DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 219

[Docket No. 151027994–6421–01]

RIN 0648–BF47

Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Northwest Fisheries Science Center Fisheries Research

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Proposed rule; request for comments.

SUMMARY: NMFS' Office of Protected Resources has received a request from NMFS' Northwest Fisheries Science Center (NWFSC) for authorization to take marine mammals incidental to fisheries research conducted in the Pacific Ocean off the northwest United States, over the course of five years from the date of issuance. As required by the Marine Mammal Protection Act (MMPA), NMFS is proposing regulations to govern that take, and requests comments on the proposed regulations.

DATES: Comments and information must be received no later than July 13, 2016.

ADDRESSES: You may submit comments on this document, identified by NOAA–NMFS–2016–0060, by any of the following methods:

- *Electronic submission:* Submit all electronic public comments via the federal e-Rulemaking Portal. Go to *www.regulations.gov,* enter 0648–BF47 in the ''Search'' box, click the ''Comment Now!'' icon, complete the required fields, and enter or attach your comments.
- *Mail:* Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East West Highway, Silver Spring, MD 20910.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. Attachments to electronic comments will be accepted in Microsoft Word or Excel or Adobe PDF file formats only. To help NMFS process and review comments more efficiently, please use only one method to submit comments. All comments received are a part of the public record and will generally be posted on *www.regulations.gov* without change. All personal identifying information (*e.g.,* name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information. NMFS will accept anonymous comments (enter N/A in the required fields if you wish to remain anonymous).

FOR FURTHER INFORMATION CONTACT: Ben Laws, Office of Protected Resources, NMFS, (301) 427–8401.

SUPPLEMENTARY INFORMATION:

Availability

A copy of NWFSC's application and any supporting documents, as well as a list of the references cited in this document, may be obtained by visiting the Internet at: *www.nmfs.noaa.gov/pr/permits/incidental/research.htm.* In case of problems accessing these documents, please call the contact listed above (see **FOR FURTHER INFORMATION CONTACT**).

Purpose and Need for Regulatory Action

This proposed rule, to be issued under the authority of the Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361 *et seq.*), would establish a framework for authorizing the take of marine mammals incidental to the NWFSC's fisheries research activities in the California Current and Pacific Northwest.

The NWFSC collects a wide array of information necessary to evaluate the status of exploited fishery resources and the marine environment. NWFSC scientists conduct fishery-independent research onboard NOAA-owned and operated vessels or on chartered vessels. A few surveys are conducted onboard commercial fishing vessels, but the NWFSC designs and executes the studies and funds vessel time.

We received an application from the NWFSC requesting five-year regulations and authorization to take multiple species of marine mammals. Take would occur by Level B harassment incidental to the use of active acoustic devices, as well as by visual disturbance of pinnipeds, and by Level A harassment, serious injury, or mortality incidental to the use of fisheries research gear. The regulations would be valid from 2016 to 2021. Please see ''Background'' below for definitions of harassment.

Legal Authority for the Proposed Action

Section 101(a)(5)(A) of the MMPA (16 U.S.C. 1371(a)(5)(A)) directs the Secretary of Commerce to allow, upon request, the incidental, but not intentional taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region for up to five years if, after notice and public comment, the agency makes certain findings and issues regulations that set forth permissible methods of taking pursuant to that activity, as well as monitoring and reporting requirements. Section 101(a)(5)(A) of the MMPA and the implementing regulations at 50 CFR part 216, subpart I provide the legal basis for issuing this proposed rule containing five-year regulations, and for any subsequent Letters of Authorization. As directed by this legal authority, this proposed rule contains mitigation, monitoring, and reporting requirements.

Summary of Major Provisions Within the Proposed Rule

The following provides a summary of some of the major provisions within the proposed rulemaking for the NWFSC fisheries research activities. We have preliminarily determined that the NWFSC's adherence to the proposed mitigation, monitoring, and reporting measures listed below would achieve the least practicable adverse impact on the affected marine mammals. They include:

- Required monitoring of the sampling areas to detect the presence of marine mammals before deployment of certain research gear.
- Required use of acoustic deterrent devices on surface trawl nets.
- Required implementation of the mitigation strategy known as the ''move-on rule mitigation protocol'' which incorporates best professional judgment, when necessary during certain research fishing operations.

Background

Paragraphs 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1371 (a)(5)(A) and (D)) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

An authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.''

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment].

Summary of Request

On August 10, 2015, we received an adequate and complete request from NWFSC for authorization to take marine mammals incidental to fisheries research activities. We received an initial draft of the request on January 2, 2015, followed by a revised draft on April 28, 2015. On August 28, 2015 (80 FR 52256), we published a notice of receipt of NWFSC's application in the **Federal Register**, requesting comments and information related to the NWFSC request for thirty days. We received comments jointly from The Humane Society of the United States and Whale and Dolphin Conservation, which we considered in development of this proposed rule and which are available on the Internet at: *www.nmfs.noaa.gov/pr/permits/incidental/research.htm.*

NWFSC proposes to conduct fisheries research using trawl gear used at various levels in the water column, hook-and-line gears (including longlines with multiple hooks, rod and reel, and troll deployments), purse seine/tangle net gear, and other gear. If a marine mammal interacts with gear deployed by NWFSC, the outcome could potentially be Level A harassment, serious injury (*i.e.,* any injury that will likely result in mortality), or mortality. Therefore, NWFSC has pooled the estimated number of incidents of take that could reasonably result from gear interactions, and we have assessed the potential impacts accordingly. NWFSC also uses various active acoustic devices in the conduct of fisheries research, and use of these devices has the potential to result in Level B harassment of marine mammals. Level B harassment of pinnipeds hauled out may also occur, as a result of visual disturbance from vessels conducting NWFSC research. The proposed regulations would be valid for five years from the date of issuance.

NWFSC requests authorization to take individuals of sixteen species by Level A harassment, serious injury, or mortality (hereafter referred to as M/SI + Level A) and of 34 species by Level B harassment.

Description of the Specified Activity

Overview

The NWFSC collects a wide array of information necessary to evaluate the status of exploited fishery resources and the marine environment. NWFSC scientists conduct fishery-independent research onboard NOAA-owned and operated vessels or on chartered vessels. A few surveys are conducted onboard commercial fishing vessels, but the NWFSC designs and executes the studies and funds vessel time. The NWFSC proposes to administer and conduct approximately 36 survey programs over the five-year period. The gear types used fall into several categories: Towed nets fished at various levels in the water column, longline and other hook and line gear, seine nets, traps, and other gear. Only use of trawl nets, hook and line gears, and purse seine nets are likely to result in interaction with marine mammals. Many of these surveys also use active acoustic devices.

The federal government has a responsibility to conserve and protect living marine resources in U.S. waters and has also entered into a number of international agreements and treaties related to the management of living marine resources in international waters outside the United States. NOAA has the primary responsibility for managing marine finfish and shellfish species and their habitats, with that responsibility delegated within NOAA to NMFS.

In order to direct and coordinate the collection of scientific information needed to make informed fishery management decisions, Congress created six regional fisheries science centers, each a distinct organizational entity and the scientific focal point within NMFS for region-based federal fisheries-related research. This research is aimed at monitoring fish stock recruitment, abundance, survival and biological rates, geographic distribution of species and stocks, ecosystem process changes, and marine ecological research. The NWFSC is the research arm of NMFS in the northwest region of the United States. The NWFSC conducts research and provides scientific advice to manage fisheries and conserve protected species in the geographic research area described below and provides scientific information to support the Pacific Fishery Management Council and numerous other domestic and international fisheries management organizations.

Dates and Duration

The specified activity may occur at any time during the five-year period of validity of the proposed regulations. Dates and duration of individual surveys are inherently uncertain, based on congressional funding levels for the NWFSC, weather conditions, or ship contingencies. In addition, cooperative research is designed to provide flexibility on a yearly basis in order to address issues as they arise. Some cooperative research projects last multiple years or may continue with modifications. Other projects only last one year and are not continued. Most cooperative research projects 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.

Specified Geographical Region

The NWFSC conducts research in the Pacific Northwest and California Current within three research areas: The California Current Research Area (CCRA), Puget Sound Research Area (PSRA), and Lower Columbia River Research Area (LCRRA). Please see Figures 1–2 through 1–4 in the NWFSC application for maps of the three research areas. We note here that, while the NWFSC specified geographical region extends outside of the U.S. Exclusive Economic Zone (EEZ), from the Mexican EEZ (not including Mexican territorial waters) north into the Canadian EEZ (not including Canadian territorial waters), the MMPA's authority does not extend into foreign territorial waters. In addition to general knowledge and other citations contained herein, this section relies upon the descriptions found in Sherman and Hempel (2009) and Wilkinson *et al.* (2009). As referred to here, productivity refers to fixated carbon (*i.e.,* g $C/m^2/yr$) and can be related to the carrying capacity of an ecosystem.

The NWFSC conducts research surveys off the Pacific coast within the California Current Large Marine Ecosystem (CCE). This region is considered to be of moderately high productivity. Sea surface temperature (SST) is fairly consistent, ranging from 9–14 °C in winter and 13–15 °C in summer. Major biogeographic breaks are found at Point Conception and Cape Mendocino, and the region includes major estuaries such as San Francisco Bay, the Columbia River, and Puget Sound. The latter two are areas of research focus for NWFSC and are described in further detail below. The shelf is generally narrow in the CCE, and shelf-break topography (*e.g.,* underwater canyons) creates localized upwelling conditions that concentrate nutrients into areas of high topographic relief.

The California Current determines the general hydrography off the coast of California. The current is part of the North Pacific Gyre, related to the anticyclonic circulation of the central North Pacific and brings cool waters southward. In general, an area of divergence parallels the coast of California, with a zone of convergence 200–300 km from the coastline. The current moves south along the western coast of North America, beginning off southern British Columbia and flowing southward past Washington, Oregon and California, before ending off southern Baja California (Bograd *et al.,* 2010). Extensive seasonal upwelling of colder, nutrient-rich subsurface waters is predominant in the area south of Cape Mendocino and supports large populations of whales, seabirds and important fisheries. Significant interannual variation in productivity results from the effects of this coastal upwelling as well as from the El Niño-Southern Oscillation and the Pacific Decadal Oscillation. Both oscillations involve transitions from cooler, more productive conditions to warmer, less productive conditions, but over different timescales.

On the shoreward side of the California Current, the California Current Front separates cold, low-salinity upwelled waters from the warmer, saltier waters close to shore. Offshore frontal filaments transport the frontal water across the entire ecosystem. In winter, the wind-driven Davidson Current is the dominant nearshore system, and its associated front forms along the boundary between inshore subtropical waters and colder offshore temperate and subarctic waters. Surface flow of the California Current appears to be diverted offshore at Point Conception and again at Punta Eugenia, while semi-permanent eddies exist south of these headlands.

NWFSC conducts research programs specific to two major estuaries of the CCE: Puget Sound and the Columbia River. Offshore of these estuaries, the CCE is affected by the Heceta Bank, which rises to within 80 m of the ocean surface and causes coastal eddies, and underwater canyons (*e.g.,* Juan de Fuca Canyon), which create upwelling conditions driving high biologic productivity. This portion of the region is also affected by high amounts of runoff from the Columbia and Fraser Rivers (the latter being the largest freshwater input to Puget Sound). The river plumes stimulate primary productivity, with the Columbia River plume creating a large surface lens of lower-salinity water in the spring and summer and the Fraser River plume carrying nutrients northwards past Vancouver Island year-round.

Puget Sound, with more than 8,000 km^2 of marine waters and estuarine environment and a watershed of more than 33,000 km^2, is one of the largest estuaries in the United States and is the only inland sea with fjords in the continental United States. Puget Sound is a place of great physical and ecological complexity and productivity, with many diverse and important habitat types. Kelp beds and eelgrass meadows cover almost 1,000 km^2, while other major habitat types include subtidal and intertidal wetlands, mudflats, and sandflats (Gustafson *et al.,* 2000). Concentrations of nutrients (*i.e.,* nitrates and phosphates) are consistently high throughout most of Puget Sound, largely due to the flux of oceanic water into the basin (Harrison *et al.,* 1994), with circulation driven by tides, gravity, and freshwater influx. The average surface water temperature is 12.8 °C in summer and 7.2 °C in winter (Staubitz *et al.,* 1997), but surface waters frequently exceed 20 °C in the summer and fall. With nearly six million people (doubled since the 1960s), Puget Sound is also heavily influenced by human activity.

The Columbia River is the largest in the Pacific Northwest, draining a watershed of 671,000 km^2. The Columbia River estuary encompasses more than 325 km^2 and is one of the largest on the west coast. Dams, diking, and dredging have dramatically altered the hydrologic processes that historically shaped the wetlands of the lower Columbia River. Prior to these alterations, many of the riverine islands and much of the floodplain were inundated several times a year, typically in December and again in May or June. Operation of dams has substantially reduced peak river flows and has nearly eliminated flooding in many low-lying areas. Dredging of shipping channels has required disposal of massive quantities of sediments, resulting in creation of new islands, filling of many former wetlands, and changing shoreline sediment types (OWJV, 1994).

The LCRRA includes the Columbia River from its mouth, west of Astoria, OR, to the Bonneville Dam at river mile (RM) 145. Downstream of approximately RM 120, the river widens to include a broad floodplain and elongated islands that divide the river and form sloughs and side-channels in the formerly marshy lowlands. The floodplain expands around the confluence with the Willamette River (which accounts for approximately fifteen percent of Columbia River flow) at RM 101. Downstream of approximately RM 35 the channel is dotted with low islands of deposited sediments and widens into several broad bays (OWJV, 1994).

Detailed Description of Activities

The federal government has a trust responsibility to protect living marine resources in waters of the United States. These waters extend to 200 nm from the shoreline and include the EEZ. 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 EEZ (*i.e.,* the high seas). To carry out its responsibilities over U.S. 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, NMFS has been delegated primary responsibility for the science-based management, conservation, and protection of living marine resources under statutes including the Magnuson-Stevens Fishery Conservation and Management Act, the Pacific Salmon Treaty Act, and the Endangered Species Act, as well as under treaties with Native American tribes inside the EEZ off the Washington Coast.

Within NMFS, six regional fisheries science centers direct and coordinate the collection of scientific information needed to inform fisheries management decisions. Each Fisheries Science Center is a distinct entity and is the scientific focal point for a particular region. NWFSC conducts research and provides scientific advice to manage fisheries and conserve protected species along the U.S. west coast, including estuaries and freshwater systems of Puget Sound and the major rivers in Washington and Oregon. NWFSC provides scientific information to support the Pacific Fishery Management Council and other domestic and international fisheries management organizations.

The NWFSC collects a wide array of information necessary to evaluate the status of exploited fishery resources and the marine environment. NWFSC scientists conduct fishery-independent research onboard NOAA-owned and operated vessels or on chartered vessels. A few surveys are conducted onboard commercial fishing vessels, but the NWFSC designs and executes the studies and funds vessel time. The NWFSC proposes to administer and conduct approximately 36 survey programs over the five-year period.

The gear types used fall into several categories: Towed nets fished at various levels in the water column, longline and other hook and line gear, seine nets, traps, and other gear. Only use of trawl nets, hook and line gears, and purse seine nets are likely to result in interaction with marine mammals. Many of these surveys also use active acoustic devices. These surveys may be conducted aboard NOAA-operated research vessels (R/V), including the *Bell M. Shimada, Reuben Lasker,* and assorted other small vessels owned by NWFSC, aboard vessels owned and operated by cooperating agencies and institutions, or aboard charter vessels.

In the following discussion, we first summarily describe various gear types used by NWFSC and then describe specific fisheries and ecosystem research activities conducted by the NWFSC. This is not an exhaustive list of gear and/or devices that may be utilized by NWFSC but is representative of gear categories and is complete with regard to all gears with potential for interaction with marine mammals. Additionally, relevant active acoustic devices, which are commonly used in NWFSC survey activities, are described separately in a subsequent section. Please see Appendix A of NWFSC's draft EA for further description, pictures, and diagrams of research gear and vessels.

Trawl nets—A trawl is a funnel-shaped net towed behind a boat to capture fish. The codend (or bag) is the fine-meshed portion of the net most distant from the towing vessel 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 to enable estimates of the size and age distributions of fish in a particular area. The body of a trawl net is generally constructed of relatively coarse mesh that functions to gather schooling fish so that they can be collected in the codend. The opening of the net, called the mouth, is extended horizontally by large panels of wide mesh called wings. The mouth of the net is held open by hydrodynamic force exerted on the trawl doors attached to the wings of the net. As the net is towed through the water, the force of the water spreads the trawl doors horizontally apart. The top of a net is called the headrope, and the bottom is called the footrope.

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 played out until the net reaches the fishing depth. Commercial trawl vessels travel at speeds of 2–5 kn while towing the net for time periods up to several hours. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. At the end of the tow the net is retrieved and the contents of the codend are emptied onto the deck. For research purposes, the speed and duration of the tow and the characteristics of the net must be standardized to allow meaningful comparisons of data collected at different times and locations. Active acoustic devices (described later) incorporated into the research vessel and the trawl gear monitor the position and status of the net, speed of the tow, and other variables important to the research design. NWFSC research trawling activities utilize pelagic (or midwater) and surface trawls, which are designed to operate at various depths within the water column but not to contact the seafloor, as well as bottom trawls.

NWFSC also uses beam trawls, a type of bottom trawl in which the horizontal opening of the net is provided by a heavy beam mounted at each end on guides or skids that travel along the seabed. On sandy or muddy bottoms, a series of 'tickler' chains are strung between the skids ahead of the net to stir up the fish from the seabed and chase them into the net. On rocky grounds, these ticklers may be replaced with chain matting. Several trawls are towed, one on each side of the vessel. NWFSC attaches video camera systems to some beam trawls. The trawls are towed along the seafloor at speeds of 1–1.5 kn.

Longline—Longline vessels fish with baited hooks attached to a mainline (or groundline). The length of the longline and the number of hooks depend on the species targeted, the size of the vessel, and the purpose of the fishing activity. Hooks are attached to the mainline by another thinner line called a gangion. The length of the gangion and the distance between gangions depends on the purpose of the fishing activity. Depending on the fishery, longline gear can be deployed on the seafloor (bottom longline), in which case weights are attached to the mainline, or near the surface of the water (pelagic longline), in which case buoys are attached to the mainline to provide flotation and keep the baited hooks suspended in the water. Radar reflectors, radio transmitters, and light sources are often used to help fishers determine the location of the longline gear prior to retrieval.

A commercial pelagic longline can be over 100 km long and have thousands of hooks attached, although longlines used for research surveys are shorter. The pelagic longline gear used for NWFSC research surveys typically use 500 hooks attached to a mainline less than 2 km long, with snap-on gangions less than 1 m long spaced at intervals of approximately 3 m. There are no internationally-recognized standard measurements for hook size, and a given size may be inconsistent between manufacturers. Larger hooks, as are used in longlining, are referenced by increasing whole numbers followed by a slash and a zero as size increases (*e.g.,* 1/0 up to 20/0). The numbers represent relative sizes, normally associated with the gap (the distance from the point tip to the shank). Because pelagic longline gear is not anchored to the seafloor, it floats freely in the water and may drift considerable distances between the time of deployment and the time of retrieval. Bottom longlines used for commercial fishing can be up to several miles long, but those used for NWFSC research use shorter lines with approximately thirty hooks per line.

The time period between deployment and retrieval of the longline gear is the soak time. Soak time is an important parameter for calculating fishing effort. For commercial fisheries the goal is to optimize the soak time in order to maximize catch of the target species while minimizing the bycatch rate and minimizing damage to target species that may result from predation by sharks or other predators.

Other hook and line gear—Hook and line is a general term used for a range of fishing methods that employ short fishing lines with hooks in one form or another (as opposed to longlines). This gear is similar to methods commonly used by recreational fishers and may generally include handlines, hand reels, powered reels, rod/pole and line, drop lines, and troll lines, all using bait or lures in various ways to attract target species. NWFSC uses barbed or barbless circle hooks used depending on the needs of the research (*i.e.,* to retain fish or release them with minimal injury) and would typically deploy multiple lines at once.

Other nets—NWFSC surveys utilize various small, fine-mesh, towed nets designed to sample small fish and pelagic invertebrates. These nets can be broadly categorized as small trawls (which are separated from large trawl nets due to discountable potential for interaction with marine mammals; see ''Potential Effects of the Specified Activity on Marine Mammals and Their Habitat'') and plankton nets.

1. The Tucker trawl is a medium-sized single-warp net used to study pelagic fish and zooplankton. The Tucker trawl consists of a series of nets that can be opened and closed sequentially via stepping motor without retrieving the net from the fishing depth. It is designed for deep oblique tows where up to three replicate nets can be sequentially operated by a double release mechanism and is typically equipped with a full suite of instruments, including inside and outside flow meters, CTD, and pitch sensor.

2. NWFSC also uses various neuston nets, which are frame trawls towed horizontally at the top of the water column in order to capture neuston (*i.e.,* organisms that inhabit the water's surface).

3. An epibenthic tow sled is an instrument designed to collect organisms that live on bottom sediments. It consists of a fine mesh net, typically 1 m x 1 m opening with 1-mm mesh, attached to a rigid frame with runners to help it move along the substrate.

The remainder of nets described here are plankton nets, which usually consist of fine mesh attached to a weighted frame which spreads the mouth of the net to cover a known surface area in order to sample plankton and fish eggs from various parts of the water column. Plankton nets used by NWFSC generally employ 20 to 500-µm mesh.

4. Ring nets are used to capture plankton with vertical tows. These nets consist 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.

5. Bongo nets are towed through the water at an oblique angle to sample plankton over a range of depths. Similar to ring nets, these nets typically have a cylindrical section coupled to a conical portion that tapers to a detachable codend constructed of nylon mesh. During each plankton tow, the bongo nets are deployed to depth and are 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. Some bongo nets can be opened and closed using remote control to enable the collection of samples from particular depth ranges. A group of depth-specific bongo net samples can be used to establish the vertical distribution of zooplankton species in the water column at a site. Bongo nets are generally used to collect zooplankton for research purposes and are not used for commercial harvest.

Seine nets—Seine nets typically hang vertically in the water with the bottom edge held down by weights and the top edge buoyed by floats. Seine nets can be deployed from the shore as a beach seine or from a boat and are actively fished, in comparison with gillnets which may be similar but fish passively. NWFSC uses both purse seines and beach seines. Beach seines are deployed from shore to surround all fish in the nearshore area, and typically have one end fastened to the shore while the other end is set out in a wide arc and brought back to the beach. This may be done by hand or with a small boat. The beach seines used in NWFSC research are 1.8–2.4 m in depth and 36–45 m in length, with mesh sizes of less than 25 mm. A pole seine is a type of beach seine deployed by hand. 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. The NWFSC pole seine is 12 x 2 m, with mesh smaller than 25 mm.

