysis. Among those operating within the audible band of marine mammal hearing, three predominant sources were identified as having the largest potential impact zones during operations, based on their relatively lower output frequency, higher output power, and their operational pattern of use. In determining the effective line km for each of these predominant sources (Table 6-8) the operational patterns of use relative to one another were further applied to determine which source was the predominant one operating at any point in time for each survey. When multiple sound sources were used simultaneously, the one with the largest potential impact zone in each relevant depth strata was used in calculating takes. For example, when species (e.g., sperm whales) regularly dive deeper than 200 meters, the largest potential impact zone was calculated for both depth strata and in some cases resulted in a different source being predominant in either depth strata. This enabled a more comprehensive way of accounting for maximum exposures for animals diving in a complex sound field resulting from simultaneous sources with different spatial profiles. This overall process effectively resulted in three sound sources (ES60, EK60/ME70, and Reson 7111) comprising the total effective line km, their relative proportions depending on the nature of each survey (see Tables 6-8 and 6-9).

Table 6-8 Output Characteristics for Predominant AFSC Acoustic Sources

Note: Calculations of effective exposure areas are made with the lowest frequency from sources with multiple frequencies; the full range of frequencies used is shown in parentheses. Abbreviations: dB re 1 µPa at 1 m = decibels referenced at one micro Pascal at one meter; km^2 = square kilometer

Acoustic system	Operating frequencies (kHz)	Source level (dB re 1 µPa at 1 m)	Nominal beam width (deg)	Effective exposure area: Sea surface to 200 m depth (km^2)	Effective exposure area: Sea surface to 500 m depth (km^2)	Effective exposure area: Sea surface to depth at which sound is attenuated to 160 dB SPL (km^2)
ES60	38 kHz (120 kHz)	226.6	7	0.0112	0.0112	0.0712
EK60/ME70	18 kHz (38, 70, 120, 200 kHz/70 kHz)	226.7	11	0.0173	0.0561	0.2173
Reson 7111	100 kHz (50, 38 kHz)	230	150	0.1419	0.9144	1.204

6.2.3 Calculating Effective Line Kilometer for Each Vessel

Estimated volumes of water insonified to the 160 dB rms received level and water insonified to 500 m was determined based on the operating parameters for each sound source type as described below. In all cases where multiple sources are operated simultaneously, the one with the largest estimated acoustic footprint (and thus leading to higher estimated Level B harassment) was used as the effective source. Two depth zones were defined for each of the three research areas: 0-200 m and > 200 m, generally relating to operations on the shallower upper Continental Shelf and those in deeper waters. Effective line distance and volume insonified was calculated for each depth strata (0-200 m and > 200 m), where appropriate. In some cases, this resulted in different sources being predominant in each depth strata for all line km when multiple sources were in operation; this was accounted for in estimating overall exposures for species that utilize both depth strata (deep divers). The line distance was calculated for each survey using acoustic gear by accumulating or estimating the distance traveled during targeted survey operations and did not include the distances running between stations or to port. For each AFSC research area, the total number of line km that would be surveyed was determined, as was the relative percentage of surveyed linear km associated with each source. The total line km for each dominant source used over the various projects, the effective portions associated with each of the dominant sound sources, and the effective total km for operation for each sound source is given in Table 6.9.

Table 6-9 Annual Linear Survey Distance for Each Survey using NOAA and Charter Vessels and the Dominant Sources within Two Depth Strata for Each of the Three AFSC Research Areas

Only the sound sources that were the dominant sources of sound during AFSC research are shown.

Vessel Survey	Total Distance (km/vessel) over five years [a]	Source	% of Distance Source Dominant (0-200m)	% of Distance Source Dominant (>200m)	Line km source <200m	Line km source >200m	Volume Insonified 0-200 m Depth (km^3)	Volume Insonified 0-500 m Depth (km^3)	Volume Insonified Full Depth (surface to on-axis range at which SL is attenuated to 160 dB) (km^3)
GULF OF ALASKA RESEARCH AREA									
R/V *Oscar Dyson* Pollock summer Acoustic Trawl (GOA biennial)	17558	EK60/ ME70	74%	26%	12993	4565	224.778	256.101	991.992
R/V *Oscar Dyson* Pollock Winter Acoustic Trawl Survey - Shelikof Strait	9540	EK60/ ME70	31%	69%	2957	6583	51.163	369.284	1430.399
R/V *Oscar Dyson* Pollock Winter Acoustic Trawl Survey – Shumagin/ Sanak Islands	4520	EK60/ ME70	99%	1%	4475	45	77.414	2.536	9.822
Charter Vessels (3) Gulf of Alaska Shelf and Slope Bottom Trawl Groundfish Survey (Biennial)	9189	ES60	76%	24%	6983.64	2205.36	78.217	79.393	157.022
BERING SEA/ALEUTIAN ISLANDS RESEARCH AREA									
Charter Vessels (2) Aleutian Islands Shelf and Slope Bottom Trawl Groundfish Survey (Biennial)	3190	ES60	61%	39%	1946	1244	21.794	44.788	88.580
Charter Vessel Arctic Ecosystem Integrated Survey	2599	ES60	100%	0%	2599	0	29.109	0	0
Charter Vessels (2) Bering Sea Shelf Bottom Trawl Survey	11200	ES60	100%	0%	11200	0	125.440	0	0
Charter Vessel Eastern Bering Sea Upper Continental Slope Trawl Survey Summer (Biennial)	1125	ES60	0%	100%	0	1125	0.000	40.500	80.100

Vessel Survey	Total Distance (km/vessel) over five years [a]	Source	% of Distance Source Dominant (0-200m)	% of Distance Source Dominant (>200m)	Line km source <200m	Line km source >200m	Volume Insonified 0-200 m Depth (km^3)	Volume Insonified 0-500 m Depth (km^3)	Volume Insonified Full Depth (surface to on-axis range at which SL is attenuated to 160 dB) (km^3)
R/V *Oscar Dyson* Pollock Summer Acoustic Trawl Survey - Bering Sea	25460	EK60/ ME70	91%	9%	23169	2291	400.817	128.548	497.921
R/V *Oscar Dyson* Pollock Winter Acoustic Trawl Survey - Bogoslof Island (Biennial)	2788	EK60/ ME70	15%	85%	418	2370	7.235	132.946	514.958
Charter Vessel Bering Aleutian Salmon International Survey (BASIS)	12288	ES60	95%	5%	11674	614	130.744	34.468	43.745
R/V *Fairweather* Acoustic Research and Mapping to Characterize EFH (FISHPAC)	145	Reson 7111	100%	0%	145	0	20.576	0	0
Charter Vessel Response of Fish to Drop Camera Systems	259	ES60	100%	0%	259	0	2.901	0	0
Charter Vessel Northern Bering Sea Bottom Trawl Survey	1440	ES60	100%	0%	1440	0	16.128	0	0
CHUKCHI SEA/BEAUFORT SEA RESEARCH AREA									
Charter Vessel Arctic Ecosystem Integrated Survey	5915	ES60	100%	0%	5915	0	66.248	0	0

a. Estimated Annual Active Lineal Distance (km) - This considers ONLY effective line effort of active acoustic operations directed at mobile survey efforts (not transit or other non-directed times) for each research area.

6.2.4 Calculating Volume of Water Insonified to 160 dB RMS Received Level

The cross-sectional area of water insonified to 160+ dB rms received level was calculated using a simple model of sound propagation loss, which accounts for the loss of sound energy over increasing range. We used a spherical spreading model (where propagation loss = 20 x log (range) - such that there would be 60 dB of attenuation over 1000 m). This is a reasonable assumption even in relatively shallow waters since, taking into account the beam angle, the reflected energy from the seafloor will be much weaker than the direct source and the volume influenced by the reflected acoustic energy would be much smaller over the relatively short ranges involved. The spherical spreading model accounted for the frequency dependent absorption coefficient and the highly directional beam pattern of most of these sound sources. For absorption coefficients, the most commonly used formulas given by Francios and Garrison (1982) were used. The lowest frequency was used for systems that are operated over a range of frequencies. The vertical extent of this area is calculated for two depth strata (surface to 200 m, and for deep water operations, surface to range at which the on-axis received level reaches 160 dB rms up to 500 m depth). This was applied differentially based on the typical vertical stratification of marine mammals (see Tables 6.10 a-c). A simple visualization of a two-dimensional slice of modeled sound propagation is shown in Figure 6-2 to illustrate the predicted area ensonified to the 160 dB level by an EK-60 operated at 18kHz.

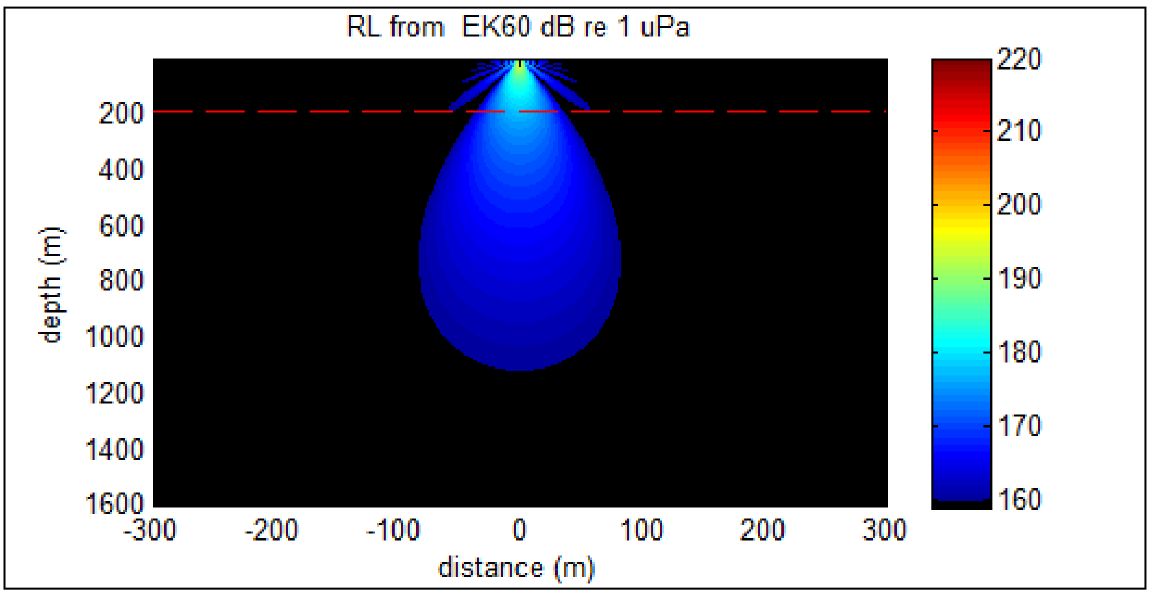

Figure 6-2 Visualization of a Two-Dimensional Slice of Modeled Sound Propagation to Illustrate the Predicted Area Insonified to the 160 dB Level by an EK-60 Operated at 18 kHz

The dashed red line marks the transition between the two depth strata (0-200 m and >200 m).

Following the determination of effective sound exposure area for transmissions considered in two dimensions, the next step was to determine the effective volume of water insonified >160 dB rms for the entirety of each survey in each region. For each of the three predominant sound sources, the volume of water insonified is estimated as the athwartship cross-sectional area (in km^2) of sound above 160 dB rms (as shown in the figure above) multiplied by the total distance traveled by the ship. When different sources are operating simultaneously, they may be predominant in different depth strata (e.g., if ME70 and EK60 are operating simultaneously, the ME70 could be predominant in shallow water but the EK60 could be predominant in deeper water). The resulting calculated cross sectional area took this into account. Specifically, for shallow-diving species this cross-sectional area was determined for whichever was predominant in the shallow strata whereas for deeper diving species in deeper water this area was calculated from the combined effects of the predominant source in the shallow strata and the (sometimes different) source predominating in the deeper strata). This creates an effective total volume characterizing the area insonified when each predominant source is operated and accounts for the fact that deeper diving species may encounter a complex sound field in different portions of the water column. These same inputs were used to determine the volume of water insonified to a depth of 500 m.

6.2.5 Species-specific Marine Mammal Densities

One of the primary limitations to traditional estimates of acoustic exposure is the assumption that animals are uniformly distributed in time and space across very large geographical areas, such as those being considered here. There is ample evidence that this is in fact not the case and marine species are highly heterogeneous in terms of their spatial distribution, largely as a result of species-typical utilization of heterogeneous ecosystem features. Some more sophisticated modeling efforts have attempted to include species typical behavioral patterns and diving parameters in movement models that more adequately assess the spatial and temporal aspects of distribution and thus exposure to sound. While simulated movement models were not used to mimic individual diving or aggregation parameters in the determination of animal density in this estimation, the vertical stratification of marine mammals based on known or reasonably assumed diving behavior was integrated into the density estimates used.

First, typical two-dimensional marine mammal density estimates (animals/km^2) were obtained from various sources for each ecosystem area. These included marine mammal Stock Assessment Reports for the Pacific and Alaska and other sources and are based on the best scientific information available to the AFSC (Table 6-10d). There are a number of caveats associated with these estimates:

- They are often calculated using visual sighting data collected during one season rather than throughout the year. The time of year when data were collected and from which densities were estimated may not always overlap with the timing of AFSC fisheries research surveys (see section 1.6 or Table 1.1 for survey periods).
- Marine mammal survey areas do not necessarily coincide spatially with the entire AFSC fisheries research area boundaries. Estimated densities from the survey areas are assumed to apply to the entire research area.
- The densities used for purposes of estimating acoustic harassment takes do not take into account the patchy distributions of marine mammals in an ecosystem, at least on the moderate to fine scales over which they are known to occur. Instead, animals are considered evenly distributed throughout the assessed area and seasonal movement patterns are not taken into account.

In addition and to account for at least some coarse differences in marine mammal diving behavior and the effect this has on their likely exposure to these kinds of sometimes highly directional sound sources, a volumetric density of marine mammals of each species was determined. This value is estimated as the abundance averaged over the two-dimensional geographic area of the surveys and the vertical range of typical habitat for the population. Habitat ranges were categorized in two generalized depth strata (0-200 m, and 0 to >200 m) based on gross differences between known generally surface-associated and typically deep-diving marine mammals (Reynolds and Rommel 1999, Perrin et al. 2008). Animals in the shallow diving strata were reasonably estimated, based on empirical measurements of diving with monitoring tags and reasonable assumptions of behavior based on other indicators to spend a large majority of their lives (>75 percent) at depths of 200 m or shallower. Their volumetric density and thus exposure to sound is thus limited by this depth boundary. Species in the deeper diving strata were reasonably estimated to regularly dive deeper than 200 m and spend significant time at these greater depths. Their volumetric density and thus potential exposure to sounds up to the 160 dB rms level is extended from the surface to the depth at which this received level condition occurs and/or the water depth in the region of interest (e.g. the Continental Shelf region was generally considered to be comprised of water no deeper than 500 m, the outer limit of most research surveys).

The volumetric densities are estimates of the three-dimensional distribution of animals in their typical depth strata. For shallow diving species or in regions where water depth is <200m (e.g., CSBSRA) the volumetric density is the area density divided by 0.2 km (i.e., 200 m depth). For deeper diving species, the volumetric density is the area density divided 0.5 km (i.e., 500 m depth). The two-dimensional and resulting three-dimensional (volumetric) densities for each species in each AFSC fisheries research area are shown in Tables 6.10a, 6.10b, and 6.10c.

Volumetric densities and takes were further affected by whether the species occurred in inshore or offshore waters. Most species designated as shallow divers (<200 m depth) were considered to be shelf and inshore species, and their lineal distance was the extent of survey areas to 200 m in depth. However, some shallow diving species also occur in offshore waters so the density to 200 m depth was applied to the volumetric density of all survey tracks. These species included gray whale; harbor porpoise in GOARA; northern fur seal; Steller sea lion; Dalls's porpoise; humpback, beluga (Bristol Bay stock), killer (ENP stock), and sei whales in the BSAIRA; and bearded, ribbon, ringed, and spotted seals in the BSAIRA. Ensonified volumes for deep diving species were summed for the shallow inshore component and the deeper waters.

Table 6-10a Volumetric Densities Calculated for Each Species in the GOARA used in Level B Acoustic Take Estimation

Species (common name)	Typical Dive Depth Strata		Area density (#/km^2)	Volumetric density (#/km^3)
	0-200 m	>200 m		
GULF OF ALASKA RESEARCH AREA				
Baird's beaked whale - Alaska Stock		X	0.0017	0.0034
Beluga whale - Cook Inlet DPS	X		0.2	1
Blue whale - Eastern North Pacific stock	X		0.0001	0.0005
Cuvier's beaked whale - Alaska Stock		X	0.00009	0.00018
Dall's porpoise - Alaska Stock	X		1.6	8.0
Fin whale - Northeast Pacific Stock	X		0.02	0.1
Gray whale - Eastern North Pacific Stock	X		1.7	8.5
Harbor porpoise - Gulf of Alaska Stock	X		0.2	1
Harbor porpoise - Southeast Alaska Stock	X		0.11	0.55
Harbor seal - Clarence Strait Stock	X		0.099	0.4942
Harbor seal - Cook Inlet/Shelikof Strait Stock	X		0.031	0.1555
Harbor seal - Dixon/Cape Decision Stock	X		0.057	0.2829
Harbor seal - Glacier Bay/Icy Strait Stock	X		0.022	0.1126
Harbor seal - Lynn Canal/Stephens Passage Stock	X		0.030	0.1481
Harbor seal - North Kodiak Stock	X		0.009	0.472
Harbor seal - Prince William Sound Stock	X		0.061	0.3034
Harbor seal - Sitka/Chatham Strait Stock	X		0.046	0.2321

Species (common name)	Typical Dive Depth Strata		Area density (#/km^2)	Volumetric density (#/km^3)
	0-200 m	>200 m		
Harbor seal - South Kodiak Stock	X		0.022	0.1090
Humpback whale - Central North Pacific Stock	X		0.0653	0.3265
Humpback whale - Western North Pacific Stock	X		0.0007	0.0035
Killer whale - AT1 Transient/Prince William Sound Stock	X		0.0007	0.0035
Killer whale - Eastern North Pacific Alaska Resident Stock	X		0.009	0.045
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	X		0.0007	0.0035
Killer whale - Eastern North Pacific Northern Resident Stock	X		0.0025	0.0125
Killer whale - West Coast Transient Stock	X		0.0056	0.028
Killer whale - Offshore Stock	X		0.011	0.055
Minke whale - Alaska Stock	X		0.0012	0.006
North Pacific right whale - Eastern North Pacific Stock	X		0.0053	0.0265
Northern elephant seal		X	0.02	0.045
Northern fur seal - California Stock GOA E 144	X		0.0437	0.2185
Northern fur seal - Eastern Pacific Stock GOA wide, winter	X		0.3766	1.8831
Northern fur seal - Eastern Pacific Stock GOA wide, summer	X		0.1163	0.5817
Pacific white-sided dolphin - North Pacific Stock	X		0.015	0.075
Sei whale - Eastern North Pacific stock	X		0.000006	0.00003
Sperm whale - North Pacific Stock		X	0.001	0.002
Stejneger's beaked whale - Alaska Stock		X	0.0051	0.0102
Steller sea lion - Eastern Stock GOA wide	X		0.0588	0.294
Steller sea lion - Eastern Stock E 144	X		0.2206	1.103
Steller sea lion - Eastern Stock W 144	X		0.0012	0.006
Steller sea lion - Western DPS GOA wide	X		0.0351	0.1755
Steller sea lion - Western DPS E 144	X		0.0029	0.0145
Steller sea lion - Western DPS W 144	X		0.0478	0.239

Table 6-10b Volumetric Densities Calculated for Each Species in the BSAIRA used in Level B Acoustic Take Estimation

Species (common name)	Typical Dive Depth Strata		Area density (#/km^2)	Volumetric density (#/km^3)
	0-200 m	>200 m		

Species (common name)	Typical Dive Depth Strata		Area density (#/km²)	Volumetric density (#/km³)
	0-200 m	>200 m		
BERING SEA – ALEUTIAN ISLANDS RESEARCH AREA				
Baird's beaked whale - Alaska Stock		X	0.0017	0.0034
Bearded seal - Alaska Stock	X		0.3935	1.9675
Beluga whale - Bristol Bay Stock	X		0.7	3.5
Beluga whale - Eastern Bering Sea Stock	X		0.242	0.484
Bowhead whale - Western Arctic Stock	X		0.017	0.085
Cuvier's beaked whale - Alaska Stock		X	0.00009	0.00018
Dall's porpoise - Alaska Stock	X		0.0327	0.1635
Fin whale - Northeast Pacific Stock	X		0.0014	0.007
Gray whale - Eastern North Pacific Stock	X		0.38	1.9
Harbor porpoise - Bering Sea Stock	X		0.45	2.25
Harbor seal - Aleutian Islands Stock	X		0.0029	0.0144
Harbor seal - Bristol Bay Stock	X		0.0145	0.0724
Harbor seal - Pribilof Islands Stock	X		0.0001	0.0005
Humpback whale - Central North Pacific Stock	X		0.0184	0.092
Humpback whale - Western North Pacific Stock	X		0.0016	0.008
Killer whale - Eastern North Pacific Alaska Resident Stock	X		N/A	
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	X		0.0026	0.013
Killer whale - Offshore Stock	X		0.011	0.055
Minke whale - Alaska Stock	X		0.0021	0.0105
North Pacific right whale - Eastern North Pacific Stock	X		0.0003	0.0015
Northern fur seal - Eastern Pacific Stock, winter	X		0.0753	0.3765
Northern fur seal - Eastern Pacific Stock, summer	X		0.2151	1.0753
Pacific white-sided dolphin - North Pacific Stock	X		0.0054	0.027
Ribbon seal - Alaska Stock	X		0.2407	1.2035
Ringed seal - Arctic Subspecies/Alaska Stock	X		0.3492	1.746
Sei whale - Eastern North Pacific stock	X		0.00018	0.0009
Sperm whale - North Pacific Stock		X	0.008	0.016
Spotted seal - Alaska Stock	X		0.6012	3.006
Stejneger's beaked whale - Alaska Stock		X	0.0012	0.0024
Steller sea lion - Western DPS	X		0.0119	0.0595
Steller sea lion - Eastern DPS	X		0.0001	0.0005

Table 6-10c Volumetric Densities Calculated for Each Species in the CSBSRA used in Level B Acoustic Take Estimation

Species (common name)	Typical Dive Depth Strata		Area density (#/km^2)	Volumetric density (#/km^3)
	0-200 m	>200 m		
CHUKCHI SEA – BEAUFORT SEA RESEARCH AREA				
Beluga whale - Beaufort Sea Stock	X		0.008	0.04
Beluga whale - Eastern Chukchi Sea Stock	X		0.008	0.04
Bowhead whale - Western Arctic Stock	X		2.27	11.35
Fin whale - Northeast Pacific Stock	X		0.0001	0.0005
Gray whale - Eastern North Pacific Stock	X		0.01	0.05
Harbor porpoise – Bering Sea Stock	X		0.0001	0.0005
Humpback whale - Central North Pacific Stock	X		0.0001	0.0005
Humpback whale - Western North Pacific Stock	X		0.0001	0.0005
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	X		0.00001	0.00005
Minke whale - Alaska Stock	X		0.0001	0.0005
Ribbon seal - Alaska Stock	X		0.18436	0.9218
Ringed seal - Arctic Subspecies/Alaska Stock	X		1.765	8.825
Spotted seal - Alaska Stock	X		0.460	2.302
Bearded seal - Alaska Stock	X		0.175	0.875

Table 6-10d Sources of Marine Mammal Density Information used to Develop Tables 6-10a-c

Species/Stock	Source of estimate (e.g. reference, short description of process used to estimate density)
GOARA	
Baird's beaked whale - Alaska Stock	GOALS sightings from Rone, BK, AB Douglas, TM Yack, AN Zerbini, TN Norris, E Ferguson, J Calambokidis, and PJ Clapham. 2014. Report for the Gulf of Alaska line-transect survey (GOALS)II: marine mammal occurrence in the temporary maritime activities area (TMAA). Submitted to Naval Facilites Engineering Command (NAVFAC) Pacific, Honolulu, Hawaii under Contract No. N62470-10-D-3011, Task Order 0022, issued to HDR Inc., San Diego, California. Prepared by Cascadia Research Collective, Olympia, Washington; Alaska Fisheries Science Center, Seattle, Washington; and Bio-Waves, Inc., Encinitas, California, April 2014, with g(0) and ESW from Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka, and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family Ziphiidae). J. Cetacean Res. Manage 783(3) 263-270; Table 2 California Surveys
Beluga whale - Cook Inlet DPS	Based on 2014 abundance estimate and region in upper CI where whales were found (340 whales within 1740 sq. km). Note Goetz et al. 2012, Endang. Spec. Res., found at river mouths this density could be as high as 1.1/sq. km)
Blue whale – Eastern North Pacific Stock	Rone, BK, AN Zerbini, AB Douglas, J Calambokidis, PJ Clapham. Abundance and distribution of cetacean in the central Gulf of Alaska, in review.

Species/Stock	Source of estimate (e.g. reference, short description of process used to estimate density)
Cuvier's beaked whale - Alaska Stock	GOALS sightings from Rone, BK, AB Douglas, TM Yack, AN Zerbini, TN Norris, E Ferguson, J Calambokidis, and PJ Clapham. 2014. Report for the Gulf of Alaska line-transect survey (GOALS)II: marine mammal occurrence in the temporary maritime activities area (TMAA). Submitted to Naval Facilites Engineering Command (NAVFAC) Pacific, Honolulu, Hawaii under Contract No. N62470-10-D-3011, Task Order 0022, issued to HDR Inc., San Diego, California. Prepared by Cascadia Research Collective, Olympia, Washington; Alaska Fisheries Science Center, Seattle, Washington; and Bio-Waves, Inc., Encinitas, California, April 2014, with g(0) and ESW from Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka, and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family Ziphiidae). J. Cetacean Res. Manage 783(3) 263-270; Table 2 California Surveys
Dall's porpoise - Alaska Stock	MML staff, in prep.; Laake, J. L., J. Calambokidis, S. D. Osmek, and D. J. Rugh. 1997. Probability of detecting harbor porpoise from aerial surveys: Estimating g(0). J. Wildl. Manage. 61(1):63-75
Fin whale - Northeast Pacific Stock	NMML staff, publication in review.
Gray whale - Eastern North Pacific Stock	Moore et al. 2007, Mar. Mammal Sci., gray whale feeding aggregation off Kodiak Is. (400 whales within 240 sq. km area)
Harbor porpoise - Gulf of Alaska Stock	N/area from Hobbs, R. C. and J M. Waite. 2010. Abundance of harbor porpoise (Phocoena phocoena) in three Alaskan regions, corrected for observer errors due to perception bias and species misidentification, and corrected for animals submerged from view. Fish. Bull., U.S. 108(3):251-267.
Harbor porpoise - Southeast Alaska Stock	N/area from Hobbs, R. C. and J M. Waite. 2010. Abundance of harbor porpoise (Phocoena phocoena) in three Alaskan regions, corrected for observer errors due to perception bias and species misidentification, and corrected for animals submerged from view. Fish. Bull., U.S. 108(3):251-267. Note Dahlheim et al found densities of 0.18 and 0.14 in two regions of SEAK
Harbor seal - Clarence Strait Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - Cook Inlet/Shelikof Strait Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - Dixon/Cape Decision Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - Glacier Bay/Icy Strait Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - Lynn Canal/Stephens Passage Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - North Kodiak Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - Prince William Sound Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. This stock was split 55/45 to west and east areas based upon lineal distance of approximate distribution. Source: 2015 Draft SARs.
Harbor seal - Sitka/Chatham Strait Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - South Kodiak Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.