Purse seines are typically much larger and are deployed from vessels. Commercial fishers use purse seines to capture schooling pelagic species by encircling the fish and then using a line at the bottom that enables the net to be closed like a purse. Commercial purse seines may be more than 2,000 m in length and 200 m in depth, varying in size according to vessel, mesh size, and target species. The purse seines employed by NWFSC are between 150–450 m in length, between 9–27 m in depth and have mesh sizes ranging from 11–33 mm depending on the location in the net.

Tangle net—Tangle nets are similar to gillnets (*i.e.,* vertical panels of netting buoyed with floats at top and weighted at bottom) but are typically considered to be more selective and less lethal than gillnets, using smaller mesh sizes to allow fish to be caught by nose or jaw and thus able to be resuscitated. NWFSC uses a 180 x 12 m tangle net with 108-mm mesh.

Traps and pots—Traps and pots are submerged, three-dimensional devices, often baited, that permit organisms to enter the enclosure but make escape extremely difficult or impossible. Most traps are attached by a rope to a buoy on the surface of the water and may be deployed in series. The trap entrance can be regulated to control the maximum size of animal that can enter, and the size of the mesh in the body of the trap can regulate the minimum size that is retained. In general, the species caught depends on the type and characteristics of the pot or trap used. NWFSC uses fyke traps and sablefish (*Anoplopoma fimbria*) pots.

Fyke traps are bag-shaped nets held open by frames or hoops, often outfitted with wings and/or leaders to guide fish towards the entrance of the actual trap. Fyke trap wings can be set up to form a barrier across a channel, trapping fish that attempt to proceed through the channel. As the tide ebbs, fish eventually seek to leave the wetland channel and are then trapped. NWFSC sets fyke traps with 6.4-mm mesh in estuarine channels that are approximately 1–5 m wide. NWFSC uses conical sablefish pots to catch fish. These pots consist of a conical-frustum-shaped frame covered in nylon netting with one or more funnel-shaped entrance tunnels and are 1.2 m in diameter.

Conductivity, temperature, and depth profilers (CTD)—A CTD profiler is the primary research tool for determining chemical and physical properties of seawater (see Figure A–22 of NWFSC's EA for a photograph). A shipboard CTD is made up of a set of small probes attached to a large (1–2 m diameter) metal rosette wheel. The rosette is lowered through the water column on a cable, and CTD data are observed in real time via a conducting cable connecting the CTD to a computer on the ship. The rosette also holds a series of sampling bottles that can be triggered to close at different depths in order to collect a suite of water samples that can be used to determine additional properties of the water over the depth of the CTD cast. A standard CTD cast, depending on water depth, requires two to five hours to complete. The data from a suite of samples collected at different depths are often called a depth profile. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column. Salinity, temperature, and depth data measured by the CTD instrument are essential for characterization of seawater properties.

Other instruments—NWFSC uses a continuous water pump with a thermosalinograph to measure sea surface conductivity and temperature. The pump continuously pumps seawater from a depth of 3 m near the bow of the research vessel to the thermosalinograph which sends the temperature and conductivity data to a shipboard computer. To collect physical environmental data in riverine and estuarine habitats, NWFSC uses water level and temperature loggers. These devices are placed underwater at fixed locations where they continuously record data.

Video cameras—The NWFSC uses several apparatuses to collect underwater videos of benthic habitats and organisms. These include a CamPod, a video camera sled, video beam trawls and a remotely operated vehicle (ROV). Each apparatus includes a video camera system consisting of a digital video camera, lights, and a power source. The CamPod is a lightweight, three-legged platform equipped with a video system and adequate illumination. The frame holds a 35-mm stills camera system and two video cameras—one that provides a forward-looking oblique view and a high-resolution video camera that faces downward. Designed primarily for making images of the benthic environment, the configuration of the device focuses on minimizing its hydrodynamic presence in the field of view of the cameras. The CamPod is deployed vertically through the water column on a cable and is intended to view one point on the bottom.

A video camera sled consists of a video camera system mounted on a metal frame with runners to allow it to move along the benthic substrate. A research vessel tows the sled along the seafloor, allowing the camera to capture video footage of the benthic environment. NWFSC uses a video ROV to capture underwater footage of the benthic environment. The ROV is controlled and powered from a surface vessel. Electrical power is supplied through an umbilical or tether which also has fiber optics which carry video and data signals between the operator and the ROV. This enables researchers on the vessel to control the ROV's position in the water with joysticks while they view the video feed on a monitor.

Section 1.6 of the NWFSC's application provides a detailed account of all surveys planned by NWFSC in the CCRA, PSRA, and LCRRA. We note here that active acoustic systems are used for data acquisition purposes only within the CCRA. Many of these surveys also use small trawls, plankton nets, and/or other gear; however, only gear with likely potential for marine mammal interaction is described. Table 1.1 of NWFSC's application provides summary information related to these surveys. Please see those sections for full details of survey activity planned by NWFSC. Here we provide relevant information related to a subset of survey programs with potential for marine mammal interactions.

1. *Bycatch Reduction Research*—Bycatch reduction research programs are conducted in the CCRA, from southern Oregon to Canada. This intermittent research is conducted aboard chartered commercial fishing vessels, involving thirty to ninety days at sea (DAS) from April to October, in order to test gear improvements in commercial trawls. Specific trawl gear tested varies based on survey objectives and vessel chartered. Projected annual effort is approximately forty bottom trawls per year (50–1,000 m depth; up to four hour tows), up to sixty midwater trawls per year (50–1,000 m depth; average two hour tow), and up to an additional sixty bottom trawls per year with a double-rigged shrimp trawl (100–300 m depth; thirty to eighty minute tows).

2. *Flatfish Broodstock Collection*—In order to collect fish for aquaculture development, intermittent surveys are conducted aboard charter fishing vessels or small NOAA vessels. These surveys use commercial bottom trawls and hook and line and are conducted in Puget Sound and along the Washington coast for approximately twenty DAS. The hook and line portion involves approximately eighteen trips per year with up to twelve lines in the water at once, using barbed circle hooks. Total hook-hours are dependent on target species and catch per unit effort (CPUE). Trawls (6–24 per year) are deployed for approximately ten minutes each at depths greater than 10 m.

3. *Groundfish Bottom Trawl Survey*—This survey is conducted annually from May to October for at least 190 DAS, extending throughout the U.S. west coast, and is designed to monitor groundfish distribution and biomass. Commercial fishing vessels are used to deploy Aberdeen bottom trawls (5 x 15 m mouth opening) for approximately 750 tows per year (55–1,280 m depth; fifteen minute tows).

4. *Hake Acoustic Survey/Camera Trawl Research*—These surveys are conducted annually from March to September (up to 80 DAS) from southern California to southeast Alaska, following hake (*Merluccius productus*) distribution in order to measure abundance using active acoustic systems and trawl gear. NOAA vessels as well as commercial fishing vessels may be used, deploying Aleutian Wing midwater trawls (100 m headrope) for 225 trawls per year (30–1,500 m depth; variable tow duration) and Poly Nor'Easter bottom trawls (36 m footrope x 27 m headrope) for five to ten trawls per year (variable depth and duration). Results of the survey inform assessments of several rockfish (*Sebastes* spp.) populations and may be used in assessments of central California salmon productivity. It is either conducted on a NOAA ship or a charter vessel and requires about 45 survey days. The protocols for this survey include underway multi-frequency active acoustic devices, modified-Cobb midwater trawls, various plankton tows, and CTD profiles at fixed stations. The modified-Cobb trawl is deployed for fifteen-minute tows at 2 kn during dark hours at 15–30 m depth.

5. *Juvenile Salmon Pacific Northwest Coastal Survey*—This survey complements similar surveys conducted by NMFS' Southwest Fisheries Science Center (SWFSC), is conducted annually in May, June, and September (36 DAS) from Newport, OR, to Cape Flattery, WA, aboard commercial fishing vessels, and is designed to assess ocean conditions and growth, relative abundance, and survival of juvenile salmon (*Oncorhynchus* spp.). The survey deploys the Nordic 264 surface trawl (30 m wide x 20 m deep) for 180 trawls per year (surface to 30 m depth; thirty minute tow).

6. *Marine Fish Broodstock Collection, Sampling, and Tagging*—This variable research program occurs annually for approximately ten DAS aboard charter fishing vessels along the Washington coast. In order to collect fish, commercial bottom trawls (ten trawls per year; 50–1,000 m depth, up to four hour tow duration), pelagic longline, and hook and line gear are used. Approximately thirty longline sets per year, using five hundred barbed circle hooks per set, are set at approximately 215–915 m depth (mainline length 1,370–1,830 m; soak time approximately three hours). Hook and line effort involves eight lines with barbed circle hooks deployed for six-hour fishing days for a total of ninety hours or 720 hook-hours per year.

7. *Northern Juvenile Rockfish Survey*—This survey complements similar surveys conducted by SWFSC, is conducted annually from May to June from Cape Mendocino, CA, to Cape Flattery, WA, for fifteen to thirty DAS, and targets the pelagic phase of juvenile rockfish using a modified Cobb midwater trawl net (26 m headrope; 12 x 12 m opening). It is typically conducted on a charter vessel, with approximately one hundred trawls per year (fifteen-minute tows at night; 15–30 m depth).

8. *Video Beam Trawl Collaborative Research*—This survey is conducted monthly along the continental shelf from Oregon to Washington aboard partner research vessels or chartered commercial vessels. The survey uses a 2-m beam trawl system with open codend outfitted with a digital video camera to assess the seasonal and interannual distribution of young-of-the-year groundfishes and the potential impacts of hypoxia and requires twenty DAS annually with twenty to forty trawl deployments of ten minutes each.

9. *Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat*—This survey to monitor groundfish distribution and abundance along the U.S. west coast is conducted annually from May to October aboard charter sportfishing vessels (250 DAS). Hook and line gear is deployed by rod and reel, with approximately 1,000 sites visited annually. At each site, each of three anglers deploys a line with five hooks for a five-minute soak and repeats this five times. Therefore, 75 total hooks are deployed per site for five minutes each, yielding an annual total of 6,250 hook-hours.

10. *Near Coastal Ocean Purse Seining*—This study of salmon habitat use is conducted monthly from May to September nearshore near the mouth of the Columbia River aboard chartered commercial vessels (12 DAS). Purse seines (228 x 18 m or 305 x 12 m) are deployed for 75 sets per year, with generally less than one hour set duration.

11. *Beam Trawl Survey to Evaluate Effects of Hypoxia*—Conducted only in Puget Sound, with twenty DAS in summer and fall, this survey is designed to examine effects of hypoxia on demersal fish in Hood Canal. A 2-m beam trawl, primarily with open codend and outfitted with a video camera, is deployed for one tow per each of ten sites per season for a total of twenty tows (each tow at varying depths [30, 60, 90 m]; ten minute duration).

12. *Marine Fish Collections Including Flatfish*—This survey, conducted only in Puget Sound aboard charter vessels with variable monthly effort (fifteen DAS), utilizes commercial bottom trawls. Annual effort is forty trawls at 50–1,000 m depth and tow duration is up to four hours.

13. *Movement Studies of Puget Sound Species*—These surveys occur in Puget Sound aboard a variety of small boats, with year-round sampling totaling 25 DAS. Survey effort involves commercial bottom trawls (twelve tows per year at greater than 10 m depth and for ten minutes), hook and line (twenty trips per year with up to twelve barbless hooks in the water at once), and bottom longline (180-m mainline deployed to approximately 60 m depth). The latter involves three sets per year with thirty 16/0 circle hooks per set.

14. *Puget Sound Marine Pelagic Food Web*—These surveys occur in Puget Sound only about every five years from April to October aboard charter vessels and totaling thirty DAS when it occurs. The survey deploys a Kodiak surface trawl (3.1 x 6.1 m) for five hundred tows of ten minute duration and depths greater than 10 m.

15. *Skagit Bay Juvenile Salmon Survey*—This survey occurs in Puget Sound aboard chartered vessels annually from April to September for thirty DAS and uses the same Kodiak surface trawl with the same protocols as the Puget Sound marine pelagic food web survey (180 tows per year).

16. *Elwha Dam Removal*—This Puget Sound study of the effects of dam removal on nearshore fish species includes use of a beach seine (43 x 1.8 m). The survey is conducted monthly using a small vessel, totaling 20 DAS and up to 140 samples per year (less than ten minutes per sample). Separate studies (''Snohomish Juvenile Salmon Studies'' [up to 200 sets annually during 50 DAS; conducted monthly and twice-monthly from February to September] and ''Puget Sound Salmon Contaminant Study'' [up to 100 sets annually during 30 DAS from May to July]) use similar beach seines in similar ways. Additional surveys in the Columbia River (''Estuary Tidal Habitats'' [up to 100 sets annually during 25 DAS, quarterly to monthly] and ''LCR Ecosystem Monitoring'' [up to 200 sets annually during 16 DAS, monthly from February to December]) also use beach seines similarly.

17. *Rockfish Genetics*—Hook and line fishing gear is used to capture bottomfish for biological sampling. Conducted in Puget Sound aboard charter boats from April to November (35–41 DAS), this survey uses baited hooks or bottom jigs for approximately 750 hook-hours per year.

18. *Marine Fish Research Including Broodstock Collection, Sampling, and Tagging*—This research involves pelagic longline and hook and line survey effort conducted in Puget Sound aboard charter vessels for approximately 15 DAS with effort varying monthly. The gear specifications and effort are similar to those described previously (for pelagic longline and hook and line only) for marine fish broodstock collection in the California Current.

19. *Eulachon Arrival Timing*—This survey uses a modified Cobb midwater trawl net 26-m headrope; 12 x 12 m opening) in the Columbia River estuary and plume to determine the arrival timing and distribution of spawning eulachon. The survey is conducted from January to March (15 DAS) aboard NOAA vessels, with sixty trawls per year (fifteen-minute tow duration at 30–40 m depth).

20. *Pair Trawl Juvenile Salmon Survey*—This trawl survey is conducted in the Columbia River between approximately RM 40–50 from March to August (80 DAS) aboard small vessels. A surface pair trawl (wings 92 x 92 m; trawl body 9 m wide x 6 m deep x 18 m long) modified with an open codend (2.4 x 3 m opening) is towed near the surface for eight to fifteen hours per trawl, totaling 800–1,200 tow-hours per year. The trawl is outfitted with a flow-through Passive Integrated Transponder (PIT) tag detector to assess passage of tagged juvenile salmon.

21. *Benefits of Wetland Restoration to Juvenile Salmon*—This study, occurring throughout the LCRRA, uses purse seines (150 x 9 m), beach seines (46 x 1.8 m), and surface trawls (3 x 6 m opening) to study salmon habitat use. The surveys are typically conducted aboard small research vessels and/or skiffs, with purse seine effort occurring for 32 DAS bi-weekly from March to October (ninety sets per year; typically less than one hour set duration) and beach seines and surface trawls (fifteen minute tows) occurring quarterly from March to December. The latter portion is conducted for 16 DAS, at two sites per day with two to three hauls of each type per site.

22. *Migratory Behavior of Adult Salmon*—This LCRRA survey uses tangle nets to catch and tag fish. Tangle nets (180 x 12 m) are deployed from commercial fishing vessels for 32 DAS from spring to fall, with up to 75 sets per year deployed for 25–45 minutes each.

Description of Active Acoustic Sound Sources—This section contains a brief technical background on sound, the characteristics of certain sound types, and on metrics used in this proposal inasmuch as the information is relevant to NWFSC's specified activity and to a discussion of the potential effects of the specified activity on marine mammals found later in this document. We also describe the active acoustic devices used by NWFSC.

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the ''loudness'' of a sound and is typically described using the relative unit of the decibel (dB). A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal [µPa]), and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) represents the SPL referenced at a distance of 1 m from the source (referenced to 1 µPa), while the received level is the SPL at the listener's position (referenced to 1 µPa).

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Rms is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Rms accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Sound exposure level (SEL; represented as dB re 1 μPa^2-s) represents the total energy contained within a pulse, and considers both intensity and duration of exposure. For a single pulse, the numerical value of the SEL measurement is usually 5–15 dB lower than the rms sound pressure in dB re 1 µPa, with the comparative difference between measurements of rms and SEL measurements often tending to decrease with increasing range (Greene, 1997; McCauley *et al.,* 1998). Peak sound pressure is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure. Another common metric is peak-to-peak sound pressure (p-p), which is the algebraic difference between the peak positive and peak negative sound pressures. Peak-to-peak pressure is typically approximately 6 dB higher than peak pressure (Southall *et al.,* 2007).

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams (as for the sources considered here) or may radiate in all directions (omnidirectional sources). The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound. Ambient sound is defined as environmental background sound levels lacking a single source or point (Richardson *et al.,* 1995), and the sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.,* wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.,* sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.,* vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including the following (Richardson *et al.,* 1995):

- Wind and waves: The complex interactions between wind and water surface, including processes such as breaking waves and wave-induced bubble oscillations and cavitation, are a main source of naturally occurring ambient sound for frequencies between 200 Hz and 50 kHz (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Surf sound becomes important near shore, with measurements collected at a distance of 8.5 km from shore showing an increase of 10 dB in the 100 to 700 Hz band during heavy surf conditions.
- Precipitation: Sound from rain and hail impacting the water surface can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times.
- Biological: Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz.
- Anthropogenic: Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, seismic surveys, sonar, explosions, and ocean acoustic studies. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly. Sound from identifiable anthropogenic sources other than the activity of interest (*e.g.,* a passing vessel) is sometimes termed background sound, as opposed to ambient sound.

The sum of the various natural and anthropogenic sound sources at any given location and time—which comprise ''ambient'' or ''background'' sound—depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10–20 dB from day to day (Richardson *et al.,* 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect marine mammals. Details of source types are described in the following text.

Sounds are often considered to fall into one of two general types: Pulsed and non-pulsed (defined in the following). The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.,* Ward, 1997 in Southall *et al.,* 2007). Please see Southall *et al.* (2007) for an in-depth discussion of these concepts.

Pulsed sound sources (*e.g.,* explosions, gunshots, sonic booms, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or non-continuous (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.,* rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, machinery operations such as drilling or dredging, vibratory pile driving, and active sonar systems (such as those used by the U.S. Navy). The duration of such sounds, as received at a distance, can be greatly extended in a highly reverberant environment.

We use generic sound exposure thresholds (see Table 1) to determine when an activity that produces sound might result in impacts to a marine mammal such that a take by harassment might occur. These thresholds should be considered guidelines for estimating when harassment may occur (*i.e.,* when an animal is exposed to levels equal to or exceeding the relevant criterion) in specific contexts; however, useful contextual information that may inform our assessment of effects is typically lacking and we consider these thresholds as step functions. NMFS is currently revising these acoustic guidelines; for more information on that process, please visit *www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.* NMFS has determined that the 160-dB threshold for impulsive sources is most appropriate for use in considering the potential effects of the NWFSC's activities.

TABLE 1—CURRENT ACOUSTIC EXPOSURE CRITERIA

Criterion	Definition	Threshold
Level A harassment (underwater) ...	Injury (PTS—any level above that which is known to cause TTS).	180 dB (cetaceans)/190 dB (pinnipeds) (rms).
Level B harassment (underwater) ...	Behavioral disruption	160 dB (impulsive source)/120 dB (continuous source) (rms).

A wide range of active acoustic devices are used in NWFSC fisheries surveys for remotely sensing bathymetric, oceanographic, and biological features of the environment. Most of these sources involve relatively high frequency, directional, and brief repeated signals tuned to provide sufficient focus and resolution on specific objects. NWFSC also uses passive listening sensors (*i.e.,* remotely and passively detecting sound rather than producing it), which do not have the potential to impact marine mammals. NWFSC active acoustic sources 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).

Mid- and high-frequency underwater acoustic sources typically used for scientific purposes operate by creating an oscillatory overpressure through rapid vibration of a surface, using either electromagnetic forces or the piezoelectric effect of some materials. A vibratory source based on the piezoelectric effect is commonly referred to as a transducer. Transducers are usually designed to excite an acoustic wave of a specific frequency, often in a highly directive beam, with the directional capability increasing with operating frequency. The main parameter characterizing directivity is the beam width, defined as the angle subtended by diametrically opposite "half power" (−3 dB) points of the main lobe. For different transducers at a single operating frequency the beam width can vary from 180° (almost omnidirectional) to only a few degrees. Transducers are usually produced with either circular or rectangular active surfaces. For circular transducers, the beam width in the horizontal plane (assuming a downward pointing main beam) is equal in all directions, whereas rectangular transducers produce more complex beam patterns with variable beam width in the horizontal plane. Please see Zykov and Carr (2014) for further discussion of electromechanical sound sources.

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.

Category 1 active fisheries acoustic sources include those with high output frequencies (≤180 kHz) that are outside the known functional hearing capability of any marine mammal. Sounds that are above the functional hearing range of marine animals may be audible if sufficiently loud (*e.g.,* Møhl, 1968). However, the relative output levels of these sources mean that they would potentially be detectable to marine mammals at maximum distances of only a few meters, and are highly unlikely to be of sufficient intensity to result in behavioral harassment. These sources also generally have short duration signals and highly directional beam patterns, meaning that any individual marine mammal would be unlikely to even receive a signal that would almost certainly be inaudible.

We are aware of two recent studies (Deng *et al.,* 2014; Hastie *et al.,* 2014) demonstrating some behavioral reaction by marine mammals to acoustic signals at frequencies above 180 kHz. These studies generally indicate only that sub-harmonics could be detectable by certain species at distances up to several hundred meters. However, this detectability is in reference to ambient noise, not to NMFS' established 160 dB threshold for assessing the potential for incidental take for these sources. Source levels of the secondary peaks considered in these studies—those within the hearing range of some marine mammals—range from 135–166 dB, meaning that these sub-harmonics would either be below the threshold for behavioral harassment or would attenuate to such a level within a few meters. Beyond these important study details, these high-frequency (*i.e.,* Category 1) sources and any energy they may produce below the primary frequency that could be audible to marine mammals would be dominated by a few primary sources that are operated near-continuously, and the potential range above threshold would be so small as to essentially discount them. Therefore, Category 1 sources are not expected to have any effect on marine mammals and are not considered further in this document.

Category 2 acoustic sources, which are present on most NWFSC 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 lower output frequencies than Category 1 sources. Category 2 active acoustic sources have moderate to high output frequencies (10 to 180 kHz) that are generally within the functional hearing range of marine mammals and therefore have the potential to cause behavioral harassment. However, while likely potentially audible to certain species, these sources have generally short ping durations and are typically focused (highly directional) to serve their intended purpose of mapping specific objects, depths, or environmental features. These characteristics reduce the likelihood of an animal receiving or perceiving the signal. A number of these sources, particularly those with relatively lower output 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 mammals.

We now describe specific acoustic sources used by NWFSC. The acoustic system used during a particular survey is optimized for surveying under specific environmental conditions (*e.g.,* depth and bottom type). Lower frequencies of sound travel further in the water (*i.e.,* good range) but provide lower resolution (*i.e.,* are less precise). Pulse width and power may also be adjusted in the field to accommodate a variety of environmental conditions. Signals with a relatively long pulse width travel further and are received more clearly by the transducer (*i.e.,* good signal-to-noise ratio) but have a lower range resolution. Shorter pulses provide higher range resolution and can detect smaller and more closely spaced objects in the water. Similarly, higher power settings may decrease the utility of collected data. Power level is also adjusted according to bottom type, as some bottom types have a stronger return and require less power to produce data of sufficient quality. Power is typically set to the lowest level possible in order to receive a clear return with the best data. Survey vessels may be equipped with multiple acoustic systems; each system has different advantages that may be utilized depending on the specific survey area or purpose. In addition, many systems may be operated at one of two frequencies or at a range of frequencies. Characteristics of these sources are summarized in Table 2.

(1) *Multi-Frequency Narrow Beam Scientific Echosounders*—Echosounders and sonars work by transmitting acoustic pulses into the water that travel through the water column, reflect off the seafloor, and return to the receiver. Water depth is measured by multiplying the time elapsed by the speed of sound in water (assuming accurate sound speed measurement for the entire signal path), while the returning signal itself carries information allowing ‘‘visualization’’ of the seafloor. Multi-frequency split-beam sensors are deployed from NWFSC 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 NWFSC operates the Simrad EK60 system, which typically transmits and receives at four frequencies ranging from 38–200 kHz.

(2) *Multibeam Echosounder and Sonar*—Multibeam echosounders and sonars operate similarly to the devices described above. However, 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 NWFSC operates the Simrad ME70 system, which is mounted to the hull of the research vessel and emits frequencies in the 70–120 kHz range.

(3) *Single-Frequency Omnidirectional Sonar*—These sources provide omnidirectional imaging around the source with different vertical beamwidths available, which results in differential transmitting beam patterns. The cylindrical multi-element transducer allows the omnidirectional sonar beam to be electronically tilted down to −90°, allowing automatic tracking of schools of fish within the entire water volume around the vessel. NWFSC operates the Simrad SX90 system.

(4) *Acoustic Doppler Current Profiler (ADCP)*—An ADCP is a type of sonar used for measuring water current velocities simultaneously at a range of depths. Whereas current depth profile measurements in the past required the use of long strings of current meters, the ADCP enables measurements of current velocities across an entire water column. The ADCP measures water currents with sound, using the Doppler effect. A sound wave has a higher frequency when it moves towards the sensor (blue shift) than when it moves away (red shift). The ADCP works by transmitting ‘‘pings’’ of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument. Due to the Doppler effect, sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return. Particles moving toward the instrument send back higher frequency waves. The difference in frequency between the waves the profiler sends out and the waves it receives is called the Doppler shift. The instrument uses this shift to calculate how fast the particle and the water around it are moving. Sound waves that hit particles far from the profiler take longer to come back than waves that strike close by. By measuring the time it takes for the waves to return to the sensor, and the Doppler shift, the profiler can measure current speed at many different depths with each series of pings.

An ADCP anchored to the seafloor can measure current speed not just at the bottom, but at equal intervals to the surface. An ADCP instrument may be anchored to the seafloor or can be mounted to a mooring or to the bottom of a boat. ADCPs that are moored need an anchor to keep them on the bottom, batteries, and a data logger. Vessel-mounted instruments need a vessel with power, a shipboard computer to receive the data, and a GPS navigation system so the ship’s movements can be subtracted from the current velocity data. ADCPs operate at frequencies between 75 and 300 kHz.

(5) *Net Monitoring Systems*—During trawling operations, a range of sensors may be used to assist with controlling and monitoring gear. Net sounders give information about the concentration of fish around the opening to the trawl, as well as the clearances around the opening and the bottom of the trawl; catch sensors give information about the rate at which the codend is filling; symmetry sensors give information about the optimal geometry of the trawls; and tension sensors give information about how much tension is in the warps and sweeps. NWFSC uses the Simrad ITI Catch Monitoring System, which allows monitoring of the exact position of the gear and of what is happening in and around the trawl, and the Simrad FS70 Third Wire Net Sonde, which allows monitoring of the trawl opening.

TABLE 2—OPERATING CHARACTERISTICS OF NWFSC ACTIVE ACOUSTIC SOURCES

Active acoustic system	Operating frequencies (kHz)	Maximum source level	Single ping duration (ms) and repetition rate (Hz)	Orientation/directionality	Nominal beamwidth
Simrad EK60 narrow beam echosounder	38, 70, 120, 200	224 dB	1 ms at 1 Hz	Downward looking	11°.
Simrad ME70 multibeam echosounder	70–120	205 dB	2 ms at 1 Hz	Downward looking	140°.
Simrad SX90 omnidirectional multibeam sonar	70–120	206 dB	2 ms at 1 Hz	Downward omnidirectional.	0°–90° tilt angle from vertical (average).
Teledyne RD Instruments ADCP, Ocean Surveyor	75	224 dB	External trigger	Downward looking (30° tilt).	40° × 100°.
Simrad ITI Trawl Monitoring System	27–33	<200 dB	0.05–0.5 Hz	Downward looking	40° × 100°.
Simrad FS70 trawl sonar	330	216	1 ms at 120 kHz	Third wire trawl sonar for monitoring net opening and fishing conditions.	40°.

Proposed Mitigation

In order to issue an incidental take authorization under section 101(a)(5)(A) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, ''and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for subsistence uses.'' Note that taxonomic information for certain species mentioned in this section is provided in the following section (''Description of Marine Mammals in the Area of the Specified Activity'').

The NWFSC has invested significant time and effort in identifying technologies, practices, and equipment to minimize the impact of the proposed activities on marine mammal species and stocks and their habitat. These efforts have resulted in the consideration of many potential mitigation measures, including those the NWFSC has determined to be feasible and has implemented in recent years as a standard part of sampling protocols. These measures include the move-on rule mitigation protocol (also referred to in the preamble as the move-on rule), protected species visual watches and use of acoustic pingers on trawl gear, as well as use of a marine mammal excluder device (MMED) in Nordic 264 midwater trawls.

Development of Mitigation Measures

In survey year 2008 in the CCE, NMFS' SWFSC had dramatically more incidental takes of marine mammals in research gear, in terms of both interactions and animals captured, than in any other year. The SWFSC had previously conducted over a thousand midwater trawl survey tows over more than 25 years, with very few incidents of marine mammal interactions (Hewitt, 2009), but the number of incidental takes in 2008 exceeded the aggregate total over all preceding years. Following the first SWFSC survey cruise in April 2008, during which a number of marine mammals were captured in trawl gear, the SWFSC convened a workshop involving SWFSC staff with expertise in survey design and operations and marine mammal bycatch mitigation (Hewitt, 2009). Participants worked to determine appropriate mitigation measures and to consider changes to sampling protocols in an effort to reduce marine mammal interactions.

The SWFSC also allocated resources towards the design, construction, and testing of a MMED that could be incorporated into the Nordic 264 trawl net, use of which had resulted in a large portion of takes. In 2009, the MMED was tested and use of the device added to SWFSC standard survey protocol for the Nordic 264 net (Dotson *et al.,* 2010).

These efforts resulted in the consideration of many potential mitigation measures for all NMFS Science Centers, including those the NWFSC has determined to be feasible and relevant to their operations. These measures include the move-on rule, protected species visual watches and use of acoustic pingers on certain trawl gear, as well as use of the MMED in Nordic 264 trawls.

General Measures

Coordination and communication—When NWFSC survey effort is conducted aboard NOAA-owned vessels, there are both vessel officers and crew and a scientific party. Vessel officers and crew are not composed of NWFSC staff, but are employees of NOAA's Office of Marine and Aviation Operations (OMAO), which is responsible for the management and operation of NOAA fleet ships and aircraft and is composed of uniformed officers of the NOAA Commissioned Corps as well as civilians. The ship's officers and crew provide mission support and assistance to embarked scientists, and the vessel's Commanding Officer (CO) has ultimate responsibility for vessel and passenger safety and, therefore, decision authority. When NWFSC survey effort is conducted aboard cooperative platforms (*i.e.,* non-NOAA vessels), ultimate responsibility and decision authority again rests with non-NWFSC personnel (*i.e.,* vessel's master or captain). Decision authority includes the implementation of mitigation measures (*e.g.,* whether to stop deployment of trawl gear upon observation of marine mammals). The scientific party involved in any NWFSC survey effort is composed, in part or whole, of NWFSC staff and is led by a Chief Scientist (CS). Therefore, because the NWFSC—not OMAO or any other entity that may have authority over survey platforms used by NWFSC—is the applicant to whom any incidental take authorization issued under the authority of these proposed regulations would be issued, we require that the NWFSC take all necessary measures to coordinate and communicate in advance of each specific survey with OMAO, or other relevant parties, to ensure that all mitigation measures and monitoring requirements described herein, as well as the specific manner of implementation and relevant event-contingent decision-making processes, are clearly understood and agreed-upon. This may involve description of all required measures when submitting cruise instructions to OMAO or when completing contracts with external entities. NWFSC will coordinate and conduct briefings at the outset of each survey and as necessary between ship's crew (CO/master or designee(s), as appropriate) and scientific party in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures. The CS will be responsible for coordination with the Officer on Deck (OOD; or equivalent on non-NOAA platforms) to ensure that requirements, procedures, and decision-making processes are understood and properly implemented.

Vessel speed—Vessel speed during active sampling rarely exceeds 5 kn, with typical speeds being 2–4 kn. Transit speeds vary from 6–14 kn but average 10 kn. These low vessel speeds minimize the potential for ship strike (see ''Potential Effects of the Specified Activity on Marine Mammals and Their Habitat'' for an in-depth discussion of ship strike). At any time during a survey or in transit, if a crew member standing watch or dedicated marine mammal observer sights marine mammals that may intersect with the vessel course that individual will immediately communicate the presence of marine mammals to the bridge for appropriate course alteration or speed reduction, as possible, to avoid incidental collisions.

Other gears—The NWFSC deploys a wide variety of gear to sample the marine environment during all of their research cruises. Many of these types of gear (*e.g.,* plankton nets, video camera and ROV deployments) are not considered to pose any risk to marine mammals and are therefore not subject to specific mitigation measures. However, at all times when the NWFSC is conducting survey operations at sea, the OOD and/or CS and crew will monitor for any unusual circumstances that may arise at a sampling site and use best professional judgment to avoid any potential risks to marine mammals during use of all research equipment.

Handling procedures—The NWFSC will implement a number of handling protocols to minimize potential harm to marine mammals that are incidentally taken during the course of fisheries research activities. In general, protocols have already been prepared for use on commercial fishing vessels. Because incidental take of marine mammals in fishing gear is similar for commercial fisheries and research surveys, NWFSC proposes to adopt these protocols, which are expected to increase post-release survival. In general, following a ''common sense'' approach to handling captured or entangled marine mammals will present the best chance of minimizing injury to the animal and of decreasing risks to scientists and vessel crew. Handling or disentangling marine mammals carries inherent safety risks, and using best professional judgment and ensuring human safety is paramount.

Captured live or injured 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 and data collection is conducted in such a manner as not to delay release of the animal(s) or endanger the crew. NWFSC staff will be instructed on how to identify different species; handle and bring marine mammals aboard a vessel; assess the level of consciousness; remove fishing gear; and return marine mammals to water.

Trawl Survey Visual Monitoring and Operational Protocols

Specific mitigation protocols are required for all trawl operations conducted by the NWFSC using Nordic 264 surface trawl gear, midwater trawl gear (modified Cobb, Aleutian Wing, and various commercial nets), and bottom trawl gear (double-rigged shrimp, Poly Nor'easter, modified Aberdeen, beam, and various commercial nets). Separate protocols (described below) are in place for the Kodiak surface trawl and pair trawl gear. Marine mammal watches will be conducted for at least ten minutes prior to the beginning of the planned set and throughout the tow and net retrieval, by scanning the surrounding waters with the naked eye and rangefinding binoculars (or monocular). Lookouts immediately alert the OOD and CS as to their best estimate of the species and number of animals observed and any observed animal's distance, bearing, and direction of travel relative to the ship's position. The CS must confirm with the OOD that no marine mammals have been seen within 500 m (or as far as may be observed if less than 500 m) of the ship or appear to be approaching the ship during the pre-set watch period prior to the deployment of any trawl gear. During nighttime operations, visual observation may be conducted using the naked eye and available vessel lighting but effectiveness is limited. The visual observation period typically occurs during transit leading up to arrival at the sampling station, rather than upon arrival on station. However, in some cases it may be necessary to conduct a plankton tow or other small net cast prior to deploying trawl gear. In these cases, the visual watch will continue until trawl gear is ready to be deployed. Aside from pre-trawl monitoring, the OOD/CS and crew standing watch will visually scan for marine mammals during all daytime operations.

It is important to note that the 500 m distance is provided only as a frame of reference for marine mammal observations that would nominally be of greater concern as regards the potential for interaction with research fishing gear. The primary concern is to avoid all marine mammal interactions (regardless of the numbers of takes proposed for authorization here), and the most appropriate course of action to achieve this goal in any given instance is likely to be related more to event-specific elements than to an arbitrary distance from the vessel. Depending on unpredictable contextual elements, animals sighted at distances greater than 500 m could provoke mitigation action or, conversely, animals sighted at closer range could be determined to not be at risk of interacting with research fishing gear. The NWFSC considers 500 m to be the average effective observation distance, but the actual effective range is determined by numerous factors related to the weather, ship observations, and the species observed.

The primary purpose of conducting pre-trawl visual monitoring is to implement the move-on rule. If marine mammals are sighted within 500 m (or as far as may be observed if less than 500 m) of the vessel and are considered at risk of interacting with the vessel or research gear, or appear to be approaching the vessel and are considered at risk of interaction, NWFSC may elect to either remain onsite to see if the animals move off or may move on to another sampling location. When remaining onsite, the set is delayed (typically for at least ten minutes) and, if the animals depart or appear to no longer be at risk of interacting with the vessel or gear, a further ten minute observation period is conducted. If no further observations are made or the animals still do not appear to be at risk of interaction, then the set may be made. If the vessel is moved to a different section of the sampling area, move-on rule mitigation protocols would begin anew. If, after moving on, marine mammals remain at risk of interaction, the CS or watch leader may decide to move again or to skip the station. Marine mammals that are sighted further than 500 m from the vessel would be monitored to determine their position and movement in relation to the vessel. If they appear to be closing on the vessel, the move-on rule protocols may be implemented even if they are initially further than 500 m from the vessel.

For surface trawl surveys (*i.e.,* those surveys deploying the Nordic 264 net), which have historically presented the greatest risk of marine mammal interaction, dedicated crew are assigned to marine mammal monitoring duty (*i.e.,* have no other tasks) and care is taken to provide some rest periods for observers to avoid fatigue. At least two pairs of binoculars are available for verification of potential sightings. As the vessel approaches the station, the OOD and at least one assigned member of the scientific party monitor for marine mammals. Within several minutes of arriving on station and finishing their sampling duties, two additional members of the scientific party are assigned to monitor for marine mammals and, for the remainder of the tow, there would be a minimum of three members of the scientific party watching for marine mammals. Depending on the situational context (*e.g.,* numbers of marine mammals seen during the station approach or expected at that particular place and season), additional crew may be assigned to stand watch as necessary to provide full monitoring coverage around the vessel. Up to eight observers in total (including ship's crew standing watch) may be on duty during active trawling. The focus on the full area around the ship continues until trawl retrieval begins, at which point observational focus turns to the stern and the trawl net itself.

For midwater and bottom trawl surveys, the pre-set watch period is conducted by the OOD and bridge crew and typically occurs during transit prior to arrival at the sampling station, but may also include time on station if other types of gear or equipment (*e.g.,* bongo nets) are deployed before the trawl. For these trawls, risk of interaction during the tow is lower and monitoring effort is reduced to the bridge crew until trawl retrieval.

For all surveys, although the minimum pre-set watch period is ten minutes, the actual monitoring period is typically longer. During standard trawl operations, at least some of the trackline to be towed is typically traversed prior to setting gear in order to check for hazards. On surface trawl surveys, CTD casts and plankton/bongo net hauls are made prior to setting the trawl. These activities can take 25–35 minutes after the vessel arrives on station, depending on water depth, and monitoring for marine mammals continues throughout these activities. Midwater trawls and bottom trawls do not typically deploy other gears before deploying trawl gear but reconnaissance of the trackline often takes ten to fifteen minutes after arriving on station. In addition, once the decision is made to deploy the trawl gear, monitoring continues while the net is unspooled, which may take about ten minutes. Before the trawl doors are deployed, the net floats closed on the surface behind the vessel, and appropriate actions can be taken if marine mammals are sighted near the ship. Therefore, the marine mammal monitoring period—which begins before the vessel arrives on station and extends continuously through gear deployment—typically extends for over thirty minutes for all trawl types.

The effectiveness of visual monitoring may be limited depending on weather and lighting conditions. The OOD, CS or watch leader will determine the best strategy to avoid potential takes of marine mammals based on the species encountered and their numbers and behavior, position, and vector relative to the vessel, as well as any other factors. For example, a whale transiting through the sampling area in the distance may only require a short move from the designated station, whereas a pod of dolphins in close proximity to the vessel may require a longer move from the station or possibly cancellation of the planned tow if the group follows the vessel.

In general, trawl operations will be conducted immediately upon arrival on station (and on conclusion of the pre-watch period) in order to minimize the time during which marine mammals (particularly pinnipeds) may become attracted to the vessel. However, in some cases it will be necessary to conduct small net tows (*e.g.,* bongo net) prior to deploying trawl gear.

Once the trawl net is in the water, the OOD, CS, and/or crew standing watch will continue to visually monitor the surrounding waters and will maintain a lookout for marine mammal presence as far away as environmental conditions allow. If marine mammals are sighted before the gear is fully retrieved, the most appropriate response to avoid marine mammal interaction will be determined by the professional judgment of the CS, watch leader, OOD and other experienced crew as necessary. This judgment will be based on past experience operating trawl gears around marine mammals (*i.e.,* best professional judgment) and on NWFSC training sessions that will facilitate dissemination of expertise operating in these situations (*e.g.,* factors that contribute to marine mammal gear interactions and those that aid in successfully avoiding such events). Best professional judgment takes into consideration the species, numbers, and behavior of the animals, the status of the trawl net operation (*e.g.,* 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. We recognize that it is not possible to dictate in advance the exact course of action that the OOD or CS should take in any given event involving the presence of marine mammals in proximity to an ongoing trawl tow, given the sheer number of potential variables, combinations of variables that may determine the appropriate course of action, and the need to consider human safety in the operation of fishing gear at sea. Nevertheless, we require a full accounting of factors that shape both successful and unsuccessful decisions, and these details will be fed back into NWFSC training efforts and ultimately help to refine the best professional judgment that determines the course of action taken in any given scenario (see further discussion in ''Proposed Monitoring and Reporting'').

If trawling operations have been suspended because of the presence of marine mammals, the vessel will resume trawl operations (when practicable) only when the animals are believed to have departed the area. This decision is at the discretion of the OOD/CS and is dependent on the situation.

Standard survey protocols that are expected to lessen the likelihood of marine mammal interactions include standardized tow durations and distances. Standard tow durations of not more than thirty minutes at the target depth will typically be implemented, excluding deployment and retrieval time (which may require an additional thirty minutes, depending on target depth), to reduce the likelihood of attracting and incidentally taking marine mammals. Short tow durations decrease the opportunity for marine mammals to find the vessel and investigate. Trawl tow distances will be less than 3 nm—typically 1–2 nm, depending on the specific survey and trawl speed—which is expected to reduce the likelihood of attracting and incidentally taking marine mammals. In addition, care will be taken when emptying the trawl to avoid damage to marine mammals that may be caught in the gear but are not visible upon retrieval. The gear will be emptied as quickly as possible after retrieval in order to determine whether or not marine mammals are present. The vessel's crew will clean trawl nets prior to deployment to remove prey items that might attract marine mammals. Catch volumes are typically small with every attempt made to collect all organisms caught in the trawl.

Marine mammal excluder device—Excluder devices are specialized modifications, typically used in trawl nets, which are designed to reduce bycatch by allowing non-target taxa to escape the net. These devices generally consist of a grid of bars fitted into the net that allow target species to pass through the bars into the codend while larger, unwanted taxa (*e.g.,* turtles, sharks, mammals) strike the bars and are ejected through an opening in the net. Marine turtle bycatch in the commercial shrimp trawl industry led to the development of turtle excluder devices (TED) (*e.g.,* Mitchell *et al.,* 1995) in the 1970s. TEDs are perhaps the most commonly used excluder devices, but devices designed specifically for the exclusion of marine mammals have also been developed for various fisheries around the world where marine mammal interactions are problematic (*e.g.,* Gibson and Isakssen, 1998; Northridge, 2003).

Similar to TEDs, MMEDs generally consist of a large aluminum grate positioned in the intermediate portion of the net forward of the codend and below an escape opening constructed into the upper net panel above the grate. These devices enable target species to pass through a grid or mesh barrier and into the codend while preventing the passage of marine mammals, which are ejected out through an escape opening or swim back out of the mouth of the net. The angled aluminum grate is intended to guide marine mammals through the escape opening. For full details of design and testing of the MMED designed by the SWFSC for the Nordic 264 net, please see Dotson *et al.* (2010).

MMEDs have not been proven to be fully effective at preventing marine mammal capture in trawl nets (*e.g.,* Chilvers, 2008) and are not expected to prevent marine mammal capture in NWFSC trawl surveys. It is difficult to effectively test such devices, in terms of effectiveness in excluding marine mammals as opposed to effects on target species catchability, because realistic field trials would necessarily involve marine mammal interactions with trawl nets. Use of artificial surrogates in field trials has not been shown to be a realistic substitute (Gibson and Isakssen, 1998). Nevertheless, we believe it reasonable to assume that use of MMEDs may reduce the likelihood of a given marine mammal interaction with trawl gear resulting in mortality. We do not infer causality, but note that annual marine mammal interactions with the Nordic 264 trawl net have been much reduced for the SWFSC (relative to 2008) since use of the MMED began.