Species/Stock	Source of estimate (e.g. reference, short description of process used to estimate density)
Humpback whale - Central North Pacific Stock	Zerbini, AN; Waite, JM; Laake, JL; Wade, PR 2006. Abundance, trends and distribution of baleen whales off Western Alaska and the central Aleutian Islands. Took highest density of any block from Zerbini et al. 2006, which was 0.066 in block 5. Prorated stocks according to Wade et al., with 99% CNP and 1% WNP in BSAI, resulting in 0.0653 for CNP and 0.0007 for WNP.
Humpback whale - Western North Pacific Stock	Zerbini, AN; Waite, JM; Laake, JL; Wade, PR 2006. Abundance, trends and distribution of baleen whales off Western Alaska and the central Aleutian Islands. Took highest density of any block from Zerbini et al. 2006, which was 0.066 in block 5. Prorated stocks according to Wade et al., with 99% CNP and 1% WNP in BSAI, resulting in 0.0653 for CNP and 0.0007 for WNP.
Killer whale - AT1 Transient/Prince William Sound Stock	Seven individuals/area of Prince William Sound (10,000 km2)
Killer whale - Eastern North Pacific Alaska Resident Stock	Density computed with "post-encounter group sizes" for resident killer whales in the Gulf of Alaska (DART blocks 1-10). Ref: Zerbini et al. 2007. Marine Biology
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	Density computed with "post-encounter group sizes" for transient killer whales in the Gulf of Alaska (DART blocks 1-10). Ref: Zerbini et al. 2007. Marine Biology
Killer whale - Eastern North Pacific Northern Resident Stock	As of 2010, 261 individual northern residents were identified via photo-identification studies conducted in British Columbia waters (Ellis, Towers, and Ford, 2011). Some individuals have also been documented in Southeast Alaska. As of 2014, NMML studies have observed approximately 70 individuals in the inland waters of Southeast Alaska between May and September during the years (1991-2014; Dahlheim et al., 2009). Here we use the value of 70 different individuals to calculate density in the inland waters of Southeast Alaska. This density estimate was used for the entire Gulf of Alaska.
Killer whale - West Coast Transient Stock	As of 2011, 274 individual transient killer whales have been documented in the coastal waters of northern Washington, British Columbia, and Southeast Alaska (Towers et al., 2012). Of the total, 155 individuals have been documented from the inland waters of Southeast Alaska (Dahlheim and White, 2010). We used the 155 estimate to calculate density for the inland waters of Southeast Alaska. This density estimate was used for all waters of the Gulf of Alaska.
Killer whale - Offshore Stock	Current abundance estimate of offshore killer whales is 300 (95% probability interval = 257-373; see Ford et al., 2014). We used the estimate of 300 to calculate density for the inland waters of Southeast Alaska. This density estimate was used for the entire Gulf of Alaska.
Minke whale - Alaska Stock	Density in blocks 1-10 (Gulf of Alaska) in Zerbini, AN; Waite, JM; Laake, JL; Wade, PR 2006. Abundance, trends and distribution of baleen whales off Western Alaska and the central Aleutian Islands
North Pacific right whale - Eastern North Pacific Stock	The GOALSII survey had 4 acoustic detections near or in the Critical Habitat area (Rone et al. 2014). The number of photo identifications in the Gulf of Alaska (including BC) in recent years is also 4. It is plausible that all Gulf of Alaska right whales move up onto the shelf area off Kodiak to take advantage of concentrations of diapausing zooplankton that occur in mid to late summer (Wade et al. 2011a). Therefore, a cautious approach (calculating a maximum density) would be a total number from the GOA divided by the area of the Critical Habitat. The number of located or identified whales (4) was arbitrarily multiplied by 4 to account for undetected whales (note that the correction in the Bering Sea was much less (Wade et al. 2011b), so this is hopefully conservative). Therefore, the density is calculated as 16 divided by 3042.2 sq. km.
Northern elephant seal	MML staff based on estimates of age-sex distribution, dive studies, and published population estimates (Lowry et al. 2014).
Northern fur seal - California Stock GOA wide	Pup production * 4.5 in San Miguel and Farallons 2012 = 13,658 all E of 144; 0 west of 144

Species/Stock	Source of estimate (e.g. reference, short description of process used to estimate density)
Northern fur seal - Eastern Pacific Stock GOA wide	Revised to entire Gulf with summer vs winter numbers: Summer, 451,290 animals present, Winter, 139,600 animals present based upon Towell et al. 2016 and Delong pers comm. These numbers are for Unimak east, we will neglect the 1% in the Islands of 4 mountains to Unimak.
Pacific white-sided dolphin - North Pacific Stock	N/A from Hobbs, R.C., and J.A. Lerczak. 1993. Abundance of Pacific white-sided dolphin and Dall's porpoise in Alaska estimated from sightings in the North Pacific Ocean and the Bering Sea during 1987-1991. NMML, AFSC, NOAA, 7600 Sand Point Way, NE, Bldg. 4, Seattle, WA 98115. 13p.
Sei whale – Eastern North Pacific Stock	2 ind/ 321,750 km2 Area of POWER2010 transects within EEZ with 2 sightings; Figure 2b (top) in 2010 Japan Joint Cetacean Sighting Survey Cruise in the North Pacific (IWC)
Sperm whale - North Pacific Stock	NMML staff, publication in review.
Stejneger's beaked whale - Alaska Stock	Based on total number of unidentified beaked whales (assuming they are all Stejneger's, which is a conservative assumption given there are Cuvier's and Baird's there as well) from GOALS II, and effort and area from the slope, offshore, and sea mount strata, then assumed an ESW of 1.0 and g(0) of 0.45 from Barlow et al. This gave an abundance of 726, divided by an area of 142,204 sq km. There were acoustic detections but it is not clear how to easily turn those into a density.
Steller sea lion - Eastern Stock GOA wide	Pup production * 4.5 in SE AK + BC + OR + CA in 2013 100% E of 144 N=70498, N=1093 W of 144 Fritz et al. 2013 tech memo
Steller sea lion - Western DPS GOA wide	Pup production * 4.5 in E ALEU + W GULF + C GULF + E GULF in 2014 100% W of 144 N=42129; N=917 E of 144 Fritz et al. 2013 tech memo
BSAIRA	
Baird's beaked whale - Alaska Stock	GOALS sightings with g(0) and ESW from Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka, and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family Ziphiidae). J. Cetacean Res. Manage 783(3) 263-270; Table 2 California Surveys
Bearded seal - Alaska Stock	Conn et al. 2014, has the most recent abundance estimates for the Bering Sea.
Beluga whale - Bristol Bay Stock	Based on Lowry et al. 2005, J. Cetacean Res. Manage., area surveyed (2900 sq. km) and abundance estimate pers comm to IUCN (2,133 whales,http://www.iucnredlist.org/details/6335/0)
Beluga whale - Eastern Bering Sea Stock	Norton Sound estimates from NMML staff and collaborators (publication in preparation)
Bowhead whale - Western Arctic Stock	See Chukchi-Beaufort
Cuvier's beaked whale - Alaska Stock	GOALS sightings with g(0) and ESW from Barlow, J., M.C. Ferguson, W.F. Perrin, L. Balance, T. Gerrodette, G. Joyce, C.D. MacLeod, K. Mullin, D.L. Palka, and G. Waring. 2006. Abundance and densities of beaked and bottlenose whales (family Ziphiidae). J. Cetacean Res. Manage 783(3) 263-270; Table 2 California Surveys
Dall's porpoise - Alaska Stock	Friday et al. 2013
Fin whale - Northeast Pacific Stock	Friday et al. 2013
Gray whale - Eastern North Pacific Stock	Mate et al. 2010, SC/62/BRG21, reported in 2005 six tagged whales made it to the Chukchi and one tag showed return migration to CA but detailed data were not provided in the paper. Three whales tagged in 2009 continued to transmit into May but the paper ends with the April observations. Whales tagged in September were off the OR/CA coast. Use calculation for Chukchi-Beaufort

Species/Stock	Source of estimate (e.g. reference, short description of process used to estimate density)
Harbor porpoise - Bering Sea Stock	N/area from Hobbs, R. C. and J M. Waite. 2010. Abundance of harbor porpoise (Phocoena phocoena) in three Alaskan regions, corrected for observer errors due to perception bias and species misidentification, and corrected for animals submerged from view. Fish. Bull., U.S. 108(3):251-267. Note MML staff and collaborators found densities of 0.18 and 0.14 in two regions of SEAK
Harbor seal - Aleutian Islands Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - Bristol Bay Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs.
Harbor seal - Pribilof Islands Stock	Sum of abundance estimates for stocks within the East and West areas then divided by surface area of each stock range. Source: 2015 Draft SARs..
Humpback whale - Central North Pacific Stock	Took highest density of any block from Zerbini et al. 2006, which was 0.02 in block 12. Prorated stocks according to Wade et al., with 92% CNP and 8% WNP in AIBS, resulting in 0.0184 for CNP and 0.0016 for WNP.
Humpback whale - Western North Pacific Stock	Took highest density of any block from Zerbini et al. 2006, which was 0.02 in block 12. Prorated stocks according to Wade et al., with 92% CNP and 8% WNP in AIBS, resulting in 0.0184 for CNP and 0.0016 for WNP.
Killer whale - Eastern North Pacific Alaska Resident Stock	Density computed with "post-encounter group sizes" for resident killer whales in the Aleutian Islands (DART blocks 11-14). Ref: Zerbini et al. 2007. Marine Biology
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	Density computed with "post-encounter group sizes" for transient killer whales in the Aleutian Islands (DART blocks 11-14). Ref: Zerbini et al. 2007. Marine Biology
Killer whale - Offshore Stock	Used the same density as that calculated for the Gulf of Alaska.
Minke whale - Alaska Stock	Friday et al. 2013
North Pacific right whale - Eastern North Pacific Stock	Took abundance estimate from Wade et al. 2011 of 31 whales, and divided by area of critical habitat, calculated as 92,698 sq. km. This assumes all whales could be in the critical habitat area at one time.
Northern fur seal - California Stock	CA stock does not travel to BSAI
Northern fur seal - Eastern Pacific Stock	Based on Towell et al. 2016. Population assessment of northern fur seals on the Priblof Islands, Alaska. Fur Seal Investigations and Robert DeLong, Personal communicaiton. Winter density does not include those animals in GOA during the winter (168,280 in BSAI)
Pacific white-sided dolphin - North Pacific Stock	200/37,260 sq km (estimated number of 200 individuals/an area ~up to 30 nm offshore of the Alaska Peninsula)
Ribbon seal - Alaska Stock	Conn et al. 2014, has the most recent abundance estimates for the Bering Sea.
Ringed seal - Arctic Subspecies/Alaska Stock	Conn et al. 2014, has the most recent abundance estimates for the Bering Sea. n= 171,418 for ice covered area of the US sector of the Bering Sea (apply an approximate c.f. of 0.64 and you get 267,841)
Sei whale – Eastern North Pacific Stock	From Friday et al 2013: used minke whale detection function and sei whale encounter rate
Sperm whale - North Pacific Stock	Density computed for DART blocks 13-16 (the ones with sperm whale sigthings in the Aleutian). n/L and mean s is from DART, ESW is from Branch and Butterworth 2001 for sperm whales

Species/Stock	Source of estimate (e.g. reference, short description of process used to estimate density)
Spotted seal - Alaska Stock	Conn et al. 2014, has the most recent abundance estimates for the Bering Sea.
Stejneger's beaked whale - Alaska Stock	Took the average yearly effort and areas from Aleutians strata from Zerbini et al. 2006, assumed there was one detection with a group size of 1.6. Based on not having more than one detection in a year on a survey (although none happened on DART cruises unfortunately). Used ESW of 1.0 and g(0) of 0.45 from Barlow et al., resulting in abundance of 256 divided by 217,613 sq km.
Steller sea lion - Western DPS	(Pup production * 4.5 in W Aleu, C Aleu, E Aleu and Bering 2014:N = 25,164) + (5% Pup production * 4.5 in W Gulf, C Gulf, E Gulf 2014 N=1467); total N = 26631; latter accounts for wDPS males from Gulf in BSAI, MML staff.
Steller sea lion - Eastern DPS	2% of Pup production * 4.5 in SE AK and BC in 2013; accounts for eDPS males N=259
CSBSRA	
Bearded seal - Alaska Stock	Bengtson et al. 2005, has the most recent density estimates for the Chukchi Sea. The survey was conducted in May and so the spotted and ribbon seal counts were essentially zero. There are no surveys for the Beaufort, used the average Chukchi density (km2) estimates shown for the entire LME.
Beluga whale - Beaufort Sea Stock	ASAMM 2008-2014 survey data. See MML’s R code ArcticLMEdensity.r for summary of methods and code. Beluga densities were not differentiated by stock. Density estimate corresponds to an August max from the 200-2000 m West depth stratum in the Beaufort Sea.
Beluga whale - Eastern Chukchi Sea Stock	ASAMM 2008-2014 survey data. See MML's R code ArcticLMEdensity.r for summary of methods and code. Beluga densities were not differentiated by stock. Density estimate corresponds to an August max from the 200-2000 m West depth stratum in the Beaufort Sea.
Bowhead whale - Western Arctic Stock	ASAMM 2008-2014 survey data. See MML's R code ArcticLMEdensity.r for summary of methods and code. Density estimate was highest pooled monthly estimate for either August or September for the 35-50 m depth zone in the Chukchi Sea.
Fin whale – Northeast Pacific stock	Sample sizes too low to derive density estimates, so the density estimate represents a guess. Max depth at sighting in the ASAMM 1979-2014 historical database is 52 m.
Gray whale - Eastern North Pacific Stock	ASAMM 2008-2014 survey data. See M. Ferguson's R code ArcticLMEdensity.r for summary of methods and code. Density estimate was an August max for the 50-200 m South depth stratum in the Chukchi Sea.
Harbor porpoise	MML staff email 7/7/15
Humpback whale - Central North Pacific Stock	ASAMM 2008-2014 survey data. See MML's R code ArcticLMEdensity.r for summary of methods and code. Stock unknown. Max depth of water at sighting in the ASAMM 1979-2014 database is 61 m.
Humpback whale - Western North Pacific Stock	ASAMM 2008-2014 survey data. See MML's R code ArcticLMEdensity.r for summary of methods and code. Stock unknown. Max depth of water at sighting in the ASAMM 1979-2014 database is 61 m.
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	Sample sizes too low to derive density estimates, so the estimate is best professional judgement of MML staff. Max depth at sighting in the ASAMM 1979-2014 historical database is 56 m.
Minke whale - Alaska Stock	Sample sizes too low to derive density estimates, so the estimate is best professional judgement of MML staff. Max depth at sighting in the ASAMM 1979-2014 historical database is 60 m.

Species/Stock	Source of estimate (e.g. reference, short description of process used to estimate density)
Ribbon seal - Alaska Stock	Densities of ribbon and spotted seals have a common basis between the BSAI and CSBS Research Areas because the same populations of these seals use both areas during the year. MML staff used the densities for each species estimated for the Bering Sea (Conn et al. (2014) multiplied by the proportion of the BSAI research area to the sum of both the BSAI and CSBS Research Areas. The same down-weighted density was then used to calculate the volumetric densities for each research area.
Ringed seal - Arctic Subspecies/Alaska Stock	Bengtson et al. 2005, has the most recent density estimates for the Chukchi Sea. The survey was conducted in May and so the spotted and ribbon seal counts were essentially zero. There are no surveys for the Beaufort, you may want to use the average Chukchi density (km2) estimates shown for the entire LME.
Spotted seal - Alaska Stock	See ribbon seal for CSBSRA, above.

6.2.6 Using Areas Insonified and Volumetric Density to Calculate Acoustic Takes

Level B harassment by acoustic sources, according to current NMFS guidelines, has been calculated for each AFSC fisheries research area by using (1) the combined results from output characteristics of each source and identification of the predominant sources in terms of usage and acoustic output (6.2.2), (2) their relative annual usage patterns for each operational area (6.2.3), (3) a source-specific determination made of the area of water associated with received sounds at either the extent of a depth boundary or the 160 dB rms received sound level (6.2.4), and (4) determination of a biologically-relevant volumetric density of marine mammal species in each area (6.2.5).These estimated takes are the product of the volume of water insonified at 160 dB rms or higher for the predominant sound source for each portion of the total line km for which it is used and the volumetric density of animals for each species. These annual take estimates are given for each of the three AFSC fisheries research areas in Tables 6-11a, 6-11b, and 6-11c. Note that acoustic Level B takes were set to zero for baleen whales exposed to sonar systems that operated above 25 kHz, i.e. the ES60 system, because the frequency is above the range of the low frequency cetacean functional hear group (Table 4-1, see Sections 4.0 and 7.2.2).

The suite of variables used may result in estimates for a species occurring in differing research areas that at first glance may seem inconsistent. A high profile species, the bowhead whale, provides a worthwhile case showing the complexity of deriving such estimates. In the case of the BSAIRA, our estimated Level B request for acoustic take of bowhead whale (Western stock) is 42 animals; for the CSBSRA, this estimate is zero. The key factor to consider in these estimates is that AFSC research in the BSAIRA involves surveys using the EK60/ME70 producing sounds as low as 18 kHz (and 38, 70, 120, 200 kHz/70 kHz) within the hearing range of the bowhead whale. In the CSBSRA, AFSC research does not employ this sound source, the only sources used are above the hearing threshold of this whale, thus no Level B takes are requested.

The acoustic take estimates were modified from this general approach for several species due to their limited range and/or limited research efforts within their ranges. Two stocks of beluga whales have limited distributions or limited summer distributions when active research surveys occur. The geospatial coverage of the surveys were compared to the beluga whale distributions found in Allen and Angliss (2015). When no overlap occurred, the acoustic take was set at zero. When overlap occurred, the number of stations in the overlap area was counted and a percentage of these stations was calculated from the total stations of the survey. This percentage was then applied to the take estimate to reflect the more likely acoustic take. Surveys using active acoustics do not overlap with the summer time distribution of beluga whales in Bristol Bay. The take estimate for beluga whales from that stock is therefore zero. Surveys using EK60/ME70 or the Reson systems do not overlap with the Cook Inlet stock of beluga whales.

However, 20 out of 825 (2.4%) stations of the bottom trawl survey using the ES60 frequencies do typically occur in the southern third of Cook Inlet. Therefore, the acoustic take for that stock is estimated at 3 over 5 years.

Because of their extreme rarity and likely occurrence only within their designated critical habitat areas, the acoustic takes for North Pacific Right Whales were estimated by a special procedure. Since only the Summer Pollock Acoustic-Trawl Surveys operate sonars at low frequencies that may affect this species, the percentage of acoustic track lines from these surveys within each of the critical habitats for GOARA and BSAIRA to the entire track lines in each research area were calculated. For the GOARA, the percentage was 1.66 of the 8396 km of track line, and for the BSAIRA, the percentage was 18.93 for the 10235 km of trackline. These percentages were applied to the distance expected to be traveled during the next five years of summer pollock acoustic-trawl surveys, and acoustic takes were estimated in a similar manner to other species and surveys.

The acoustic take estimates for eastern Pacific stocks of northern fur seal were refined to better reflect the differences in abundance between the BSAIRA and GOARA by age class and by time of year. Population information was obtained from Towell et al. (2016) and information on the summer and winter distributions by age classes was obtained from R. DeLong at MML (pers. Comm.). During the summer, 480,600 adults, juveniles, and yearlings occur in the BSAIRA but during the winter, only 168,280 remain in the area. In the GOARA, 139,600 yearlings and juveniles occur during the summer, but during the winter 451,920 animals are found in the area between Unimak Pass and eastwards. At sea densities were estimated for each research area and season and take estimates were made for specific surveys that occur during the summer or winter.

The acoustic takes for harbor seal were estimated on a stock specific basis. First, the at-sea density was estimated for the BSAIRA and the eastern and western portions of the GOARA by summing the 2011 harbor seal breeding populations and then dividing by the amount of area in each study area. One exception was the Prince William Sound stock which straddles the 144° W longitude line demarcating the eastern and western GOARA. This stock was apportioned 55/45 between the west and east GOARA based upon the direct lineal distances between the western and eastern extents of the approximate stock range (MML, unpublished GIS coverage). The stock specific density was estimated by multiplying the at-sea density by the proportion of breeding population to total population in each research area. Acoustic takes were then estimated in a similar manner to the other species.

Table 6-11a Estimated Acoustic Takes (Level B harassment) by Sound Type for Each Marine Mammal Species in the GOARA Requested by AFSC for the Five-year Authorization Period

The volume of water insonified to 160 dB by each sound source and depth strata is shown in the row below the sound source (see Table 6-3 and 6-4 for derivation). The number of Level B harassment takes for each species is derived by multiplying the volume of insonified water by the volumetric density for each species/stock.

Species/Stock	Volumetric Density (#/km^3)	Estimated Level B Harassment (Number of animals over five years) in the GOARA								
		0-200m				>200m				Total Level B Take (rounded up)
		EK60 (18kHz)		ES60 (38kHz)		EK60 (18kHz)		ES60 (38kHz)		
		Volume Insonified	Level B Take	Volume Insonified	Level B Take	Volume Insonified	Level B Take	Volume Insonified	Level B Take	
Baird's beaked whale - Alaska Stock	0.0034	353.4	1.2	78.2	0.3	627.9	2.1	79.4	0.3	**4**
Beluga whale - Cook Inlet DPS	1	0	0	2.47	2.5	0	0	0	0	**3**
Blue whale - Eastern North Pacific Stock	0.0005	353.4	0.2	78.2	0	627.9	0	79.4	0	**1**
Cuvier's beaked whale - Alaska Stock	0.0002	353.4	0.1	78.2	0	627.9	0.1	79.4	0	**1**
Dall's porpoise - Alaska Stock	8.0	547	4375.9	102.9	823.3	0	0	0	0	**5200**
Fin whale - Northeast Pacific Stock	0.1	353.4	35.3	78.2	7.8	627.9	0	79.4	0	**44**
Gray whale - Eastern North Pacific Stock	8.5	547	4649.4	102.9	0	0	0	0	0	**4650**
Gray whale - Western North Pacific Stock	0	353.4	0	78.2	0	627.9	0	79.4	0	**0**
Harbor porpoise - Gulf of Alaska Stock	1	547	547.0	102.9	102.9	0	0	0	0	**650**
Harbor porpoise - Southeast Alaska Stock	0.55	547	300.8	102.9	56.6	0	0	0	0	**358**
Harbor seal - Clarence Strait Stock	0.4942	353.4	174.6	78.2	38.7	627.9	0	79.4	0	**214**
Harbor seal - Cook Inlet/Shelikof Strait Stock	0.1555	353.4	54.9	78.2	12.2	627.9	0	79.4	0	**68**
Harbor seal - Dixon/Cape Decision Stock	0.2829	353.4	99.9	78.2	22.1	627.9	0	79.4	0	**123**
Harbor seal - Glacier Bay/Icy Strait Stock	0.1126	353.4	39.8	78.2	8.8	627.9	0	79.4	0	**49**

Species/Stock	Volumetric Density ($\#/km^3$)	Estimated Level B Harassment (Number of animals over five years) in the GOARA								
		0-200m				>200m				Total Level B Take (rounded up)
		EK60 (18kHz)		ES60 (38kHz)		EK60 (18kHz)		ES60 (38kHz)		
		Volume Insonified	Level B Take	Volume Insonified	Level B Take	Volume Insonified	Level B Take	Volume Insonified	Level B Take	
Harbor seal - Lynn Canal/Stephens Passage Stock	0.1481	353.4	52.3	78.2	11.6	627.9	0	79.4	0	**64**
Harbor seal - North Kodiak Stock	0.0472	353.4	16.7	78.2	3.7	627.9	0	79.4	0	**21**
Harbor seal - Prince William Sound Stock	0.3034	353.4	107.2	78.2	23.7	627.9	0	79.4	0	**131**
Harbor seal - Sitka/Chatham Strait Stock	0.2321	353.4	82.0	78.2	18.2	627.9	0	79.4	0	**101**
Harbor seal - South Kodiak Stock	0.1090	353.4	38.6	78.2	8.5	627.9	0	79.4	0	**48**
Humpback whale - Central North Pacific Stock	0.3265	353.4	115.4	78.2	0	627.9	0	79.4	0	**116**
Humpback whale - Western North Pacific Stock	0.0035	353.4	1.2	78.2	0	627.9	0	79.4	0	**2**
Killer whale - AT1 Transient/Prince William Sound Stock	0.0035	353.4	1.2	78.2	0.3	627.9	0	79.4	0	**2**
Killer whale - Eastern North Pacific Alaska Resident Stock	0.0450	353.4	15.9	78.2	3.5	627.9	0	79.4	0	**20**
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	0.0035	353.4	1.2	78.2	0.3	627.9	0	79.4	0	**2**
Killer whale - Eastern North Pacific Northern Resident Stock	0.0125	353.4	4.4	78.2	1.0	627.9	0	79.4	0	**6**
Killer whale - West Coast Transient Stock	0.0280	353.4	9.9	78.2	2.2	627.9	0	79.4	0	**13**
Killer whale - Offshore Stock	0.0550	353.4	19.4	78.2	4.3	627.9	0	79.4	0	**24**
Minke whale - Alaska Stock	0.0060	353.4	2.1	78.2	0	627.9	0	79.4	0	**3**
North Pacific right whale - Eastern North Pacific Stock	0.0265	3.7	0.1	0	0	0	0	0	0	**1**

Species/Stock	Volumetric Density (#/km^3)	Estimated Level B Harassment (Number of animals over five years) in the GOARA								
		0-200m				>200m				Total Level B Take (rounded up)
		EK60 (18kHz)		ES60 (38kHz)		EK60 (18kHz)		ES60 (38kHz)		
		Volume Insonified	Level B Take	Volume Insonified	Level B Take	Volume Insonified	Level B Take	Volume Insonified	Level B Take	
Northern elephant seal	0.0450	353.4	15.9	78.2	3.5	627.9	28.3	79.4	3.6	**52**
Northern fur seal - California Stock GOA E 144	0.2185	547	119.5	102.9	22.5	0	0	0	0	**143**
Northern fur seal - Eastern Pacific Stock GOA wide, winter	1.8831	243.2	458.0	0	0	0	0	0	0	**459**
Northern fur seal - Eastern Pacific Stock GOA wide, summer	0.5817	303.8	176.7	102.9	59.9	0	0	0	0	**237**
Pacific white-sided dolphin - North Pacific Stock	0.075	353.4	26.5	78.2	5.9	627.9	0	79.4	0	**33**
Sei whale - Eastern North Pacific Stock	0.00003	353.4	0.011	78.2	0	628	0	79.4	0	**1**
Sperm whale - North Pacific Stock	0.002	353.4	0.7	78.2	0.2	627.9	1.3	79.4	0.2	**3**
Stejneger's beaked whale - Alaska Stock	0.0102	353.4	3.6	78.2	0.8	627.9	6.4	79.4	0.8	**12**
Steller sea lion - Eastern Stock GOA wide	0.294	547	160.8	102.9	30.3	0	0	0	0	**192**
Steller sea lion - Eastern Stock E 144	1.103	547	603.3	102.9	113.5	0	0	0	0	**717**
Steller sea lion - Eastern Stock W 144	0.006	547	3.3	102.9	0.6	0	0	0	0	**4**
Steller sea lion - Western DPS GOA wide	0.1755	547	96.0	102.9	18.1	0	0	0	0	**115**
Steller sea lion - Western DPS E 144	0.0145	547	7.9	102.9	1.5	0	0	0	0	**10**
Steller sea lion - Western DPS W 144	0.239	547	130.7	102.9	24.6	0	0	0	0	**156**

Table 6-11b Estimated Acoustic Takes (Level B harassment) by Sound Type for Each Marine Mammal Species in the BSAIRA Requested by AFSC for the Five-year Authorization Period

The volume of water insonified to 160 dB by each sound source and depth strata is shown in the row below the sound source (see Table 6-3 and 6-4 for derivation). The number of Level B harassment takes for each species is derived by multiplying the volume of insonified water by the volumetric density for each species/stock.