Multiple types of midwater trawl nets are used in NWFSC trawl surveys. The Nordic 264 trawl net, used as a surface trawl by NWFSC, is generally much larger than the midwater trawls, is fished at faster speeds, and has a different shape and functionality than these nets. Very few marine mammal interactions with NWFSC pelagic trawl gear have involved nets other than the Nordic 264 (one of 37 total incidents since 1999; Table 4). Therefore, MMED use is not proposed for nets other than the Nordic 264.

The NWFSC has tested the MMED design used by the SWFSC and found that it caused a significant loss of some salmon species that were the target of their research. More recent experiments have used video cameras attached to the net opening and near the excluder device to test different configurations of the excluder device to minimize loss of target species. The experiments have looked at adding weight and stiffeners to the flap covering the escape hatch to keep it closed and flipping the MMED so the escape hatch faces down rather than up. Based on preliminary results, this downward-pointing escape hatch appears to be the best design for minimizing loss of target species. Additional research will be necessary to calibrate catch levels in tows with the excluder device compared to past tows that did not contain the excluder (*i.e.,* to align the new catchability rates with historical data sets). During these configuration and calibration experiments some nets will be fished without the MMED in order to provide controls for catchability. Once the NWFSC completes these experiments the MMED will be used in all future trawls with the Nordic 264. Please see ''Proposed Monitoring and Reporting'' for additional discussion.

Acoustic deterrent devices—Acoustic deterrent devices (pingers) are underwater sound-emitting devices that have been shown to decrease the probability of interactions with certain species of marine mammals when fishing gear is fitted with the devices. Multiple studies have reported large decreases in harbor porpoise mortality (approximately eighty to ninety percent) in bottom-set gillnets (nets composed of vertical panes of netting, typically set in a straight line and either anchored to the bottom or drifting) during controlled experiments (*e.g.,* Kraus *et al.,* 1997; Trippel *et al.,* 1999; Gearin *et al.,* 2000). Using commercial fisheries data rather than a controlled experiment, Palka *et al.* (2008) reported that harbor porpoise bycatch rates in the northeast U.S gillnet fishery when fishing without pingers was about two to three times higher compared to when pingers were used. After conducting a controlled experiment in a California drift gillnet fishery during 1996–97, Barlow and Cameron (2003) reported significantly lower bycatch rates when pingers were used for all cetacean species combined, all pinniped species combined, and specifically for short-beaked common dolphins (85 percent reduction) and California sea lions (69 percent reduction). While not a statistically significant result, catches of Pacific white-sided dolphins (which are historically one of the most frequently captured species in NWFSC surveys; see Table 4) were reduced by seventy percent. Carretta *et al.* (2008) subsequently examined nine years of observer data from the same drift gillnet fishery and found that pinger use had eliminated beaked whale bycatch. Carretta and Barlow (2011) assessed the long-term effectiveness of pingers in reducing marine mammal bycatch in the California drift gillnet fishery by evaluating fishery data from 1990–2009 (with pingers in use beginning in 1996), finding that bycatch rates of cetaceans were reduced nearly fifty percent in sets using a sufficient number of pingers. However, in contrast to the findings of Barlow and Cameron (2003), they report no significant difference in pinniped bycatch.

To be effective, a pinger must emit a signal that is sufficiently aversive to deter the species of concern, which requires that the signal is perceived while also deterring investigation. In rare cases, aversion may be learned as a warning when an animal has survived interaction with gear fitted with pingers (Dawson, 1994). The mechanisms by which pingers work in operational settings are not fully understood, but field trials and captive studies have shown that sounds produced by pingers are aversive to harbor porpoises (*e.g.,* Laake *et al.,* 1998; Kastelein *et al.,* 2000; Culik *et al.,* 2001), and it is assumed that when marine mammals are deterred from interacting with gear fitted with pingers that it is because the sounds produced by the devices are aversive.

Two primary concerns expressed with regard to pinger effectiveness in reducing marine mammal bycatch relate to habituation (*i.e.,* marine mammals may become habituated to the sounds made by the pingers, resulting in increasing bycatch rates over time; Dawson, 1994; Cox *et al.,* 2001; Carlström *et al.,* 2009) and the ''dinner bell effect'' (Dawson, 1994; Richardson *et al.,* 1995), which implies that certain predatory marine mammal species (*e.g.,* sea lions) may come to associate pingers with a food source (*e.g.,* fish caught in nets) with the result that bycatch rates may be higher in nets with pingers than in those without.

Palka *et al.* (2008) report that habituation has not occurred on a level that affects the bycatch estimate for the northeast U.S. gillnet fishery, while cautioning that the data studied do not provide a direct method to study habituation. Similarly, Carretta and Barlow (2011) report that habituation is not apparent in the California drift gillnet fishery, with the proportion of pinger-fitted sets with bycatch not significantly different for either cetaceans or pinnipeds between the periods 1996–2001 and 2001–09; in fact, bycatch rates for both taxa overall were lower in the latter period. We are not aware of any long-term behavioral studies investigating habituation. Bycatch rates of California sea lions, specifically, did increase during the latter period. However, the authors do not attribute the increase to pinger use (*i.e.,* the ''dinner bell effect''); rather, they believe that continuing increases in population abundance for the species (Carretta *et al.,* 2015a) coincident with a decline in fishery effort are responsible for the increased rate of capture. Despite these potential limitations on the effectiveness of pingers, and while effectiveness has not been tested on trawl gear, we believe that the available evidence supports an assumption that use of pingers is likely to reduce the potential for marine mammal interactions with NWFSC trawl gear.

If one assumes that use of a pinger is effective in deterring marine mammals from interacting with fishing gear, one must therefore assume that receipt of the acoustic signal has a disturbance effect on those marine mammals (*i.e.,* Level B harassment). However, Level B harassment that may be incurred as a result of NWFSC use of pingers does not constitute take that must be authorized under the MMPA. The MMPA prohibits the taking of marine mammals by U.S. citizens or within the U.S. EEZ unless such taking is appropriately permitted or authorized. However, the MMPA provides several narrowly defined exemptions from this requirement (*e.g.,* for Alaskan natives; for defense of self or others; for Good Samaritans [16 U.S.C. 1371(b)–(d)]). Section 109(h) of the MMPA (16 U.S.C. 1379(h)) allows for the taking of marine mammals in a humane manner by federal, state, or local government officials or employees in the course of their official duties if the taking is necessary for ''the protection or welfare of the mammal,'' ''the protection of the public health and welfare,'' or ''the non-lethal removal of nuisance animals.'' NWFSC use of pingers as a deterrent device, which may cause Level B harassment of marine mammals, is intended solely for the avoidance of potential marine mammal interactions with NWFSC research gear (*i.e.,* avoidance of Level A harassment, serious injury, or mortality). Therefore, use of such deterrent devices, and the taking that may result, is for the protection and welfare of the mammal and is covered explicitly under MMPA section 109(h)(1)(A). Potential taking of marine mammals resulting from NWFSC use of pingers is not discussed further in this document.

Pingers will be deployed during all surface trawl operations (*i.e.,* using the Nordic 264 net), with two pairs of pingers installed near the net opening. The vessel's crew will ensure that pingers are operational prior to deployment. Pinger brands typically used by NWFSC include the Aquatec Subsea Limited model AQUAmark and Fumunda Marine models F10 and F70, with the following attributes: (1) Operational depth of 10–200 m; (2) tones range from 200–400 ms in duration, repeated every five to six seconds; (3) variable frequency of 10–160 kHz; and (4) maximum source level of 145 dB rms re 1 μPa. Please see ''Marine Mammal Hearing'' below for reference to functional and best hearing ranges for marine mammals present in the CCE.

Kodiak surface trawl and pair trawl gear—The Kodiak surface trawl, used only in Puget Sound, has only limited potential for marine mammal interaction. This gear type is a small net towed at slow speeds (about 2 kn) as close to shore as the net can be fished, and these characteristics mean that marine mammals would likely be able to avoid the net or swim out of it if necessary. However, rules for cetaceans would be similar as for other net types (*i.e.,* delay and/or move-on if cetaceans observed within approximately 500 m or clearly approaching from greater distance). If killer whales are observed at any distance, the net would not be deployed and the move-on rule invoked.

The pair trawl is used only in the Columbia River, and is fished with an open codend. Although unlikely, there is some potential for pinnipeds to become entangled in the net material. NWFSC's practice, which would be allowed under section 109(h) of the MMPA, is to deter pinnipeds from encountering the net using pyrotechnic devices and other measures. Therefore, separate mitigation is not warranted, and we do not discuss NWFSC deterrence of pinnipeds associated with pair trawl surveys further in this document. Please see the NWFSC's draft Programmatic Environmental Assessment for further information about this practice.

Longline and Other Hook and Line Survey Visual Monitoring and Operational Protocols

Visual monitoring requirements for all longline surveys are similar to the general protocols described above for trawl surveys. Please see that section for full details of the visual monitoring protocol and the move-on rule mitigation protocol. In summary, requirements for longline surveys are to: (1) Conduct visual monitoring during the thirty-minute period prior to arrival on station; (2) implement the move-on rule if marine mammals are observed within the area around the vessel and maybe at risk of interacting with the vessel or gear; (3) deploy gear as soon as possible upon arrival on station (depending on presence of marine mammals); and (4) maintain visual monitoring effort throughout deployment and retrieval of the longline gear. As was described for trawl gear, the OOD, CS, or watch leader will use best professional judgment to minimize the risk to marine mammals from potential gear interactions during deployment and retrieval of gear. If marine mammals are detected during setting operations and are considered to be at risk, immediate retrieval or suspension of operations may be warranted. If operations have been suspended because of the presence of marine mammals, the vessel will resume setting (when practicable) only when the animals are believed to have departed the area. If marine mammals are detected during retrieval operations and are considered to be at risk, haul-back may be postponed. These decisions are at the discretion of the OOD/CS and are dependent on the situation. If killer whales are observed at any distance, the set would not occur and the move-on rule would be invoked.

Other types of hook and line surveys (*e.g.,* rod and reel) generally use the same protocols as longline surveys.

However, for hook and line surveys in Puget Sound the move-on rule is not required for pinnipeds because they are commonly abundant on shore nearby hook and line sampling locations. Use of the move-on rule in these circumstances would represent an impracticable impact on NWFSC survey operations, and we note that no marine mammals have ever been captured in NWFSC hook and line surveys (Table 4). However, the NWFSC would implement the move-on rule for hook and line surveys in Puget Sound for any cetaceans that are within 500 m and may be at risk of interaction with the survey operation. If killer whales are observed at any distance, fishing would not occur.

As for trawl surveys, some standard survey protocols are expected to minimize the potential for marine mammal interactions. Soak times are typically short relative to commercial fishing operations, measured from the time the last hook is in the water to when the first hook is brought out of the water. NWFSC longline protocols specifically prohibit chumming (releasing additional bait to attract target species to the gear) and spent bait and offal is retained on the vessel until all gear has been retrieved. Some hook and line surveys use barbless hooks, which are less likely to injure a hooked animal.

Seine Survey Visual Monitoring and Operational Protocols

Visual monitoring and operational protocols for seine surveys are similar to those described previously for trawl surveys, with a focus on visual observation in the survey area and avoidance of marine mammals that may be at risk of interaction with survey vessels or gear. For purse seine operations, visual monitoring is focused on avoidance of cetaceans and aggregations of pinnipeds. Individual or small numbers of pinnipeds may be attracted to purse seine operations, especially in Puget Sound, and are frequently observed to enter operational purse seines to depredate the catch and exit the net unharmed. Use of the move-on rule in these circumstances would represent an impracticable impact on NWFSC survey operations, and we note that no marine mammals have ever been captured in NWFSC seine surveys (Table 4).

If pinnipeds are in the immediate vicinity of a purse seine survey, the set may be delayed until animals move away or the move-on rule is determined to be appropriate, but the net would not be opened if already deployed and pinnipeds enter it. However, delay would not be invoked if only few pinnipeds are present (*e.g.,* less than five), and they do not appear to obviously be at risk.

If any dolphins or porpoises are observed within approximately 500 m of the purse seine survey location, the set would be delayed. If any dolphins or porpoises are observed in the net, the net would be immediately opened to free the animals. If killer whales or other large whales are observed at any distance the net would not be set, and the move-on rule would be invoked.

Beach seines are typically set nearshore by small boat crews, who visually survey the area prior to the set. The set would not be made within 200 m of any hauled pinnipeds. Otherwise, marine mammals are unlikely to be at risk of interaction with NWFSC beach seine operations, as the nets are relatively small and deployed and retrieved slowly. If a marine mammal is observed attempting to interact with the beach seine gear, the gear would immediately be lifted and removed from the water.

Tangle net protocols—Tangle nets are used only in the Columbia River. NWFSC attempts to avoid pinnipeds by rotating sampling locations on a daily basis and by avoiding fishing near haulout areas. However, as was described for NWFSC use of pair trawl gear in the LCRRA, NWFSC also deters pinnipeds from interacting with tangle net gear as necessary using pyrotechnic devices and visual presence, a practice allowed under section 109(h) of the MMPA. Therefore, we do not discuss NWFSC deterrence of pinnipeds associated with tangle net surveys further in this document. Please see the NWFSC's draft Programmatic Environmental Assessment for further information about this practice. If pinniped presence in the vicinity of tangle net surveys is so abundant as to be uncontrollable through deterrence, sampling would be discontinued for a given day.

We have carefully evaluated the NWFSC's proposed mitigation measures and considered a range of other measures in the context of ensuring that we prescribed the means of effecting the least practicable adverse impact on the affected marine mammal species and stocks and their habitat. Our evaluation of potential measures included consideration of the following factors in relation to one another: (1) The manner in which, and the degree to which, the successful implementation of the measure is expected to minimize adverse impacts to marine mammals, (2) the proven or likely efficacy of the specific measure to minimize adverse impacts as planned; and (3) the practicability of the measure for applicant implementation.

Any mitigation measure(s) we prescribe should be able to accomplish, have a reasonable likelihood of accomplishing (based on current science), or contribute to the accomplishment of one or more of the general goals listed below:

(1) Avoidance or minimization of injury or death of marine mammals wherever possible (goals 2, 3, and 4 may contribute to this goal).

(2) A reduction in the number (total number or number at biologically important time or location) of individual marine mammals exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(3) A reduction in the number (total number or number at a biologically important time or location) of times any individual marine mammal would be exposed to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing takes by behavioral harassment only).

(4) A reduction in the intensity of exposure to stimuli expected to result in incidental take (this goal may contribute to 1, above, or to reducing the severity of behavioral harassment only).

(5) Avoidance or minimization of adverse effects to marine mammal habitat, paying particular attention to the prey base, blockage or limitation of passage to or from biologically important areas, permanent destruction of habitat, or temporary disturbance of habitat during a biologically important time.

(6) For monitoring directly related to mitigation, an increase in the probability of detecting marine mammals, thus allowing for more effective implementation of the mitigation.

Based on our evaluation of the NWFSC's proposed measures, as well as other measures we considered, we have preliminarily determined that the proposed mitigation measures provide the means of effecting the least practicable adverse impact on marine mammal species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Description of Marine Mammals in the Area of the Specified Activity

We have reviewed NWFSC's species descriptions—which summarize available information regarding status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities of the potentially affected species—for accuracy and completeness and refer the reader to Sections 3 and 4 of NWFSC's application, as well as to NMFS' Stock Assessment Reports (SARs; *www.nmfs.noaa.gov/pr/sars/*), instead of reprinting the information here. Table 3 lists all species with expected potential for occurrence in the specified geographical region where NWFSC proposes to conduct the specified activity and summarize information related to the population or stock, including potential biological removal (PBR). For taxonomy, we follow Committee on Taxonomy (2015). PBR, defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population, is discussed in greater detail later in this document (see ''Negligible Impact Analyses''). Species that could potentially occur in the proposed research areas but are not expected to have the potential for interaction with NWFSC research gear or that are not likely to be harassed by NWFSC's use of active acoustic devices are described briefly but omitted from further analysis. These include extralimital species, which are species that do not normally occur in a given area but for which there are one or more occurrence records that are considered beyond the normal range of the species. For status of species, we provide information regarding U.S. regulatory status under the MMPA and ESA.

Marine mammal abundance estimates presented in this document 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 SARs. These surveys may also extend beyond U.S. waters.

Thirty-four species (with 43 managed stocks) are considered to have the potential to co-occur with NWFSC activities. Extralimital species or stocks in the California Current include the Bryde's whale (*Balaenoptera edeni brydei*) and the North Pacific right whale (*Eubalaena japonica*). In addition, the sea otter is found in coastal waters, with the southern sea otter (*Enhydra lutris nereis*) found in California and the northern (or eastern) sea otter (*E. l. kenyoni;* Washington stock only) found in Washington. However, sea otters are managed by the U.S. Fish and Wildlife Service and are not considered further in this document. All stocks are assessed in NMFS' U.S. Pacific SARs (Carretta *et al.,* 2015a,b), with the exception of the west coast transient and northern resident stocks of killer whales, the eastern North Pacific stock of the northern fur seal, and the eastern stock of the Steller sea lion, which are considered in the U.S. Alaska SARs (Allen and Angliss, 2015; Muto and Angliss, 2015). Values presented in Table 3 reflect the most recent information available (*i.e.,* final 2014 and draft 2015 reports, as appropriate).

Two populations of gray whales are recognized, eastern and western North Pacific (ENP and WNP). WNP whales are known to feed in the Okhotsk Sea and off of Kamchatka before migrating south to poorly known wintering grounds, possibly in the South China Sea. The two populations have historically been considered geographically isolated from each other; however, recent data from satellite-tracked whales indicate that there is some overlap between the stocks. Two WNP whales were tracked from Russian foraging areas along the Pacific rim to Baja California (Mate *et al.,* 2011), and, in one case where the satellite tag remained attached to the whale for a longer period, a WNP whale was tracked from Russia to Mexico and back again (IWC, 2012). Between 22–24 WNP whales are known to have occurred in the eastern Pacific through comparisons of ENP and WNP photo-identification catalogs (IWC, 2012; Weller *et al.,* 2011; Burdin *et al.,* 2011), and WNP animals comprised 8.1 percent of gray whales identified during a recent field season off of Vancouver Island (Weller *et al.,* 2012). In addition, two genetic matches of WNP whales have been recorded off of Santa Barbara, CA (Lang *et al.,* 2011). More recently, Urban *et al.* (2013) compared catalogs of photo-identified individuals from Mexico with photographs of whales off Russia and reported a total of 21 matches. Therefore, a portion of the WNP population is assumed to migrate, at least in some years, to the eastern Pacific during the winter breeding season.

However, the NWFSC does not believe that any gray whale (WNP or ENP) would be likely to interact with its research gear, as it is extremely unlikely that a gray whale in close proximity to NWFSC research activity would be one of the approximately twenty WNP whales that have been documented in the eastern Pacific. The likelihood that a WNP whale would interact with NWFSC research gear is insignificant and discountable, and WNP gray whales are omitted from further analysis.

TABLE 3—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF NWFSC RESEARCH ACTIVITIES

Common name	Scientific name	Stock	Occurrence			ESA/MMPA status; strategic (Y/N)[1]	Stock abundance (CV, N_{min}, most recent abundance survey)[2]	PBR	Annual M/SI[3]
			CC	LCR	PS				
Order Cetartiodactyla—Cetacea—Superfamily Mysticeti (baleen whales)									
Family Eschrichtiidae									
Gray whale	*Eschrichtius robustus*	Eastern North Pacific	X	....	X	-; N	20,990 (0.05; 20,125; 2011).	624	132
Family Balaenopteridae (rorquals)									
Humpback whale	*Megaptera novaeangliae kuzira.*	California/Oregon/Washington (CA/OR/WA).	X	....	X	E/D; Y	1,918 (0.03; 1,855; 2011).	[12] 11	≥5.5
Minke whale	*Balaenoptera acutorostrata scammoni.*	CA/OR/WA	X	....	X	-; N	478 (1.36; 202; 2008)	2	0
Sei whale	*B. borealis borealis*	Eastern North Pacific	X	....	....	E/D; Y	126 (0.53; 83; 2008)	0.17	0
Fin whale	*B. physalus physalus*	CA/OR/WA	X	....	....	E/D; Y	3,051 (0.18; 2,598; 2008).	16	2.2

TABLE 3—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF NWFSC RESEARCH ACTIVITIES—Continued

Common name	Scientific name	Stock	Occurrence			ESA/MMPA status; strategic (Y/N) [1]	Stock abundance (CV, N_{min}, most recent abundance survey) [2]	PBR	Annual M/SI [3]
			CC	LCR	PS				
Blue whale	*B. musculus musculus*	Eastern North Pacific	X			E/D; Y	1,647 (0.07; 1,551; 2011).	[12] 2.3	0.9
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)									
Family Physeteridae									
Sperm whale	*Physeter macrocephalus*	CA/OR/WA	X			E/D; Y	2,106 (0.58; 1,332; 2008).	2.7	1.7
Family Kogiidae									
Pygmy sperm whale	*Kogia breviceps*	CA/OR/WA	X			-; N	579 (1.02; 271; 2008)	2.7	0
Dwarf sperm whale	*K. sima*	CA/OR/WA [5]	X			-; N	Unknown	Undet.	0
Family Ziphiidae (beaked whales)									
Cuvier's beaked whale	*Ziphius cavirostris*	CA/OR/WA	X			-; Y	6,590 (0.55; 4,481; 2008).	45	0
Baird's beaked whale	*Berardius bairdii*	CA/OR/WA	X			-; N	847 (0.81; 466; 2008)	4.7	0
Hubbs' beaked whale	*Mesoplodon carlhubbsi*	CA/OR/WA [6]	X			-; Y	694 (0.65; 389; 2008)	3.9	0
Blainville's beaked whale	*M. densirostris*		X						
Ginkgo-toothed beaked whale.	*M. ginkgodens*		X						
Perrin's beaked whale	*M. perrini*		X						
Lesser (pygmy) beaked whale.	*M. peruvianus*		X						
Stejneger's beaked whale.	*M. stejnegeri*		X						
Family Delphinidae									
Common bottlenose dolphin.	*Tursiops truncatus truncatus.*	CA/OR/WA Offshore	X			-; N	1,006 (0.48; 684; 2008)	5.5	≥2
		California Coastal	X			-; N	323 (0.13; 290; 2005)	2.4	0.2
Striped dolphin	*Stenella coeruleoalba*	CA/OR/WA	X			-; N	10,908 (0.34; 8,231; 2008).	82	0
Long-beaked common dolphin.	*Delphinus capensis capensis.*	California	X			-; N	107,016 (0.42; 76,224; 2009).	610	13.8
Short-beaked common dolphin.	*D. delphis delphis*	CA/OR/WA	X			-; N	411,211 (0.21; 343,990; 2008).	3,440	64
Pacific white-sided dolphin.	*Lagenorhynchus obliquidens.*	CA/OR/WA	X		X	-; N	26,930 (0.28; 21,406; 2008).	171	17.8
Northern right whale dolphin.	*Lissodelphis borealis*	CA/OR/WA	X			-; N	8,334 (0.4; 6,019; 2008)	48	4.8
Risso's dolphin	*Grampus griseus*	CA/OR/WA	X			-; N	6,272 (0.3; 4,913; 2008)	39	1.6
Killer whale	*Orcinus orca* [4]	West Coast Transient [7]	X	X	X	-; N	243 (n/a; 2009)	2.4	0
		Eastern North Pacific Offshore.	X			-; N	240 (0.49; 162; 2008)	1.6	0
		Eastern North Pacific Southern Resident.	X		X	E/D; Y	78 [10] (n/a; 2014)	0.14	0
		Eastern North Pacific Northern Resident.	X		X	-; N	261 (n/a; 2011)	1.96	0
Short-finned pilot whale	*Globicephala macrorhynchus.*	CA/OR/WA	X			-; N	760 (0.64; 465; 2008)	4.6	0
Family Phocoenidae (porpoises)									
Harbor porpoise	*Phocoena phocoena vomerina.*	Morro Bay	X			-; N	2,917 (0.41; 2,102; 2012).	21	≥0.6
		Monterey Bay	X			-; N	3,715 (0.51; 2,480; 2011).	25	0
		San Francisco-Russian River.	X			-; N	9,886 (0.51; 6,625; 2011).	66	0
		Northern CA/Southern OR.	X			-; N	35,769 (0.52; 23,749; 2011).	475	≥0.6
		Northern OR/WA Coast	X	X		-; N	21,487 (0.44; 15,123; 2011).	151	≥3
		Washington Inland Waters.			X	-; N	10,682 (0.38; 7,841; 2003).	63	≥2.2
Dall's porpoise	*Phocoenoides dalli dalli*	CA/OR/WA	X	X	X	-; N	42,000 (0.33; 32,106; 2008).	257	≥0.4
Order Carnivora—Superfamily Pinnipedia									
Family Otariidae (eared seals and sea lions)									
Guadalupe fur seal	*Arctocephalus philippii townsendi.*		X			T/D; Y	7,408 (n/a; 3,028; 1993)	91	[13] 0