Species/Stock	Volumetric Density (#/km^3)	Estimated Level B Harassment (Number of animals over five years) in the BSAIRA										
		0-200m						>200m				Total Level B Take (rounded up)
		EK60 (18kHz)		ES60 (38kHz)		Reson 7111 (100 kHz)		EK60 (18kHz)		ES60 (38kHz)		
		Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	
Baird's beaked whale - Alaska Stock	0.0034	408.1	1.4	346.7	1.2	20.6	0.1	261.5	0.9	119.8	0.4	**4**
Bearded seal - Alaska Stock	1.9675	488.7	961.5	359.5	707.4	20.6	40.5	0	0	0	0	**1710**
Beluga whale - Bristol Bay Stock	3.5	0	0	0	0	0	0	0	0	0	0	**0**
Beluga whale - Eastern Bering Sea Stock	1.21	408.1	493.7	346.7	419.5	20.6	24.9	261.5	0	119.8	0	**939**
Bowhead whale - Western Arctic Stock	0.085	488.7	41.5	359.5	0	20.6	0	0	0	0	0	**42**
Cuvier's beaked whale - Alaska Stock	0.00018	408.1	0.1	346.7	0.1	20.6	0	261.5	0	119.8	0	**1**
Dall's porpoise - Alaska Stock	0.1635	488.7	79.9	359.5	58.8	20.6	3.4	0	0	0	0	**143**
Fin whale - Northeast Pacific Stock	0.007	488.7	3.4	359.5	0	20.6	0	0	0	0	0	**4**
Gray whale - Eastern North Pacific Stock	1.9	488.7	928.5	359.5	0	20.6	0	0	0	0	0	**929**
Gray whale - Western North Pacific Stock	0	408.1	0	346.7	0	20.6	0	261.5	0	119.8	0	**0**
Harbor porpoise - Bering Sea Stock	2.25	408.1	918.1	346.7	780.1	20.6	46.3	261.5	0	119.8	0	**1745**
Harbor seal - Aleutian Islands Stock	0.014	408.1	5.9	346.7	5.0	20.6	0.3	261.5	0	119.8	0	**12**
Harbor seal - Bristol Bay Stock	0.072	408.1	29.5	346.7	25.1	20.6	1.5	261.5	0	119.8	0	**57**
Harbor seal - Pribilof Islands Stock	0.001	408.1	0.2	346.7	0.2	20.6	0.01	261.5	0	119.8	0	**1**
Humpback whale - Central North Pacific Stock	0.092	488.7	45.0	359.5	0	20.6	0	0	0	0	0	**45**
Humpback whale - Western North Pacific Stock	0.008	488.7	3.9	359.5	0	20.6	0	0	0	0	0	**4**

Species/Stock	Volumetric Density (#/km^3)	Estimated Level B Harassment (Number of animals over five years) in the BSAIRA										
		0-200m						>200m				Total Level B Take (rounded up)
		EK60 (18kHz)		ES60 (38kHz)		Reson 7111 (100 kHz)		EK60 (18kHz)		ES60 (38kHz)		
		Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	
Killer whale - Eastern North Pacific Alaska Resident Stock	0.005	408.1	2.0	346.7	1.7	20.6	0.1	261.5	0	119.8	0	**4**
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	0.013	408.1	5.3	346.7	4.5	20.6	0.3	261.5	0	119.8	0	**11**
Killer whale - Eastern North Pacific Northern Resident Stock	0	488.7	0	359.5	0	20.6	0	0	0	0	0	**0**
Killer whale - Offshore Stock	0.055	408.1	22.4	346.7	19.1	20.6	1.1	261.5	0	119.8	0	**43**
Minke whale - Alaska Stock	0.0105	408.1	4.3	346.7	0	20.6	0	261.5	0	119.8	0	**5**
North Pacific right whale - Eastern North Pacific Stock	0.0015	75.87	0.1	346.7	0	20.6	0	261.5	0	119.8	0	**1**
Northern fur seal - Eastern Pacific Stock, winter	0.3765	48.2	18.2	0	0	0	0	0	0	0	0	**19**
Northern fur seal - Eastern Pacific Stock, summer	1.0753	440.5	473.6	359.5	386.6	20.6	22.1	0	0	0	0	**883**
Pacific white-sided dolphin - North Pacific Stock	0.027	408.1	11.0	346.7	9.4	20.6	0.6	261.5	0	119.8	0	**21**
Ribbon seal - Alaska Stock	1.2035	488.7	450.5	359.5	331.4	20.6	19.0	0	0	0	0	**801**
Ringed seal - Arctic Subspecies/Alaska Stock	1.746	488.7	853.3	359.5	627.7	20.6	35.9	0	0	0	0	**1517**
Sei whale - Eastern North Pacific Stock	0.0009	488.7	0.4	359.5	0	20.6	0	0	0	0	0	**1**
Sperm whale - North Pacific Stock	0.016	408.1	6.5	346.7	5.5	20.6	0.3	261.5	4.2	119.8	1.9	**19**
Spotted seal - Alaska Stock	3.006	488.7	1125.1	359.5	827.8	20.6	47.4	0	0	0	0	**2001**
Stejneger's beaked whale - Alaska Stock	0.0024	408.1	1.0	346.7	0.8	20.6	0	261.5	0.6	119.8	0.3	**3**
Steller sea lion - Western DPS	0.0595	488.7	29.1	359.5	21.4	20.6	1.2	0	0	0	0	**52**

Species/Stock	Volumetric Density (#/km^3)	Estimated Level B Harassment (Number of animals over five years) in the BSAIRA										
		0-200m						>200m				Total Level B Take (rounded up)
		EK60 (18kHz)		ES60 (38kHz)		Reson 7111 (100 kHz)		EK60 (18kHz)		ES60 (38kHz)		
		Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	Volume Insonified	Estimated Take	
Steller sea lion - Eastern DPS	0.0005	488.7	0.2	359.5	0.2	20.6	0	0	0	0	0	**1**

Table 6-11c Estimated Acoustic Takes (Level B harassment) by Sound Type for Each Marine Mammal Species in the CSBSRA Requested by AFSC for the Five-year Authorization Period

The volume of water insonified to 160 dB by each sound source and depth strata is shown in the row below the sound source (see Table 6-3 and 6-4 for derivation). The number of Level B harassment takes for each species is derived by multiplying the volume of insonified water by the volumetric density for each species/stock. There are no surveys in waters deeper than 200m; therefore no take is requested for deep and offshore waters.

Species/Stock	Volumetric Density (#/km^3)	Estimated Level B Harassment (Number of animals over five years) in the CSBSRA		
		0-200 m		Total Level B Take (rounded up)
		ES60 (38kHz)		
		Volume Insonified	Level B Take	
Bearded seal - Alaska Stock	0.875	0	0	**58**
Beluga whale - Beaufort Sea Stock	0.04	66.2	3	**3**
Beluga whale - Eastern Chukchi Sea Stock	0.04	66.2	3	**3**
Bowhead whale - Western Arctic Stock	11.35	66.2	0	**0**
Fin whale	0.0005	66.2	0	**0**
Gray whale - Eastern North Pacific Stock	1.9	66.2	0	**0**
Gray whale - Western North Pacific Stock	0	66.2	0	**0**
Harbor porpoise	0.0002	66.2	0.033	**1**
Humpback whale - Central North Pacific Stock	0.0005	66.2	0	**0**
Humpback whale - Western North Pacific Stock	0.0005	66.2	0	**0**
Killer whale - Eastern North Pacific Gulf of Alaska, Aleutian Islands, Bering Sea Transient Stock	0.00005	66.2	0.003	**1**
Minke whale - Alaska Stock	0.0005	66.2	0	**0**
Ribbon seal - Alaska Stock	0.922	66.2	61.1	**62**
Ringed seal - Arctic Subspecies/Alaska Stock	8.825	66.2	584.6	**585**
Spotted seal - Alaska Stock	2.302	66.2	152.5	**153**

6.2.7 Conclusion Regarding Total Estimates of Level B Harassment due to Acoustic Sources

The results given in Tables 6.11 a-c are based on the approach taken here to estimate marine mammal Level B harassment takes under the MMPA and should be interpreted with caution. This method is prescribed by the current definition of Level B harassment given in NMFS policy guidelines for acoustic impacts with several modifications specific to the directional nature of high-frequency fisheries acoustic sources, the vertical stratification of marine species applied, and what is currently known about the hearing capabilities of marine mammals. Given the simplistic step-function approach and lack of species-specific hearing parameters inherent in the NMFS prescribed approach, large uncertainty in some areas, and a number of underlying assumptions based on how these sources may be used variably in the field, this approach should be considered to result in a precautionary estimate of potential impact (e.g., higher estimated “takes” than are in fact likely). Factors believed to result in the estimated Level B harassment by acoustic sources being conservative (i.e., higher than what may actually occur in situ) include the following:

- While the hearing ranges of the functional hearing groups (see section 7.2 below and Southall et al. 2007) are accounted for in a straightforward manner in these calculations (i.e. sources are considered unlikely to lead to any Level B harassment if they are above or below functional hearing cut-offs), the known differences in hearing sensitivities between different marine mammal species, and within a functional hearing range (e.g., as reflected in auditory weighting functions), are not considered in estimates of Level B harassment by acoustic sources. All species are assumed to be equally sensitive to acoustic systems operating within their functional hearing range.
- Other known aspects of hearing as they relate to transient sounds (specifically auditory integration times) are also not taken into account in this estimation. Specifically, sounds associated with these fisheries acoustic sources are typically repetitive and quite brief in duration. All Sound Pressure Levels (SPLs) are calculated by assuming a continuous transmission, without taking into account the duty cycle, i.e., the ratio of pulse duration to ping interval. While some animals may potentially hear these signals well (e.g., odontocete cetaceans), for other animals, the perceived sound loudness may be considerably reduced based on their brief nature and the fact that auditory integration times in many species likely exceed the duration of individual signals. More research is needed, however, in order to be able to quantify any potential reduction in perceived received level due to the brief nature of the sounds and to determine to which species this applies.
- Several other precautionary assumptions are made, including the use of the lowest frequencies and highest output power levels utilized (with greatest potential propagation leading to higher received levels) in cases where source operational parameters may be varied (Table 6-8).
- It should be recognized that the estimates of take by acoustic sources take into account that more than one animal could be insonified several times and the total estimated take cannot be directly compared to the total number of animals in any particular population stock.

In conclusion, the estimated Level B harassment due to insonification from a variety of acoustic sources likely overestimates the actual magnitude of behavioral impacts of these operations for the reasons given above. This approach is deemed appropriate despite some of the uncertainties in terms of response thresholds to these types of sounds, overall density estimates, and other complicating factors.

6.2.8 Level B Harassment Takes of Hauled Out Pinnipeds Due to Adjacent Fisheries Research Activities

It is possible that 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 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 transiting past or operating near 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 from research station to station. Table 6-12 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 based on past experiences under status quo conditions.

To determine these estimates AFSC employed Geographic Information System (GIS) analytical tools to estimate potential Level B Harassment takes of Steller sea lions and harbor seals using count data for the respective species, haulout and rookery locations, and research survey station and track line locations. Known sea lion haul outs and rookery areas and harbor seal haulouts were provided by the AFSC Marine Mammal Laboratory (MML). MML also provided sea lion counts from each site and density estimates for harbor seals. The geographic division of the DPSs at Cape Suckling (144° W longitude) was used to subdivide Steller sea lion counts into those from the ESA-listed Western DPS (west of 144° W) and the delisted Eastern DPS (east of 144° W).

The analysis was sub-divided into the three AFSC fisheries research areas. Geographic coverages were obtained from all recent single or regular survey or research activities conducted by the AFSC. Coverages may have been provided as sampling points, as survey lines, or as polygons. Investigators were asked to reduce expansive coverages to those areas where the research or survey activity was focused. Coverages were received as points, lines, and polygons where past or ongoing research occurs. Geographic take analysis was limited to activities that occurred within a 5 km buffer zone from the Alaska Department of Natural Resources shoreline. For point data, a 2 km zone around the point was assumed to represent the extent of the vessel and survey activity around the point. For line data representing the Alaska Longline Survey and the Gulf of Alaska Acoustic Pollock Survey, a 0.5 nm (0.9 km) buffer around the line was used to represent the potential interaction area. Take interactions where then tallied if the buffered line or point data from the research activities intersected within a 0.5 nm buffer zone around any identified Steller sea lion rookery or harbor seal haul out. The selection of the 0.5 nm (0.9 km) buffer zone was based on studies of human disturbance of Alaskan pinnipeds (Jansen et al. 2006, 2010, 2015; Young et al. 2014).

Where AFSC activities intersected a Steller sea lion haulout or rookery, the number of Steller sea lion individuals for that rookery was tallied as potential takes. The sum of these intersections from the accumulated survey and research activities was used as an annual land-based take, even though the activity might occur on an irregular or biennial basis. This annual estimated take (Table 6-12) for each research area was then multiplied by five to represent the Steller sea lion land-based takes over the five-year authorization period. There were not any land-based takes determined for Eastern DPS Steller sea lions (east of 144°W longitude) due to the lack of AFSC fisheries research activities near enough to known haulouts.

The areas where AFSC research and survey activities intersected harbor seal haul outs were determined in the same way as Steller sea lions; the respective harbor seal density at known haulouts was multiplied by the areas of research activities within the buffered haul out areas to estimate the annual take for each research area, even though the activity might occur on an irregular or biennial basis. For harbor seals in Prince William Sound and around Kodiak Island, point data were restricted to current research and the last survey, and biennial surveys were discounted by one half to annualize the activity and area affected. Most line coverages were for biennial acoustic surveys and these activities were halved to annualize the affected areas for harbor seals. These annual takes (Table 6-12) were multiplied by five to estimate the land-based takes of harbor seals over the five-year authorization period.

AFSC believes the land-based take estimates for both pinniped species are conservative because the estimated annual takes may only be one-time, sporadic, or biennial activities. Furthermore, it is likely many of these animals are not disturbed as research vessels pass, but AFSC fisheries researchers have previously not recorded numbers of animals actually affected by their presence. Until more accurate data becomes available through the proposed new monitoring and reporting program outlined in this application (i.e., sections 11 and 13), it is assumed that 100 percent of these animals may react to AFSC fisheries research activities. 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 AFSC is requesting a combined estimated annual Level B Harassment take for the GOARA and BSAIRA of 15,970 Western

DPS Steller sea lions and 84,988 harbor seals (all stocks combined) over the five-year authorization period (Table 6-12). 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 use of the region by any of these stocks.

Table 6-12 Estimated 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 Harrassment 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
CookyInlet/Shelikof	2,554	12,772
Dixon/Cape Decision	30	151
GlacieryBay/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 seals (all stocks) All areas	**11,699**	**58,497**

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7.0 THE ANTICIPATED IMPACT OF THE ACTIVITY UPON THE SPECIES OR STOCK

We anticipate that the specified activities could impact the species or stocks of marine mammals by causing mortality, serious injury, and/or Level A (non-serious injury) harassment (through gear interaction) or by causing Level B (behavioral) harassment (through use of active acoustic sources and close proximity of vessels to haulouts). These could occur through the following:

- Entanglement in trawl and gillnets and hooking in longline gear; and
- Alterations in behavior caused by acoustics sources, close vessel approaches, and the physical presence of researchers near to pinniped haulouts during research activities.

Other potential effects of the activity could include hearing impairment, masking, or non-auditory physiological effects, such as stress responses, resonance, and other types of organ or tissue damage related to the use of active acoustics. However, because AFSC activities do not involve the use of devices such as explosives or mid-frequency active sonar that are associated with these types of effects, we do not expect that these effects would occur. In addition, we do not expect that the anticipated impact of the activity upon the species or stocks would include effects on marine mammals from ship collision or vessel strike (see 7.4 Collision and Ship Strike for details).

The AFSC does not expect its survey operations or its cooperative surveys with other research entities would cause the marine mammal populations in the GOARA, BSAIRA, or the CSBSRA to experience reductions in reproduction, numbers, or distribution that might appreciably reduce their likelihood of surviving and recovering in the wild. Although these surveys have the potential to adversely impact the health and condition of an individual marine mammal, we anticipate no adverse effects on annual rates of recruitment or survival of the affected marine mammal species or stocks. The AFSC notes, however, that marine mammal distribution and abundance is not uniform in all parts of the study area, and varies substantially in different seasons. Most marine mammal surveys are conducted during the spring, summer, and fall; however, density information is not available for every season in all the study regions. But the AFSC believes that the direct effects on species or stocks would be minor since over the course of the operations from 2004 through 2015 only three marine mammals under NMFS jurisdiction have been incidentally caught (two Dall’s porpoise and one northern fur seal). From a population perspective, the impacts of these incidental captures are minimal.

While there are different approaches that could be taken to evaluating the significance of anticipated interactions with marine mammals during the course of fisheries research, the Potential Biological Removal (PBR) level used in classifying commercial fisheries is well established and applicable to removals of marine mammals in fisheries research activities, as well. PBR is defined by the MMPA as the maximum number of animals that may be removed from a marine mammal stock, not including natural mortalities, while allowing that stock to reach or maintain its optimum sustainable population. The PBR level is the product of the minimum population estimate of the stock, one-half the maximum theoretical or estimated net productivity rate of the stock at a small population size, and a recovery factor of between 0.1 and 1.0.

In using PBR to evaluate the impact of AFSC fisheries research activities on affected marine mammal stocks, two assumptions should be noted. First, as described in Section 6.0 of this application, AFSC has requested a single number of takes in each gear for each stock in a combined category that includes Level A injury, serious injury and mortality. It is possible that some marine mammals that interact with AFSC research gears will experience only non-serious injuries. However, for purposes of evaluating the significance of the AFSC take request relative to PBR we assume the worst-case outcome that all animals in this combined category will be seriously injured or killed. The rationale for this binning of Level A injury, serious injury and mortality takes is also described in Section 6 of this application.

Second, AFSC is assuming its anticipated take will equal its actual take of marine mammals in fisheries research activities. PBR was developed as a tool to evaluate actual human-caused removals from a population, not anticipated future removals. Nonetheless, the take request described in Section 6.0 is based on historical interactions, and as such AFSC believes its request is a reasonable approximation of the number of takes that may occur in the future. Clearly, the actual number of serious injuries and mortalities that result from AFSC research will need to be evaluated to understand the significance of these activities. As described in Section 11 of this application, AFSC plans to implement an adaptive management approach to evaluating its actual takes and continuing to revisit its mitigation measures in light of take events to ensure they are appropriate.

7.1 Physical Interactions with Fishing Gear

The AFSC incidentally caught three marine mammals under NMFS jurisdiction during fisheries research related activities from 2004-2015 (Table 6-1). Two Dall's porpoise were caught and died in the Gulf Project-Upper trophic level using Cantrawl surface trawl gear. One northern fur seal was found dead in a bottom trawl employed in the Gulf of Alaska Biennial Shelf and Slope Groundfish survey.

Several gear types used during AFSC fisheries research surveys are similar to those used in commercial fishing operations in Alaska. Included are bottom, mid-water, and surface trawls, small beach seines, hook-and-line gear, longlines, gillnets, and pots/traps (See Appendix A). However, it is important to note that even though AFSC uses similar types of gear as that in commercial fisheries, the size, configuration, and methods of use of this gear during AFSC research surveys differs significantly than that used in commercial operations thereby reducing or eliminating the likelihood of incidental catch of marine mammals. For example, the annual summer bottom trawl surveys are based on a stratified random sampling design and cover a vast area of the Gulf of Alaska and eastern Bering Sea. Tows are of short duration between 15 and 30 minutes, and the survey does not deliberately target important fishing grounds, which may also have higher concentrations of marine mammals. The mouth openings of the research bottom trawls are less than 20 m, while the openings of commercial trawls can range to 90 meters. The durations of commercial tows can be as short as 15 minutes, but are often an hour to many hours. Figure 6-1 shows the spatial distribution of marine mammals that have been taken in AFSC surveys from 2004 through 2015. These limited historical takes are dispersed widely within the GOARA only 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 AFSC has made a concerted effort to develop and implement mitigation measures to reduce the risk of such takes. These mitigation measures are part of the proposed action (continuing fisheries research program) and are described in Section 11. 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.

Because of the low level of historical takes by various gear types used during AFSC fisheries research surveys, as well as the low level of predicted future takes associated with the use of trawl, longline, and gillnet gear in research activities in the GOARA, BSAIRA, and the CSBSRA, the AFSC believes that the surveys described below: (1) will have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival); and (2) will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses.

7.1.1 Anticipated Impact of Trawl, Longline, and Gillnet Surveys Conducted in the GOARA, BSAIRA, and the CSBSRA on Marine Mammal Stocks

Marine mammals have been caught during AFSC research using trawl gear, primarily Cantrawl Surface Trawl but also a bottom trawl. No marine mammals have been caught during AFSC research using other net gears such as purse seines, gillnets, or tangle nets or with various hook-and-line gears, including pelagic or demersal longlines or rod and reel deployments. However, the AFSC acknowledges the risk of capturing marine mammals in gillnets, longlines, purse seines and other hook-and-line gears, as well as various trawl gears, based on the frequent presence of marine mammals near research activities and documented marine mammal interactions with similar commercial fishing gears. Mitigation measures include a move-on rule to minimize chances for gear to be deployed with marine mammals nearby and modified net retrieval procedures if marine mammals are sighted while gear is in the water (see Section 11 for additional information on mitigation and Section 13 for information on monitoring and reporting interactions). For detailed descriptions of research efforts, see see Table 1-1. For descriptions of various research gears and instruments used by the AFSC, see Appendix A.

The AFSC also deploys a wide variety of gears and equipment to sample the marine environment that are not considered to pose any risk of adverse gear interactions with marine mammals and are therefore not subject to specific mitigation measures and have no associated gear take requests (see section 6.1.8). Many of the research efforts using trawl or longline gears also use these gears and instruments, such as plankton nets, CTDs, and video cameras.

As described in Section 6, the AFSC relied on its historic marine mammal interactions with its trawl surveys and used other relevant information in developing its take request. This section examines the impact of those potential takes relative to the status of each stock.

The impact criteria the AFSC used to assess the magnitude of research 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 Potential Biological Removal (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 optimum sustainable population." PBR was intended to serve as an upper limit guideline for anthropogenic mortality for each stock. 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 Endangered Species Act (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 mortality and serious injury (M&SI) and is a recognized and acceptable metric used by NMFS Office of Protected Resources 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 impacts of AFSC research on marine mammals in this document 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 research activities and commercial fishing practices, it is appropriate 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 research activities are similar to many commercial fisheries in the fishing gear and types of vessels used, and
- AFSC research plays a key role in supporting commercial fisheries.

For the purposes of assessing the impact of requested marine mammal takes (combined Level A Harassment and M&SI) on the respective stocks, if the projected annual M&SI of a marine mammal stock from all AFSC 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 gear takes from AFSC research activities between 10 and 50 percent of PBR for that stock would be considered 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 gear takes from AFSC 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.

Table 7-1 compares the AFSC take request for all gears used in its fisheries research relative to each stock's PBR. The take request is based on a five-year authorization period, not an annual basis, so the total take request for all gears was divided by five to provide an annual average take for each species with which to compare to the annual PBR values. For all stocks for which take is requested and PBR is known, the average annual take in all gear types and all research areas combined is less than 10 percent of PBR, even if all annual takes were from a single stock for species with multiple stocks. This level of mortality, if it occurred, would be unlikely to affect the survival or reproductive success of any species and would be considered minor.

The AFSC take request also includes an average of 0.4 "undetermined dolphin or porpoise" takes per year in trawl gear and 0.2 in gillnet gear. Similarly, the request includes an average of 0.6 "undetermined pinniped" takes per year in trawl gear and 0.4 in longline gear. For impact analysis purposes, we assigned these undetermined takes to each dolphin, porpoise, or respective pinniped stock in addition to those takes requested for the particular stock. Under these assumptions, the combined M&SI/Level A take request would still be less than 10 percent of PBR for all stocks and would be considered minor in magnitude (Table 7-1).

As indicated in Table 7-1, a number of marine mammal stocks for which take is requested do not have current population data to support calculation of PBR for the stock. The lack of any recent population information for these stocks prevents the AFSC from providing a quantitative assessment with up-to-date information on the potential impacts of the requested takes of animals from these stocks in AFSC fisheries research gear. The resulting uncertainty regarding the potential effects on these populations could only be addressed with new field and laboratory research on these stocks. Given the number of stocks with undetermined PBR and the huge geographic area in which they occur, such a research program to better define the populations of these species would be a large and expensive operation. It is not clear what the prospect is that such a comprehensive research program would be funded in the future but it would likely take years to conduct the research, analyze the data, and incorporate the information into the SARs. This LOA application is based on the best, currently available information but if new population estimates for one or more stocks with undetermined PBR are developed in the future, the AFSC will consider the potential impacts of its ongoing fisheries research program and requested take authorizations on an adaptive management basis, including the potential for additional mitigation measures as necessary.

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:

1. Will have a minimal impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival); and
2. Will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses.

Table 7-1 Analysis of Potential Effect on Stocks for which AFSC is Requesting M&SI/Level A 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. All population estimates, Potential Biological Removal (PBR) values, and total annual mortality and serious injury data are from the most recent draft stock assessment reports (Allen and Angliss 2015, Carretta et al. 2015a, Muto and Angliss 2015). 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
Pacific white-sided dolphin (North Pacific)	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	0.88%	3.2	1.1%
Steller sea lion (Eastern DPS)	1.4	1,645 or 2,193	0.09% 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%
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%

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 (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 across all areas.

7.2 Disturbance and Behavioral Changes

7.2.1 Due to Physical Presence of Researchers

As described previously, during surveys conducted near shore, pinnipeds are expected to be hauled out and at times experience close approaches by the survey vessel during the course of its fisheries research activities. AFSC expects some of these animals will exhibit a behavioral response to the visual stimuli (e.g., including flushing, vocalizing and head alerts), and as a result estimates of Level B harassment have been calculated (Table 6-12). These events are expected to be infrequent and cause only a very temporary disturbance (minutes). However, relevant studies of pinniped populations that experience more regular vessel disturbance indicate that population level impacts are unlikely to occur. Some key findings from these studies are summarized below.

In a popular tourism area of the Pacific Northwest where human disturbances were frequent to occur, past studies observed stable populations of seals over a 20-year period (Calambokidis et al. 1991). Despite high levels of seasonal disturbance by tourists using both motorized and non-motorized vessels, Calambokidis et al. (1991) observed an increase in site use (pup rearing) and classified this area as one of the most important pupping sites for seals in the Pacific Northwest. Another study observed an increase in seal vigilance only when vessels passed the haul out site, but then vigilance relaxed within 10 minutes of the vessels' passing (Fox 2008). If vessels were frequent to occur within a short time period (e.g., 24 hours), a reduction in the total number of seals present was also observed (Fox 2008).

Based on these studies, repeated disturbance can cause behavioral disturbance and alter normal activity patterns, and as such minimizing these types of disturbances, particularly those that are frequent and prolonged, is important. However, if disturbances resulting from most research activities are brief and infrequent (often the case during AFSC surveys), AFSC does not expect the close approaches to result in prolonged or permanent separation of mothers and pups or to result in responses of the frequency or magnitude that would adversely affect annual recruitment or survival or the health and condition of pinniped species or stocks.

7.2.2 Due to Noise

Characteristics of hearing and the effects of noise on marine life have been reviewed extensively (Richardson et al. 1995, Wartzok and Ketten 1999, Nowacek et al. 2007, Southall et al. 2007, Au and Hastings 2008). Several recent studies on hearing in individual species or species groups of odontocetes and pinnipeds also exist (e.g., Kastelein et al. 2009, Kastelein et al. 2013, Ruser et al. 2014). General characteristics of hearing in marine mammals is described briefly here primarily for the purposes of categorization with regard to the potential impacts of high frequency active acoustic sources, as well as current information regarding sound exposures that may be detectable, disturbing, or injurious to marine mammals.

Hearing in Marine Mammals

Within marine taxa, there is probably the most known about the hearing capabilities of marine mammals. However, many species and, in fact, entire taxa (e.g., large whales) have not been measured directly in controlled/laboratory settings. Current knowledge is based on direct measurements (using behavioral testing methods with trained animals and electrophysiological measurements of neural responses to sound production), as well as various ways of predicting hearing sensitivity using ranges of vocalization, morphology, observed behavior, and/or taxonomic relatedness to known species (e.g., Ketten 1997, Houser et al. 2001). While less than a third of the >120 marine mammal species have been tested directly, sufficient data exist to indicate general similarities and differences within taxa (e.g., Richardson et al. 1995, Wartzok and Ketten 1999, Au and Hastings 2008) and reasonably assign marine mammal species into functional hearing groups (as in Southall et al. 2007). Based on the functional hearing groupings made in Southall et al. (2007) conclusions may be made about marine mammal hearing, as described below.

No direct measurements of hearing exist in large whales, primarily because of their sheer size and the resulting difficulties in housing and testing them in normal captive settings. Conclusions about their hearing capabilities must be considered somewhat speculative, but some general conclusions and predictions are possible (Richardson et al. 1995, Ketten 1997, Wartzok and Ketten 1999, Houser et al. 2001, Erbe 2002, Clark and Ellison 2004). The thirteen species of baleen whales have been determined to comprise a low frequency cetacean functional hearing group with estimated functional hearing between 7 Hz and 25 kHz (NOAA 2015, Southall et al. 2007, Figure 7-1). Humpback whales produce sounds with some energy above 24 kHz (Au et al. 2006), so it is possible that functional hearing could extend slightly higher in this group. Empirical measurements of Frankel (2005) in demonstrating minor avoidance behavior in gray whales to 21-25 kHz sounds and the anatomical predictions of Parks et al. (2007) are consistent with the interpretation of a slightly higher upper frequency hearing cut-off in mysticetes, perhaps extending close to 30 kHz in some species.

Odontocetes are segregated into two functional hearing groups based on their relative specialization (or lack thereof) to detect very high frequency sounds (Table 4-1). Southall et al. (2007) distinguished these into the mid-frequency cetaceans including 32 species and subspecies of "dolphins", 6 species of larger toothed whales, and 19 species of beaked and bottlenose whales. These species are determined, based on direct behavioral and electrophysiological methods, to have functional hearing between approximately 150 Hz and 160 kHz (see references in Southall et al. 2007).

High frequency cetaceans include eight species and subspecies of true porpoises, six species and subspecies of river dolphins plus the Franciscana (*Pontoporia blainvillei*)), Kogia, and four species of cephalorhynchids and have functional hearing between 200 Hz and 180 kHz (Southall et al. 2007, and citations therein).

The pinnipeds (seals and sea lions) function in both air and water and have functional hearing in each media. Only underwater hearing is considered here, given that the active acoustic sources associated with AFSC research vessels are operated in water. This group includes 16 species and subspecies of sea lions and fur seals (otariids), 23 species and subspecies of true seals (phocids), and two subspecies of walrus (odobenids). Based on the existing empirical data on hearing in laboratory individuals of nine pinniped species, Southall et al. (2007) estimated functional underwater hearing sensitivity in this group to be between 75 Hz and 75 kHz, but noted that there is considerable evidence that phocid seals have a broader range of hearing sensitivity than the otariids; the use of this bandwidth is thus a precautionary estimate in terms of how high frequency sounds might affect otariid pinnipeds. To account for this, modified functional hearing groups divide pinnipeds into Phocids and Otariids, with estimated auditory bandwidths of 75 Hz to 100 kHz and 100 Hz to 48 kHz, respectively (NOAA 2015).

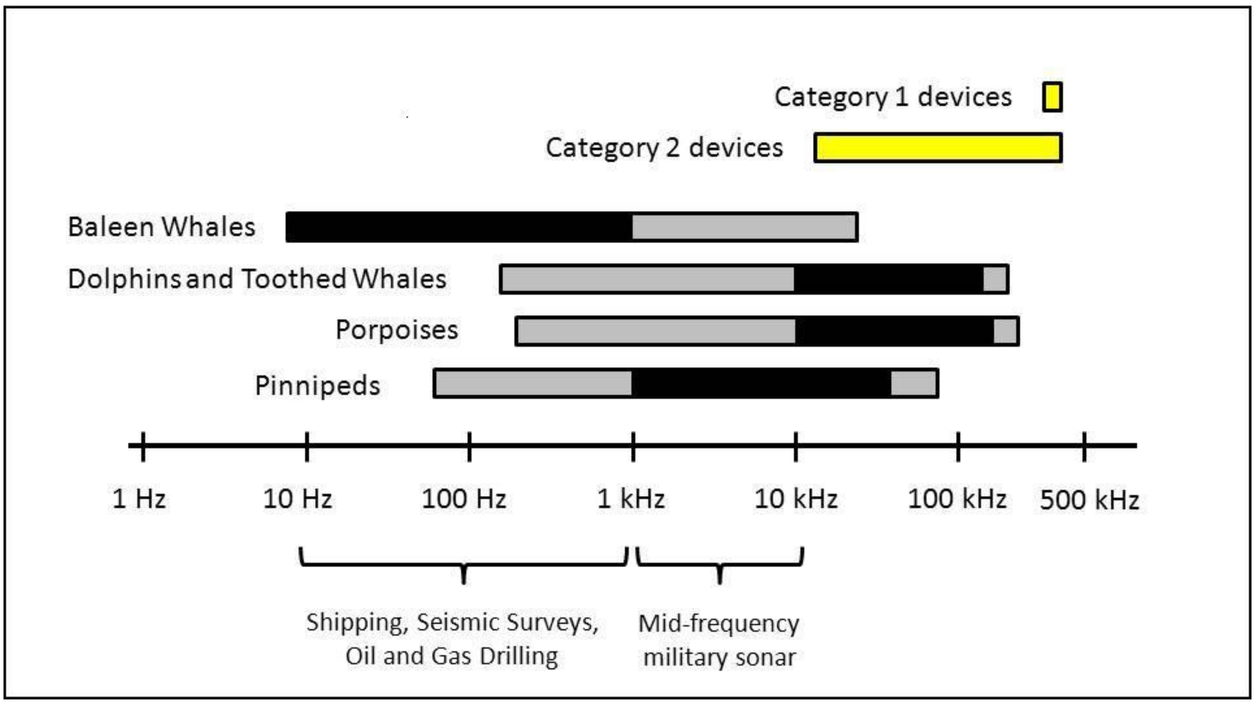


Figure 7-1 Typical Frequency Ranges of Hearing in Marine Animals Shown Relative to Various Underwater Sound Sources, Particularly High Frequency Active Acoustic Sources

Figure 7-1 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, see below), as identified in 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 (2008).

Effects of Anthropogenic Noise on Marine Mammals

Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of impacts on marine life, from no or minor responses to potentially severe, depending on received levels, behavioral context and various other factors. Many of the kinds of sources that have been investigated included sounds that are either much lower frequency and/or higher total energy (considering output sound levels and signal duration) than the high frequency mapping and fish-finding sonars used by the AFSC. These include low- and mid-frequency military sonars, seismic airguns used in geophysical research, pile-driving sounds associated with marine construction, and low- and mid- frequency sounds associated with vessel operations (NRC 1994, 2000, 2003, 2005; Nowacek et al. 2007, Southall et al. 2007, Popper and Hastings 2009). Other than the Navy's studies on the High-Frequency Marine Mammal Monitoring (HF/M3) active sonar system since 2001, there has been relatively little attention given to the potential impacts of high-frequency sonar systems on marine life, largely because their combination of high output frequency and relatively low output power is likely to render them less likely to impact many marine species than some of the other acoustic sources. However, it should be noted that some species of marine animals do hear and produce sounds at some of the frequencies used in these sources and ambient noise is much lower at high frequencies, increasing the relative probability of their detection relative to other sounds in the environment.

Sounds must presumably be audible to be detected and the known or estimated functional hearing capabilities for different species are indicated in Figure 7-1. Additionally, Southall et al. (2007) provided a recent and extensive review on the effects of noise on marine mammal hearing and behavior.

The results of that review indicate that relatively high levels of sound are likely required to cause temporary hearing threshold shifts (TTS) in most pinnipeds and odontocete cetaceans species (e.g., Schlundt et al. 2000, Finneran et al. 2002, 2005, 2007, 2010a and b; Kastak et al. 1999, 2005,2007). The exposures required are often measured with a variety of sound exposure metrics related to level (e.g., rms, peak, or peak-peak sound pressure level) or sound energy (e.g., sound exposure level that considers level as well as exposure duration). While clearly dependent on sound exposure frequency, level, and duration, based on the results of these studies, for the kinds of relatively brief exposures associated with transient sounds such as the active acoustic sources usd by the AFSC, rms sound pressure levels in the range of approximately 180-220 dB re: 1µPa are required to induce onset TTS levels for most species (Chapter 3 in Southall et al. 2007). Recently, Lucke et al. (2009) found a TTS onset in a harbor porpoise exposed to airgun noise at much lower (>20 dB) levels than reported by Finneran et al. (2002) for belugas using a similar impulse noise source; Kastelein (unpubl. data) has similarly observed increased sensitivity in this species. Additionally, Finneran and Schlundt (2010) indicate relatively lower TTS onset levels for higher sound exposure frequencies (20 kHz) than for lower frequencies (3 kHz) in some cetaceans. However, for these animals, which are better able to hear higher frequencies and may be more sensitive to higher frequencies, exposures on the order of ~170 dB rms or higher for brief transient signals are likely required for even temporary (recoverable) changes in hearing sensitivity that would likely not be categorized as physiologically damaging. The corresponding estimates for permanent threshold shift (PTS), which would be considered injurious, would still be at quite high received sound pressure levels that would rarely be experienced in practice.

Southall et al. (2007) provided a number of extrapolations to assess the potential for permanent hearing damage (permanent threshold shift or PTS) from discrete sound exposures and concluded that very high levels (exceeding 200 dB re: 1µPa received sound pressure levels) would be required; typically quite large TTS is required (~40dB) to result in PTS from a single exposure. Southall et al. (2007) also provided some frequency weighting functions for different marine mammal groups, which essentially account for the fact that impacts of noise on hearing depends in large part on the frequency overlap between noise and hearing. 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 10s to 100m for the kinds of sources in the fisheries surveys considered here. They also emphasized that these effects would very likely only occur in the cone ensonified below the ship and that animal responses to the vessel at these extremely close ranges would very likely influence their probability of being exposed to these levels. For certain species (e.g., odontocete cetaceans and especially harbor porpoises), these ranges may be somewhat greater based on more recent data (Lucke et al. 2009, Finneran and Schlundt 2010), although they are likely still on the order of hundreds of meters for most fisheries acoustic sources. The overall conclusion here is that the available information on hearing and potential auditory effects in marine mammals would suggest that the high frequency cetacean species would be the most likely to have temporary (not permanent) hearing losses from a vessel operating high frequency sonar sources, but that even for these species, individuals would have to either be very close to and also remain very close to vessels operating these sources for multiple exposures at relatively high levels. Given the moving nature of vessels in fisheries research surveys, the likelihood that animals may avoid the vessel to some extent based on either its physical presence or active acoustic sources, and the intermittent nature of many of these sources, the potential for TTS is probably low for high frequency cetaceans and very low to zero for other species. In addition, the behavioral responses that typically occur (described below) further reduce this already low likelihood that an animal may approach close enough for any type of hearing loss to occur.

The overall conclusion here is that the available information on hearing and potential auditory effects in marine mammals would suggest that the high frequency cetacean species would be the most likely to have temporary (not permanent) hearing losses from a vessel operating high frequency sonar sources, but that even for these species, individuals would have to either be very close to and also remain very close to vessels operating these sources for multiple exposures at relatively high levels. Given the moving nature of vessels in fisheries research surveys, the likelihood that animals may avoid the vessel to some extent based on either its physical presence or active acoustic sources, and the intermittent nature of many of these sources, the potential for TTS is probably low for high frequency cetaceans and very low to zero for other species. In addition, the behavioral responses that typically occur (described below) further reduce this already low likelihood that an animal may approach close enough for any type of hearing loss to occur.

Behavioral responses of marine mammals are extremely variable depending on a host of exposure factors, including exposure level, behavioral context and other factors. The most common type of behavioral response seen across studies is behavioral avoidance of areas around sound sources. These are typically the types of responses seen in species that do clearly respond, such as harbor porpoises, around temporary/mobile higher frequency sound sources in both the field (e.g., Culik et al. 2001, Johnston et al. 2002) and in the laboratory settings (e.g., Kastelein et al. 2000, 2005a, 2008a and b). However, what appears to be more sustained avoidance of areas where high frequency sound sources have been deployed for long durations has also been documented in some odontocete cetaceans, particularly those like porpoises and beaked whales that seem to be particularly behaviorally sensitive (e.g., Carretta et al. 2008, Southall et al. 2007). While low frequency cetaceans and pinnipeds have been observed to respond behaviorally to low- and mid-frequency sounds, there is little evidence of behavioral responses in these species to high frequency sound exposure (see e.g., Jacobs and Terhune 2002, Kastelein et al. 2005b).

Active Acoustic Sources Used by the AFSC and their Effect on Marine Mammals

A brief discussion of the general characteristics of high frequency acoustic sources associated with fisheries research activities is given below, followed by a qualitative assessment of how those sources may affect marine life. Marine mammals are the focus of this assessment given their overlapping hearing capabilities (Figure 7.1) with the sounds produced by high frequency sound sources.

The high frequency transient sound sources operated by the AFSC are used for a wide variety of environmental and remote-object sensing in the marine environment. They include various echosounders (e.g., multibeam systems), scientific sonar systems, positional sonars (e.g., net sounders for determining trawl position), and environmental sensors (e.g., current profilers). The specific acoustic sources used in AFSC active acoustic surveys, are described in section 6.2. As a general categorization, however, the types of active sources employed in fisheries acoustic research and monitoring may be considered in two broad categories here, based largely on their respective operating frequency (e.g., within or outside the known audible range of marine species) and other output characteristics (e.g., signal duration, directivity). As described below, these operating characteristics result in differing potential for acoustic impacts on marine mammals and other protected species.

Category 1 active acoustic sources

Certain active fisheries acoustic sources (e.g., short range echosounders, acoustic Doppler current profilers) are distinguished by having very high output frequencies (>180 kHz) and generally short duration signals and highly directional beam patterns. Based on the frequency band of transmissions relative to the functional hearing capabilities of marine species, they are not expected to have any negative effect on marine life. They are thus not considered explicitly in the qualitative assessment below (or in the quantitative analysis conducted in section 6.2). Additionally, passive listening sensors which are sometimes described as elements of fisheries acoustic systems that exist on many oceanographic research vessels have no potential impact on marine life because they are remotely and passively detecting sound rather than producing it.

These sources are determined to have essentially no probability of being detected by or resulting in any potential adverse impacts on marine species. This conclusion is based on the relative output frequencies (> 180 kHz) and the fact that this is above the known hearing capabilities of any marine species (as described above). Sounds that are above the functional hearing range of marine animals may be audible if sufficiently loud. However, the relative output levels of these sources and the levels that would likely be required for animals to detect them would be on the order of a few meters. The probability for injury or disturbance from these sources is essentially zero. In fact, NMFS does not regulate or require take assessments for acoustic sources with source frequencies at or above 180 kHz because they are above the functional hearing range of any known marine animal (including high frequency odontocete cetaceans, such as harbor porpoises; Deng et al. 2014, Hastie et al. 2014).

Category 2 active acoustic sources

These acoustic sources, which are present on most AFSC fishery research vessels, include a variety of single, dual, and multi-beam echosounders (many with a variety of modes), sources used to determine the orientation of trawl nets, and several current profilers with slightly lower output frequencies than category 1 sources. Category 2 active acoustic sources have moderate to very high output frequencies (10 to 180 kHz), generally short ping durations, and are typically focused (highly directional) to serve their intended purpose of mapping specific objects, depths, or environmental features. A number of these sources, particularly those with relatively lower sound frequencies coupled with higher output levels can be operated in different output modes (e.g., energy can be distributed among multiple output beams) that may lessen the likelihood of perception by and potential impact on marine life.

Category 2 active acoustic sources are likely to be audible to some marine mammal species. Among the marine mammals, most of these sources are unlikely to be audible to whales and most pinnipeds, whereas they may be detected by odontocete cetaceans (and particularly high frequency specialists such as harbor porpoise). There is relatively little direct information about behavioral responses of marine mammals, including the odontocete cetaceans, but the responses that have been measured in a variety of species to audible sounds (see Nowacek et al. 2007, Southall et al. 2007 for reviews) suggest that the most likely behavioral responses (if any) would be short-term avoidance behavior of the active acoustic sources.

The potential for direct physical injury from these types of active sources is low, but there is a low probability of temporary changes in hearing (masking and even temporary threshold shift) from some of the more intense sources in this category. Recent measurements by Finneran and Schlundt (2010) of TTS in mid-frequency cetaceans from high frequency sound stimuli indicate a higher probability of TTS in marine mammals for sounds within their region of best sensitivity; the TTS onset values estimated by Southall et al. (2007) were calculated with values available at that time and were from lower frequency sources. Thus, there is a potential for TTS from some of the category 2 active sources, particularly for mid- and high-frequency cetaceans. However, even given the more recent data, animals would have to be either very close (few hundreds of meters) and remain near sources for many repeated pings to receive overall exposures sufficient to cause TTS onset (Lucke et al. 2009, Finneran and Schlundt 2010). If behavioral responses typically include the temporary avoidance that might be expected (see above), the potential for auditory effects considered physiological damage (injury) is considered extremely low so as to be negligible in relation to realistic operations of these devices.

Acoustic summary

Based on current scientific understanding and knowledge of the kinds of sources used in field operations, many of the high frequency, directional, and transient active acoustic sources used in AFSC fisheries research operations are unlikely to be audible to and thus have no adverse impacts on most marine mammals. Sources operating at lower output frequencies, higher output levels, more continuous types of operation and with less directed acoustic energy are more likely to be audible to and affect more marine species.

Mitigating factors are inherent in the operational aspects of these fisheries acoustic systems. Operational frequencies are typically above the hearing range of most marine mammals, the duty cycle is of short pulse length (milliseconds), and involve directed (narrow) beams - as opposed to mid-frequency seismic and military sonar with less directional and longer duration pulse lengths. This difference in exposure time is important because our current understanding is that marine mammals integrate hearing over short periods on the order of .05 -.2 seconds (e.g., for dolphins), so a longer pulse will be perceived as louder. Another feature of these frequencies is the much greater propagation losses due to increased absorption of sound, so range effects are highly diminished.

Among the marine mammals, the whales and pinnipeds are the least likely to detect and be affected by these sounds. The most likely taxa to hear and react would be the odontocete cetaceans (and especially the high frequency specialized and relatively behaviorally sensitive harbor porpoises), who have specialized echolocation systems and associated high frequency hearing and excellent temporal processing of short-duration signals. The current NMFS acoustic step-function threshold of (160 dB rms received level, irrespective of sound frequency) is applied in the quantitative assessment in section 6.2 because this is the current requirement. However, for many marine mammal species with reduced functional hearing at the higher frequencies produced by category 2 active sources (e.g., 40-180 kHz), based purely on their auditory abilities, the potential impacts are likely much less (or non-existent) than might be calculated in the quantitative assessment since these relevant factors are not taken into account.

For species that can detect sounds associated with high frequency active sources, based on the limited observational and experimental data on these and similar sound sources, the most likely impacts would be localized and temporary behavioral avoidance. These kinds of reactions, depending on their relative duration and severity, have been considered relatively low to moderately significant behavioral responses in the severity scaling assessment for marine mammals by Southall et al. (2007).

There is a low probability of some temporary hearing impacts and an even lower probability of direct physical harm for odontocete cetaceans to the loudest kinds of these high frequency sources over very localized areas (tens of meters) around the source. However, recent analysis of a mass stranding of 100 typically oceanic melon-headed whales (*Peponocephala electra*) in a shallow estuarine area in

Madagascar in 2008 implicate a mapping survey using a high-powered 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).

As a general conclusion, while some of the active acoustic sources used in AFSC active acoustics during fisheries research surveys are likely to be detected by some marine species (particularly phocid pinnipeds and odontocete cetaceans), the potential for direct injury or hearing impairment is extremely low and the most likely responses involve temporary avoidance behavior. Consequently, and in a manner consistent with the current NMFS acoustic guidelines for defining level B takes of marine mammals from impulse noise sources, a quantitative framework was developed (Section 6.2) for assessing the potential impacts of AFSC active acoustic sources used in fisheries research.

7.3 Surveys Conducted by the AFSC that May Take Marine Mammals by Level B Harassment using Category 2 Acoustic Sources

Current NMFS practice regarding exposure of marine mammals to sound is that cetaceans and pinnipeds exposed to impulsive sounds of 180 and 190 dB rms or above, respectively, are considered to have been taken by Level A (i.e., injurious) harassment. Behavioral harassment (Level B) is considered to have occurred when marine mammals are exposed to sounds at or above 160 dB rms or impulse sounds (e.g., impact pile driving) and 120 dB rms for continuous noise (e.g., vibratory pile driving), but below injurious thresholds. NMFS uses these levels as guidelines to estimate when harassment may occur.

Level B harassment take associated with use of active acoustics equipment may occur in AFSC fisheries research surveys; the species/stocks, geographical regions, and numbers of requested takes are detailed in Tables 6-11a-c. These surveys are described in Section 1.6 and Table 1-1. The AFSC believes that the activities listed below will have a minimal impact on the affected species or stocks of marine mammals based on the likelihood that the activities will not affect annual rates of recruitment or survival.

The AFSC deploys active acoustic equipment that may be heard by marine mammals and produce sounds loud enough to cause potential Level B harassment in the GOARA, BSAIRA, and CSBSRA regions of Alaska.

7.3.1 Acoustic Surveys Conducted in the GOARA

- Pollock Summer Acoustic Trawl Survey - Gulf of Alaska (Biennial)
- Pollock Winter Acoustic Trawl Survey - Shelikof Strait
- Pollock Winter Acoustic Trawl Survey – Shumagin/Sanak Islands
- Gulf of Alaska Shelf and Slope Bottom Trawl Groundfish Survey (Biennial)

7.3.2 Acoustic Surveys Conducted in the BSAIRA

- Aleutian Islands Shelf and Slope Bottom Trawl Groundfish Survey (Biennial)
- Arctic Ecosystem Integrated Survey
- Bering Sea Shelf Bottom Trawl Survey
- Eastern Bering Sea Upper Continental Slope Trawl Survey Summer (Biennial)
- Pollock Summer Acoustic Trawl Survey - Bering Sea

- Pollock Winter Acoustic Trawl Survey - Bogoslof Island (Biennial)
- Bering Aleutian Salmon International Survey (BASIS)
- Acoustic Research and Mapping to Characterize EFH (FISHPAC)
- Response of Fish to Drop Camera Systems
- Northern Bering Sea Bottom Trawl Survey

7.3.3 Acoustic Surveys Conducted in the CSBSRA

- Arctic Ecosystem Integrated Survey

7.4 Collisions and Vessel Strikes

Collisions with vessels, or ship strikes, threaten numerous marine animals and are of great concern for endangered large whales, particularly North Pacific right whales. Ship strikes with marine mammals 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 from 1975 to 2003 and found that most collisions occurred in the open ocean involving large vessels. Commercial fishing vessels were responsible for four of 134 records (3 percent), and one collision (0.75 percent) was reported for a research boat, pilot boat, whale catcher boat, and dredge boat.

In an analysis of the probability of lethal mortality of large whales at a given speed, results of a study using a logistic regression model showed that the greatest rate of change in the probability of a lethal injury to a large whale, as a function of vessel speed, occurs between vessel speeds of 8.6 and 15 knots (Vanderlaan and Taggart 2007). Across this speed range, they found that the chances of a lethal injury decline from approximately 80 percent at 15 knots to approximately 20 percent at 8.6 knots. Notably, it is only at speeds below 11.8 knots that the chances of lethal injury drop below 50 percent and above 15 knots the chances asymptotically increase toward 100 percent. The AFSC has concluded the probability of vessel and marine mammal interactions occurring during AFSC operations is minimal due to the vessel's slow operational speed, which is typically four knots or less during sampling and average about 10 knots while in transit, which is generally below the speed at which studies have noted reported increases of marine mammal injury or death (Laist et al. 2001).

Even though the likelihood of a ship strike is very small, we reviewed the available literature to assess the possible impact of ship strike as it applies to AFSC survey vessels. Williams and O’Hara (2009) summarized their modeling efforts to characterize ship strikes of large cetaceans in British Columbia. Their information on ship strikes was based on ship activity provided to them by the Canadian Coast Guard. Spatially-explicit statistical modeling and Geographic Information System visualization techniques identified areas of overlap between shipping activity and waters used by humpback, fin and killer whales. Areas of highest risk were far removed from areas with high concentrations of people, suggesting that many beach-cast carcasses could go undetected. With few exceptions, high-risk areas were found in geographic bottlenecks, such as narrow straits and passageways. Although not included in the geographic area of the Williams and O’Hara study, the AFSC survey area is such an area where large numbers of cargo ships transit the area each year, yet evidence for ship collisions are rare. Williams and O’Hara (2009) state that their risk assessments illustrate where ship strikes are most likely to occur, but cannot estimate how many strikes might occur. Propeller wounds on live killer whales were common in their study region, and fatal collisions have been reported in B.C. for all three species. One killer whale mortality due to a ship strike occurred in 1998, when a whale was struck by a propeller of a vessel in the

Bering Sea groundfish trawl fishery (Allen and Angliss 2015). 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).

When research vessels are actively sampling, cruise speeds are less than four knots, a speed at which the probability of collision and serious injury of large whales is low. However, when transiting between sampling stations, research vessels travel at speeds up to ten knots, ocassionally reaching 12 knots in high current areas only. AFSC vessel captains and crew watch for marine mammals while underway during daylight hours and take necessary actions to avoid them. Whe transiting areas with high marine mammal activity, such as Seguam Pass, extra crew are often called to provide additional monitoring capability around the vessel.

No collisions with large whales have been reported from any fisheries research activities conducted or funded by the AFSC. That, combined with adherence to the above mentioned mitigation measures, indicate that vessel collisions are possible, but unlikely to occur, and anticipated impacts to most species would be negligible to minor. The exception to this determination is the North Pacific right whale or other large endangered balaenopterid whales. Although it is highly unlikely that an AFSC fisheries research vessel would strike such a scarce, large baleen whale, doing so, especially if fatal, would be considered a substantial impact for a small population of endangered whales and would result in the re-initiation of ESA section 7 consultation.

7.5 Conclusions Regarding Impacts of AFSC Fisheries Research Activities on Marine Mammal Species and Stocks

As outlined in this and previous sections, there are several AFSC fisheries research activities that have the potential to cause Level A and Level B harassment and serious injury or mortality of marine mammals in the GOARA, BSAIRA, and CSBSRA study areas. However, because of the low level of historical interactions relative to the abundance of affected populations, as well as the low level of predicted future takes associated with AFSC surveys, the AFSC believes its activities will not affect annual rates of recruitment or survival or the health and condition of the species or stock of the requested species.

- As discussed earlier in this Section, the requested annual takes associated with trawls, gillnet entanglement or hooking in longlines associated with AFSC fisheries research surveys over the five-year authorization period would not exceed any stock's PBR, and for most affected stocks with known PBR, the AFSC take request is only a small fraction of PBR. The requested levels of take are precautionary and, if they occurred, would likely have minimal effects on all stocks.
- In the GOARA and BSAIRA, the AFSC expects that some hauled out pinnipeds may experience Level B harassment when a survey vessel passes nearby during the course of conducting fisheries research operations. The frequency and intensity of these events are expected to be temporary and may affect only small numbers of pinnipeds. Further, cited studies on pinniped disturbance do not indicate that impacts would be of the magnitude likely to result in population-level impacts.
- AFSC surveys use a variety of active acoustic systems in the GOARA, BSAIRA, and CSBSRA study areas. These are expected to result in Level B harassment for marine mammals in close proximity to the survey vessel and its active acoustic systems. However, exposure to active acoustics used on AFSC fisheries research surveys is not expected to result in injury to animals and behavioral disturbance is expected to be temporary and not result in population level impacts.

Based on this information the AFSC believes that its activities will have a minimal impact on the affected species or stocks of marine mammals based on the likelihood that the activities will not affect annual rates of recruitment or survival.

8.0 THE ANTICIPATED IMPACT OF THE ACTIVITY ON THE AVAILABILITY OF THE SPECIES OR STOCKS OF MARINE MAMMALS FOR SUBSISTENCE USES

The taking of small numbers of marine mammals under section 101(a)(5) (A) through (D) of the Marine Mammal Protection Act "may be allowed only if the National Marine Fisheries Service: (a) Finds, based on the best scientific evidence available, that the total taking by the specified activity during the specified time period will have a negligible impact on species or stock of marine mammal(s) *and will not have an unmitigable adverse impact on the availability of those species or stocks of marine mammals intended for subsistence uses…*" (61 FR 15884, April 10, 1996; emphasis added).

Unmitigable adverse impact "means an impact resulting from the specified activity: (1) That is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) Causing the marine mammals to abandon or avoid hunting areas; (ii) Directly displacing subsistence users; or (iii) Placing physical barriers between the marine mammals and the subsistence hunters; and (2) That cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met."

This application requests authorization to take marine mammals in three vast oceanic regions of Alaska in the process of conducting AFSC fisheries and ecosystem research. The type of potential takes include serious injury and mortality, harassment of marine mammals due to the propagation of sounds into the ocean, and incidental disturbance of marine mammals on haulout sites in the GOARA and BSAIRA. Each of these activities also has the potential for causing "unmitigable adverse impact" as defined above. The AFSC is aware of this potential and is committed to implementing actions to avoid or to minimize any such affects to the Alaska Native subsistence community.

The AFSC will implement fisheries research so that there will not be a reduction in the availability of those species to a level insufficient for harvest to meet subsistence needs due to:

1) Actions that may cause marine mammals to abandon or avoid hunting areas

Some AFSC fisheries research efforts use high frequency mapping and fish-finding sonars to assess abundance and distribution of target stocks of fish. The high frequency transient sound sources operated by the AFSC are used for a wide variety of environmental and remote-object sensing in the marine environment. These acoustic sources, which are present on most AFSC fishery research vessels, include a variety of single, dual, and multi-beam echosounders, sources used to determine the orientation of trawl nets, and several current profilers. The specific acoustic sources used in AFSC active acoustic surveys, are described in section 6.2. Some of these acoustic sources are likely to be audible to some marine mammal species. Among the marine mammals, most of these sources are unlikely to be audible to whales and most pinnipeds, whereas they may be detected by odontocete cetaceans (and particularly high frequency specialists such as harbor porpoise). There is relatively little direct information about behavioral responses of marine mammals, including the odontocete cetaceans to these devices, but the responses that have been measured in a variety of species to audible sounds (see Nowacek et al. 2007 and Southall et al. 2007 for reviews) suggest that the most likely behavioral responses (if any) would be localized short-term avoidance behavior. As a general conclusion, while some of the sources used in AFSC active acoustics during fisheries research surveys are likely to be detected by some marine species (particularly phocid pinnipeds and odontocete cetaceans), the sound sources with potential for disturbance would be temporary and transient in any particular location as the research vessels move through an area. Any changes in marine mammal behavior in response to the sound sources or physical presence of the research vessel would likely involve temporary avoidance behavior of the research vessel and would return to normal after the vessel passed. Given the small number of research vessels involved and their inconsistent presence in any given area from day to day, the potential for animals to avoid any particular area due to research is negligible.