TABLE 3—MARINE MAMMALS POTENTIALLY PRESENT IN THE VICINITY OF NWFSC RESEARCH ACTIVITIES—Continued

Common name	Scientific name	Stock	Occurrence			ESA/MMPA status; strategic (Y/N) [1]	Stock abundance (CV, N_{min}, most recent abundance survey) [2]	PBR	Annual M/SI [3]
			CC	LCR	PS				
Northern fur seal	*Callorhinus ursinus*	Pribilof Islands/Eastern Pacific.	X			D; Y	648,534 (0.2; 548,919; 2012).	11,802	439
		California	X			-; N	14,050[10] (n/a; 7,524; 2013).	451	1.8
California sea lion	*Zalophus californianus*	United States	X	X	X	-; N	296,750 (n/a; 153,337; 2011).	9,200	389
Steller sea lion	*Eumetopias jubatus monteriensis.*	Eastern U.S.[9]	X	X	X	D; Y	60,131–74,448 (n/a; 36,551; 2013) [11].	1,645	92.3
Family Phocidae (earless seals)									
Harbor seal	*Phoca vitulina richardii*	California	X			-; N	30,968 (n/a; 27,348; 2012).	1,641	43
		OR/WA Coast [8]	X	X		-; N	24,732 (0.12; 22,380; 1999).	Undet.	10.6
		Washington Northern Inland Waters.[8]			X	-; N	11,036 (0.15; 7,213; 1999).	Undet.	9.8
		Southern Puget Sound [8]			X	-; N	1,568 (0.15; 1,025; 1999).	Undet.	3.4
		Hood Canal [8]			X	-; N	1,088 (0.15; 711; 1999)	Undet.	0.2
Northern elephant seal	*Mirounga angustirostris*	California Breeding	X		X	-; N	179,000 (n/a; 81,368; 2010).	4,882	8.8

[1] Endangered Species Act (ESA) status: Endangered (E), Threatened (T)/MMPA status: Depleted (D). A dash (−) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] NMFS marine mammal stock assessment reports at: *www.nmfs.noaa.gov/pr/sars/.* CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For three stocks of killer whales, the abundance values represent direct counts of individually identifiable animals; therefore there is only a single abundance estimate with no associated CV. For certain stocks of pinnipeds, abundance estimates are based upon observations of animals (often pups) ashore multiplied by some correction factor derived from knowledge of the species' (or similar species') life history to arrive at a best abundance estimate; therefore, there is no associated CV. In these cases, the minimum abundance may represent actual counts of all animals ashore.

[3] These values, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (*e.g.,* commercial fisheries, subsistence hunting, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value. All M/SI values are as presented in the draft 2015 SARs (Carretta *et al.,* 2015b; Muto and Angliss, 2015).

[4] Transient and resident killer whales are considered unnamed subspecies (Committee on Taxonomy, 2015).

[5] No information is available to estimate the population size of dwarf sperm whales off the U.S. west coast, as no sightings of this species have been documented despite numerous vessel surveys of this region (Carretta *et al.,* 2015a). Dwarf and pygmy sperm whales are difficult to differentiate at sea but, based on previous sighting surveys and historical stranding data, it is thought that recent ship survey sightings were of pygmy sperm whales.

[6] The six species of Mesoplodont beaked whales occurring in the CCE are managed as a single stock due to the rarity of records and the difficulty in distinguishing these animals to species in the field. Based on bycatch and stranding records, it appears that *M. carlhubbsi* is the most commonly encountered of these species (Carretta *et al.,* 2008; Moore and Barlow, 2013). Additional managed stocks in the Pacific include *M. stejnegeri* in Alaskan waters and *M. densirostris* in Hawaiian waters.

[7] The abundance estimate for this stock includes only animals from the "inner coast" population occurring in inside waters of southeastern Alaska, British Columbia, and Washington—excluding animals from the "outer coast" subpopulation, including animals from California—and therefore should be considered a minimum count. For comparison, the previous abundance estimate for this stock, including counts of animals from California that are now considered outdated, was 354.

[8] Abundance estimates for these stocks are not considered current. PBR is therefore considered undetermined for these stocks, as there is no current minimum abundance estimate for use in calculation. We nevertheless present the most recent abundance estimates, as these represent the best available information for use in this document.

[9] The eastern distinct population segment of the Steller sea lion, previously listed as threatened, was delisted under the ESA on December 4, 2013 (78 FR 66140; November 4, 2013).

[10] These are provisional abundance estimates presented in the draft 2015 SARs.

[11] Best abundance is calculated as the product of pup counts and a factor based on the birth rate, sex and age structure, and growth rate of the population. A range is presented because the extrapolation factor varies depending on the vital rate parameter resulting in the growth rate (*i.e.,* high fecundity or low juvenile mortality).

[12] These stocks are known to spend a portion of their time outside the U.S. EEZ. Therefore, the PBR presented here is the allocation for U.S. waters only and is a portion of the total. The total PBR for blue whales is 9.3 (one-quarter allocation for U.S. waters), and the total for humpback whales is 22 (one half allocation for U.S. waters). Annual M/SI presented for these species is for U.S. waters only.

[13] This represents annual M/SI in U.S. waters. However, the vast majority of M/SI for this stock—the level of which is unknown—would likely occur in Mexican waters.

Take reduction planning—Take reduction plans are designed to help recover and prevent the depletion of strategic marine mammal stocks that interact with certain U.S. commercial fisheries, as required by Section 118 of the MMPA. The immediate goal of a take reduction plan is to reduce, within six months of its implementation, the M/SI of marine mammals incidental to commercial fishing to less than the PBR level. The long-term goal is to reduce, within five years of its implementation, the M/SI of marine mammals incidental to commercial fishing to insignificant levels, approaching a zero serious injury and mortality rate, taking into account the economics of the fishery, the availability of existing technology, and existing state or regional fishery management plans. Take reduction teams are convened to develop these plans.

For marine mammals in the California Current Ecosystem, there is currently one take reduction plan in effect (Pacific Offshore Cetacean Take Reduction Plan). The goal of this plan is to reduce M/SI of several marine mammal stocks incidental to the California thresher shark/swordfish drift gillnet fishery (CA DGN). A team was convened in 1996 and a final plan produced in 1997 (62 FR 51805; October 3, 1997). Marine mammal stocks of concern initially included the California, Oregon, and Washington stocks for all CCE beaked whales, short-finned pilot whales, pygmy sperm whales, sperm whales, and humpback whales. The most recent five-year averages of M/SI for these stocks are below PBR, and none of these species were taken in the fishery in 2012–13. More information is available on the Internet at: *www.nmfs.noaa.gov/pr/interactions/trt/poctrp.htm.* Of the stocks of concern, the NWFSC has requested the authorization of incidental M/SI + Level A for the short-finned pilot whale only (see ''Estimated Take by Incidental Harassment'' later in this document). The most recent reported average annual human-caused mortality for short-finned pilot whales (2004–08) is zero animals. The NWFSC does not use drift gillnets in its fisheries research program; therefore, take reduction measures applicable to the CA DGN fisheries are not relevant to the NWFSC.

Unusual Mortality Events (UME)—A UME is defined under the MMPA as ''a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response.'' From 1991 to the present, there have been sixteen formally recognized UMEs on the U.S. west coast involving species under NMFS' jurisdiction. The most recent of these, and the only ones involving currently ongoing investigations, involve Guadalupe fur seals and California sea lions. Increased strandings of Guadalupe fur seals (eight times the historical average) have occurred along the entire coast of California. These increased strandings were reported beginning in January 2015 and peaked from April through June 2015. Findings from the majority of stranded animals include malnutrition with secondary bacterial and parasitic infections. Beginning in January 2013, elevated strandings of California sea lion pups were observed in southern California, with live sea lion strandings nearly three times higher than the historical average. Findings to date indicate that a likely contributor to the large number of stranded, malnourished pups was a change in the availability of sea lion prey for nursing mothers, especially sardines. These UMEs are occurring in the same areas and the causes and mechanisms of this remain under investigation (*www.nmfs.noaa.gov/pr/health/mmume/guadalupefurseals2015.html; www.nmfs.noaa.gov/pr/health/mmume/californiasealions2013.htm;* accessed December 3, 2015).

Additional UMEs in the past ten years include those involving harbor porpoises in California (2008; cause determined to be ecological factors); Guadalupe fur seals in the Northwest (2007; undetermined); large whales in California (2007; human interaction); cetaceans in California (2007; undetermined); and harbor porpoises in the Pacific Northwest (2006; undetermined). There is also an ongoing UME in the western Gulf of Alaska that involves elevated large whale mortalities and may be affecting eastern North Pacific gray whales, which also occur in the NWFSC's research areas. For more information on UMEs, please visit the Internet at: *www.nmfs.noaa.gov/pr/health/mmume/events.html.*

Potential Effects of the Specified Activity on Marine Mammals and Their Habitat

This section includes a summary and discussion of the ways that components of the specified activity (*e.g.,* gear deployment, use of active acoustic sources, visual disturbance) may impact marine mammals and their habitat. The ''Estimated Take by Incidental Harassment'' section later in this document will include a quantitative analysis of the number of individuals that are expected to be taken by this activity. The ''Negligible Impact Analysis'' section will include an analysis of how this specific activity will impact marine mammals and will consider the content of this section, the ''Estimated Take by Incidental Harassment'' section, and the ''Proposed Mitigation'' section, to draw conclusions regarding the likely impacts of this activity on the reproductive success or survivorship of individuals and from that on the affected marine mammal populations or stocks. In the following discussion, we consider potential effects to marine mammals from ship strike, physical interaction with the gear types described previously, use of active acoustic sources, and visual disturbance of pinnipeds.

Ship Strike

Vessel collisions with marine mammals, or ship strikes, can result in death or serious injury of the animal. Wounds resulting from ship strike may include massive trauma, hemorrhaging, broken bones, or propeller lacerations (Knowlton and Kraus, 2001). An animal at the surface may be struck directly by a vessel, a surfacing animal may hit the bottom of a vessel, or an animal just below the surface may be cut by a vessel's propeller. More superficial strikes may not kill or result in the death of the animal. These interactions are typically associated with large whales (*e.g.,* fin whales), which are occasionally found draped across the bulbous bow of large commercial ships upon arrival in port. Although smaller cetaceans or pinnipeds are more maneuverable in relation to large vessels than are large whales, they may also be susceptible to strike. The severity of injuries typically depends on the size and speed of the vessel, with the probability of death or serious injury increasing as vessel speed increases (Knowlton and Kraus, 2001; Laist *et al.,* 2001; Vanderlaan and Taggart, 2007; Conn and Silber, 2013). Impact forces increase with speed, as does the probability of a strike at a given distance (Silber *et al.,* 2010; Gende *et al.,* 2011).

Pace and Silber (2005) found that the probability of death or serious injury increased rapidly with increasing vessel speed. Specifically, the predicted probability of serious injury or death increased from 45 to 75 percent as vessel speed increased from 10 to 14 kn, and exceeded ninety percent at 17 kn. Higher speeds during collisions result in greater force of impact, but higher speeds also appear to increase the chance of severe injuries or death through increased likelihood of collision by pulling whales toward the vessel (Clyne, 1999; Knowlton *et al.,* 1995). In a separate study, Vanderlaan and Taggart (2007) analyzed the probability of lethal mortality of large whales at a given speed, showing 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 8.6 and 15 kn. The chances of a lethal injury decline from approximately eighty percent at 15 kn to approximately twenty percent at 8.6 kn. At speeds below 11.8 kn, the chances of lethal injury drop below fifty percent, while the probability asymptotically increases toward one hundred percent above 15 kn.

In an effort to reduce the number and severity of strikes of the endangered North Atlantic right whale (*Eubalaena glacialis*), NMFS implemented speed restrictions in 2008 (73 FR 60173; October 10, 2008). These restrictions require that vessels greater than or equal to 65 ft (19.8 m) in length travel at less than or equal to 10 kn near key port entrances and in certain areas of right whale aggregation along the U.S. eastern seaboard. Conn and Silber (2013) estimated that these restrictions reduced total ship strike mortality risk levels by eighty to ninety percent.

For vessels used in NWFSC research activities, transit speeds average 10 kn (but vary from 6–14 kn), while vessel speed during active sampling is typically only 2–4 kn. At sampling speeds, both the possibility of striking a marine mammal and the possibility of a strike resulting in serious injury or mortality are discountable. At average transit speed, the probability of serious injury or mortality resulting from a strike is less than fifty percent. However, the likelihood of a strike actually happening is again discountable. Ship strikes, as analyzed in the studies cited above, generally involve commercial shipping, which is much more common in both space and time than is research activity. Jensen and Silber (2004) summarized ship strikes of large whales worldwide from 1975–2003 and found that most collisions occurred in the open ocean and involved large vessels (*e.g.,* commercial shipping). Commercial fishing vessels were responsible for three percent of recorded collisions, while only one such incident (0.75 percent) was reported for a research vessel during that time period.

It is possible for ship strikes to occur while traveling at slow speeds. For example, a NOAA-chartered survey vessel traveling at low speed (5.5 kn) while conducting multi-beam mapping surveys off the central California coast struck and killed a blue whale in 2009. The State of California determined that the whale had suddenly and unexpectedly surfaced beneath the hull, with the result that the propeller severed the whale's vertebrae, and that this was an unavoidable event. This strike represents the only such incident in approximately 540,000 hours of similar coastal mapping activity ($p = 1.9 \times 10^{-6}$; 95% CI = $0–5.5 \times 10^{-6}$; NMFS, 2013). In addition, a research vessel reported a fatal strike in 2011 of a dolphin in the Atlantic, demonstrating that it is possible for strikes involving smaller cetaceans or pinnipeds to occur. In that case, the incident report indicated that an animal apparently was struck by the vessel's propeller as it was intentionally swimming near the vessel. While indicative of the type of unusual events that cannot be ruled out, neither of these instances represents a circumstance that would be considered reasonably foreseeable or that would be considered preventable.

In summary, we anticipate that vessel collisions involving NWFSC research vessels, while not impossible, represent unlikely, unpredictable events for which there are no preventive measures. No ship strikes have been reported from any fisheries research activities conducted or funded by the NWFSC in any of the three research areas. Given the relatively slow speeds of research vessels, the presence of bridge crew watching for obstacles at all times (including marine mammals), the presence of marine mammal observers on some surveys, and the small number of research cruises, we believe that the possibility of ship strike is discountable and, further, that were a strike of a large whale to occur, it would be unlikely to result in serious injury or mortality. No incidental take resulting from ship strike is anticipated, and this potential effect of research will not be discussed further in the following analysis.

Research Gear

The types of research gear used by NWFSC were described previously under ''Detailed Description of Activity.'' Here, we broadly categorize these gears into those whose use we consider to have an extremely unlikely potential to result in marine mammal interaction and those whose use we believe may result in marine mammal interaction. Gears in the former category are not considered further, while those in the latter category are carried forward for further analysis. Gears with likely potential for marine mammal interaction include trawls, longlines and other hook and line gear, seines (primarily purse seines), and tangle nets.

Trawl nets, longlines, and purse seines deployed by NWFSC are similar to gear used in various commercial fisheries, and the potential for and history of marine mammal interaction with these gears through physical contact (*i.e.,* capture or entanglement) is well-documented. Read *et al.* (2006) estimated marine mammal bycatch in U.S. fisheries from 1990–99 and derived an estimate of global marine mammal bycatch by expanding U.S. bycatch estimates using data on fleet composition from the United Nations Food and Agriculture Organization (FAO). Although most U.S. bycatch for both cetaceans (84 percent) and pinnipeds (98 percent) occurred in gillnets (a gear type not generally used by NWFSC), global marine mammal bycatch in trawl nets and longlines is likely substantial given that total global bycatch is thought to number in the hundreds of thousands of individuals (Read *et al.,* 2006). In addition, global bycatch via longline has likely increased, as longlines have become the most common method of capturing swordfish and tuna since the U.N. banned the use of high seas driftnets over 2.5 km long in 1991 (high seas driftnets were previously often 40–60 km long) (Read, 2008; FAO, 2001).

Marine mammals are widely regarded as being quite intelligent and inquisitive, and when their pursuit of prey coincides with human pursuit of the same resources, it should be expected that physical interaction with fishing gear may occur (*e.g.,* Beverton, 1985). Fishermen and marine mammals are both drawn to areas of high prey density, and certain fishing activities may further attract marine mammals by providing food (*e.g.,* bait, captured fish, bycatch discards) or by otherwise making it easier for animals to feed on a concentrated food source. Provision of foraging opportunities near the surface may present an advantage by negating the need for energetically expensive deep foraging dives (Hamer and Goldsworthy, 2006). Trawling, for example, can make available previously unexploited food resources by gathering prey that may otherwise be too fast or deep for normal predation, or may concentrate calories in an otherwise patchy landscape (Fertl and Leatherwood, 1997). Pilot whales, which are generally considered to be teuthophagous (*i.e.,* feeding primarily on squid), were commonly observed in association with Atlantic mackerel (*Scomber scombrus*) trawl fisheries from 1977–88 in the northeast U.S. EEZ (Waring *et al.,* 1990). Not surprisingly, stomach contents of captured whales were observed to have high proportions of mackerel (68 percent of non-trace food items), indicating that the ready availability of a novel, concentrated, high-calorie prey item resulted in changed dietary composition (Read, 1994).

These interactions can result in injury or death for the animal(s) involved and/or damage to fishing gear. Coastal animals, including various pinnipeds, bottlenose dolphins, and harbor porpoises, are perhaps the most vulnerable to these interactions and set or passive fishing gear (*e.g.,* gillnets, traps) the most likely to be interacted with (*e.g.,* Beverton, 1985; Barlow *et al.,* 1994; Read *et al.,* 2006; Byrd *et al.,* 2014; Lewison *et al.,* 2014). Although interactions are less common for use of trawl nets and longlines (gear used by NWFSC), they do occur with sufficient frequency to necessitate the establishment of required mitigation measures for multiple U.S. fisheries using both types of gear (NMFS, 2014). It is likely that no species of marine mammal can be definitively excluded from the potential for interaction with fishing gear (*e.g.,* Northridge, 1984); however, the extent of interactions is likely dependent on the biology, ecology, and behavior of the species involved and the type, location, and nature of the fishery.

Trawl nets—As described previously, trawl nets are towed nets (*i.e.,* active fishing) consisting of a cone-shaped net with a codend or bag for collecting the fish and can be designed to fish at the bottom, surface, or any other depth in the water column. Here we refer to bottom trawls and pelagic trawls (midwater or surface, *i.e.,* any net not designed to tend the bottom while fishing). Trawl nets in general have the potential to capture or entangle marine mammals, which have been known to be caught in bottom trawls, presumably when feeding on fish caught therein, and in pelagic trawls, which may or may not be coincident with their feeding (Northridge, 1984).

Capture or entanglement may occur whenever marine mammals are swimming near the gear, intentionally (*e.g.,* foraging) or unintentionally (*e.g.,* migrating), and any animal captured in a net is at significant risk of drowning unless quickly freed. Animals can also be captured or entangled in netting or tow lines (also called lazy lines) other than the main body of the net; animals may become entangled around the head, body, flukes, pectoral fins, or dorsal fin. Interaction that does not result in the immediate death of the animal by drowning can cause injury (*i.e.,* Level A harassment) or serious injury. Constricting lines wrapped around the animal can immobilize the animal or injure by cutting into or through blubber, muscles and bone (*i.e.,* penetrating injuries) or constricting blood flow to or severing appendages. Immobilization of the animal, if it does not result in immediate drowning, can cause internal injuries from prolonged stress and/or severe struggling and/or impede the animal's ability to feed (resulting in starvation or reduced fitness) (Andersen *et al.,* 2008).

Marine mammal interactions with trawl nets, through capture or entanglement, are well-documented. Dolphins are known to attend operating nets in order to either benefit from disturbance of the bottom or to prey on discards or fish within the net. For example, Leatherwood (1975) reported that the most frequently observed feeding pattern for bottlenose dolphins in the Gulf of Mexico involved herds following working shrimp trawlers, apparently feeding on organisms stirred up from the benthos. Bearzi and di Sciara (1997) opportunistically investigated working trawlers in the Adriatic Sea from 1990–94 and found that ten percent were accompanied by foraging bottlenose dolphins. However, pelagic trawls have greater potential to capture cetaceans, because the nets may be towed at faster speeds, these trawls are more likely to target species that are important prey for marine mammals (*e.g.,* squid, mackerel), and the likelihood of working in deeper waters means that a more diverse assemblage of species could potentially be present (Hall *et al.,* 2000).