Most AFSC fisheries research activities occur well away from land and, in cases where they do approach land, include mitigation measures to minimize the risk of disturbing pinnipeds hauled out on land. Any incidental disturbance of pinnipeds on haulouts would likely be infrequent and result in temporary or short term changes in behavior. This sporadic and temporary type of disturbance is not likely to result in a change in use or abandonment of a known haulout.

AFSC fisheries research activities generally are highly transient and short term (e.g., hours to a day in any one location) in duration and take place well out to sea, far from coastal or ice pack subsistence hunting activities. It is possible, albeit unlikely, for these fisheries research sound sources to interact with migratory species hunted for subsistence such that there could be short term alterations in migratory pathways. However, as described in the Communication Plan (CP, Section 12, Appendix B of this application), the AFSC will work with subsistence users to identify important areas for marine mammals and subsistence hunters early in the planning process as well as in real time to identify the potential for overlap between migratory pathways, key hunting regions and seasons, and proposed fisheries research. This communication should lead to avoidance of any issues of displacement of marine mammals and their prey.

2) Activities that may directly displace subsistence users

AFSC fisheries research primarily utilizes ocean going ships generally suited for offshore work. These vessels are not designed to work in or near sea ice where much of the subsistence harvest of pinnipeds occurs; thus research activities are most likely to occur outside of periods when this type of hunting occurs. Due to the desire to avoid disturbing pinnipeds hauled out on land, these ships largely avoid nearshore routes that might otherwise put them in the path of seal hunters.

Bowhead whale hunts may occur near sea ice in the spring or in open water in the fall. AFSC fisheries research is only conducted during the open water season in the Arctic so there is no risk of potential interference with subsistence hunts in the spring. However, AFSC fisheries research vessels may be present in whale hunting areas in the fall and could potentially interfere with subsistence activities. The CP is designed to minimize the risk of any such interference by advance planning and communication between AFSC scientists and subsistence hunting organizations (e.g., Alaska Eskimo Whaling Commission) and real-time communication between AFSC research vessels as they approach subsistence areas and nearby coastal community contacts. The AFSC is committed to alter its research plans to address any concerns about potential interference and to avoid any such interference in the field.

AFSC fisheries research vessels make port calls in established harbors and ports, thus reducing the chances for interaction with the transit of hunters to and from coastal villages to nearby hunting regions. As described in the CP for this application, in those rare cases where a research vessel may need to anchor offshore from a subsistence community, AFSC personnel will, within the limits of maritime safety, direct the ship to a predetermined location in coordination with the local subsistence community so as to avoid interfering with those activities.

3) Activities that may place physical barriers (vessels and gear) between the marine mammals and the subsistence hunters

The AFSC uses a variety of towed nets and sampling gear to conduct its fisheries and ecosystem research. However, current operational guidelines designed to reduce incidental catch of marine mammals include measures that direct activities away from marine mammals near the research vessel (move-on rule). These measures will reduce the possibility for placing any barriers between subsistence hunters and their marine mammal prey. As outlined in the CP, AFSC will not deploy such research gear when subsistence hunters have been visually observed in the area.

> AFSC fisheries research will also strive to avoid working in any areas when migrating species are present in the immediate vicinity. Per the CP, the AFSC will coordinate both in advance and in real time with known marine mammal hunting communities within the immediate vicinity of research to avoid any interactions between hunting activity and fisheries research vessels or gear.

The AFSC is committed to conduct its fisheries and ecosystem research activities in ways that do not affect the availability of marine mammals to subsistence hunters. The AFSC will implement standard operational procedures and mitigation measures to minimize direct impacts on marine mammals and will work with Alaska Native organizations and coastal communities to develop effective communication protocols to minimize the risk of potential interference with subsistence activities. The AFSC will thus work to ensure that its fisheries and ecosystem research activities do not negatively impact the availability of marine mammals to Alaska Native subsistence users.

9.0 THE ANTICIPATED IMPACT OF THE ACTIVITY UPON THE HABITAT OF THE MARINE MAMMAL POPULATIONS, AND THE LIKELIHOOD OF RESTORATION OF THE AFFECTED HABITAT

The fisheries research activities conducted by the AFSC take place in the Gulf of Alaska, Bering Sea, Aleutian Islands, Chukchi Sea, and Beaufort Sea. The proposed activities will not result in any permanent impact on habitats used by marine mammals or to the food resources that they utilize and thus will not affect marine mammal stocks, populations or species within the AFSC survey areas. Modifications to the water column are expected to be short-term in nature while modifications to the sea floor from actively sampling gear (e.g., bottom trawls) may be longer-term. Expected modifications to the sea floor are insignificant relative to the size of the ocean floor (<0.01 percent of the research areas) or the areas affected by commercial bottom trawls. The levels of removals of finfish and invertebrates relative to overall population sizes was evaluated in the Draft Programatic Environmental Assessment (DPEA) supporting this LOA application (see Sections 4.3.3 and 4.3.7 in the DPEA) and found to be minor for all common prey items of marine mammals. Potential impacts to marine mammal habitat are not anticipated to alter the function of the habitat and, therefore, will have little to no impact on marine mammal stocks or species.

9.1 Changes in Food Availability

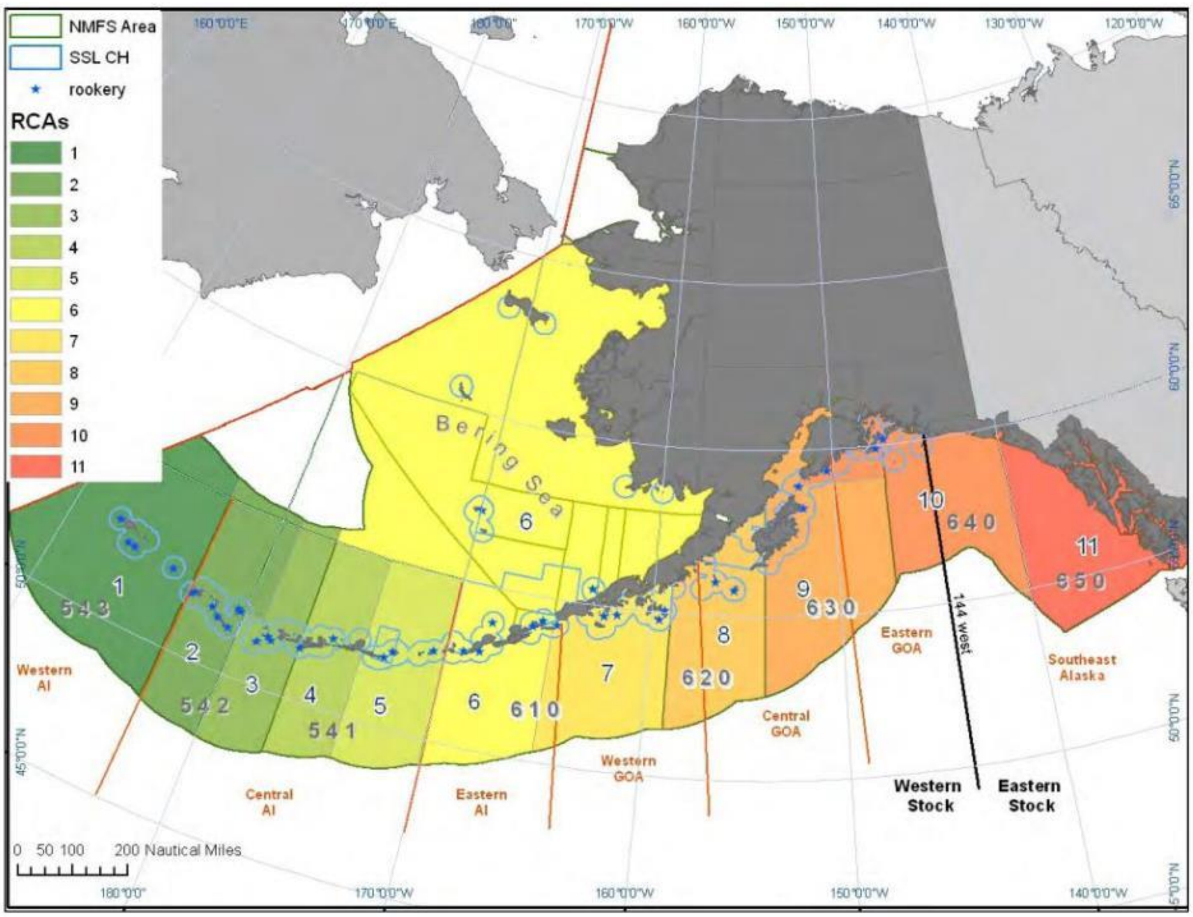
Prey of marine mammals varies by species, season, and location and, for some, is not well documented. AFSC fisheries research removals of commonly utilized species are relatively low. Prey of baleen whales are primarily zooplankton, which are sampled in plankton nets by many AFSC fisheries research projects but only in minute quantities so the likelihood of research activities changing prey availability for these marine mammal species is negligible.

There is some overlap in prey of marine mammals in the three AFSC research areas and the species sampled and removed during AFSC fisheries and ecosystem research. The removal by AFSC fisheries research, regardless of season and location is, however, minimal relative to that taken through commercial fisheries (see Tables 4.3-3, 4.3-4, and 4.3-5 in the DPEA), which are just fractions of the total biomass of each fish stock. In addition, fisheries research catches are characterized by many small samples distributed over a wide area, some of which have random sampling designs that avoid repeated sampling in the same location in subsequent years. Fish removals by AFSC fisheries research are therefore unlikely to affect the spatial concentrations and availability of any prey for marine mammals.

Scientific research proposals for both long-term and short-term projects require scientific research permits. The potential impacts of proposed projects are assessed for each fish stock 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. This type of annual review of AFSC fisheries research proposals would continue to occur in the future. Supplements to this LOA may be needed if the nature of future AFSC fisheries research and equipment extends beyond the range of activities described in this application.

9.1.1 Prey Removal from Fisheries Research Activities in Steller Sea Lion Critical Habitat

Several AFSC fisheries research projects target prey of endangered Western DPS Steller sea lions within the GOARA and BSAIRA. These studies are, in part, designed to assess aspects of the seasonal abundance and distribution of sea lion prey as part of a NMFS comprehensive examination of how nutritional status and prey availability may affect the recovery of the species. Some of these studies may be conducted within designated critical habitat for Steller sea lions, no-transit zones around rookeries, and areas designated as fishery closure zones see (Figure 9-1). The primary prey caught in critical habitat includes: rockfishes, walleye pollock, Atka mackerel, arrowtooth flounder, and Pacific cod. Table 9-1 shows the average annual AFSC fisheries research catch within Steller sea lion critical habitat. On an annual basis over the next five years, the AFSC expects these studies to remove similar amounts of these prey species from the identified regions. These amounts of prey are but a small fraction (<2.5 percent) of the commercial harvest total allowable catch in the GOARA and BSAIRA, which are typically in the tens of thousands or hundreds of thousands of metric tons (see Tables 4.3-3, 4.3-4, and 4.3-5 in the DPEA), and an even smaller fraction of the biomass available to Steller sea lions. AFSC fisheries research catches are therefore anticipated to result in little to no effects on foraging sea lions in the general area or in their critical habitat. AFSC fisheries research in the GOARA has routinely undergone project-specific ESA section 7 consultations as part of the process for obtaining regional scientific research permits. These consultations have not found any of the fisheries research prey removals to jeopardize listed species or to adversely modify critical habitat in the GOARA or BSARA. Furthermore, as part of the process for considering authorization under this LOA application, the full five-year scope of AFSC fisheries research proposed here will undergo a programmatic section 7 consultation.



Source: NMFS 2010b, Figure 3.8

Figure 9-1 Rookery Cluster Areas and Fishery Management Zones in Relation to Steller Sea Lion Critical Habitat

Table 9-1 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 AFSC 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 sole	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
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 Biennial Bottom Trawl Survey (2009, 2012, 2015), Aleutian Islands Biennial Survey (2010), Aleutian Islands Bottom Trawl Survey (2012, 2014), Eastern Bering Sea Shelf Survey (2013, 2014, 2015), and Eastern Bering Sea Slope Survey (2012).

9.2 Physical Damage to Benthic (Seafloor) Habitat

The potential effects of AFSC fishery research activities on the physical environment vary depending on the survey gear and other equipment used but generally includes:

- Physical damage to benthic (seafloor) habitat
- Biological damage to infauna and epifauna
- Alteration of the turbidity and geochemistry of the water column and seabed.

Fishing gear that contacts the seafloor can physically damage seafloor habitat. 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). Other survey equipment that contacts the seafloor, such as sensors and samplers, could cause localized physical damage to benthic habitats; but the effects of such equipment on benthic habitat would be limited to a very small area because this equipment is not usually dragged along the seafloor.

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).

The area of benthic habitat affected by AFSC research each year would be a very small fraction (< 0.001 percent) of the total of the three research areas (Table 4.2-2 in the DPEA). Considering the small area affected and the short-term duration of physical effects, the overall effects of AFSC fisheries research surveys on benthic habitat in each of the AFSC research areas would be minimal.

9.3 Physical Damage to Infauna and Epifauna

Infauna are animals that live in the seafloor or within structures that are on the seafloor. Infauna usually construct tubes or burrows and are commonly found in deeper and subtidal waters. Clams, tubeworms, and burrowing crabs are infaunal animals. Epifauna live on the surface of the seafloor or on structures on the seafloor such as rocks, pilings, or vegetation. Epifauna may attach themselves to such surfaces or range freely over them, as by crawling or swimming. Mussels, crabs, starfish, and flounder are epifaunal animals. Fishing gear that contact the seafloor can disturb infauna and epifauna by crushing them, burying 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 to more severe particularly with repeated disturbance in the same areas (Stevenson et al. 2004).

The recovery time for damage to infauna and epifauna varies based on the type of fishing gear used, the type of seafloor surface (i.e., mud, sand, gravel, mixed substrate), and the level of repeated disturbances. In general, biological damage from a single disturbance is 1-18 months, and up to three years from repeated disturbances (Stevenson et al. 2004). Because research surveys are conducted in the same areas, but usually not in the exact same locations, they are expected to cause single rather than repeated disturbances in any one area. Therefore any physical damage caused by AFSC fishery research activities would be expected to recover within 1-18 months. Given the small magnitude of area affected by research and the short-term nature of physical damage effects, these impacts to benthic habitat are considered negligible.

9.4 Alteration of the Turbidity and Geochemistry of the Water Column

Fishing gear that contacts the seafloor can increase the turbidity of the water by the suspension of fine sediments and benthic algae. Suspension of fine sediments and turnover of sediment can also alter the geochemistry of the seafloor and the water column (Stevenson et al. 2004).

The impacts of alteration of turbidity and geochemistry in the water column and seabed are not very well understood (Stevenson et al. 2004). However, these types of effects from fisheries research activities as they relate to potential impacts on marine mammals would be periodic, temporary, and localized and are therefore considered negligible.

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10.0 ANTICIPATED IMPACT OF LOSS OR MODIFICATION OF HABITAT ON MARINE MAMMAL POPULATIONS

As stated in Section 9 above, the proposed activities are not anticipated to result in impacts to marine mammal habitats or to the food resources on which they depend. Modifications to the water column are expected to be short-term in nature while modifications to the sea floor from actively sampling gear (e.g., bottom trawls) may be longer-term. Expected modifications to the sea floor are insignificant relative to the current and anticipated future levels of commercial fishing activity. While commercial trawling is usually concentrated in productive fishing grounds, AFSC surveys synoptically cover most habitats that can be trawled. Since the amount of affected habitat is less than 0.01 percent of the research areas, the anticpated impact is not expected to significantly alter seafloor habitat or the marine mammals which depend on the habitats for foraging. The levels of removals of finfish and invertebrates relative to overall population sizes was evaluated in the supporting DPEA and found to be minor for all common prey items of marine mammals. Potential impacts to marine mammal habitat are not anticipated to alter the function of the habitat and, therefore, will have little to no impact on marine mammal species.

Finally, NMFS will, as part of the process for granting authorization under this LOA application, conduct a programmatic section 7 biological consultation on the full five-year scope of the AFSC fisheries research proposed here. That consultation will evaluate the potential for effects to ESA-listed species and will determine the potential for adverse modification to designated critical habitat within the GOARA, BSAIRA, and CSBSRA study regions.

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11.0 THE AVAILABILITY AND FEASIBILITY (ECONOMIC AND TECHNOLOGICAL) OF EQUIPMENT, AND MANNER OF CONDUCTING SUCH ACTIVITY OR OTHER MEANS OF EFFECTING THE LEAST PRATICABLE ADVERSE IMPACT UPON THE AFFECTED SPECIES OR STOCKS, THEIR HABITAT, AND ON THEIR AVAILABILITY FOR SUBSISTENCE USES, PAYING PARTICULAR ATTENTION TO ROOKERIES, MATING GROUNDS, AND AREAS OF SIMILAR SIGNIFICANCE

The following suite of mitigation measures will be employed by the AFSC during fisheries research. These procedures are the same whether the survey is conducted onboard a NOAA vessel or charter vessel. The procedures described are based on protocols used during previous research surveys and/or best practices developed for commercial fisheries using similar gear. The AFSC continually reviews its procedures and investigates options for incorporating new mitigation measures and equipment into its on-going survey programs. Evaluations of new mitigation measures include assessments of their potential effectiveness in reducing risk to marine mammals but any such measures must also pass safety considerations and allow survey results to remain compatible with previous data sets. Additional mitigation measures that are being proposed for further development and implementation by the AFSC during the five-year life of the authorization are detailed in Section 11.8.

11.1 Mitigation Measures for Ship Strikes

When research vessels are actively sampling with towed gear, 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, but average ten knots. This is slower than marine mammals can swim so the risk of collisions and serious injury or mortality is still very low. 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 (OMAO) 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.

11.2 Mitigation Measures for Marine Mammals Common to all Fisheries Research Activities

- AFSC scientists are aware of the need to prevent or minimize disturbance of marine mammals when operating vessels nearshore around harbor seal and Steller sea lion rookeries and haulouts, and other places where marine mammals are aggregated, such as observed schools, pods or areas where animals are congregated for feeding and other behavior. Minimum approaches shall be not less than one km from the aggregation area.
- The Chief Scientist or Field Party Chief will document significant marine mammal sightings, direct interactions, and mitigation actions onto the AFSC Research Protected Species Interaction

Form (See Appendix D in the DPEA). Forms will be forwarded to Survey Coordinators and then to the Division Directorate who will be responsible for compiling, reporting, and evaluation of the interactions. Specimens and images will be forwarded to the Marine Mammal Laboratory.

11.3 Mitigation Measures for Marine Mammals during Research with Trawl Gear

11.3.1 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. Some sets may be made at night or other limited visibility conditions.

11.3.2 Operational Procedures

- "Move-On" Rule. If any marine mammals are sighted around the vessel before setting 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, 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 gear, as determined by the judgment of the Chief Scientist and vessel operator. 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 the 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. Encounters, actions, and outcomes will be documented on the Marine Mammal Encounter Form (See Appendix D in the DPEA).

- 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 then 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 (10 kHz, 132 dB) that are intended to deter the presence of marine mammals and therefore decrease the probability of entanglement or unintended capture of marine mammals.
- The scientific crew will avoid dumping previous catches when the net is being retrieved, especially when the net is at the surface at the trawl alley. This practice of dumping fish when the net is near the vessel may train marine mammals to expect food when the net is retrieved and may capture the protected species.

11.3.3 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 nautical miles, depending on the survey and trawl speed. Some trawl gear, such as the FOCI midwater tows, may take one hour to retrieve.

11.4 Mitigation Measures for Marine Mammals during Research with Longline Gear

11.4.1 Monitoring Measures

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 during all longline operations. The objective is to avoid transecting or operating in areas with significant concentrations of animals.

11.4.2 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 and vessel operator. 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 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 to associate

particular sounds 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 other demersal 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 has been altered to disrupt the survey pattern as a means to dissuade the animals from this behavior and to avoid continued interactions.

- 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 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 (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.

11.5 Mitigation Measures for Marine Mammals with Gillnet Gear

11.5.1 Monitoring Methods

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

11.5.2 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.

11.6 Mitigation Measures for Marine Mammals with Other Research Gear

- 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.

11.7 Handling Procedures for Incidentally Captured Marine Mammals

- 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. 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 (See Appendix D in the DPEA). Photos of dead marine mammals (and live if possible), should include an image of the left and right side of the dorsal fin to help determine stock ID and a picture of the nature of gear entanglement. Information should also describe whether the animal was seen prior to the entanglement, a description of its behavior, and any mitigation measures used and/or discretionary decisions made by the Chief Scientist, including a rationale for those decisions. This information will be recorded on standardized forms or similar forms developed for the purpose (See DPEA 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 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.

- 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. 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).
- 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. AFSC staff will submit data on all captured animals to marine mammal experts at 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 experts may not be able to determine the severity of the injury. Collecting this data is a priority, as long as doing so does not compromise human safety. The Chief Scientist or other designated scientists will therefore receive training on the types of information needed to make injury determinations through the protocols and training described in Section 11.8 and DPEA Appendix D.
- If regulations are promulgated and the AFSC receives subsequent Letters of Authorization for incidental take of marine mammals during its fisheries and ecosystem research, the AFSC could collect biological samples in accordance with section 109(h) of the MMPA for live/dead marine mammals (non-listed), or under a directed scientific research and enhancement permit.
- 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) and to NMFS Office of Protected Resources (301-713-8401).

11.8 Improved Implementation of Existing Mitigation Measures

To date, the specific conditions for implementing these mitigation measures in all situations have not been formalized or widely discussed among all scientific parties and vessel operators. The AFSC therefore will be implementing a series of internal actions to improve its marine mammal training, awareness, and reporting procedures. The AFSC expects these new procedures will facilitate and improve the implementation of the mitigation measures described in Sections 11.1 through 11.7.

11.8.1 Judgment Consistency

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 above 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, 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 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 above, 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 with similar experience.

11.8.2 Protected Species Training

Another new element 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 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 experience protected species interactions during research activities.

11.8.3 Written Protocols

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 (DPEA

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.

11.8.4 Contract Language

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.

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.

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12.0 WHERE THE PROPOSED ACTIVITY WOULD TAKE PLACE IN OR NEAR A TRADITIONAL ARCTIC SUBSISTENCE HUNTING AREA AND/OR MAY AFFECT THE AVAILABILITY OF A SPECIES OR STOCK OF MARINE MAMMAL FOR ARCTIC SUBSISTENCE USES, THE APPLICANT MUST SUBMIT EITHER A "PLAN OF COOPERATION" (POC) OR INFORMATION THAT IDENTIFIES WHAT MEASURES HAVE BEEN TAKEN AND/OR WILL BE TAKEN TO MINIMIZE ANY ADVERSE EFFECTS ON THE AVAILABILITY OF MARINE MAMMALS FOR SUBSISTENCE USES.

Please refer to the Draft Communication Plan, attached to this LOA application as Appendix B. This document describes AFSC's commitment to minimize any adverse effects on the availability of marine mammals for subsistence uses through extensive communication and collaboration with Alaska Native hunters and fishers throughout the Arctic. This draft document has not yet been approved by all the necessary parties, including the appropriate Alaska Native representatives, but it is a high priority for the AFSC and the terms and procedures will be finalized in consultation with Alaska subsistence communities during the rule-making process.

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13.0 MONITORING AND REPORTING PLAN

13.1 Monitoring

Marine mammal watches are now a standard part of conducting fisheries research activities, particularly those that use gears (e.g., trawls, gillnets, and longline gear) that are known to interact with marine mammals or that we believe have a reasonable likelihood of doing so in the future. As described in Section 11, marine mammal watches and monitoring occurs prior to deployment of these research gears, and they continue until gear is brought back on board. If marine mammals are sighted in the area and are considered to be at risk of interaction with the research gear then the sampling station is delayed, moved, or canceled. When marine mammal researchers are on board (distinct from marine mammal observers dedicated to monitoring for potential gear interactions) they will record the estimated species and numbers of animals present and their behavior. If marine mammal researchers are not onboard or available (due to vessel size limits or other reason) then the AFSC will develop protocols and provide training as practical to bridge crew and other marine mammal observer crew to record such information. This information can be valuable in understanding whether some species may be attracted to vessels or gears. NOAA vessels are required to monitor interactions with marine mammals (and report interactions to the AFSC Director) but in reality are limited to direct interactions and reporting floaters or entangled whales. Similarly, there is a condition of grant and contract awards for monitoring of marine mammal takes.

Whales, particularly killer whales in the Bering Sea and sperm whales in the Gulf of Alaska, are commonly attracted to longline fishing operations and have learned how to remove fish from longline gear as it is retrieved. Such depredation of fish off the longline by whales can significantly affect catch rate and species composition data collected by the survey. The effect of depredation activity on survey results has been a research subject for many years and many aspects are therefore recorded as part of normal survey protocols, including the amount of catch depredated (percent of empty hooks or damaged fish), number of whales visible, behavior of whales, whale proximity to the vessel, and any whale/vessel interactions.

13.2 Reporting

The AFSC will coordinate with the local Alaska Regional Stranding Coordinator and the NMFS Stranding Coordinator for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that are encountered during field research activities.

In the event of any incidental capture or entanglement of marine mammals in any research gear or any collisions with marine mammals with research vessels, vessel or scientific personnel will contact their Division Directorate with the encounter and condition information. The Division Directorate will report the encounter to the various required reporting contacts. Reporting contacts include the NOAA Protected Species Incidental Take (PSIT) System, the Alaska regional Office of Protected Resources Division, the NMFS Office of Protected Resources, the NMFS Alaska Region Stranding Network Coordinator, and the U.S. Coast Guard, as appropriate or required. The incident report and subsequent contacts should be made as soon as possible and no longer than 24 hours after the incident. As part of this communication, a written report will be provided that details the events that preceded the incidental take, including the mitigation measures that were implemented and how they were implemented, whether any marine mammals were observed before the interaction occurred (species, numbers, and behavior relative to the ship or research gear), any decisions that were made regarding avoidance of the marine mammals (e.g, change of course or speed, early removal of research gear from the water, or other efforts), and a post-hoc analysis of the decision-making process before the take (e.g., who made the decision, other members of the crew or scientific party that were involved in the decision, and whether an alternative course of action may have avoided the take). The Division Directorate, in consultation with the MML, is also responsible for evaluating protected species interactions and for improving procedures and mitigation based upon the analysis of actual events. These monitoring and reporting procedures are intended to facilitate avoiding some of these situations in the future.

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. Ultimately, the AFSC would hope that a single reporting tool capable of disseminating and archiving all relevant details of marine mammal interactions during fisheries research activities could be developed and implemented. Until that time, AFSC will input data both into the PSIT database and submit detailed event reports, which will also be uploaded to PSIT.

A final and equally important component of reporting being implemented by AFSC will facilitate serious injury determinations for marine mammals that are released alive. As discussed in Section 11, AFSC is requiring that scientists complete data forms and address supplemental questions (see DPEA Appendix D), both of which have been developed to aid in serious injury determinations. The AFSC understands the critical need to provide scientists who make serious injury determinations with as much relevant information as possible about marine mammal interactions to inform their decisions.

14.0 COORDINATING RESEARCH TO REDUCE AND EVALUATE INCIDENTAL TAKE

NOAA Fisheries and the AFSC provide a significant amount of funding and support for marine research. Specifically, NOAA Fisheries provides significant funding annually to universities, research institutions, Federal laboratories, private companies, and independent researchers around the world to study marine mammals. The AFSC actively participates on Take Reduction Teams and in Take Reduction Planning and it conducts a variety of studies, convenes workshops and engages in other activities aimed at developing effective bycatch reduction technologies, gears and practices. For example, AFSC scientists are continually engaged in research to modify commercial fishing gear to reduce the bycatch of Pacific halibut and crabs by bottom trawls, AFSC scientists are involved with cooperative efforts to reduct the bycatch of seabirds including the endangered short-tailed albatross, and AFSC staff also assist with the rescue of entangled marine mammals, as needed. The AFSC will continue to foster this research to further reduce takes of marine mammals and other protected or species of concern in both its operations and in commercial fisheries to the lowest practicable levels.

Following the first year of implementation of the MMPA incidental take authorization, the AFSC will convene a workshop with Alaska Region Protected Species Division, 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.

The AFSC has a keen awareness that an increase in fisheries research effort is expected to result in more marine mammal takes over time. For this reason and because of resource limitations, the AFSC maximizes efficient use of the charter and NOAA ship time it can attain. We also engage in operational plans with the Southwest and Northwest Fisheries Science Centers in order to clearly delineate our respective research responsibilities and to ensure we avoid research gaps and duplication of effort between Centers. In short, the AFSC is on the water conducting fisheries research activities no more often than is necessary to fulfill its responsibilities to provide scientific advice to the Alaska Regional Office, the North Pacific Fisheries Management Council, and other relevant domestic and international management bodies.