Globally, at least seventeen cetacean species are known to feed in association with trawlers and individuals of at least 25 species are documented to have been killed by trawl nets, including several large whales, porpoises, and a variety of delphinids (Perez, 2006; Young and Iudicello, 2007; Karpouzli and Leaper, 2004; Hall *et al.,* 2000; Fertl and Leatherwood, 1997; Northridge, 1991; Song *et al.,* 2010). At least eighteen species of seals and sea lions are known to have been killed in trawl nets (Wickens, 1995; Perez, 2006; Zeeberg *et al.,* 2006). Generally, direct interaction between trawl nets and marine mammals (both cetaceans and pinnipeds) has been recorded wherever trawling and animals co-occur. A lack of recorded interactions where animals are known to be present may indicate simply that trawling is absent or an insignificant component of fisheries in that region or that interactions were not observed, recorded, or reported.

In evaluating risk relative to a specific fishery (or comparable research survey), one must consider the size of the net as well as frequency, timing, and location of deployment. These considerations inform determinations of whether interaction with marine mammals is likely. Of the net types described previously under ''Trawl Nets,'' NWFSC has recorded marine mammal interactions primarily with the Nordic 264 surface trawl net but also has one recorded interaction with the modified Cobb midwater trawl. No marine mammal interactions have been recorded for any bottom trawl survey.

Longlines—Longlines are basically strings of baited hooks that are either anchored to the bottom, for targeting groundfish, or are free-floating, for targeting pelagic species and represent a passive fishing technique. Pelagic longlines, which notionally fish near the surface with the use of floats, may be deployed in such a way as to fish at different depths in the water column. For example, deep-set longlines targeting tuna may have a target depth of 400 m, while a shallow-set longline targeting swordfish is set at 30–90 m depth. We refer here to bottom and pelagic longlines. Any longline generally consists of a mainline from which leader lines (gangions) with baited hooks branch off at a specified interval, and is left to passively fish, or soak, for a set period of time before the vessel returns to retrieve the gear. Longlines are marked by two or more floats that act as visual markers and may also carry radio beacons; aids to detection are of particular importance for pelagic longlines, which may drift a significant distance from the deployment location. Pelagic longlines are generally composed of various diameter monofilament line and are generally much longer, and with more hooks, than are bottom longlines. Bottom longlines may be of monofilament or multifilament natural or synthetic lines.

Marine mammals may be hooked or entangled in longline gear, with interactions potentially resulting in death due to drowning, strangulation, severing of carotid arteries or the esophagus, infection, an inability to evade predators, or starvation due to an inability to catch prey (Hofmeyr *et al.,* 2002), although it is more likely that animals will survive being hooked if they are able to reach the surface to breathe. Injuries, which may include serious injury, include lacerations and puncture wounds. Animals may attempt to depredate either bait or catch, with subsequent hooking, or may become accidentally entangled. As described for trawls, entanglement can lead to constricting lines wrapped around the animals and/or immobilization, and even if entangling materials are removed the wounds caused may continue to weaken the animal or allow further infection (Hofmeyr *et al.,* 2002). Large whales may become entangled in a longline and then break free with a portion of gear trailing, resulting in alteration of swimming energetics due to drag and ultimate loss of fitness and potential mortality (Andersen *et al.,* 2008). Weight of the gear can cause entangling lines to further constrict and further injure the animal. Hooking injuries and ingested gear are most common in small cetaceans and pinnipeds, but have been observed in large cetaceans (*e.g.,* sperm whales). The severity of the injury depends on the species, whether ingested gear includes hooks, whether the gear works its way into the gastrointestinal (GI) tract, whether the gear penetrates the GI lining, and the location of the hooking (*e.g.,* embedded in the animal's stomach or other internal body parts) (Andersen *et al.,* 2008). Bottom longlines pose less of a threat to marine mammals due to their deployment on the ocean bottom but can still result in entanglement in buoy lines or hooking as the line is either deployed or retrieved. The rate of interaction between longline fisheries and marine mammals depends on the degree of overlap between longline effort and species distribution, hook style and size, type of bait and target catch, and fishing practices (such as setting/hauling during the day or at night).

As was noted for trawl nets, many species of cetaceans and pinnipeds are documented to have been killed by longlines, including several large whales, porpoises, a variety of delphinids, seals, and sea lions (Perez, 2006; Young and Iudicello, 2007; Northridge, 1984, 1991; Wickens, 1995). Generally, direct interaction between longlines and marine mammals (both cetaceans and pinnipeds) has been recorded wherever longline fishing and animals co-occur. A lack of recorded interactions where animals are known to be present may indicate simply that longlining is absent or an insignificant component of fisheries in that region or that interactions were not observed, recorded, or reported. Hook and line (*e.g.,* rod and reel) gear also carries some lesser potential for marine mammal interaction, as the use of baited hooks in the presence of inquisitive marine mammals necessarily carries some risk. However, the scale of hook and line operations in relation to longline operations and the lack of extended, unattended soak times mean that use of other hook and line gear is much less likely to result in marine mammal interactions. However, due to the limited potential risk we carry this gear forward for further analysis with longline in a general category of hook and line gear.

In evaluating risk relative to a specific fishery (or research survey), one must consider the length of the line and number of hooks deployed as well as frequency, timing, and location of deployment. These considerations inform determinations of whether interaction with marine mammals is likely. NWFSC has not recorded marine mammal interactions with any longline survey. While a lack of historical interactions does not in and of itself indicate that future interactions are unlikely, we believe that the historical record, considered in context with the frequency and timing of these activities, as well as mitigation measures employed indicate that future marine mammal interactions with these gears would be uncommon.

Tangle nets and other set gear—As noted previously, tangle nets operate in similar fashion to gillnets. Marine mammal interactions with gillnets are well-documented, with a large proportion of species of all types of marine mammals (*e.g.,* mysticetes, odontocetes, pinnipeds) recorded as gillnet bycatch (Reeves *et al.,* 2013; Lewison *et al.,* 2014; Zollett, 2009). Reeves *et al.* (2013) note that numbers of marine mammals killed in gillnets tend to be greatest for species that are widely distributed in coastal and shelf waters. Because of the well-documented risk to marine mammals, and to coastally distributed pinnipeds and small cetaceans in particular, we believe there is some risk of interaction inherent to NWFSC use of tangle nets, as described below in ''Estimated Take by Incidental Harassment, Serious Injury, or Mortality.'' However, this risk is limited by the fact that NWFSC uses tangle nets only in the LCRRA, for up to 75 sets of 25–45 minutes duration each.

The NWFSC also uses fyke traps and modified sablefish pots, both of which are passive fishing gear that have limited species selectivity and may be set for long durations (FAO, 2001). Thus, these gears have the potential to capture non-targeted fauna that use the same habitat as targeted species, even without the use of bait. Mortality in fyke nets can arise from stress and injury associated with anoxia, abrasion, confinement, and starvation (Larocque, 2011). In 2010, NMFS' Northeast Fisheries Science Center captured a harbor seal in a fyke trap. However, all fyke traps used by the NWFSC are wetland systems designed to target small fish, and are fished in areas where pinnipeds are rare (estuarine, wetland channels typically 1–5 m wide, including brackish and freshwater habitats) and only limited deployments (up to one hundred sets per year). Sablefish pots are likewise used in only very limited fashion, with modified pots deployed in some Puget Sound estuaries to collect herring eggs. The doors are sewed shut such that marine mammals cannot enter the pot itself, and are unlikely to become entangled in the line. Therefore, we do not believe that there is a reasonable potential for marine mammal interaction with fyke traps or pots used by the NWFSC, and these gears are not considered further in this document.

Seine nets—Purse seine gear is well-known as a potential source of marine mammal mortality due to its use in tuna fisheries of the eastern tropical Pacific Ocean (ETP), where incidental take of dolphins was very high from the late 1950s into the 1970s (Perrin, 1969). Because large yellowfin tuna (*Thunnus albacares*) and several species of dolphin associate together, dolphins were often captured along with the target species, resulting in the deaths of hundreds of thousands of dolphins. Through a series of combined actions, including passage of the MMPA in 1972, subsequent amendments, regulations, and mitigation measures, dolphin bycatch in the ETP has since decreased 99 percent in the international fishing fleet, and was eliminated by the U.S. fleet (Gerrodette and Forcada, 2005). As in the ETP tuna fisheries, the most significant risk associated with use of purse seines are when marine mammals and target species associate together, which is not the case for any NWFSC use of purse seines. Similar to longline gear, NWFSC purse seines are much smaller than those typically used in commercial fisheries. However, there is some risk associated with use of purse seines (and to a lesser extent, seine nets in general), and we therefore carry seine nets forward for further consideration.

Other research gear—The only NWFSC research gears with any record of marine mammal interactions are pelagic trawl nets (*i.e.,* Nordic 264 and modified Cobb). Because of ample evidence from commercial fishing operations, we assume that there is also risk of marine mammal interaction due to NWFSC use of bottom trawl nets, hook and line gear (primarily longlines but also including other hook and line gear), and seine gear (primarily purse seine gear but also including beach seines). All other gears used in NWFSC fisheries research (*e.g.,* a variety of plankton nets, CTDs, ROVs) do not have the expected potential for marine mammal interactions and are not known to have been involved in any marine mammal interaction anywhere. Specifically, we consider CTDs, water pump/thermosalinograph, ROVs, small surface trawls, plankton nets, and vertically deployed or towed imaging systems to be no-impact gear types.

Unlike trawl nets, seine nets, and longline gear, which are used in both scientific research and commercial fishing applications, these other gears are not considered similar or analogous to any commercial fishing gear and are not designed to capture any commercially salable species, or to collect any sort of sample in large quantities. They are not considered to have the potential to take marine mammals primarily because of their design or how they are deployed. For example, CTDs are typically deployed in a vertical cast on a cable and have no loose lines or other entanglement hazards. A Bongo net is typically deployed on a cable, whereas neuston nets (these may be plankton nets or small trawls) are often deployed in the upper one meter of the water column; either net type has very small size (*e.g.,* two bongo nets of 0.5 m^2 each or a neuston net of approximately 2 m^2) and no trailing lines to present an entanglement risk. These other gear types are not considered further in this document.

Acoustic Effects

We previously provided general background information on sound and the specific sources used by the NWFSC (see ''Description of Active Acoustic Sound Sources''). Here, we first provide background information on marine mammal hearing before discussing the potential effects of NWFSC use of active acoustic sources on marine mammals.

Marine mammal hearing—Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.,* Richardson *et al.,* 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al.* (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for low-frequency cetaceans. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

• Low-frequency cetaceans (mysticetes): Functional hearing is estimated to occur between approximately 7 Hz and 25 kHz (up to 30 kHz in some species), with best hearing estimated to be from 100 Hz to 8 kHz (Watkins, 1986; Ketten, 1998; Houser *et al.,* 2001; Au *et al.,* 2006; Lucifredi and Stein, 2007; Ketten *et al.,* 2007; Parks *et al.,* 2007a; Ketten and Mountain, 2009; Tubelli *et al.,* 2012);

• Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): Functional hearing is estimated to occur between approximately 150 Hz and 160 kHz, with best hearing from 10 to less than 100 kHz (Johnson, 1967; White, 1977; Richardson *et al.,* 1995; Szymanski *et al.,* 1999; Kastelein *et al.,* 2003; Finneran *et al.,* 2005a, 2009; Nachtigall *et al.,* 2005, 2008; Yuen *et al.,* 2005; Popov *et al.,* 2007; Au and Hastings, 2008; Houser *et al.,* 2008; Pacini *et al.,* 2010, 2011; Schlundt *et al.,* 2011);

• High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus;* including two members of the genus *Lagenorhynchus,* including the hourglass dolphin, on the basis of recent echolocation data and genetic data [May-Collado and Agnarsson, 2006; Kyhn *et al.* 2009, 2010; Tougaard *et al.* 2010]): Functional hearing is estimated to occur between approximately 200 Hz and 180 kHz (Popov and Supin, 1990a,b; Kastelein *et al.,* 2002; Popov *et al.,* 2005); and

• Pinnipeds in water; Phocidae (true seals): Functional hearing is estimated to occur between approximately 75 Hz to 100 kHz, with best hearing between 1–50 kHz (Møhl, 1968; Terhune and Ronald, 1971, 1972; Richardson *et al.,* 1995; Kastak and Schusterman, 1999; Reichmuth, 2008; Kastelein *et al.,* 2009);

• Pinnipeds in water; Otariidae (eared seals): Functional hearing is estimated to occur between 100 Hz and 48 kHz for Otariidae, with best hearing between 2–48 kHz (Schusterman *et al.,* 1972; Moore and Schusterman, 1987; Babushina *et al.,* 1991; Richardson *et al.,* 1995; Kastak and Schusterman, 1998; Kastelein *et al.,* 2005a; Mulsow and Reichmuth, 2007; Mulsow *et al.,* 2011a, b).

The pinniped functional hearing group was modified from Southall *et al.* (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al.,* 2006; Kastelein *et al.,* 2009; Reichmuth and Holt, 2013).

Thirty-four marine mammal species (28 cetacean and six pinniped [four otariid and two phocid] species) have the potential to co-occur with NWFSC research activities. Please refer to Table 3. Of the 28 cetacean species that may be present, six are classified as low-frequency cetaceans (*i.e.,* all mysticete species), eighteen are classified as mid-frequency cetaceans (*i.e.,* all delphinid and ziphiid species and the sperm whale), and four are classified as high-frequency cetaceans (*i.e.,* porpoises and *Kogia* spp.).

Potential effects of underwater sound—Please refer to the information given previously (''Description of Active Acoustic Sources'') regarding sound, characteristics of sound types, and metrics used in this document. Anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe responses, depending on received levels, duration of exposure, behavioral context, and various other factors. The potential effects of underwater sound from active acoustic sources can potentially result in one or more of the following: Temporary or permanent hearing impairment, non-auditory physical or physiological effects, behavioral disturbance, stress, and masking (Richardson *et al.,* 1995; Gordon *et al.,* 2004; Nowacek *et al.,* 2007; Southall *et al.,* 2007; Götz *et al.,* 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing will occur almost exclusively for noise within an animal's hearing range. We first describe specific manifestations of acoustic effects before providing discussion specific to NWFSC's use of active acoustic sources (*e.g.,* echosounders).

Richardson *et al.* (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking (*i.e.,* when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold) may occur; the masking zone may be highly variable in size.

We describe the more severe effects (*i.e.,* permanent hearing impairment, certain non-auditory physical or physiological effects) only briefly as we do not expect that there is a reasonable likelihood that NWFSC use of active acoustic sources may result in such effects (see below for further discussion). Marine mammals exposed to high-intensity sound, or to lower-intensity sound for prolonged periods, can experience hearing threshold shift (TS), which is the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.,* 1999; Schlundt *et al.,* 2000; Finneran *et al.,* 2002, 2005b). TS can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall *et al.,* 2007). Repeated sound exposure that leads to TTS could cause PTS. In severe cases of PTS, there can be total or partial deafness, while in most cases the animal has an impaired ability to hear sounds in specific frequency ranges (Kryter, 1985).

When PTS occurs, there is physical damage to the sound receptors in the ear (*i.e.,* tissue damage), whereas TTS represents primarily tissue fatigue and is reversible (Southall *et al.,* 2007). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury.

Relationships between TTS and PTS thresholds have not been studied in marine mammals—PTS data exists only for a single harbor seal (Kastak *et al.,* 2008)—but are assumed to be similar to those in humans and other terrestrial mammals. PTS typically occurs at exposure levels at least several decibels above (a 40-dB threshold shift approximates PTS onset; *e.g.,* Kryter *et al.,* 1966; Miller, 1974) that inducing mild TTS (a 6-dB threshold shift approximates TTS onset; *e.g.,* Southall *et al.* 2007). Based on data from terrestrial mammals, a precautionary assumption is that the PTS thresholds for impulse sounds (such as impact pile driving pulses as received close to the source) are at least 6 dB higher than the TTS threshold on a peak-pressure basis, and PTS cumulative sound exposure level thresholds are 15 to 20 dB higher than TTS cumulative sound exposure level thresholds (Southall *et al.,* 2007). Given the higher level of sound or longer exposure duration necessary to cause PTS as compared with TTS, it is considerably less likely that PTS could occur.

Non-auditory physiological effects or injuries that theoretically might occur in marine mammals exposed to high level underwater sound or as a secondary effect of extreme behavioral reactions (*e.g.,* change in dive profile as a result of an avoidance reaction) caused by exposure to sound include neurological effects, bubble formation, resonance effects, and other types of organ or tissue damage (Cox *et al.,* 2006; Southall *et al.,* 2007; Zimmer and Tyack, 2007). NWFSC activities do not involve the use of devices such as explosives or mid-frequency active sonar that are associated with these types of effects.

When a live or dead marine mammal swims or floats onto shore and is incapable of returning to sea, the event is termed a ''stranding'' (16 U.S.C. 1421h(3)). Marine mammals are known to strand for a variety of reasons, such as infectious agents, biotoxicosis, starvation, fishery interaction, ship strike, unusual oceanographic or weather events, sound exposure, or combinations of these stressors sustained concurrently or in series (*e.g.,* Geraci *et al.,* 1999). However, the cause or causes of most strandings are unknown (*e.g.,* Best, 1982). Combinations of dissimilar stressors may combine to kill an animal or dramatically reduce its fitness, even though one exposure without the other would not be expected to produce the same outcome (*e.g.,* Sih *et al.,* 2004). For further description of stranding events see, *e.g.,* Southall *et al.,* 2006; Jepson *et al.,* 2013; Wright *et al.,* 2013.

1. *Temporary threshold shift*—TTS is the mildest form of hearing impairment that can occur during exposure to sound (Kryter, 1985). While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard. In terrestrial and marine mammals, TTS can last from minutes or hours to days (in cases of strong TTS). In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. Few data on sound levels and durations necessary to elicit mild TTS have been obtained for marine mammals, and none of the data published at the time of this writing concern TTS elicited by exposure to multiple pulses of sound.

Marine mammal hearing plays a critical role in communication with conspecifics, and interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.,* recovery time), and frequency range of TTS, and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that occurs during a time where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during time when communication is critical for successful mother/calf interactions could have more serious impacts.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale [*Delphinapterus leucas*], harbor porpoise, and Yangtze finless porpoise [*Neophocoena asiaeorientalis*]) and three species of pinnipeds (northern elephant seal, harbor seal, and California sea lion) exposed to a limited number of sound sources (*i.e.,* mostly tones and octave-band noise) in laboratory settings (*e.g.,* Finneran *et al.,* 2002; Nachtigall *et al.,* 2004; Kastak *et al.,* 2005; Lucke *et al.,* 2009; Popov *et al.,* 2011). In general, harbor seals (Kastak *et al.,* 2005; Kastelein *et al.,* 2012a) and harbor porpoises (Lucke *et al.,* 2009; Kastelein *et al.,* 2012b) have a lower TTS onset than other measured pinniped or cetacean species. Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. There are no data available on noise-induced hearing loss for mysticetes. For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see Southall *et al.* (2007) and Finneran and Jenkins (2012).

2. *Behavioral effects*—Behavioral disturbance may include a variety of effects, including subtle changes in behavior (*e.g.,* minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (*e.g.,* species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (*e.g.,* Richardson *et al.,* 1995; Wartzok *et al.,* 2003; Southall *et al.,* 2007; Weilgart, 2007; Archer *et al.,* 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al.,* 2012), and can vary depending on characteristics associated with the sound source (*e.g.,* whether it is moving or stationary, number of sources, distance from the source). Please see Appendices B–C of Southall *et al.* (2007) for a review of studies involving marine mammal behavioral responses to sound.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al.,* 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a ''progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial,'' rather than as, more generally, moderation in response to human disturbance (Bejder *et al.,* 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. As noted, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al.,* 1995; NRC, 2003; Wartzok *et al.,* 2003). Controlled experiments with captive marine mammals have showed pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway *et al.,* 1997; Finneran *et al.,* 2003). Observed responses of wild marine mammals to loud pulsed sound sources (typically seismic airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; see also Richardson *et al.,* 1995; Nowacek *et al.,* 2007).

Available studies show wide variation in response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (*e.g.,* Lusseau and Bejder, 2007; Weilgart, 2007; NRC, 2005). However, there are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.,* Frankel and Clark, 2000; Costa *et al.,* 2003; Ng and Leung, 2003; Nowacek *et al.;* 2004; Goldbogen *et al.,* 2013a, b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.,* foraging) or they may be of little biological significance. The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.,* bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.,* Croll *et al.,* 2001; Nowacek *et al.;* 2004; Madsen *et al.,* 2006; Yazvenko *et al.,* 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Variations in respiration naturally vary with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (*e.g.,* Kastelein *et al.,* 2001, 2005b, 2006; Gailey *et al.,* 2007).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al.,* 2000; Fristrup *et al.,* 2003; Foote *et al.,* 2004), while right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al.,* 2007b). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al.,* 1994).

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al.,* 1995). For example, gray whales are known to change direction—deflecting from customary migratory paths—in order to avoid noise from seismic surveys (Malme *et al.,* 1984). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.,* Bowles *et al.,* 1994; Goold, 1996; Stone *et al.,* 2000; Morton and Symonds, 2002; Gailey *et al.,* 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.,* Blackwell *et al.,* 2004; Bejder *et al.,* 2006; Teilmann *et al.,* 2006).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.,* directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England, 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008), and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (*i.e.,* when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (*e.g.,* Beauchamp and Livoreil, 1997; Fritz *et al.,* 2002; Purser and Radford, 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (*e.g.,* decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.,* Harrington and Veitch, 1992; Daan *et al.,* 1996; Bradshaw *et al.,* 1998). However, Ridgway *et al.* (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of such functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al.,* 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al.,* 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

3. *Stress responses*—An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (*e.g.,* Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical (in terms of energetic costs) response is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Neuroendocrine stress responses often involve the hypothalamus-pituitary-adrenal system. Virtually all neuroendocrine functions that are affected by stress—including immune competence, reproduction, metabolism, and behavior—are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction, altered metabolism, reduced immune competence, and behavioral disturbance (*e.g.,* Moberg, 1987; Blecha, 2000). Increases in the circulation of glucocorticoids are also equated with stress (Romano *et al.,* 2004).

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and ''distress'' is the cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose serious fitness consequences. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other functions. This state of distress will last until the animal replenishes its energetic reserves sufficient to restore normal function.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses are well-studied through controlled experiments and for both laboratory and free-ranging animals (*e.g.,* Holberton *et al.,* 1996; Hood *et al.,* 1998; Jessop *et al.,* 2003; Krausman *et al.,* 2004; Lankford *et al.,* 2005). Stress responses due to exposure to anthropogenic sounds or other stressors and their effects on marine mammals have also been reviewed (Fair and Becker, 2000; Romano *et al.,* 2002b) and, more rarely, studied in wild populations (*e.g.,* Romano *et al.,* 2002a). For example, Rolland *et al.* (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales. These and other studies lead to a reasonable expectation that some marine mammals will experience physiological stress responses upon exposure to acoustic stressors and that it is possible that some of these would be classified as ''distress.'' In addition, any animal experiencing TTS would likely also experience stress responses (NRC, 2003).

4. *Auditory masking*—Sound can disrupt behavior through masking, or interfering with, an animal's ability to detect, recognize, or discriminate between acoustic signals of interest (*e.g.,* those used for intraspecific communication and social interactions, prey detection, predator avoidance, navigation) (Richardson *et al.,* 1995; Erbe *et al.,* 2016). Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (*e.g.,* snapping shrimp, wind, waves, precipitation) or anthropogenic (*e.g.,* shipping, sonar, seismic exploration) in origin. The ability of a noise source to mask biologically important sounds depends on the characteristics of both the noise source and the signal of interest (*e.g.,* signal-to-noise ratio, temporal variability, direction), in relation to each other and to an animal's hearing abilities (*e.g.,* sensitivity, frequency range, critical ratios, frequency discrimination, directional discrimination, age or TTS hearing loss), and existing ambient noise and propagation conditions.

Under certain circumstances, marine mammals experiencing significant masking could also be impaired from maximizing their performance fitness in survival and reproduction. Therefore, when the coincident (masking) sound is man-made, it may be considered harassment when disrupting or altering critical behaviors. It is important to distinguish TTS and PTS, which persist after the sound exposure, from masking, which occurs during the sound exposure. Because masking (without resulting in TS) is not associated with abnormal physiological function, it is not considered a physiological effect, but rather a potential behavioral effect.

The frequency range of the potentially masking sound is important in determining any potential behavioral impacts. For example, low-frequency signals may have less effect on high-frequency echolocation sounds produced by odontocetes but are more likely to affect detection of mysticete communication calls and other potentially important natural sounds such as those produced by surf and some prey species. The masking of communication signals by anthropogenic noise may be considered as a reduction in the communication space of animals (*e.g.,* Clark *et al.,* 2009) and may result in energetic or other costs as animals change their vocalization behavior (*e.g.,* Miller *et al.,* 2000; Foote *et al.,* 2004; Parks *et al.,* 2007b; Di Iorio and Clark, 2009; Holt *et al.,* 2009). Masking can be reduced in situations where the signal and noise come from different directions (Richardson *et al.,* 1995), through amplitude modulation of the signal, or through other compensatory behaviors (Houser and Moore, 2014). Masking can be tested directly in captive species (*e.g.,* Erbe, 2008), but in wild populations it must be either modeled or inferred from evidence of masking compensation. There are few studies addressing real-world masking sounds likely to be experienced by marine mammals in the wild (*e.g.,* Branstetter *et al.,* 2013).

Masking affects both senders and receivers of acoustic signals and can potentially have long-term chronic effects on marine mammals at the population level as well as at the individual level. Low-frequency ambient sound levels have increased by as much as 20 dB (more than three times in terms of SPL) in the world's ocean from pre-industrial periods, with most of the increase from distant commercial shipping (Hildebrand, 2009). All anthropogenic sound sources, but especially chronic and lower-frequency signals (*e.g.,* from vessel traffic), contribute to elevated ambient sound levels, thus intensifying masking.

Potential effects of NWFSC activity—As described previously (see ''Description of Active Acoustic Sound Sources''), the NWFSC proposes to use various active acoustic sources, including 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). These acoustic sources, which are present on most NWFSC 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.

Many typically investigated acoustic sources (*e.g.,* seismic airguns, low- and mid-frequency active sonar used for military purposes, pile driving, vessel noise)—sources for which certain of the potential acoustic effects described above have been observed or inferred—produce signals 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 systems used by the NWFSC. 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 means that such systems are less likely to impact many marine species. However, some marine mammals do hear and produce sounds within the frequency range used by these sources and ambient noise is much lower at high frequencies, increasing the probability of signal detection relative to other sounds in the environment.

As noted above, relatively high levels of sound are likely required to cause TTS in most pinnipeds and odontocete cetaceans. While dependent on sound exposure frequency, level, and duration, NMFS' acoustics experts believe that existing studies indicate that for the kinds of relatively brief exposures potentially associated with transient sounds such as those produced by the active acoustic sources used by the NWFSC, SPLs in the range of approximately 180–220 dB rms might be required to induce onset TTS levels for most species (Southall *et al.,* 2007). However, it should be noted that there may be increased sensitivity to TTS for certain species generally (harbor porpoise; Lucke *et al.,* 2009) or specifically at higher sound exposure frequencies, which correspond to a species' best hearing range (20 kHz vs. 3 kHz for bottlenose dolphins; Finneran and Schlundt, 2010). 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 approximately 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 (Lucke *et al.,* 2009). The corresponding estimates for PTS would be at very high received levels that would rarely be experienced in practice.

Based on discussion provided by Southall *et al.* (2007), Lurton and DeRuiter (2011) modeled the potential impacts of conventional echosounders on marine mammals, estimating PTS onset at typical distances of 10–100 m for the kinds of sources considered here. Kremser *et al.* (2005) modeled the potential for TTS in blue, sperm, and beaked whales (please see Kremser *et al.* [2005] for discussion of assumptions regarding TTS onset in these species) from a multibeam echosounder, finding similarly that TTS would likely only occur at very close ranges to the hull of the vessel. The authors estimated ship movement at 12 kn (faster than NWFSC vessels would typically move), which would result in an underestimate of the potential for TTS to occur, but the modeled system (Hydrosweep) operates at lower frequencies and with a wider beam pattern than do typical NWFSC systems, which would result in a likely more significant overestimate of TTS potential. The results of both studies emphasize that these effects would very likely only occur in the cone ensonified below the ship and that animal responses to the vessel (sound or physical presence) at these extremely close ranges would very likely influence their probability of being exposed to these levels. At the same distances, but to the side of the vessel, animals would not be exposed to these levels, greatly decreasing the potential for an animal to be exposed to the most intense signals. For example, Kremser *et al.* (2005) note that SPLs outside the vertical lobe, or beam, decrease rapidly with distance, such that SPLs within the horizontal lobes are about 20 dB less than the value found in the center of the beam. For certain species (*i.e.,* 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) but are likely still on the order of hundreds of meters. In addition, potential behavioral responses further reduce the already low likelihood that an animal may approach close enough for any type of hearing loss to occur.

Various other studies have evaluated the environmental risk posed by use of specific scientific sonar systems. Burkhardt *et al.* (2007) considered both the Hydrosweep system evaluated by Kremser *et al.* (2005) and the Simrad EK60, which is used by the NWFSC, and concluded that direct injury (*i.e.,* sound energy causes direct tissue damage) and indirect injury (*i.e.,* self-damaging behavior as response to acoustic exposure) would be unlikely given source and operational use (*i.e.,* vessel movement) characteristics, and that any behavioral responses would be unlikely to be significant. Similarly, Boebel *et al.* (2006) considered the Hydrosweep system in relation to the risk for direct or indirect injury, concluding that (1) risk of TTS (please see Boebel *et al.* [2006] for assumptions regarding TTS onset) would be less than two percent of the risk of ship strike and (2) risk of behaviorally-induced damage would be essentially nil due to differences in source characteristics between scientific sonars and sources typically associated with stranding events (*e.g.,* mid-frequency active sonar, but see discussion of the 2008 Madagascar stranding event below). It should be noted that the risk of direct injury may be greater when a vessel operates sources while on station (*i.e.,* stationary), as there is a greater chance for an animal to receive the signal when the vessel is not moving.

Boebel *et al.* (2005) report the results of a workshop in which a structured, qualitative risk analysis of a range of acoustic technology was undertaken, specific to use of such technology in the Antarctic. The authors assessed a single-beam echosounder commonly used for collecting bathymetric data (12 kHz, 232 dB, 10° beam width), an array of single-beam echosounders used for mapping krill (38, 70, 120, and 200 kHz; 230 dB; 7° beam width), and a multibeam echosounder (30 kHz, 236 dB, 150° × 1° swath width). For each source, the authors produced a matrix displaying the severity of potential consequences (on a six-point scale) against the likelihood of occurrence for a given degree of severity. For the former two systems, the authors determined on the basis of the volume of water potentially affected by the system and comparisons between its output and available TTS data that the chance of TTS is only in a small volume immediately under the transducers, and that consequences of level four and above were inconceivable, whereas level one consequences (''Individuals show no response, or only a temporary (minutes) behavior change'') would be expected in almost all instances. Some minor displacement of animals in the immediate vicinity of the ship may occur. For the multibeam echosounder, Boebel *et al.* (2005) note that the high output and broad width of the swath abeam of the vessel makes displacement of animals more likely. However, the fore and aft beamwidth is small and the pulse length very short, so the risk of ensonification above TTS levels is still considered quite small and the likelihood of auditory or other injuries low. In general, the authors reached the same conclusions described for the single-beam systems but note that more severe impacts—including fatalities resulting from herding of sensitive species in narrow sea ways—are at least possible (*i.e.,* may occur in exceptional circumstances). However, the probability of herding remains low not just because of the rarity of the necessary confluence of species, bathymetry, and likely other factors, but because the restricted beam shape makes it unlikely that an animal would be exposed more than briefly during the passage of the vessel (Boebel *et al.,* 2005). More recently, Lurton (2016) conducted a modeling exercise and concluded similarly that likely potential for acoustic injury from these types of systems is negligible, but that behavioral response cannot be ruled out.

We have, however, considered the potential for severe behavioral responses such as stranding and associated indirect injury or mortality from NWFSC use of the multibeam echosounder, on the basis of a 2008 mass stranding of approximately one hundred melon-headed whales in a Madagascar lagoon system. An investigation of the event indicated that use of a high-frequency mapping system (12-kHz multibeam echosounder; it is important to note that all NWFSC sources operate at higher frequencies [see Table 2]) was the most plausible and likely initial behavioral trigger of the event, while providing the caveat that there is no unequivocal and easily identifiable single cause (Southall *et al.,* 2013). The panel's conclusion was based on (1) very close temporal and spatial association and directed movement of the survey with the stranding event; (2) the unusual nature of such an event coupled with previously documented apparent behavioral sensitivity of the species to other sound types (Southall *et al.,* 2006; Brownell *et al.,* 2009); and (3) the fact that all other possible factors considered were determined to be unlikely causes. Specifically, regarding survey patterns prior to the event and in relation to bathymetry, the vessel transited in a north-south direction on the shelf break parallel to the shore, ensonifying large areas of deep-water habitat prior to operating intermittently in a concentrated area offshore from the stranding site; this may have trapped the animals between the sound source and the shore, thus driving them towards the lagoon system.

The investigatory panel systematically excluded or deemed highly unlikely nearly all potential reasons for these animals leaving their typical pelagic habitat for an area extremely atypical for the species (*i.e.,* a shallow lagoon system). Notably, this was the first time that such a system has been associated with a stranding event.

The panel also noted several site- and situation-specific secondary factors that may have contributed to the avoidance responses that led to the eventual entrapment and mortality of the whales. Specifically, shoreward-directed surface currents and elevated chlorophyll levels in the area preceding the event may have played a role (Southall *et al.,* 2013). The report also notes that prior use of a similar system in the general area may have sensitized the animals and also concluded that, for odontocete cetaceans that hear well in higher frequency ranges where ambient noise is typically quite low, high-power active sonars operating in this range may be more easily audible and have potential effects over larger areas than low frequency systems that have more typically been considered in terms of anthropogenic noise impacts. It is, however, important to note that the relatively lower output frequency, higher output power, and complex nature of the system implicated in this event, in context of the other factors noted here, likely produced a fairly unusual set of circumstances that indicate that such events would likely remain rare and are not necessarily relevant to use of lower-power, higher-frequency systems more commonly used for scientific applications. The risk of similar events recurring may be very low, given the extensive use of active acoustic systems used for scientific and navigational purposes worldwide on a daily basis and the lack of direct evidence of such responses previously reported.

Characteristics of the sound sources predominantly used by NWFSC further reduce the likelihood of effects to marine mammals, as well as the intensity of effect assuming that an animal perceives the signal. Intermittent exposures—as would occur due to the brief, transient signals produced by these sources—require a higher cumulative SEL to induce TTS than would continuous exposures of the same duration (*i.e.,* intermittent exposure results in lower levels of TTS) (Mooney *et al.,* 2009a; Finneran *et al.,* 2010). In addition, intermittent exposures recover faster in comparison with continuous exposures of the same duration (Finneran *et al.,* 2010). Although echosounder pulses are, in general, emitted rapidly, they are not dissimilar to odontocete echolocation click trains. Research indicates that marine mammals generally have extremely fine auditory temporal resolution and can detect each signal separately (*e.g.,* Au *et al.,* 1988; Dolphin *et al.,* 1995; Supin and Popov, 1995; Mooney *et al.,* 2009b), especially for species with echolocation capabilities. Therefore, it is likely that marine mammals would indeed perceive echosounder signals as being intermittent.

We conclude here that, on the basis of available information on hearing and potential auditory effects in marine mammals, high-frequency cetacean species would be the most likely to potentially incur temporary hearing loss from a vessel operating high-frequency sonar sources, and the potential for PTS to occur for any species is so unlikely as to be discountable. Even for high-frequency cetacean species, individuals would have to make a very close approach and also remain very close to vessels operating these sources in order to receive multiple exposures at relatively high levels, as would be necessary to cause TTS. Additionally, given that behavioral responses typically include the temporary avoidance that might be expected (see below), the potential for auditory effects considered physiological damage (injury) is considered extremely low in relation to realistic operations of these devices. Given the fact that fisheries research survey vessels are moving, the likelihood that animals may avoid the vessel to some extent based on either its physical presence or due to aversive sound (vessel 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.

Based on the source operating characteristics, most of these sources may be detected by odontocete cetaceans (and particularly high-frequency specialists such as porpoises) but are unlikely to be audible to mysticetes (*i.e.,* low-frequency cetaceans) and some pinnipeds. While low-frequency cetaceans and pinnipeds have been observed to respond behaviorally to low- and mid-frequency sounds (*e.g.,* Frankel, 2005), there is little evidence of behavioral responses in these species to high-frequency sound exposure (*e.g.,* Jacobs and Terhune, 2002; Kastelein *et al.,* 2006). If a marine mammal does perceive a signal from a NWFSC active acoustic source, it is likely that the response would be, at most, behavioral in nature. Behavioral reactions of free-ranging marine mammals to scientific sonars are likely to vary by species and circumstance. For example, Watkins *et al.* (1985) note that sperm whales did not appear to be disturbed by or even aware of signals from scientific sonars and pingers (36–60 kHz) despite being very close to the transducers, but Gerrodette and Pettis (2005) report that when a 38-kHz echosounder and ADCP were on (1) the average size of detected schools of spotted dolphins and pilot whales was decreased; (2) perpendicular sighting distances increased for spotted and spinner dolphins; and (3) sighting rates decreased for beaked whales. As described above, behavioral responses of marine mammals are extremely variable, depending on multiple exposure factors, with the most common type of observed response being behavioral avoidance of areas around aversive sound sources. Certain odontocete cetaceans (particularly harbor porpoises and beaked whales) are known to avoid high-frequency sound sources in both field and laboratory settings (*e.g.,* Kastelein *et al.,* 2000, 2005b, 2008a, b; Culik *et al.,* 2001; Johnston, 2002; Olesiuk *et al.,* 2002; Carretta *et al.,* 2008). There is some additional, low probability for masking to occur for high-frequency specialists, but similar factors (directional beam pattern, transient signal, moving vessel) mean that the significance of any potential masking is probably inconsequential.

Potential Effects of Visual Disturbance

During NWFSC surveys conducted in coastal areas, including rivers and estuaries, pinnipeds are expected to be hauled out and at times experience incidental close approaches by researchers in small vessels during the course of fisheries research activities. Such circumstances are expected in Puget Sound and in the Columbia River. NWFSC expects some of these animals will exhibit a behavioral response to the visual stimuli (*e.g.,* including alert behavior, movement, vocalizing, or flushing). NMFS does not consider the lesser reactions (*e.g.,* alert behavior) to constitute harassment. These events are expected to be infrequent and cause only a temporary disturbance on the order of minutes. Monitoring results from other activities involving the disturbance of pinnipeds and relevant studies of pinniped populations that experience more regular vessel disturbance indicate that individually significant or population level impacts are unlikely to occur.

In areas where disturbance of haul-outs due to periodic human activity (*e.g.,* researchers approaching on foot, passage of small vessels, maintenance activity) occurs, monitoring results have generally indicated that pinnipeds typically move or flush from the haul-out in response to human presence or visual disturbance, although some individuals typically remain hauled-out (*e.g.,* SCWA, 2012). The nature of response is generally dependent on species. For example, California sea lions and northern elephant seals have been observed as less sensitive to stimulus than harbor seals during monitoring at numerous sites. Monitoring of pinniped disturbance as a result of abalone research in the Channel Islands showed that while harbor seals flushed at a rate of 69 percent, California sea lions flushed at a rate of only 21 percent. The rate for elephant seals declined to 0.1 percent (VanBlaricom, 2010).

Upon the occurrence of low-severity disturbance (*i.e.,* the approach of a vessel or person as opposed to an explosion or sonic boom), pinnipeds typically exhibit a continuum of responses, beginning with alert movements (*e.g.,* raising the head), which may then escalate to movement away from the stimulus and possible flushing into the water. Flushed pinnipeds typically re-occupy the haul-out within minutes to hours of the stimulus.

In a popular tourism area of the Pacific Northwest where human disturbances occurred frequently, past studies observed stable populations of seals over a twenty-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 region. Another study observed an increase in seal vigilance when vessels passed the haul-out site, but then vigilance relaxed within ten minutes of the vessels' passing (Fox, 2008). If vessels passed frequently within a short time period (*e.g.,* 24 hours), a reduction in the total number of seals present was also observed (Fox, 2008).

Level A harassment, serious injury, or mortality could likely only occur as a result of trampling in a stampede (a potentially dangerous occurrence in which large numbers of animals succumb to mass panic and rush away from a stimulus) or abandonment of pups. However, NWFSC surveys would be unlikely to disturb any sea lion pups, and any disturbance of harbor seal pups would be unlikely to result in abandonment. The eastern stock of Steller sea lions breeds in rookeries located in southeast Alaska, British Columbia, Oregon, and California; there are no known breeding rookeries in Washington or in the Columbia River. California sea lions breed in the Gulf of California, western Baja California, and southern California. Harbor seal pups could be present at times during NWFSC research effort (harbor seal pupping in Washington inland waters occurs from approximately June through September, depending on location), but harbor seal pups are extremely precocious, swimming and diving immediately after birth and throughout the lactation period, unlike most other phocids which normally enter the sea only after weaning (Lawson and Renouf, 1985; Cottrell *et al.,* 2002; Burns *et al.,* 2005). Lawson and Renouf (1987) investigated harbor seal mother-pup bonding in response to natural and anthropogenic disturbance. In summary, they found that the most critical bonding time is within minutes after birth. As such, it is unlikely that infrequent disturbance resulting from NWFSC research would interrupt the brief mother-pup bonding period within which disturbance could result in separation. In addition, NWFSC researchers take precautions to minimize disturbance and prevent any possibility of stampedes, including choosing travel routes as far away from hauled pinnipeds as possible and by moving sample site locations to avoid consistent haulout areas.

Disturbance of pinnipeds caused by NWFSC survey activities would be expected to last for only short periods of time, separated by significant amounts of time in which no disturbance occurred. Because such disturbance is sporadic, rather than chronic, and of low intensity, individual marine mammals are unlikely to incur any detrimental impacts to vital rates or ability to forage and, thus, loss of fitness. Correspondingly, even local populations, much less the overall stocks of animals, are extremely unlikely to accrue any significantly detrimental impacts.

Anticipated Effects on Marine Mammal Habitat

Effects to prey—In addition to direct, or operational, interactions between fishing gear and marine mammals, indirect (*i.e.,* biological or ecological) interactions occur as well, in which marine mammals and fisheries both utilize the same resource, potentially resulting in competition that may be mutually disadvantageous (*e.g.,* Northridge, 1984; Beddington *et al.,* 1985; Wickens, 1995). Marine mammal prey varies by species, season, and location and, for some, is not well documented. There is some overlap in prey of marine mammals and the species sampled and removed during NWFSC research surveys, with primary species of concern being hake, salmonids, and small, energy-rich, schooling species such as Pacific sardine, anchovies, and jack mackerel.

However, the total amount of these species taken in research surveys is very small relative to their overall biomass in the area (See Section 4.2.3 of the NWFSC EA for more information on fish catch during research surveys). For example, the average annual catch of Pacific hake in the course of all NWFSC research surveys during 2008–12 was approximately 1,181 metric tons (mt). Research catch is therefore negligible compared to the average commercial harvest for the same period (63,974 mt). For salmonids, in all cases the research take as a percent of either the average spawning population estimate or the average total juveniles produced is less than one tenth of one percent. For most commercial species, the average annual research catch is less than one percent of the overfishing limit (a fisheries management metric used to prevent overfishing). Other species of fish and invertebrates that are used as prey by marine mammals are taken in research surveys as well but, as indicated by these examples, the proportions of research catch compared to biomass and commercial harvest is very small.

In addition to the small total biomass taken, some of the size classes of fish targeted in research surveys are very small (*e.g.,* juvenile salmonids are typically only centimeters long), and these small size classes are not known to be prey of marine mammals. Research catches are also distributed over a wide area because of the random sampling design covering large sample areas. Fish removals by research are therefore highly localized and unlikely to affect the spatial concentrations and availability of prey for any marine mammal species. This is especially true for pinnipeds, which are opportunistic predators that consume a wide assortment of fish and squid, and judging by their increasing populations throughout their range and expanding range into the Pacific Northwest (Caretta *et al.,* 2015a), food availability does not appear to be a limiting factor (Baraff and Loughlin, 2000; Scordino, 2010). The overall effect of research catches on marine mammals through competition for prey may therefore be considered insignificant for all species.

Acoustic habitat—Acoustic habitat is the soundscape—which encompasses all of the sound present in a particular location and time, as a whole—when considered from the perspective of the animals experiencing it. Animals produce sound for, or listen for sounds produced by, conspecifics (communication during feeding, mating, and other social activities), other animals (finding prey or avoiding predators), and the physical environment (finding suitable habitats, navigating). Together, sounds made by animals and the geophysical environment (*e.g.,* produced by earthquakes, lightning, wind, rain, waves) make up the natural contributions to the total acoustics of a place. These acoustic conditions, termed acoustic habitat, are one attribute of an animal's total habitat.