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Request for Rulemaking and Letters of Authorization Under Section 101(a)(5)(A) of the Marine Mammal Protection Act

for the Take of Marine Mammals Incidental to Fisheries and Ecosystem Research Activities conducted or funded by the

Alaska Fisheries Science Center

within the

Gulf of Alaska, Bering Sea/Aleutian Islands, and Chukchi Sea/Beaufort Sea Research Areas

June 2016

Appendix A

AFSC Research Gear and Vessel Descriptions

Prepared for the National Marine Fisheries Service by:

URS Group

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Table of Contents

List of Figures

List of Tables

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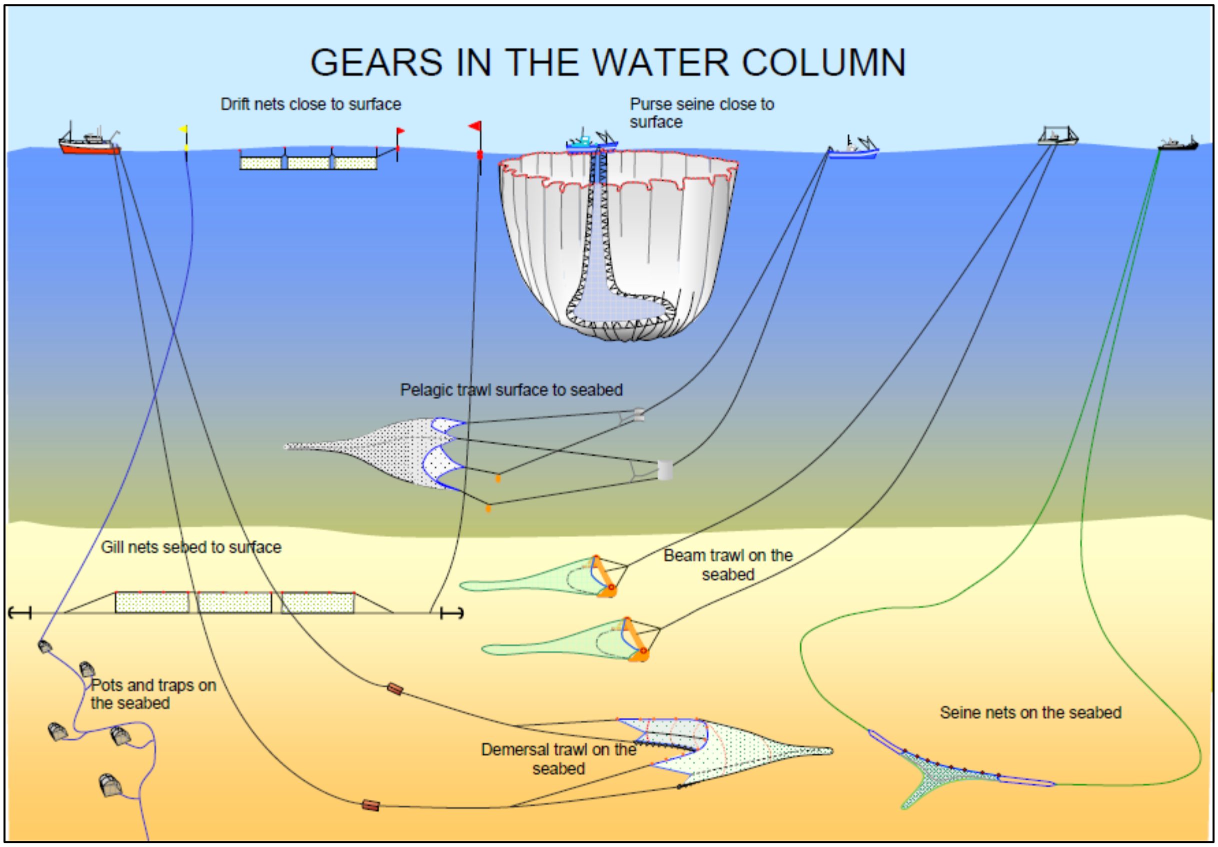
1. Net-Based Gear

Various types of sampling gear composed of or containing nets are used by the AFSC in order to catch or trap marine organisms for study. Figure A-1 depicts several types of commercial fishing net gear.



Credit: Seafish 2005. Note: not all depicted gear types are used in AFSC research.

Figure A-1 Fishing gears in the water column

Trawl Nets

A trawl net is a funnel-shaped net towed behind a boat to capture organisms. Trawl nets are made of four basic parts – the opening (or, 'mouth') of the net, the spreading mechanism, the body of the net, and the codend (or, 'bag') (Figure A-2). The mouth is held open vertically using floatation on the upper edge, or 'headrope,' and weights on the lower edge, or 'footrope.' In most trawls used in AFSC research, the mouth is spread open horizontally during fishing using steel trawl doors. In some types of trawl nets, such as beam trawls, the mouth is spread open by a rigid bar called a 'beam'. Large panels of wide mesh at the horizontal reaches of the mouth, called 'wings', are connected to the trawl doors. The mouth of the net is held open (horizontally and vertically) by the hydrodynamic force exerted on the trawl doors attached to the wings of the net, floats placed on the headrope, and the net itself as the vessel moves forward.

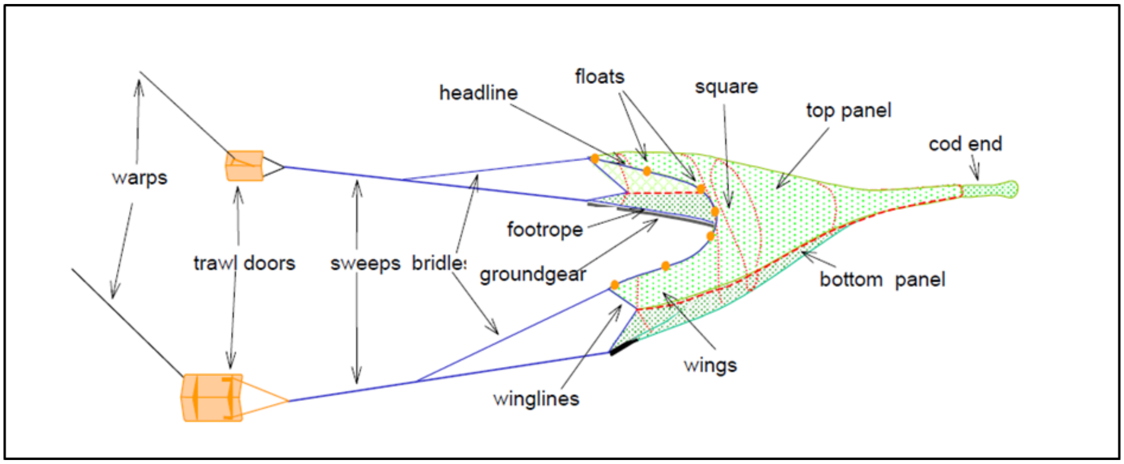


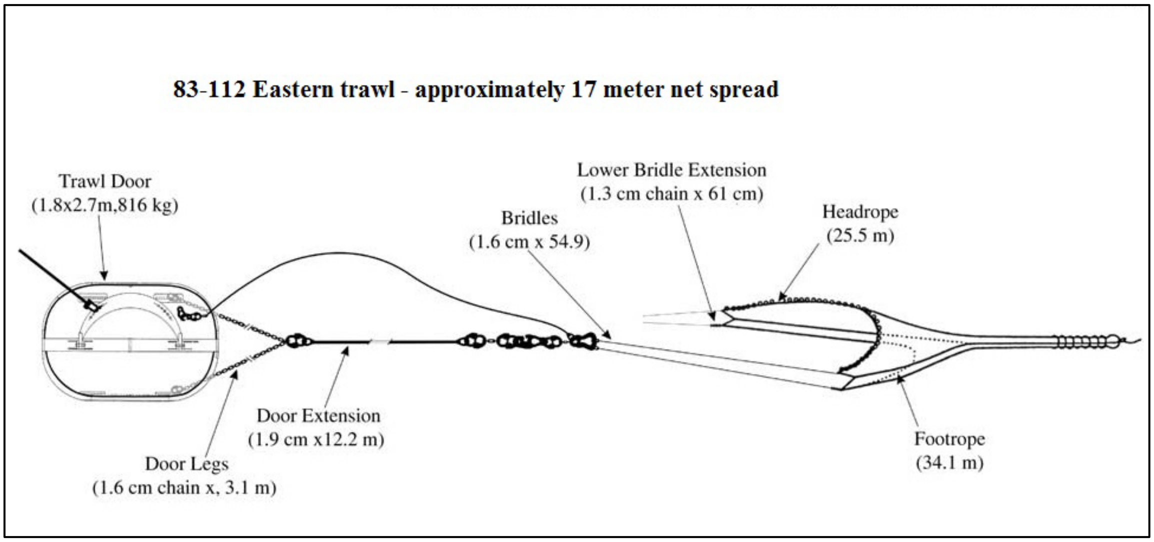
Figure A-2 Otter bottom trawl illustration

The body of the trawl net is made of panels of different sized mesh (Figure A-5). Mesh size is largest at the wings and near the mouth and, depending on construction of the net and target species, mesh size gets progressively smaller towards the codend portion of the net. The codend has the finest mesh of the net and is where fish and other organisms larger than the mesh size are retained. In contrast to commercial fishery operations, which generally use larger mesh to capture marketable fish, research trawls often use smaller mesh throughout the net to catch fish of many sizes. This helps to make estimates of the size and age distributions of fish in a particular area. Research trawls typically have much smaller openings, from 10 to 17 m compared to commercial trawls that can have openings over 90 m.

The trawl net is usually deployed over the stern of the vessel, and attached with two cables, or 'warps,' to winches on the deck of the vessel. The cables are paid out until the net reaches the fishing depth. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. AFSC trawl surveys typically involve tow speeds from two to four knots and tow durations from 10 to 45 minutes. At the end of the tow, the net is retrieved and the contents of the cod end are emptied onto the deck or sorting table. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow for meaningful comparisons of data collected at different times and locations. Active acoustic devices incorporated into some research vessels (see below) and trawl gear may be used to monitor the position and status of the net, speed of the tow, and other variables important to the research design.

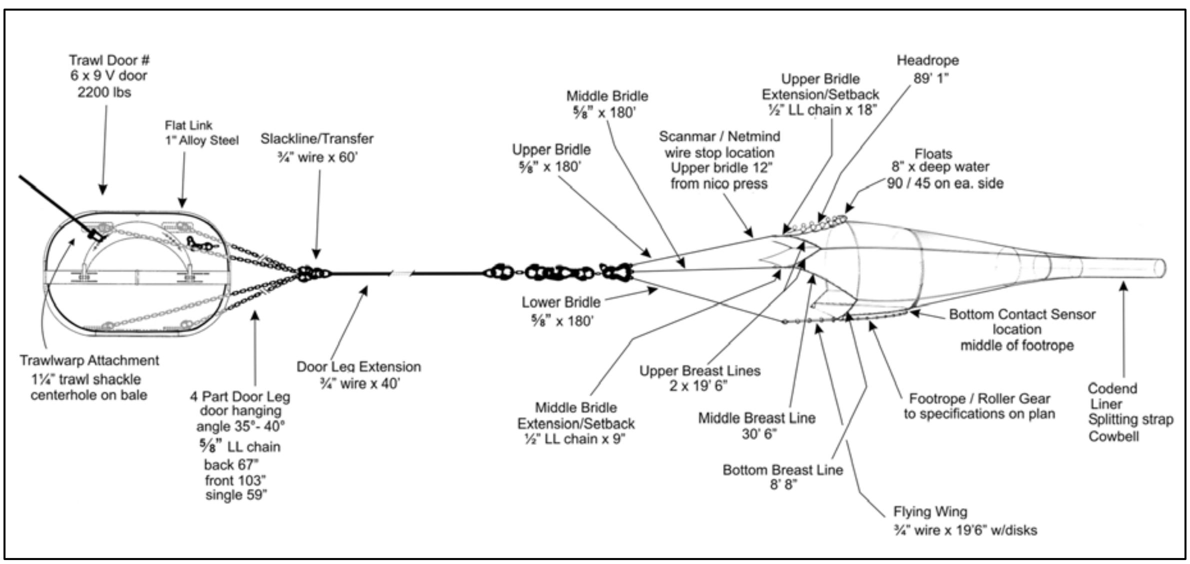
AFSC research trawling activities use both 'pelagic' (surface or mid-water) trawls, which are designed to operate at various depths within the water column, as well as 'bottom' trawls, which are designed to capture target species at or near the seafloor. Bottom trawls often have bobbins or roller gear to protect the footrope as the net is dragged along the seabed. Within these two basic deployment methodologies, there are many different designs used by the AFSC oriented to the basic needs of each survey or target species. Common bottom trawls include the 83-112 Eastern Trawl (Figure A-3) used in the Bering Sea Bottom Trawl Survey and the more fortified Poly Nor'eastern (PNE) bottom trawl (Figure A-4) used in the Aleutian Islands, Bering Sea Slope, and Gulf of Alaska Bottom Biennial Bottom Trawl Surveys.

AFSC also uses push trawls (Figure A-5) during the Yukon Delta Nearshore Surveys. Push trawls differ from most other trawls in that vessels push nets in shallow, nearshore waters.



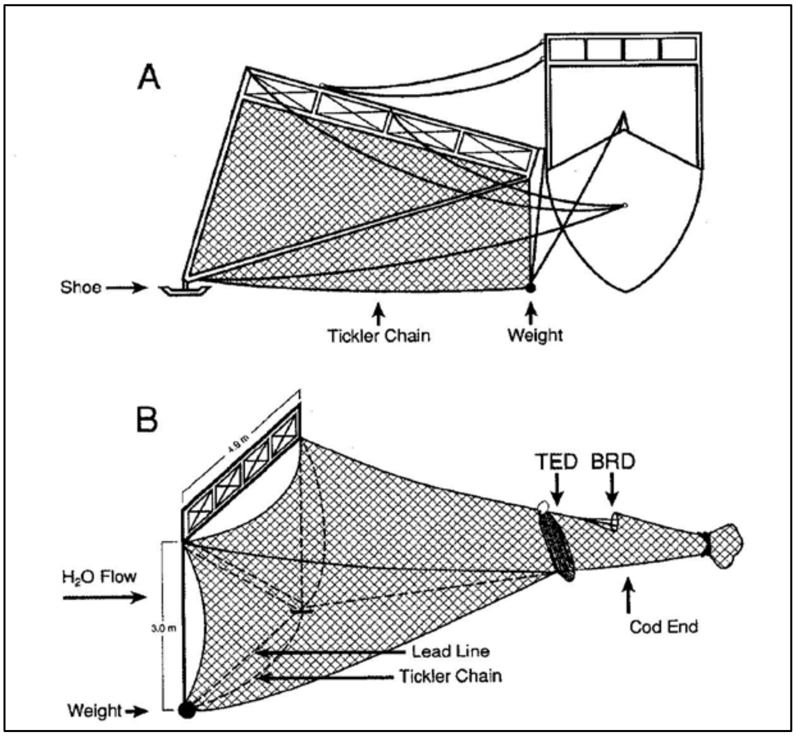
Credit: SFOS 2015

Figure A-3 83-112 Eastern trawl illustration



Credit: Stauffer 2004

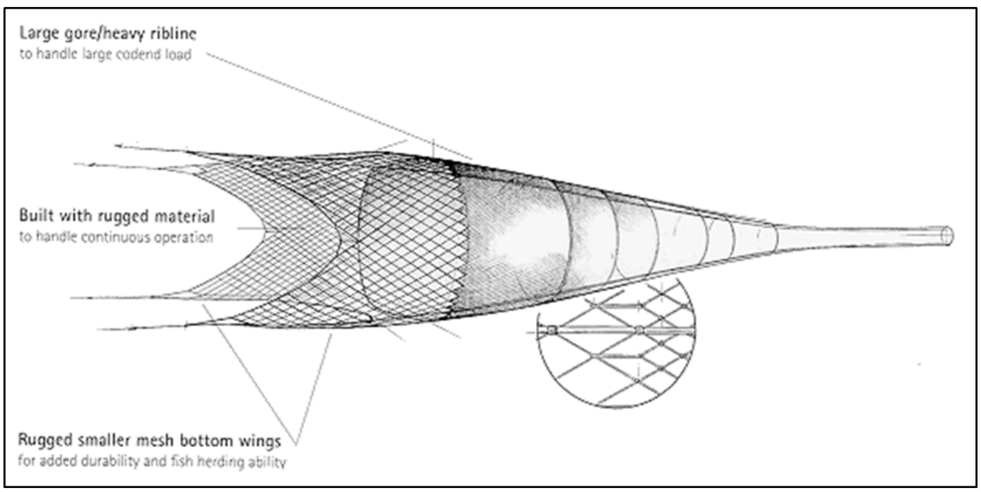
Figure A-4 Poly Nor'eastern bottom trawl illustration



Credit: NOAA 2014; Push trawls used by the AFSC do not include a Turtle Excluder Device (TED) or Bycatch Reduction Device (BRD)

Figure A-5 Push trawl illustration

Midwater trawls include the Nordic 264 trawl, anchovy trawl, Methot trawl, Cantrawl, Marinovich trawl, and Aleutian wing trawl (Figure A-6) used on the Acoustic Trawl Surveys, and the Kodiak trawl (Figure A-7) used in the Yukon Delta Nearshore Surveys. AFSC construction, repair, and use of the bottom trawl survey trawls adhere to national standards (Stauffer 2004).



Credit: Net Systems Inc. 2016

Figure A-6 Aleutian wing pelagic trawl illustration

Credit: California Department of Fish and Wildlife 2015

Figure A-7 Kodiak trawl

A beam trawl (Figure A-8) is a type of bottom trawl that uses a wood or metal beam to hold the net open as it is towed along the sea floor. The beam holds open the mouth of the net and trawl doors are not needed. Beam trawls are generally smaller than other types of bottom trawls. Beam trawls used by the AFSC typically use beams less than or equal to 3 m in length for post-larval, juvenile fish and invertebrate surveys.

Credit: SFOS 2015

Figure A-8 Plumb staff beam trawl

Plankton Nets

AFSC research activities include the use of several plankton sampling nets which employ very fine mesh to sample plankton and fish eggs from various parts of the water column. Plankton sampling nets usually consist of fine mesh attached to a rigid frame. The frame spreads the mouth of the net to cover a known surface area. Many plankton nets have a removable collection container at the codend where the sample is concentrated. When the net is retrieved, the catch is washed to the cod end with a saltwater hose and then the collecting bucket can be detached and easily transported to a laboratory. Plankton nets may be towed through the water horizontally, vertically, or at an oblique angle. Often, plankton nets are equipped with instruments such as flow meters or pitch sensors to provide researchers with additional information about the tow or to ensure plankton nets are deployed consistently. Plankton nets are generally used to collect marine organisms for research purposes, and are not used for commercial harvest. AFSC plankton nets employ mesh sizes from 63 to 500 micrometers (µm).

To capture plankton with vertical tows, the AFSC uses ring nets or CalVET nets. A ring net consists of a circular frame and a cone-shaped net with a collection jar at the codend. The net, attached to a labeled dropline, is lowered into the water while maintaining the net's vertical position. When the desired depth is reached, the net is pulled straight up through the water column to collect the sample (Dougherty 2010).

Bongo nets consist of two cylindrical nets whose frames are yoked together and allows replicate samples to be collected concurrently (Figure A-8). The bongo nets are of various diameters and fine mesh sizes and are towed through the water at various depths to sample plankton in different parts of the water column. During each plankton tow, the bongo net is deployed to the desired depth and is then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In shallow areas, sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the codend of the net, is used to contain the plankton sample.

Credit: Morgan Busby, Alaska Fisheries Science Center

Figure A-9 Bongo net

The Tucker net (Figure A-10) is a medium-sized single-warp trawl net used to capture plankton at different depths. The Tucker trawl usually consists of a series of nets that can be opened and closed sequentially without retrieving the net from the fishing depth.

Credit: AFSC 2015a

Figure A-10 Tucker trawl

Neuston nets (Figure A-11) are designed to capture members of the neuston, the collective term for the organisms that inhabit the water's surface. Neuston nets have a rectangular frame and are towed horizontally at the top of the water column, half submerged at 1-2 knots from the side of the vessel on a boom to avoid the ship's wake.

Figure A-11 Neuston net

The Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS) is based on the Tucker trawl principle where a stepping motor is used to sequentially control the opening and closing of the nets using underwater and shipboard electronics (Figure A-12). The electronics system continuously monitors the functioning of the nets, frame angle, horizontal velocity, vertical velocity, volume filtered, and selected environmental parameters, such as salinity and temperature. The AFSC utilizes the MOCNESS and the Multinet to determine the vertical distribution of larval fishes and crabs for use in transport models. Data is also used to investigate the effects of climate variability on recruitment.

Credit: AFSC 2015a

Figure A-12 MOCNESS

Seine Nets

A seine is a fishing net that generally hangs vertically in the water with its bottom edge held down by weights and its top edge buoyed by floats. AFSC uses two types of seines for research - beach seines and pole seines.

Beach seines are deployed from shore to surround all fish in a nearshore area. When setting the net, one end is fastened to the shore while the other end is set out in a wide arc and brought back to the beach. A beach seine can be deployed by hand or with the help of a small boat. When the net is set, each side is pulled in simultaneously, herding the fish toward the beach (Figure A-13). During the entire operation, the headrope with floats stays on the surface and the weighted footrope remains in contact with the bottom to prevent fish from escaping the area enclosed by the net. The beach seines used in AFSC research are 15 to 30 feet in depth and 75 to 150 feet in length, with mesh sizes of less than 1 inch.

A pole seine is a rectangular net that has a pole on either end to keep the net rigid and act as a handle for pulling the net in (Figure A-14). The net is pulled along the bottom by hand as two or more people hold the poles and walk through the water. Fish and other organisms are captured by walking the net towards shore or tilting the poles backwards and lifting the net out of the water.

Credit: Paul Olsen, NOAA Fisheries

Figure A-13 A beach seine being pulled in

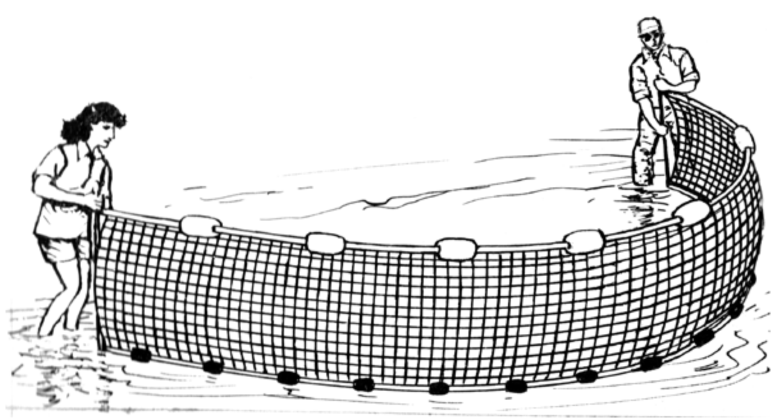


Figure A-14 Pole seine

Cast Nets

Cast nets are a light weight circular net with weights around the perimeter. The net is thrown from shore or from a vessel and falls towards the bottom, trapping any fish that are caught (FAO 2015a). The AFSC uses cast nets to survey forage fish and in educational programs.

Gillnets

Gillnets (Figure A-15) consist of vertical netting held in place by floats and weights to selectively target fish of uniform size depending on the netting size (Walden 1996). Gillnets are either anchored to the bottom (‘set gillnet’) or are deployed with one end attached to a vessel and is allowed to drift with the current or tides (‘drift gillnet’). Gillnets are made of monofilament, multi-monofilament, or multifilament nylon constructed of single, double, or triple netting/paneling of varying mesh sizes, depending on their use and target species (Hovgård and Lassen 2000). A specific mesh size will catch a target species of a limited size range, allowing this gear type to be very selective. The AFSC uses gillnets of various mesh sizes and 35 to 150 ft in length in forage fish and salmon studies.

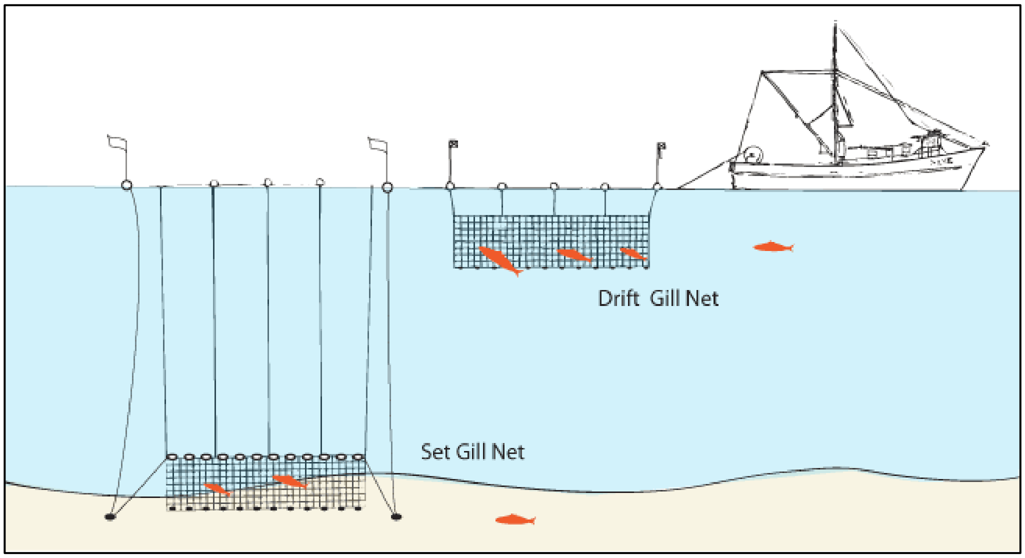


Figure A-15 Diagram of a drift and set gillnet deployment

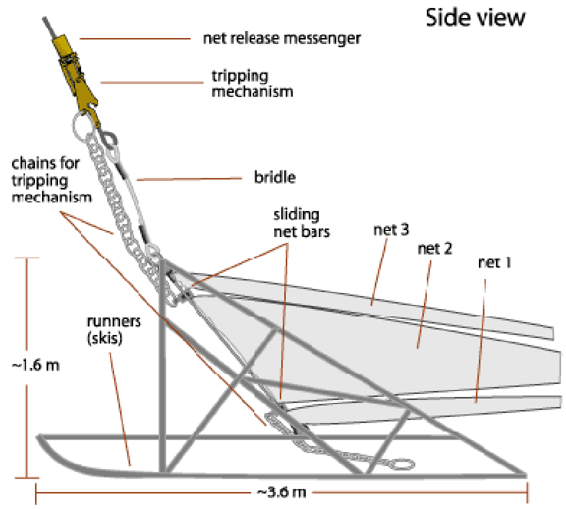
Dip Nets

A dip net (Figure A-16) is a bag net attached to a long rod that is used by hand to scoop fish or other organisms of interest from the water. Dip nets come in various sizes, the AFSC uses dip nets with a diameter range of 0.25m to 0.5m and a mesh size from 505 µm to 6300 µm.

Figure A-16 Dip net

Epibenthic tow sled

An epibenthic tow sled (Figure A-17) is an instrument that is designed to collect organisms that live on or just above bottom sediments. It consists of a fine mesh net attached to a rigid frame with runners to help it move along the substrate (it resembles a Tucker Trawl on skis). The sled is towed along the bottom at the sediment-water interface, scooping up small fish, shrimp, plankton and other organisms as it goes. The AFSC uses an epi-benthic tow sled with a 0.68 m^2 net to collect age-0 flatfish and tanner crabs in nursery areas off Kodiak Island and a 1 m^2 mouth area sled with 0.500 mm mesh in the Arctic to capture near bottom invertebrates and larval fish.



Credit: AFSC 2015a

Figure A-17 Diagram of an epibenthic tow sled

Rock Dredges

The AFSC uses a six foot wide Virginia crab style dredge fitted with a half inch nylon mesh liner (Figure A-18). This dredge type consists of a heavy metal rectangular form bearing a toothed drag bar and a mesh bag to collect specimens.

Credit: Maryland Department of Natural Resources 2016

Figure A-18 Virginia crab style dredge

Pots and Traps

Fishing pots and traps are three-dimensional structures that permit fish and other organisms to enter the enclosure but make it difficult for them to escape. Traps and pots allow commercial fishers and researchers to capture live fish and can allow them to return bycatch to the water unharmed. Traps and pots also allow some control over species and sizes of fish that are caught. The trap entrance can be regulated to control the maximum size of fish that enter. The size of the mesh in the body of the trap can regulate the minimum size that is retained. In general, the fish species caught depend on the type and characteristics of the pot or trap used. Fishing traps and pots used by AFSC include fyke nets, net pens, weirs, and pots.

A fyke net (Figure A-19) is a fish trap that consists of cylindrical or cone-shaped netting bags that are mounted on rings or other rigid structures and fixed on the bottom by anchors, ballast or stakes. Fyke traps are often outfitted with wings and/or leaders to guide fish towards the entrance of the bags. The Fyke net used by the AFSC is constructed with a length of 40 ft and a mesh size of ½ inch and is only deployed in freshwater to capture juvenile salmon.

Figure A-19 Fyke net diagram

A net pen is a three sided net with no top that is designed to hold fish alive. The net pen used by AFSC is 20 ft deep by 20 ft wide by 20 ft long.

A hoop net is a long conical trap made of multiple successive hoops, typically six or seven, and multiple nested funnels. Fish swim into each successive funnel and become trapped (FAO 2015b). The hoop net used by the AFSC is 3 ft in diameter and 8 ft in length with a mesh size of ¼ inch.

A weir is a barrier across a river that is designed to alter the movements of fish so they can be either caught more easily or counted. There are many types of designs and constructions of weirs, from temporary wood weirs to permanent concrete and metal weirs. The type of weir utilized for a particular area is dependent on the tides, bathymetry, and species being targeted. The AFSC operates the Auke Creek Weir in the Juneau area of Alaska. This weir is used for tracking salmonid migration patterns in Auke Creek.

Pots generally consist of a rigid square, circular or conical frame made of steel, wood, or plastic. Stretched between the framing members is nylon netting with one or more funnel-shaped entrance tunnels. Pots are often baited with squid and herring and thrown overboard to rest on the seafloor and are often attached by a rope to a buoy at the water’s surface. If a series of pots is set, a groundline may be used to connect the pots to each other to aid in pot deployment and retrieval. Groundlines and vertical buoy lines can pose an entanglement hazard for marine mammals (NOAA Fisheries 2014). Various pot designs set in a longline fashion are used by the AFSC for the Octopus Gear Trial and Maturity Study in order to determine a configuration that is most effective at collecting octopus and other organisms for biological collection.

2. Hook-and-Line Gear

Numerous variations of fishing gear use hooks in order to catch marine organisms. Two types used by the AFSC for research are bottom longline gear and rod-and-reel gear.

Bottom Longline

Longline fishing is a technique for catching fish in which baited hooks attached to a mainline or ‘groundline’ are deployed from a vessel. The hooks are attached to the longline by thinner lines called ‘gangions.’ Longlines can be deployed on the bottom (‘bottom longline’, Figure A-20), or suspended in midwater (‘pelagic longline’). Bottom longlines have a weighted groundline anchored on the seafloor with long buoy lines at either end to allow it to rest on the seafloor while the attached buoys float on the surface. Each end buoy has an attached mast with radar reflector and lights which help crew find the line for retrieval.

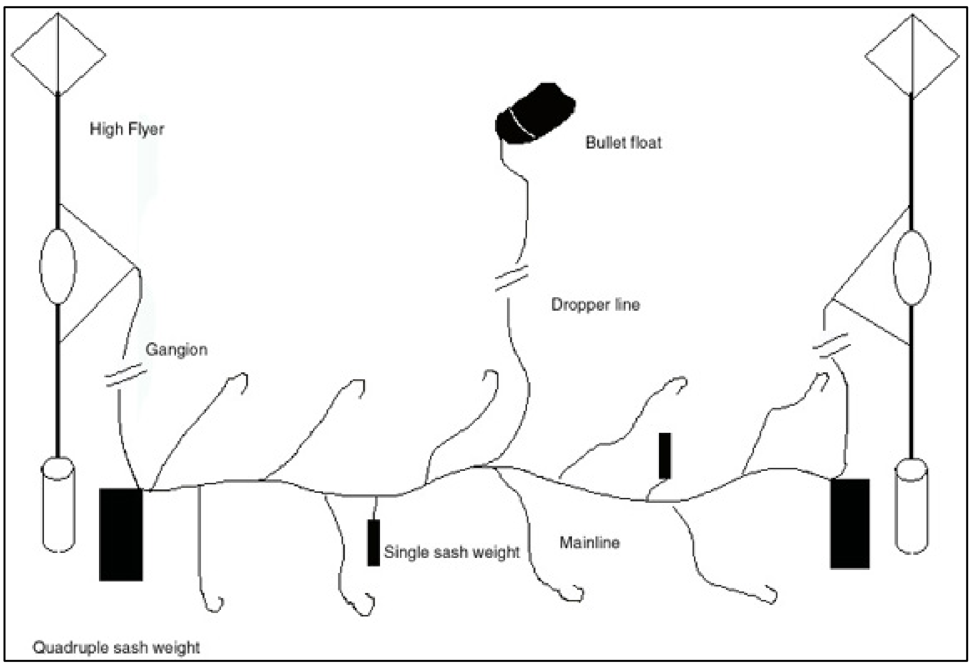
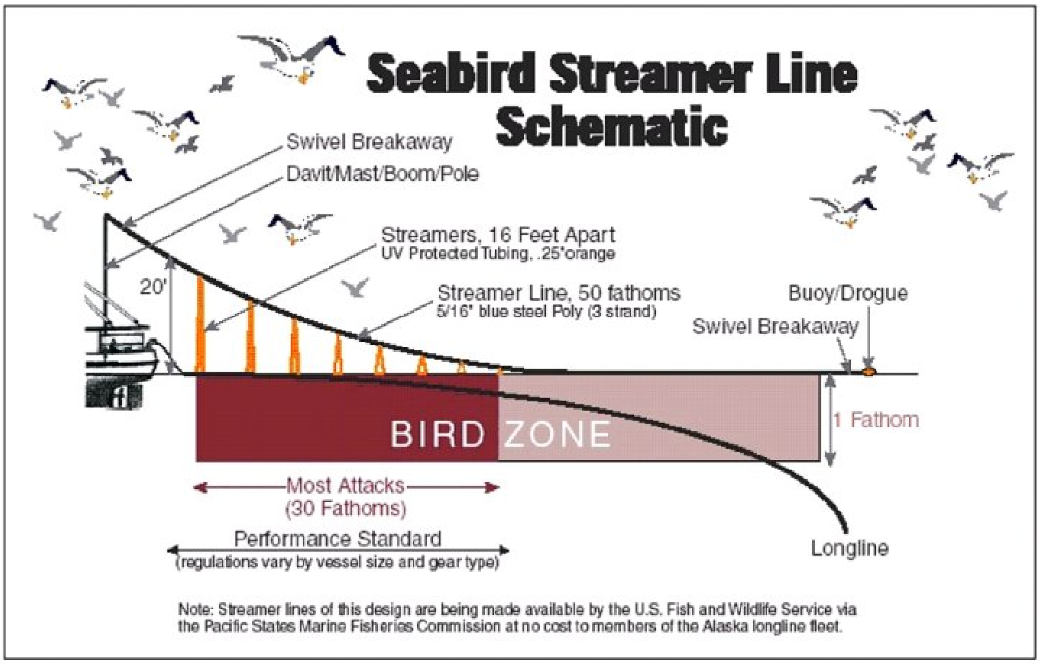


Figure A-20 General bottom longline diagram

The depth and length of the longline, the number of hooks, the length of the gangions, the duration of the set, and the distance between each gangion depend on the species targeted, the size of the vessel used, and the purpose of the fishing activity. A commercial longline set can be well over 10 miles long, have up to 20,000 baited hooks and once deployed can soak anywhere from hours to days (‘soak time’). Longlines used for AFSC research purposes are 16 km in length, have 7,200 hooks, and soak for three hours, although haulback operations can take up to eight hours to complete.

Soak time is an important parameter for calculating fishing effort. For commercial fisheries, the optimal soak time maximizes the catch of target species while minimizing bycatch and minimizing damage to hooked target fish that may result from sharks or other predators. Haulback operations and soak time can be an important factor for controlling longline interactions with protected species. Marine mammals may be attracted to bait during haulback, or to fish caught on the longline hooks, and may become caught on longline hooks or entangled in the longline while attempting to feed on the catch before the longline is retrieved.

Birds may be attracted to the baited longline hooks, particularly while the longline gear is being deployed from the vessel. Birds may get caught on the hooks, or entangled in the gangions while trying to feed on the bait. Birds may also interact with longline gear as the gear is retrieved. Tori lines, consisting of paired streamers, are deployed prior to every longline set to mitigate entanglement of seabirds diving on baited hooks. The tori line gear and deployment protocols are consistent with the bird-avoidance requirements imposed on the commercial longline fleet under Magnuson-Stevens Act regulations in Alaska (Figure A-21).



Credit: Washington Sea Grant, Seattle WA

Figure A-21 Tori lines deployed for longline sets to deter seabirds

Rod and Reel

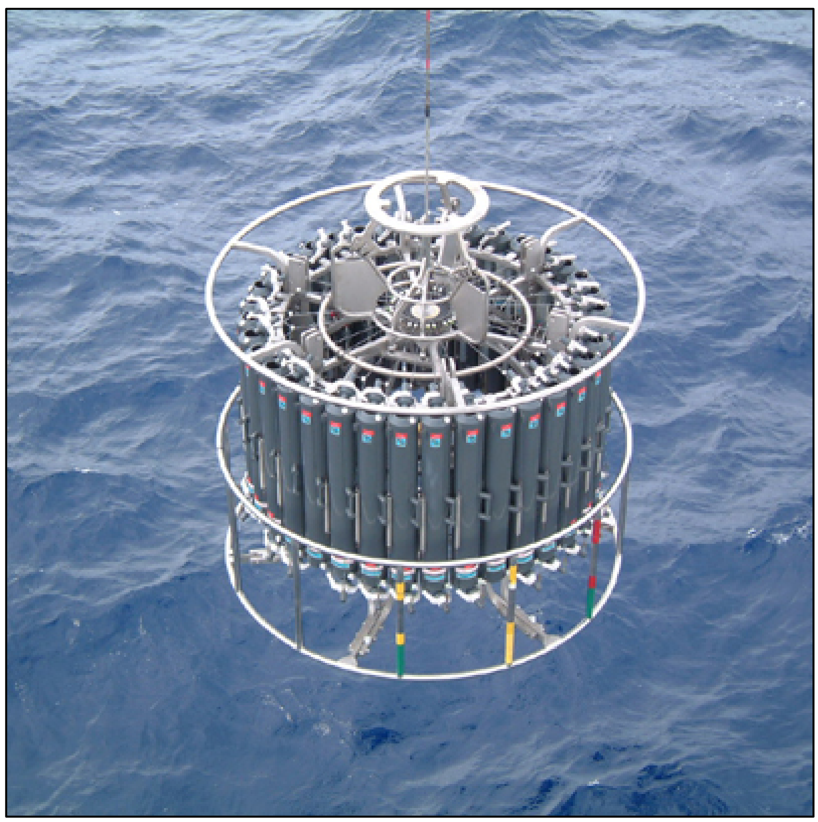
A standard fishing pole with a reel attached near the base can be used to catch fish in areas where longline, trawl or other gears are not feasible, such as complex bottom substrates, or where the survivability of the fish after capture is important. The AFSC utilizes rod and reel gear for their Juvenile

Sablefish Tagging Survey. In this survey, baited jigging rigs are used in order to catch sablefish for mark and recapture analysis.

3. Oceanographic Instruments

Conductivity, Temperature, and Depth (CTD) and Water Samples

A CTD profiler measures these parameters and is the primary research tool for determining chemical and physical properties of seawater. A CTD profiler may be a fairly small device (Figure A-8 immediately above the Bongo net) or it may be deployed with a variety of other oceanographic sensors and water sampling devices (e.g., Niskin or go-flo bottles) in a large (1 to 2 meter diameter) metal rosette wheel (Figure A-22). The CTD profiler is lowered through the water column on a cable, and CTD data are collected either within the device or via a cable connecting to the ship. Water sampling devices range from a bucket dropped over the side of a small boat to Niskin bottles that are triggered at discrete depths to collect a suite of water samples throughout the water column. A CTD cast takes from minutes to hours to complete depending on water depth (WHOI 2011). The data from a suite of samples collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x-axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.



Credit: Sea-Bird Electronics, Bellevue WA

Figure A-22 Sea-Bird 911 and CTD deployment on a sampling rosette with Niskin bottles

Free Fall Cone Penetrometer

The Free Fall Cone Penetrometer (FFCPT) is a 52 kg probe designed to free fall through the water and penetrate 3 meters into the seabed (Figure A-23). Sound velocity is measured during deployment, and deceleration and pore pressure are measured at the end of free fall, allowing a profile of sediment types to be inferred. The FFCPT can be deployed at vessel speeds of up to 6 knots, allowing sediment sampling and sound velocity data to be collected without stopping the vessel.

Figure A-23 Free Fall Cone Penetrometer

4. Submersible Delta

The Delta (Figure A-24) is a battery powered two-person submersible with sonar, data loggers, manipulating arms, and other equipment for oceanographic and biological sample collection. The Delta is 15 1/2 feet long, weighs 4,800 lbs, and can dive to a maximum depth of 1,200 feet with a maximum speed of 1.5 knots (Delta Oceanographics 2015).

Credit: AFSC 2015b

Figure A-24 Delta submersible photo

5. Active Acoustic Sources

A wide range of active acoustic sources are used in AFSC fisheries and ecosystem research for remotely sensing bathymetric, oceanographic, and biological features of the environment and for monitoring net performance. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus on and resolution of specific objects. Table A-1 shows important characteristics of the primary acoustic devices used on NOAA research vessels and NOAA-chartered vessels conducting AFSC fisheries surveys, followed by descriptions of some of the primary general categories of sources, including all those for which acoustic takes of marine mammals are calculated in the LOA application.

Table A-1 Output characteristics for predominant AFSC acoustic sources

Abbreviations: kHz = kilohertz; dB re 1 µPa at 1 m = decibels referenced at one micro Pascal at one meter; ms = millisecond; Hz = hertz

Acoustic system	Operating frequencies	Maximum source level (dB re 1 µPa at 1 m)	Single ping duration (ms) and repetition rate (Hz)	Orientation/ Directionality	Nominal beam width (degrees)
Simrad EK60 narrow beam echosounder	18, 38, 70, 120, 200 kHz	226.7	1 ms @ 1 Hz	Downward looking	11°
Simrad ME70 narrow beam echosounder	70 kHz	226.7	1 ms @ 1 Hz	Downward looking	11°
Simrad ES60 multibeam echosounder	38 and 120 kHz	226.6	1 ms @ 1 Hz	Downward looking	7°
Reson 7111 multibeam echosounder	38, 50, 100, 180, 300 kHz	230		Downward looking	150°

Single Frequency Sonars

The Dual Frequency Identification Sonar (DIDSON) operates on a high frequency of 12 MHz that allows for high resolution for up to 30 m even in dark turbid waters. This type of sonar is used for monitoring net shapes under different fishing conditions and for fish imaging and identification.

Bottom and pelagic trawls are typically outfitted with acoustic sensors that measure depths and widths of nets and transmit these data to the research vessel in real time. A headrope sensor is typically mounted on the head rope to measure the depth from the surface to the head rope and the height of the head rope above the bottom. A pair of spread sensors are mounted on the wings and/doors of the net to measure the width of the net opening. Acoustic signals can be broadcast to the research vessel to provide real time observations of net characteristics or transmitted via an electric cable to the vessel. The bottom trawl surveys use Marport head rope and spread sensors while the acoustic surveys use Simrad ITI door sensors and Simrad FS70 head rope sensor and third wire system. The Marport spread and head rope sensors and Simrad spread sensors operate at approximately 40 kHz, and the Simrad headrope sensor operates at 200 and 333 kHz.

Multibeam Echosounder and Sonar

Multibeam echosounders (Figure A-25) and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal. The depth and position of the reflecting surface can be determined from this information, provided that the speed of sound in water can be accurately calculated for the entire signal path. The use of multiple acoustic 'beams' allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. The AFSC uses the Simrad ES60 operating at 38 and 120 kHz.

Side scan sonars (Figure A-25) are designed to produce imagery of the seafloor. Each side scan sonar consists of three parts: the towfish, the transmission cable, and the topside processing unit. The towfish is deployed near the seafloor and collects echo data for transmission to the topside processing unit which uses the information to develop imagery of the seabed. Images contain information regarding sediment type and general roughness, and tend to show an improved view of the seafloor over hull-mounted systems due to a lower angle of incidence with the seafloor. In addition to creating higher resolution imagery, side scan sonars are used to collect data on fluorescence of colored dissolved organic matter (CDOM), chlorophyll-a and turbidity.

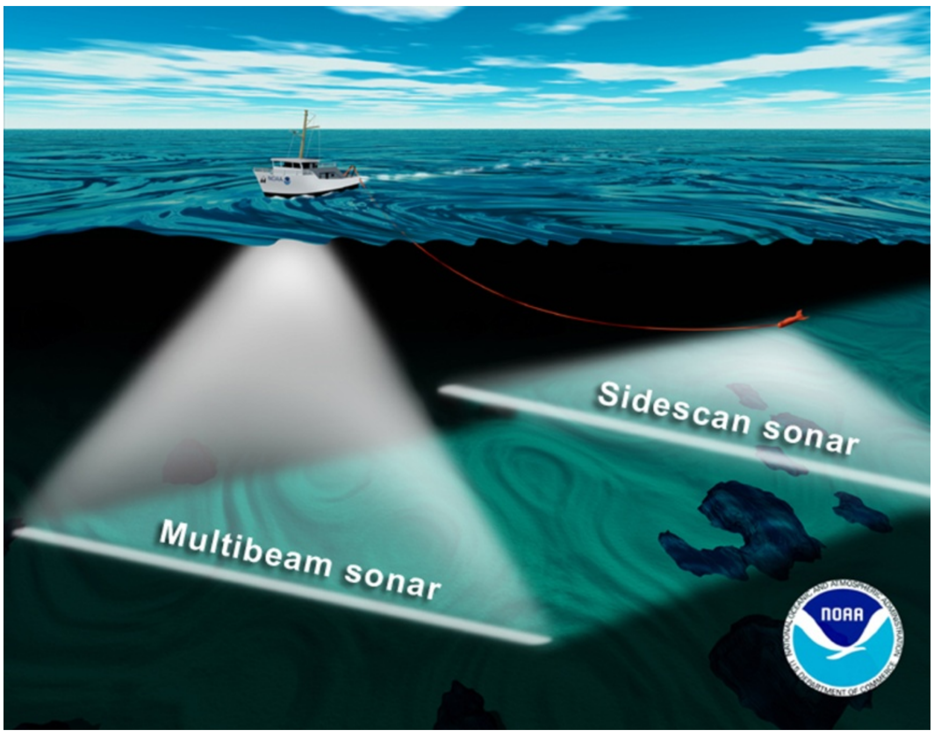


Figure A-25 Conceptual image of a multibeam echosounder and side scan sonar

Multi-Frequency Sensors

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can also be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The AFSC uses primarily the Simrad EK60, which is a split-beam echosounder with built-in calibration. It is specifically suited for permanent installation onboard a research vessel. The Simrad EK60s used in AFSC surveys operate in multiple frequencies simultaneously; 18, 38, 70, 120, and 200 kHz.

7. Underwater Cameras

The AFSC uses a diverse array of underwater camera housing designs in order to capture still and video footage of study areas. Some of these are attached to nets, and some have stand-alone housings that allow the camera to be deployed independently of survey fishing gear.

Underwater Cameras Attached to Fishing Gear

The Conservation Engineering surveys utilize a 20 x 9 x 4.5 inch camera and housing unit that is attached to the headrope of a research trawl. It is a complete integrated unit with internal LED light and battery. It is typically deployed on fishing gear by clipping it to the gear.

The FISHPAC survey utilizes a camera and sample collection device known as the Seabed Observation and Sampling System (SEABOSS, Figure A-26). The SEABOSS is designed to observe and collect data on sediment and physical seabed characteristics. The samples and video collected are used to groundtruth acoustic backscatter.

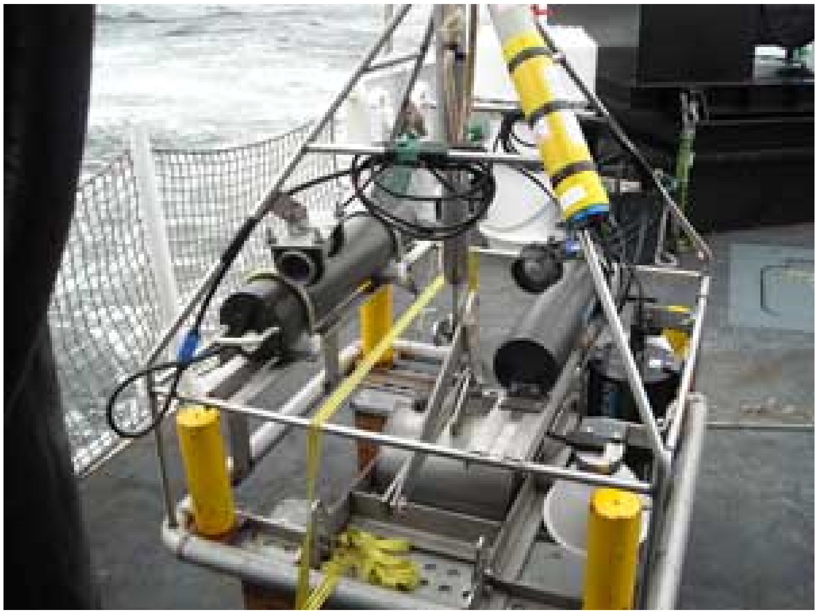


Figure A-26 SEABOSS

Underwater Cameras Deployed Independently of Fishing Gear

The Acoustic Assessment of Snakehead Bank survey used drop cameras housed in a 1 x 0.75 x 0.5 meter 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.

The Rockfish Habitat Studies survey uses paired video cameras housed and mounted in a metal frame. They are deployed for approximately ~45 minutes at a depth of 45-100 m.

The Deep Sea Coral and Sponge Distribution surveys utilize a stereo camera sled with two cameras four strobe lights contained in an aluminum frame. It is designed to be drifted or towed along the seafloor at a distance of ~1 m off the seafloor. Other towed cameras include the Towed Auto-Compensating Optical System (TACOS, Figure A-27), which utilizes four to six underwater lights and a down-weight up to 25 m in front of the camera sled to stabilize sled motion (Figure A-28). The TACOS is used in the FISHPAC survey to groundtruth acoustic data.

Remotely Operated Vehicles (ROVs) and Autonomous Underwater Vehicles (AUVs) are either owned by AFSC or other NOAA entities and have the potential to be used in new techniques to survey fishes and quantify habitat.

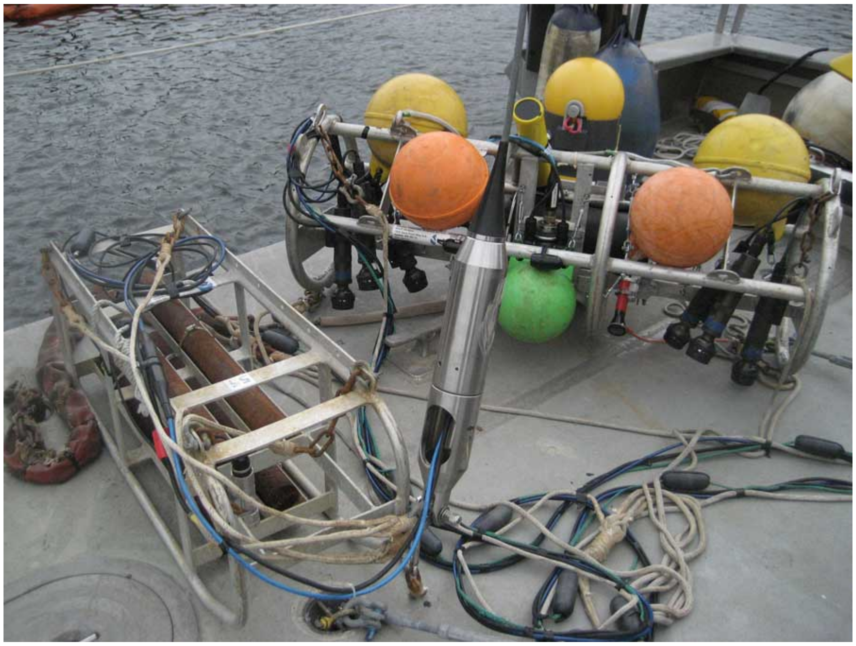


Figure A-27 TACOS video system with weighted sled

Figure A-28 TACOS video system during deployment

8. Vessels used for AFSC Survey Activities

The AFSC primarily employs one NOAA- owned and operated fisheries research vessel, the NOAA Ship *Oscar Dyson* (Figure A-29), and the Alaska Department of Fish and Game (ADFG) uses the R/V *Resolution* to conduct fisheries research on behalf of the AFSC. It also uses the NOAA Ship *Fairweather* (Figure A-30), as well as research vessels in the University National Oceanographic Laboratory (UNOLS) fleet. However, most of the vessels used for AFSC fisheries research are chartered fishing vessels. A wide range of commercial fishing vessels participate in such research, ranging from small open boats to modern trawlers and longliners measuring up to 57 m in length. The sizes of the vessels used, engine types, cruising speeds, etc. vary depending upon the location and requirements of the research for which the vessel is used. Although some vessels are chartered on a regular basis, the particular vessels used year to year depend on availability, research needs, and competition for contract services.

NOAA Ship *Oscar Dyson*

Figure A-29 NOAA Ship *Oscar Dyson*

The *Oscar Dyson* supports NOAA's mission to protect, restore and manage the use of living marine, coastal, and ocean resources through ecosystem-based management. Its primary objective is as a support platform to study and monitor Alaskan pollock and other fisheries, as well as oceanography in the Bering Sea and Gulf of Alaska. The ship also observes weather, sea state, and other environmental conditions, conducts habitat assessments, and surveys marine mammal and marine bird populations. Ship specifications are available at: http://www.moc.noaa.gov/od/

Figure A-30 NOAA Ship *Fairweather*

The *Fairweather* is a hydrographic survey ship that was originally commissioned with NOAA in 1968. The ship was deactivated in 1989 but a critical backlog of surveys for nautical charts in Alaska was a motivating factor to reactivate the ship in 2004. The ship is equipped with the latest in hydrographic survey technology – multi-beam survey systems; high-speed, high-resolution side-scan sonar; position and orientation systems, hydrographic survey launches, and an on-board data-processing server. Increased mission space and deck machinery enable *Fairweather* to be tasked with anything from buoy operations to fisheries research cruises. Ship specifications are available at: http://www.moc.noaa.gov/fa/index.html

R/V *Resolution*

Source: http://www.adfg.alaska.gov/cfregion4/dynamic/research/view/NPRB:1107_Objectives

Figure A-31 R/V *Resolution*

One of many research vessels administered by ADFG, the 27.7m R/V *Resolution* (Figure A-30) was used in the ADFG Large-mesh Trawl Survey and the ADFG Small-mesh Shrimp and Forage Fish Survey.

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Request for Rulemaking and Letters of Authorization Under Section 101(a)(5)(A) of the Marine Mammal Protection Act

for the Take of Marine Mammals Incidental to Fisheries and Ecosystem Research Activities conducted or funded by the Alaska Fisheries Science Center within the Gulf of Alaska, Bering Sea/Aleutian Islands, and Chukchi Sea/Beaufort Sea Research Areas

June 2016

Appendix B

Draft Communication Plan

Prepared for the National Marine Fisheries Service by:

URS Group
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Anchorage, Alaska 99501

TABLE OF CONTENTS

Figures

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INTRODUCTION

Compliance with both the Marine Mammal Protection Act (MMPA) and the National Environmental Policy Act (NEPA) requires that potential effects to subsistence activities are considered and expectations for communicating and coordinating with subsistence users are met. In authorizing incidental take of marine mammals, the MMPA requires that there is no unmitigable adverse impact on the availability of marine mammal species or stocks for subsistence uses, and that requirements pertaining to mitigation and monitoring are addressed. In practice, fulfillment of these requirements has resulted in the implementation of a variety of differing approaches to mitigation, monitoring, and consultation measures by agencies, corporations, industry, and other entities. The Alaska Fisheries Science Center (AFSC) request for rulemaking, subsequent Letter of Authorization (LOA), and accompanying Draft Programmatic Environmental Assessment (DPEA) provide the appropriate analysis and materials necessary to fulfill MMPA and NEPA requirements.

Section 12 of the LOA application states:

> "Where the proposed activity would take place in or near a traditional arctic subsistence hunting area and/or may affect the availability of a species or stock of marine mammal for Arctic subsistence use, the applicant must submit either a "Plan of Cooperation (POC)" or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine mammals for subsistence use."

The AFSC has determined through analysis in the DPEA/LOA that various activities of its fisheries research and assessment programs in the Arctic waters of Alaska may occur in areas utilized for traditional subsistence activities and submits this Communication Plan as an integral component under section 12 of its application for a LOA.

According to 50CFR subpart I, 216.103: "Arctic waters means the marine and estuarine waters north of 60°N latitude." Correspondingly the AFSC is planning to implement a suite of actions and activities to address the potential nexus between AFSC fisheries and ecosystem research and Arctic subsistence activities. In addition, the AFSC has taken a more expansive view of the requirements for the purpose of this Communication Plan because of the potential for interaction between some of the proposed fisheries research activities, the ranges of important marine mammal species (some of which are listed as "endangered" or "threatened" pursuant to the Endangered Species Act [ESA]), and traditional subsistence activities of Alaska Native communities situated at the intersection of those activities, research areas, and animal ranges that may extend into areas to the south of the "Arctic" as defined above. Therefore, while most of the activities considered by this plan are focused on the Arctic, the AFSC may take additional steps to expand communication and mitigation procedures throughout the greater region addressed by the accompanying LOA application (see text below, Figures B-1 and B-2).

DESCRIPTION OF PROPOSED ACTION

Recognizing that AFSC fisheries research activities and subsistence use patterns differ in various regions of Alaska (in both the species pursued and the timing of harvest), the analysis of overlap between AFSC fisheries research and subsistence activities has been divided into three geographic regions (Figure B-1): the Gulf of Alaska (from Dixon Entrance north and west to Unimak Pass, the Bering Sea/Aleutian Islands (west of Unimak to Attu, north and south of the chain, and north into the Bering Sea to the Bering Strait) in Bering Shelf waters), and the Chukchi Sea/Beaufort Sea region (Bering Strait north to Barrow and east to Demarcation Point). A detailed description of the specific fisheries research activities proposed to be conducted is provided in LOA Table 1-1 and Appendix A; additional materials are provided in Section 4.3 of the DPEA. Figure B-2 depicts in a generic way the vast array of AFSC fisheries research activities that have been conducted or are proposed throughout the year at scattered regions and locations throughout the AFSC research areas. Figure B-3 is an Arctic Waterways Safety Committee graphic which identifies proposed buffer zones of 30 nautical miles from Arctic coastal communities or at a distance of 10 nautical miles from the rest of the Arctic coastline. While this figure provides additional information informing readers about areas of potential overlap between subsistence activities and research, it is not fully inclusive of all areas within the 60°N region discussed above, nor does it address those regions and activities to the south of 60°N. The reader is also referred to Section 3.3.4 of the DPEA for a more detailed discussion of the patterns of subsistence use in those areas that may overlap with fisheries research activities. Considering these figures together provides an overview of how fisheries research and subsistence activities might overlap in space and time and why it is important to craft this Communication Plan so as to develop a process and to identify the steps that will be taken to mitigate any adverse effects on the availability of marine mammals for subsistence uses.

Communication Plan - Phase 1: Initial Outreach Activities

As part of the environmental review process for this LOA application, the AFSC contacted over 140 Alaska Native community leaders (including federally recognized tribal governments and corporations) by letters in September and October 2013 (examples attached to the end of this document as Figure B-4). The purpose of this correspondence was to alert these stakeholders to the onset of the programmatic review process and to solicit their questions and input. One response was received from a non-profit Native organization seeking clarification on the process. More recently (2015-2016) the AFSC has joined in meetings with the Arctic Waterways Safety Committee (AWSC) as an active participant in discussions intended to establish written procedures for enhancing communication between Alaska Native subsistence communities with federal research cruise operations in the northern waters of the Bering Sea and throughout the Alaskan Arctic. These discussions are continuing to evolve as this application is being submitted.

AFSC has a history of reaching out to communicate and to coordinate with Alaska Native organizations and subsistence communities as a regular part of their fisheries and marine mammal research throughout coastal and maritime Alaska. For example, AFSC scientists Drs. Libby Logerwell (Chukchi fish assessment cruise) and Suzanne McDermott (Atka mackerel and Pacific cod studies in the Aleutians) and their industry partners have routinely sent out advance notice of pending projects to study area subsistence communities. These notices contain a description of study design, areas of operation, anticipated dates of arrival and departure, and persons to contact for more information. Both of these scientists and their industry partners have routinely met with subsistence hunters and fishers in local communities such as Barrow and Unalaska to report on the results of this research and to solicit input for planning future research. With respect to marine mammal research, staff at the AFSC’s Marine Mammal Laboratory (MML) have decades-long history of cooperation with Alaska Native hunters and residents in many remote communities throughout the State. It is standard practice for AFSC scientists studying bowhead whales, beluga whales, ice seals, northern fur seals, Steller sea lions, harbor seas and other species to develop and to conduct research projects collaboratively and cooperatively through advance meetings in communities and with hunter organizations. Typically these scientists meet either in person or via teleconference with local contacts during winter months to report on the results of previously conducted projects. These extensive, long established formal and informal working relationships are expected to continue and are anticipated to be expanded as part of this Communication Plan.

Communication Plan - Phase 2: Annual Implementation Activities

Development of an annual process for establishing a formalized communication plan is a key goal of this Plan. Work towards achieving that goal is ongoing as the AFSC submits this LOA application. The AFSC has become an active participant in comprehensive discussions with a number of Alaska Native subsistence hunting and fishing organizations through full participation in the AWSC. The details of various channels of communication, the timing, and specifics of who that communication will involve and how and when it will occur are still being worked out. However, it is understood that the AFSC is committed to working through the AWSC and others to ensure there will be direct communication and coordination between AFSC principal investigators (PIs) and local and regional inhabitants and representatives in those areas where AFSC fisheries research will take place, including advance notice and planning, in-season and on-site communication, and post-season follow-up.

Part 1: Winter - Preliminary Field Season Communication and Planning

Arctic Regions: Senior AFSC staff will participate in the AWSC meeting generally scheduled for late November/early December of each year. This meeting is attended by a variety of representatives from industry, biological research, and Alaska Native hunting organizations living and working in the Arctic. As best as possible, AFSC staff will outline the planned fisheries research activities proposed for the upcoming Arctic field season. As federal budget allocations and other funding determinations are often not complete at this time of year, the briefing will provide a “best guess” as to the type, timing and distribution of AFSC research likely to be carried out in the coming field season. Information concerning the potential for interaction between the potential research and subsistence activities will be solicited and discussed. Ideas and concepts for avoiding and/or minimizing such interactions will be pursued and developed into recommendations and considered for incorporation into field operations plans. Opportunities for expanding communication between parties prior to and during the field season will be discussed and considered for incorporation into field operations plans. Points of contact for local communities will be developed and provided to all AFSC PI’s so they can establish contact and begin conversations in advance of the onset of field work. A synopsis of the recommendations and key points of discovery from these ongoing AWSC meetings will be distributed to all involved parties. While much of the communication will be direct between PIs and the local contacts, the overall responsibility for Plan implementation will be either the Alaska Regional Collaboration Team (RCT) Lead (Douglas DeMaster-Juneau, AK) or the RCT Coordinator (Amy Holman – Anchorage, AK).

Other regions outside of the Arctic: The AFSC communicates to the public and its partners when upcoming surveys and major cruises begin, about the need and nature for the survey, and more and more often news about the cruise as it occurs. These scientific activities typically have a formal cruise announcement that is sent to interested parties and that is also released to news media throughout Alaska. The AFSC Center Director will encourage PI’s from all AFSC fisheries research activities outside of the Arctic to continue and/or to expand coordination on an informal basis with local Alaska Native Organizations and subsistence hunters and fishers at local and regional levels in the northern Bering Sea, Aleutian Archipelago, Alaskan Peninsula, Bristol Bay, and southeastern Alaska.. It is desirable for this communication to follow the same “advance notice and planning, in-season and on-site communication, and post-season follow-up” model as described above for the Arctic regions. It is expected that the collaborative process now followed by some AFSC fisheries research and most marine mammal scientists at the AFSC will be implemented and, if possible, expanded so as to increase knowledge of local customs, hunting and fishing areas, the nature and benefits of AFSC fisheries research, and to collaboratively minimize potential interactions between fisheries research and subsistence activities in these project areas.

Part 2: Early Spring - Communication of Planned Operational Procedures and Actions

As operational budgets for the upcoming field season become known and the actual research activities to be conducted are determined, AFSC project leaders will begin alerting appropriate regional representatives, communities, and hunters as to the timing and specifics of each project and will again seek input on best practices for avoiding interactions. PIs will be required to provide a plan to the Director AFSC detailing field operations and a schedule for communicating with selected key communities about the upcoming research. Plans will describe the process for working with communities so as to avoid interactions between research and subsistence activities; avenues for obtaining and incorporating local input will be identified.

In addition, Senior AFSC staff will participate in the AWSC meeting generally scheduled for March of each year. It is at this meeting that AFSC leadership will present a list of AFSC cruises that have cruise tracks that could potentially interfere with subsistence hunting activities. Further, it is at this meeting that points of contacts for individual research cruises and communities will be exchanged.

It is anticipated that such pre-season communication may also include on-site or teleconference meetings in late winter/early spring preceding the upcoming field season covered by the LOA/regulations in the key communities. For the purposes of this LOA application Communication Plan, the key organizations in the Arctic include the Alaska Eskimo Whaling Commission, Ice Seal Committee, Harbor Seal Commission, and Alaska Beluga Whale Committee as well as a number of regional non-profit organizations, Alaska Native Corporations, and Borough agencies. The AFSC notes that additional meetings are likely to occur on a project by project basis whenever operations find themselves in ports and regional subsistence hubs. Staff will be encouraged to seek out the means to make public service announcements via radio (e.g., via KBRW and KOTZ, ARCS airwaves) and various internet portals.

Part 3: Field Season

A) Prior to departure for the field (going to sea):

AFSC PIs will prepare field operations or cruise plans for each project and submit them to the AFSC Director for approval. One section of these plans will address how researchers will consult and maintain communication with contacts in the affected subsistence communities when in the field (at sea). The intent will be to provide advance notice of operations and to seek information and guidance on how to avoid interactions with subsistence activities as teams approach communities and subsistence areas. Each field operations plan should include a list of local contacts and contact mechanisms such as phone numbers, email, and radio frequencies monitored (e.g., Kaktovik Call Center).

B) Real time operational procedures and actions

Field operations or cruise plans will outline steps that will be taken to avoid or to minimize the risk of interactions between AFSC fisheries research and local subsistence activities. PIs will provide a one to two page summary description of the proposed conflict avoidance/mitigation measures that will be implemented to reduce conflicts with a) marine mammals and b) subsistence activities. These should identify responses to evolving situations through specific operational procedures (“what if, then?” scenarios) designed to avoid or minimize interaction between research and subsistence activities in time and space. AFSC will evaluate the potential for including regionally appropriate subsistence communicators/marine mammal observers on cruises subject to available space and appropriate duration on a case by case basis. AFSC recognizes this may be most relevant to fisheries research in the Chukchi and Beaufort seas where there may be a nexus with bowhead whaling activities.

Part 4: Fall - Post Field Season and Subsequent Follow-up

AFSC and individual PIs will schedule post-season informational sessions with subsistence contacts from the study areas: (1) to brief them on the outcome of the AFSC fisheries research and (2) to assess how well this Communication Plan and individual field operations or cruise plans worked to minimize interactions. Incorporating a synopsis of AFSC fisheries research activities in the fall AWSC meeting would be a valuable first step or possibly meetings of the AEWC. AFSC PIs will be encouraged to also set up meetings via travel, video conference, and/or internet applications to further increase direct communication with subsistence hunters and fishers in applicable remote Alaska communities.

Communication Plan - Phase 3: Review and Preparation for Subsequent LOAs

In year four of the five-year MMPA authorization, AFSC Leadership will solicit input from PIs to determine how this Communication Plan worked to avoid interactions between fisheries research and subsistence activities. This information will be incorporated in a timely manner into a new application for subsequent MMPA regulations and LOAs.

Conclusion:

As required by regulation (§ 216.104(a)(11)), through this Communication Plan the AFSC:

- Will notify and provide the affected Alaska Native subsistence community with a draft of this Communication Plan through a series of mailings, direct contacts, and planned meetings throughout the regions where AFSC fisheries research is expected to occur over the next five years. A notice of availability of the LOA application and the draft Communication Plan will be published in the Federal Register; a public comment period will be included as part of the regular review process;
- Has outlined a proposed schedule and a strategy for meeting with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the fisheries research operations or the Communication Plan;
- Described in this Communication Plan and the accompanying LOA application those measures and procedures the AFSC will take to ensure that proposed activities will not interfere with subsistence whaling or sealing; and,
- Has detailed the plans the AFSC has proposed to ensure continued cooperation and collaboration with communities in those regions where AFSC fisheries research activities will occur, both prior to, while conducting the activity, and subsequent to the activities, so as to resolve potential conflicts and to keep these communities aware of any changes in the operations.

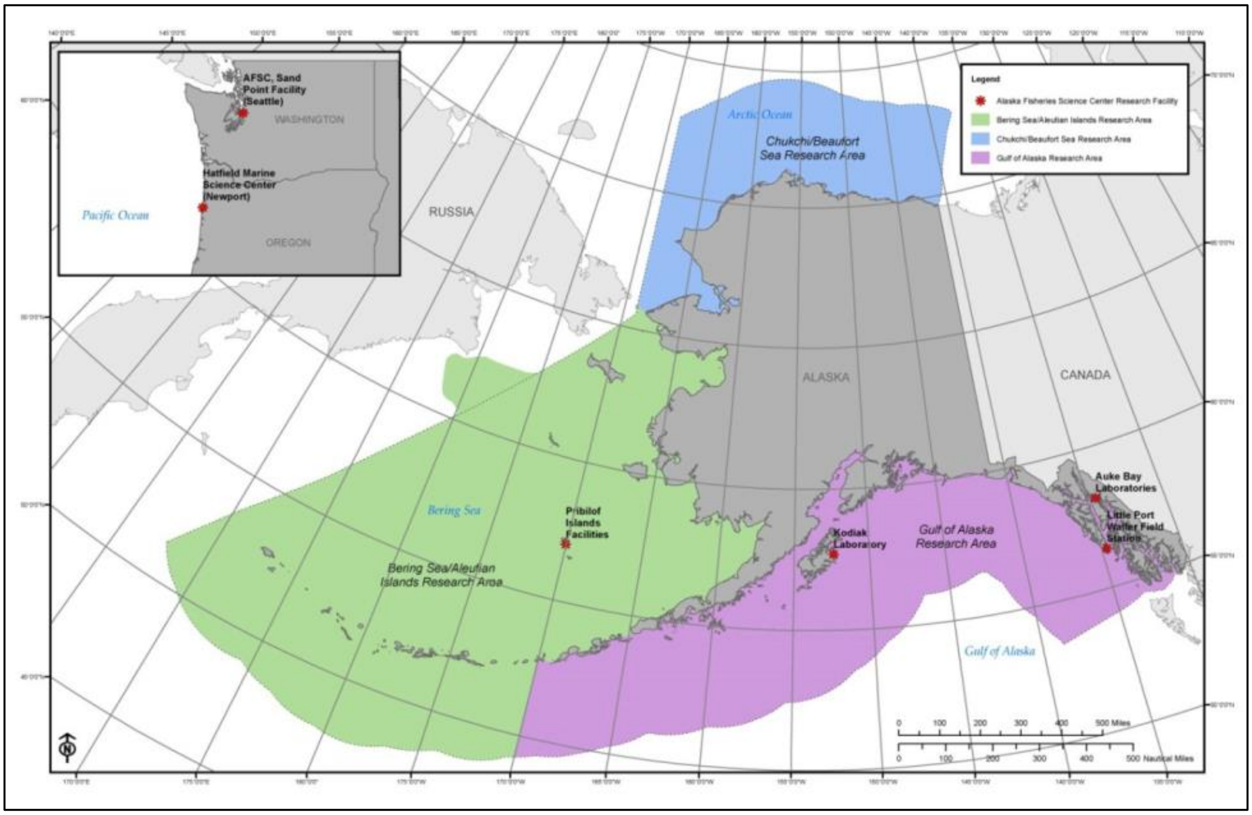

Figure B-1 AFSC fisheries research areas

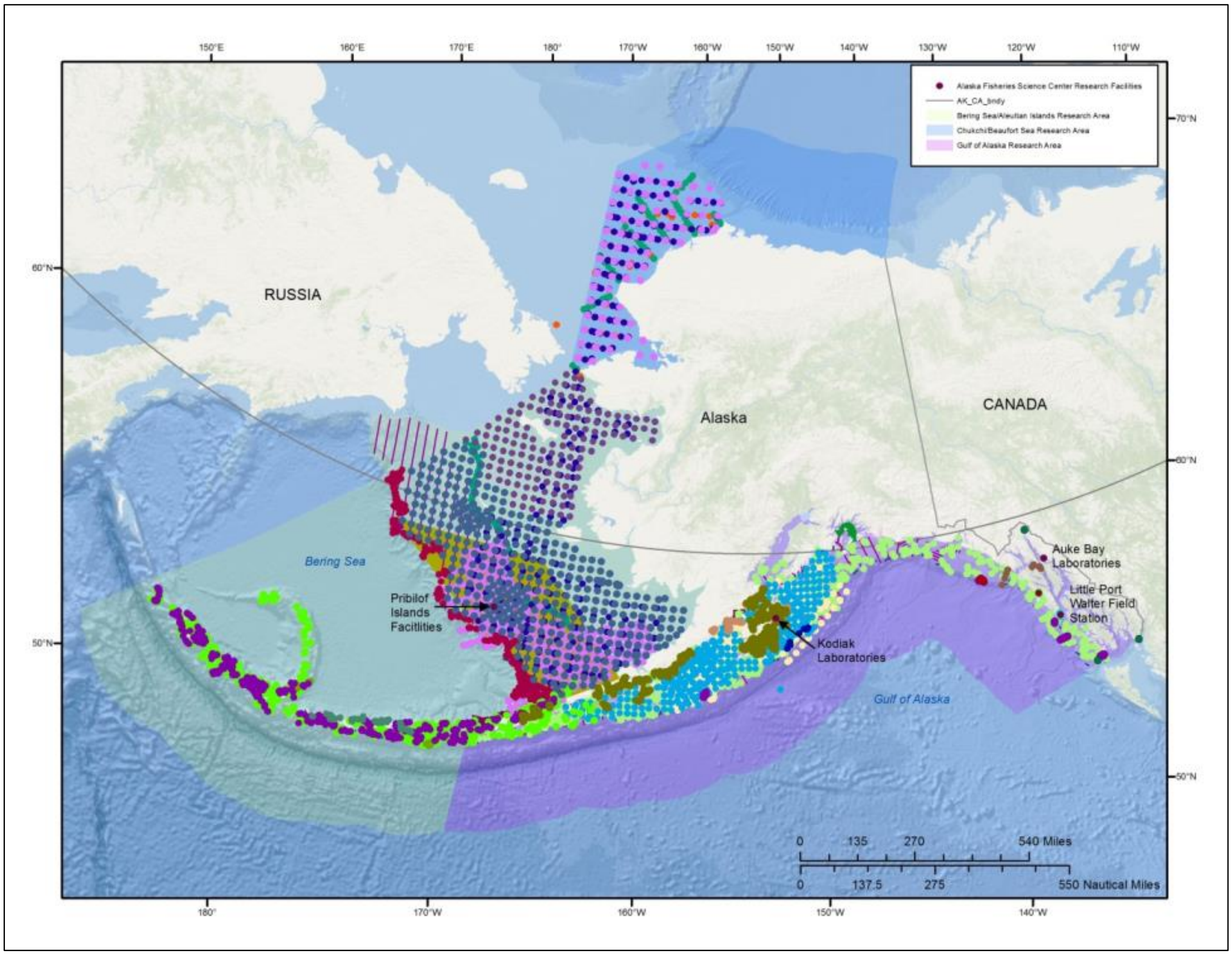

Figure B-2 Overview of the spatial distribution of AFSC fisheries research project sampling regions and locations as identified under the proposed action. See Appendix B of the DPEA for more detailed figures and information concerning sampling effort for specific research activities, organized by season and research area.

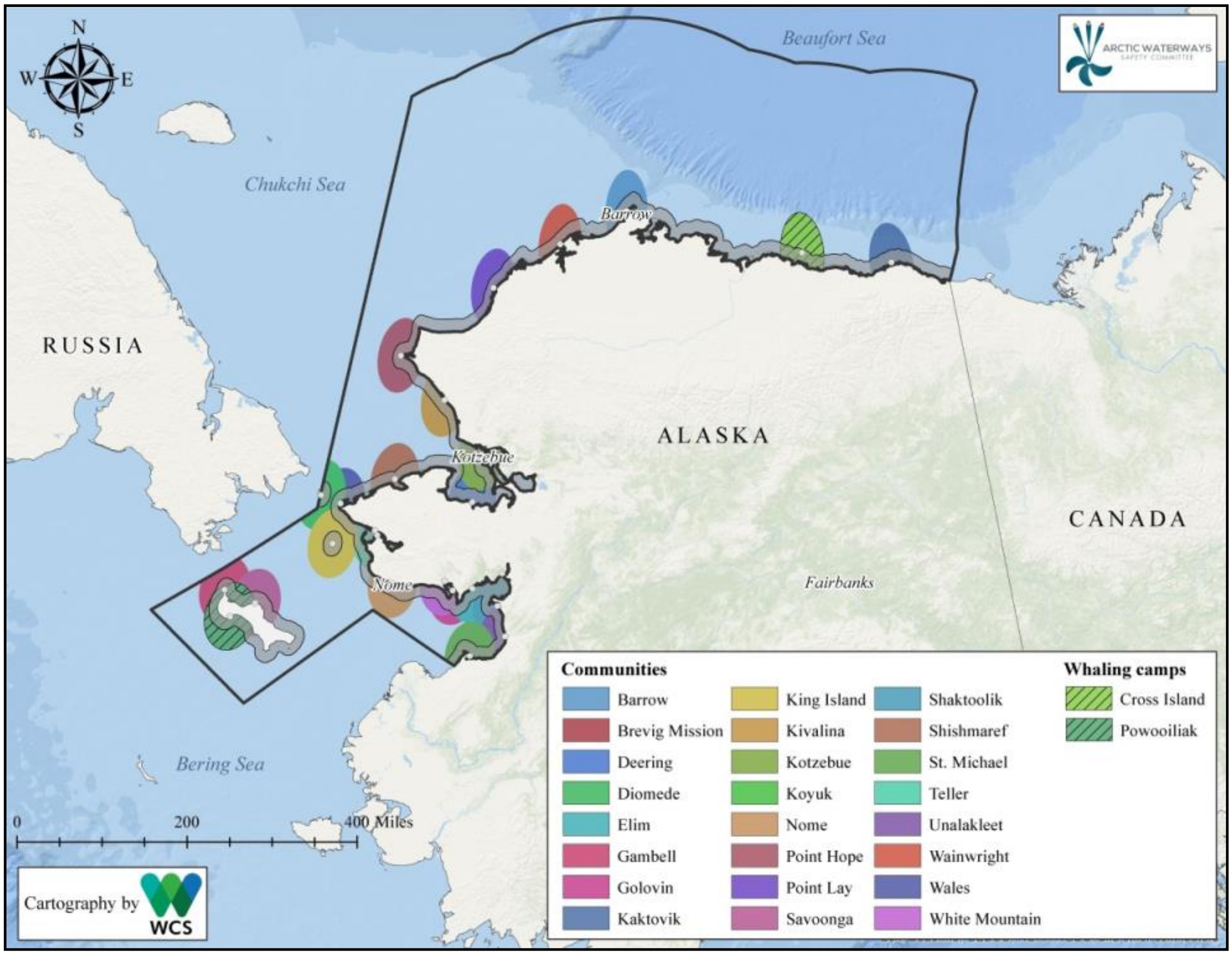

Figure B-3 Arctic Waterways Safety Committee graphic which identifies regions of distance 30 nautical miles from coastal villages (colored ovals) or at a distance of 10 nautical miles from the rest of the Arctic coastline (gray shaded areas). The black line defines the boundary of the area of concern for the Arctic Waterways Safety Committee.

Figure B-4 Letters sent to Alaska Native organizations and communities in 2013; see following pages.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Alaska Fisheries Science Center
7600 Sand Point Way N.E.
Bldg. 4, F/AKC
Seattle, Washington 98115-0070

6 September 2013

President Phyllis Amodo
Kaguyak Village
P.O. Box 5078
Akhiok, AK 99615

Re: Evaluation of Potential Impacts of Fisheries Research Activities Conducted by NMFS' Alaska Fisheries Science Center on Subsistence Resources and Activities

Dear President Amodo:

The National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) is undertaking a programmatic review of its fisheries research programs to ensure the potential impacts of these activities are assessed in compliance with applicable laws. The NMFS Alaska Fisheries Science Center (AFSC) conducts research on living marine resources in the coastal oceans off Alaska to provide scientific advice to support the North Pacific Fishery Management Council and other domestic and international fisheries management organizations. We want to take this opportunity to inform you of the processes being undertaken to complete this programmatic review relative to Alaska Native communities.

We are in the process of developing a draft programmatic Environmental Assessment (EA) for public review that will describe proposed research activities, historic catch of species targeted by fisheries research, and potential direct and cumulative effects of AFSC research on the affected environment. Initiation of this National Environmental Policy Act (NEPA) review will provide a basis to evaluate the potential impacts of these activities on subsistence activities and resources, maritime historic sites or areas of cultural significance under the National Historic Preservation Act, species listed under the Endangered Species Act, designated critical habitat, and on essential fish habitat under the Magnuson-Stevens Act. The programmatic EA will also be used as the basis to prepare an Incidental Take Authorization (ITA) application to take marine mammals under the Marine Mammal Protection Act incidental to proposed research activities.

Since AFSC research cruises have only limited operations in areas used by native communities, the AFSC expects insignificant impacts on subsistence harvest of marine mammals or other subsistence activities. To date, the AFSC is not aware that any of its fisheries research surveys have encountered or interfered with any subsistence hunts or activities. The AFSC will evaluate measures to mitigate potential impacts, including advanced notification of and communication during conduct of fisheries research activities.

As we prepare the programmatic EA, the AFSC will be conducting a spatial analysis of potential future overlaps between subsistence harvesting and research activities, as well as identify any maritime historic or culturally significant sites that may be affected. Moreover, the AFSC would like to have an open exchange of information with affected federal entities and the Alaska Native community about the AFSC's fishery research activities and will make every effort to proactively collaborate and communicate with interested Alaska Native organizations, co-management groups, Native villages and other groups during the development of the AFSC's programmatic EA.

The Kaguyak Village can provide valuable assistance by identifying any additional subsistence use areas that may overlap with AFSC fisheries research activities in time and space. In addition, if you have any other concerns about the AFSC fisheries research efforts and its impacts on specific maritime historic or culturally significant sites in your area that should be addressed in the programmatic EA, we welcome your input. You may also wait for the public comment period to formally participate in development of this EA, which is likely to be available in mid-2014.

If you have any questions, comments, and/or concerns regarding the development of this EA, please feel free to contact the following individuals on my staff: Dr. Daniel Ito (206-526-4232, Dan.Ito@noaa.gov) or Guy Fleischer (206-526-4103, Guy.Fleischer@noaa.gov).

Sincerely,

Douglas DeMaster

Douglas DeMaster, Ph.D.
Science and Research Director

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Alaska Fisheries Science Center
7600 Sand Point Way N.E.
Bldg. 4, F/AKC
Seattle, Washington 98115-0070

28 October 2013

President George Edwardson
Inupiat Community of the Arctic Slope
P.O. Box 934
Barrow, AK 99723

Re: Evaluation of Potential Impacts of Fisheries Research Activities Conducted by NMFS' Alaska Fisheries Science Center on Subsistence Resources and Activities

Dear President Edwardson:

The National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) is undertaking a programmatic review of its fisheries research programs to ensure the potential impacts of these activities are assessed in compliance with applicable laws. The NMFS Alaska Fisheries Science Center (AFSC) conducts research on living marine resources in the coastal oceans off Alaska to provide scientific advice to support the North Pacific Fishery Management Council and other domestic and international fisheries management organizations. We want to take this opportunity to inform you of the processes being undertaken to complete this programmatic review relative to Alaska Native communities.

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NMFS is contacting federally-recognized tribal governments in the coastal areas potentially affected by our research to assist in identifying any additional subsistence use areas that may overlap with AFSC fisheries research activities in time and space. In addition, Inupiat Community of the Arctic Slope can provide valuable assistance by identifying any concerns about the AFSC fisheries research efforts and its impacts on specific maritime historic or culturally significant sites in your area that should be addressed in the programmatic EA, we welcome your input. You may also wait for the public comment period to formally participate in development of this EA, which is likely to be available in mid-2014.

If you have any questions, comments, and/or concerns regarding the development of this EA, please feel free to contact the following individuals on my staff: Dr. Daniel Ito (206-526-4232, Dan.Ito@noaa.gov) or Guy Fleischer (206-526-4103, Guy.Fleischer@noaa.gov).

Sincerely,

Douglas DeMaster, Ph.D.
Science and Research Director

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