Soundscapes are also defined by, and acoustic habitat influenced by, the total contribution of anthropogenic sound. This may include incidental emissions from sources such as vessel traffic, or may be intentionally introduced to the marine environment for data acquisition purposes (as in the NWFSC's use of active acoustic sources). Anthropogenic noise varies widely in its frequency content, duration, and loudness and these characteristics greatly influence the potential habitat-mediated effects to marine mammals (please see also the previous discussion on masking under ''Acoustic Effects''), which may range from local effects for brief periods of time to chronic effects over large areas and for long durations. Depending on the extent of effects to habitat, animals may alter their communications signals (thereby potentially expending additional energy) or miss acoustic cues (either conspecific or adventitious). For more detail on these concepts see, *e.g.,* Barber *et al.,* 2010; Pijanowski *et al.,* 2011; Francis and Barber, 2013; Lillis *et al.,* 2014.

Problems arising from a failure to detect cues are more likely to occur when noise stimuli are chronic and overlap with biologically relevant cues used for communication, orientation, and predator/prey detection (Francis and Barber, 2013). As described above (''Acoustic Effects''), the signals emitted by NWFSC active acoustic sources are generally high frequency, of short duration, and transient. These factors mean that the signals will attenuate rapidly (not travel over great distances), may not be perceived or affect perception even when animals are in the vicinity, and would not be considered chronic in any given location. NWFSC use of these sources is widely dispersed in both space and time. In conjunction with the prior factors, this means that it is highly unlikely that NWFSC use of these sources would, on their own, have any appreciable effect on acoustic habitat. Sounds emitted by NWFSC vessels would be of lower frequency and continuous, but would also be widely dispersed in both space and time. NWFSC vessel traffic—including both sound from the vessel itself and from the active acoustic sources—is of very low density compared to commercial shipping traffic or commercial fishing vessels and would therefore be expected to represent an insignificant incremental increase in the total amount of anthropogenic sound input to the marine environment.

Physical habitat—NWFSC conducts some bottom trawling, which may physically damage seafloor habitat. Physical damage may include furrowing and smoothing of the seafloor as well as the displacement of rocks and boulders, and such damage can increase with multiple contacts in the same area (Morgan and Chuenpagdee, 2003; Stevenson *et al.,* 2004). Damage to seafloor habitat may also harm infauna and epifauna (*i.e.,* animals that live in or on the seafloor or on structures on the seafloor), including corals. In general, physical damage to the seafloor would be expected to recover within eighteen months through the action of water currents and natural sedimentation, with the exception of rocks and boulders which may be permanently displaced (Stevenson *et al.,* 2004). Biological damage would likely recover within the same timeframe, although repeated disturbance of an area can prolong the recovery time (Stevenson *et al.,* 2004), and recovery of corals may take significantly longer. However, NWFSC catch records show that only minimal amounts of coral are captured (annual average of 55 kg of coral in all surveys from 2008–12). Relatively small areas would be impacted by NWFSC bottom trawling and, because such surveys are conducted in the same areas but not in the exact same locations, they are expected to cause single rather than repeated disturbances in any given area. NWFSC activities would not be expected to have any other impacts on physical habitat.

As described in the preceding, the potential for NWFSC research to affect the availability of prey to marine mammals or to meaningfully impact the quality of physical or acoustic habitat is considered to be insignificant for all species. Effects to habitat will not be discussed further in this document.

Estimated Take by Incidental Harassment, Serious Injury, or Mortality

Except with respect to certain activities not pertinent here, the MMPA defines ''harassment'' as: Any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild [Level A harassment]; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering [Level B harassment]. Serious injury means any injury that will likely result in mortality (50 CFR 216.3).

Take of marine mammals incidental to NWFSC research activities could occur as a result of (1) injury or mortality due to gear interaction (Level A harassment, serious injury, or mortality); (2) behavioral disturbance resulting from the use of active acoustic sources (Level B harassment only); or (3) behavioral disturbance of pinnipeds resulting from incidental approach of researchers (Level B harassment only).

Estimated Take Due to Gear Interaction

Historical Interactions

In order to estimate the number of potential incidents of take that could occur by M/SI + Level A through gear interaction, we first consider NWFSC's record of past such incidents, and then consider in addition other species that may have similar vulnerabilities to NWFSC trawl gear as those species for which we have historical interaction records. Historical interactions with NWFSC research gear are described in Table 4. Available records are for the years 1999 through present. All historical interactions have taken place in the CCRA, offshore Washington and Oregon, and have occurred during use of the Nordic 264 surface trawl net, with a few exceptions. There is one historical interaction in the PSRA (also using the Nordic 264 surface trawl) and one CCRA historical interaction using the modified Cobb midwater trawl. NWFSC has no historical interactions for any bottom trawl, hook and line, or seine gear, and has no historical interactions in the LCRRA. Please see Figure 6–1 in the NWFSC request for authorization for specific locations of these incidents.

TABLE 4—HISTORICAL INTERACTIONS WITH RESEARCH GEAR

Gear [1]	Survey	Date	Species	Number killed	Number released alive	Total
Pelagic trawl	Juvenile Salmon Coastal (JSC)	5/24/1999	Pacific white-sided dolphin	4		4
Pelagic trawl	JSC	9/29/1999	Steller sea lion	1		1
Pelagic trawl	JSC	10/1/1999	Steller sea lion	3		3
Pelagic trawl	JSC	5/18/2000	Northern fur seal	1		1
Pelagic trawl	Piscine Predator and Forage Fish (PPFF) [2].	7/19/2001	California sea lion	1		1
Pelagic trawl	JSC	9/22/2002	Steller sea lion	1		1
Pelagic trawl	JSC	9/23/2002	Steller sea lion	1		1
Pelagic trawl	JSC	9/24/2002	Steller sea lion	2		2
Pelagic trawl	JSC	6/25/2003	Pacific white-sided dolphin	1		1
Pelagic trawl	JSC	6/30/2003	Harbor seal	1		1
Pelagic trawl	JSC	6/30/2003	Pacific white-sided dolphin	2		2
Pelagic trawl	JSC	6/18/2005	Pacific white-sided dolphin	3		3
Pelagic trawl	PPFF [2]	6/1/2006	Pacific white-sided dolphin	3		3
Pelagic trawl	PPFF [2]	8/28/2006	Pacific white-sided dolphin	2		2
Pelagic trawl	JSC	9/28/2007	California sea lion	1		1
Pelagic trawl	Skagit Bay Juvenile Salmon [3]	5/16/2009	Harbor seal		1	1
Pelagic trawl	JSC	5/23/2009	Unidentified small cetacean [4]	2		2
Pelagic trawl [5]	Northern Juvenile Rockfish	5/26/2009	California sea lion	1	1	2
Pelagic trawl	JSC	5/24/2010	Harbor seal	1		1
Pelagic trawl	JSC	6/28/2012	Pacific white-sided dolphin	3		3
Pelagic trawl	JSC	6/21/2014	Pacific white-sided dolphin	6		6
Total individuals captured (total number of interactions given in parentheses).			Northern fur seal (1)	1		1
			California sea lion (3)	3	1	4
			Pacific white-sided dolphin (8)	24		24
			Harbor seal (3)	2	1	3
			Steller sea lion (5)	8		8

[1] All incidents involved use of the Nordic 264 surface trawl, except as noted below.
[2] Survey discontinued.
[3] This incident occurred in Puget Sound; all other incidents occurred in waters offshore Washington and Oregon.
[4] Animals not identified before fishing crew returned carcasses to sea.
[5] This incident involved use of the modified Cobb midwater trawl.

Although some historical interactions resulted in the animal(s) being released alive, no serious injury determinations (NMFS, 2012a; 2012b) were made, and it is possible that some of these animals later died. In order to use these historical interaction records in a precautionary manner as the basis for the take estimation process, and because we have no specific information to indicate whether any given future interaction might result in M/SI versus Level A harassment, we conservatively assume that all interactions equate to mortality. Over the past seventeen years, NWFSC has had only infrequent interactions with marine mammals, with 0.1–0.5 animals captured per year for the pinniped species and 1.4 animals captured per year for the Pacific white-sided dolphin. No Steller sea lion has been captured since 2002, northern fur seals have been involved in only one incident (none since 2000), and only a few California sea lions and harbor seals have been involved in interactions with research fishing gear. However, we assume that any of these species could be captured in any year.

In order to produce the most precautionary take estimates possible, we consider all of the data available to us (*i.e.,* since 1999). In consideration of these interaction records, we assume that one individual of each species of otariid pinniped could be captured per year over the course of the five-year period of validity for these proposed regulations, that two individual harbor seals could be captured per year, and that the worst case event could happen each year for Pacific white-sided dolphins (*i.e.,* six dolphins could be captured in a single trawl in each year). Table 5 shows the projected five-year total captures of these five species for this proposed rule, as described above, for trawl gear only. Although more than one individual of the two sea lion species has been captured in a single tow, interactions with these species have historically occurred only infrequently, and we believe that the above assumption appropriately reflects the likely total number of individuals involved in research gear interactions over a five-year period. We assume that two total harbor seals could be captured per year in recognition of the demonstrated vulnerability to capture in the PSRA (all other species have been captured only in the CCRA). These estimates are based on the assumption that annual effort (*e.g.,* total annual trawl tow time) over the proposed five-year authorization period will not exceed the annual effort during prior years for which we have interaction records.

TABLE 5—PROJECTED FIVE-YEAR TOTAL TAKE IN TRAWL GEAR FOR HISTORICALLY CAPTURED SPECIES

Gear	Species	CCRA average annual take (total)	PSRA average annual take (total)	Projected 5-year total [1]
Trawl	Pacific white-sided dolphin	6 (30)		30
	California sea lion	1 (5)		5
	Harbor seal	1 (5)	1 (5)	10
	Northern fur seal	1 (5)		5
	Steller sea lion	1 (5)		5

[1] Because there are no historical take records from the LCRRA, we incorporate all projected LCRRA takes in Table 7 below.

In order to estimate the total potential number of incidents of M/SI + Level A that could occur incidental to the NWFSC's use of trawl, hook and line, and seine gear over the five-year period of validity for these proposed regulations (*i.e.,* takes additional to those described in Table 4), we first consider whether there are additional species that may have similar vulnerability to capture in trawl gear as the five species described above that have been taken historically and then evaluate the potential vulnerability of these and other species to additional gears.

As background to the process of determining which species not historically taken may have sufficient vulnerability to capture in NWFSC gear to justify inclusion in the take authorization request (or whether species historically taken may have vulnerability to gears in which they have not historically been taken or additional vulnerability not reflected above due to activity in other areas such as the LCRRA), we note that the NWFSC is NMFS' research arm in the northwest portion of the West Coast Region and may be considered as a leading source of expert knowledge regarding marine mammals (*e.g.,* behavior, abundance, density) in the areas where they operate. The species for which the take request was formulated were selected by the NWFSC, and we have concurred with these decisions.

In order to evaluate the potential vulnerability of additional species to trawl and of all species to hook and line and seine gear, we first consulted NMFS' List of Fisheries (LOF), which classifies U.S. commercial fisheries into one of three categories according to the level of incidental marine mammal M/SI that is known to occur on an annual basis over the most recent five-year period (generally) for which data has been analyzed: Category I, frequent incidental M/SI; Category II, occasional incidental M/SI; and Category III, remote likelihood of or no known incidental M/SI. We provide summary information, as presented in the 2015 LOF (79 FR 77919; December 29, 2014), in Table 6. In order to simplify information presented, and to encompass information related to other similar species from different locations, we group marine mammals by genus (where there is more than one member of the genus found in U.S. waters). Where there are documented incidents of M/SI incidental to relevant commercial fisheries, we note whether we believe those incidents provide sufficient basis upon which to infer vulnerability to capture in NWFSC research gear. For a listing of all Category I, II, and II fisheries using relevant gears, associated estimates of fishery participants, and specific locations and fisheries associated with the historical fisheries takes indicated in Table 6 below, please see the 2015 LOF. For specific numbers of marine mammal takes associated with these fisheries, please see the relevant SARs. More information is available on the Internet at *www.nmfs.noaa.gov/pr/interactions/lof/* and *www.nmfs.noaa.gov/pr/sars/.*

TABLE 6—U.S. COMMERCIAL FISHERIES INTERACTIONS FOR TRAWL, HOOK AND LINE, AND SEINE GEAR FOR RELEVANT SPECIES

Species [1]	Trawl [2]	Vulnerability inferred? [3]	Hook and line [2]	Vulnerability inferred? [3]	Seine [2]	Vulnerability inferred? [3]
Gray whale	Y	N	N	n/a	N	n/a
Humpback whale	Y	N	Y	N	Y	N
Balaenoptera spp.	Y	N	Y	N	N	n/a
Sperm whale	N	n/a	Y	N	N	n/a
Kogia spp.	N	n/a	Y	Y	N	n/a
Cuvier's beaked whale	N	n/a	Y	N	N	n/a
Baird's beaked whale	N	n/a	N	n/a	N	n/a
Mesoplodon spp.	N	n/a	Y	N	N	n/a
Common bottlenose dolphin	Y	Y	Y	Y	Y	N
Stenella spp.	N	n/a	Y	Y	N	n/a
Delphinus spp.	Y	Y	Y	Y	Y	Y
Lagenorhynchus spp.[4]	n/a	n/a	N	n/a	N	n/a
Northern right whale dolphin	Y [6]	Y	N	n/a	N	n/a
Risso's dolphin	Y	Y	Y	Y	N	n/a
Killer whale	Y	N	Y	N	N	n/a
Globicephala spp.	Y	N	Y	Y	Y	N
Harbor porpoise	Y	Y	N	n/a	N	n/a
Dall's porpoise	Y	Y	Y	N	N	n/a
Guadalupe fur seal [5]	N	n/a	N	n/a	N	n/a
Northern fur seal [4]	n/a	n/a	Y	N	N	n/a
California sea lion [4]	n/a	n/a	Y [6]	Y	Y	Y
Steller sea lion [4]	n/a	n/a	Y	Y	N	n/a
Phoca spp.[4]	n/a	n/a	N	n/a	Y	Y
Northern elephant seal	Y	N	N	n/a	N	n/a

[1] Please refer to Table 3 for taxonomic reference.
[2] Indicates whether any member of the genus has documented incidental M/SI in a U.S. fishery using that gear in the most recent five-year timespan for which data is available.
[3] Where there are no documented incidents of M/SI incidental to relevant commercial fisheries, this is not applicable.
[4] This exercise is considered ''not applicable'' for trawl gear for those species historically captured by NWFSC gear. Historical record, rather than analogy, is considered the best information upon which to base a take estimate.
[5] It is likely that Guadalupe fur seals are taken in Mexican fisheries, but there are no records available to us.
[6] There are no records of take for California sea lions in commercial hook and line fisheries, but there have been multiple takes of California sea lions in longline surveys conducted by the SWFSC. There are no records of take for northern right whale dolphins in commercial trawl fisheries, but this species has been captured in a trawl survey conducted by the SWFSC. We therefore infer vulnerability for those species to those research gears.

Information related to incidental M/SI in relevant commercial fisheries is not, however, the sole determinant of whether it may be appropriate to authorize M/SI + Level A incidental to NWFSC survey operations. A number of factors (*e.g.,* species-specific knowledge regarding animal behavior, overall abundance in the geographic region, density relative to NWFSC survey effort, feeding ecology, propensity to travel in groups commonly associated with other species historically taken) were taken into account by the NWFSC to determine whether a species may have a similar vulnerability to certain types of gear as historically taken species. In some cases, we have determined that species without documented M/SI may nevertheless be vulnerable to capture in NWFSC research gear. Similarly, we have determined that some species groups with documented M/SI are not likely to be vulnerable to capture in NWFSC gear. In these instances, we provide further explanation below. Those species with no records of historical interaction with NWFSC research gear and no documented M/SI in relevant commercial fisheries, and for which the NWFSC has not requested the authorization of incidental take, are not considered further in this section. The NWFSC believes generally that any sex or age class of those species for which take authorization is requested could be captured.

In order to estimate a number of individuals that could potentially be captured in NWFSC research gear for those species not historically captured, we first determine which species may have vulnerability to capture in a given gear. Of those species, we then determine whether any may have similar propensity to capture in a given gear as a historically captured species. These species are limited to a few species delphinid species that we believe may have similar risk of capture as that displayed by the Pacific white-sided dolphin. For these species, we assume it is possible that a worst-case scenario of take could occur while at the same time contending that, absent significant range shifts or changes in habitat usage, capture of a species not historically captured would likely be a very rare event. The former assumption also accounts for the likelihood that, for species that often travel in groups, an incident involving capture of that species is likely to involve more than one individual.

For example, we believe that the Risso's dolphin is potentially vulnerable to capture in trawl gear and may have similar propensity to capture in that gear as does the Pacific white-sided dolphin. Because the greatest number of Pacific white-sided dolphins captured in any one trawl tow was six individuals, we assume that six Risso's dolphins could also be captured in a single incident. However, in recognition of the fact that any incident involving the capture of Risso's dolphins would likely be a rare event, we propose a total take authorization over the five-year period of the number that may result from a single, worst-case incident (six dolphins). While we do not necessarily believe that six Risso's dolphins would be captured in a single incident—and that more capture incidents involving fewer individuals could occur, as opposed to a single, worst-case incident—we believe that this is a reasonable approach to estimating potential incidents of M/SI + Level A while balancing what could happen in a worst-case scenario with the potential likelihood that no incidents of capture would actually occur. The SWFSC historical capture of northern right whale dolphins in 2008 provides an instructive example of a situation where a worst-case scenario (six dolphins captured in a single trawl tow) did occur, but overall capture of this species was very rare (no other capture incidents before or since).

Separately, for those species that we believe may have a vulnerability to capture in given gear but that we do not believe may have a similar propensity to capture in that gear as a historically captured species, we assume that capture would be a rare event such that authorization of a single take over the five-year period is likely sufficient to capture the risk of interaction. For example, from the LOF we infer vulnerability to capture in trawl gear for the Dall's porpoise but do not believe that this species has a similar propensity for interaction in trawl gear as the Pacific white-sided dolphin.

NWFSC requested authorization of incidental take for bottlenose dolphin, for either the offshore or coastal stock. However, we have had clarifying conversations with NWFSC to more explicitly understand the interaction risk posed by NWFSC survey operations. Coastal stock dolphins are generally found within 1 km of shore, from San Francisco Bay south to Mexican waters. This distribution has very little overlap with NWFSC research survey activity and, when coupled with the limited effort involved in NWFSC survey operations in that range and the mitigation measure proposed to be implemented, we do not believe that incidental take of coastal stock bottlenose dolphins is reasonably likely and do not propose to authorize take from this stock.

Trawl—From the 2015 LOF and SWFSC historical gear interactions, we infer vulnerability to trawl gear in the CCRA for the Risso's dolphin, short- and long-beaked common dolphins, northern right whale dolphin, Dall's porpoise, harbor porpoise, and bottlenose dolphin. We consider some of these species to have a similar propensity for interaction with trawl gear as that demonstrated by the Pacific white-sided dolphin (Risso's dolphin, northern right whale dolphin) and the rest to have lower risk of interaction.

Due to their likely presence in the relevant areas and inference based on historical interactions and the LOF, we assume additional vulnerability and therefore potential take for some of these species in trawl gear used in the PSRA and LCRRA. In the PSRA, these include the harbor porpoise and Dall's porpoise and the California sea lion and Steller sea lion. In the LCRRA these include the harbor porpoise and the harbor seal, California sea lion, and Steller sea lion.

For the striped dolphin, we believe that there is a reasonable likelihood of incidental take in trawl gear although there are no records of incidental M/SI in relevant commercial fisheries. The proposed take authorization for this species was determined to be appropriate based on analogy to other similar species that have been taken either in NWFSC operations or in analogous commercial fishery operations. We believe that the striped dolphin has a similar propensity for interaction with trawl gear as that demonstrated by the Pacific white-sided dolphin.

It is also possible that a captured animal may not be able to be identified to species with certainty. Certain pinnipeds and small cetaceans are difficult to differentiate at sea, especially in low-light situations or when a quick release is necessary. For example, a captured delphinid that is struggling in the net may escape or be freed before positive identification is made. This is only likely to occur in the CCRA due to the greater diversity of pinniped and small cetacean species likely to be encountered in that area. Therefore, the NWFSC has requested the authorization of incidental M/SI + Level A for one unidentified pinniped and one unidentified small cetacean over the course of the five-year period of proposed authorization.

Hook and line—The process is the same as is described above for trawl gear. From the 2015 LOF and SWFSC historical interactions, we infer vulnerability to hook and line gear in the CCRA for the Risso's dolphin, bottlenose dolphin, striped dolphin, pygmy and dwarf sperm whale (*i.e., Kogia* spp.), short- and long-beaked common dolphins, short-finned pilot whale, and California and Steller sea lions.

Due to their likely presence in the relevant areas and inference based on historical interactions and the LOF, we assume additional vulnerability and therefore potential take for some of these species in hook and line gear used in the PSRA (hook and line gear is not used in the LCRRA). These include the California sea lion and harbor seal.

Seine—The process is the same as is described above for trawl gear. From the 2015 LOF, we infer vulnerability to seine and tangle net gear in the CCRA and/or LCRRA for the short-beaked common dolphin, harbor seal, and California sea lion. Long-beaked common dolphin is not included because they are much rarer in Oregon and Washington where seine surveys are conducted. Seine gear is used infrequently in the PSRA (*e.g.,* twelve purse seine sets per year) and the move-on rule applied if any small cetacean is seen within 500 m of the planned set. We do not believe that any take in seine gear is likely in the PSRA.

We also believe that there is a reasonable potential of seine gear interaction for a number of species in the CCRA and/or LCRRA for which there are no LOF records of interaction in commercial fisheries gears. These proposed authorizations reflect the NWFSC's expert judgment regarding the distribution of these species in relation to NWFSC use of seine gear offshore Oregon and Washington. For example, several of these species have the potential to interact with NWFSC purse seine surveys in the Columbia River plume, where there are no corresponding commercial seine fisheries. Therefore, we would not expect the LOF to adequately reflect the risk of marine mammal interaction posed by NWFSC survey activities. Species for which we propose to authorize take in seine gear in the CCRA and/or LCRRA with no LOF interaction records include the Dall's porpoise, Pacific white-sided dolphin, Risso's dolphin, northern right whale dolphin, Steller sea lion, and harbor porpoise. For the harbor porpoise, we expect that there is greater vulnerability to take in these gears (*i.e.,* we expect it could be taken in both the CCRA and LCRRA) and have increased the proposed take authorization relative to the other species accordingly. NWFSC considers the delphinid species to be at risk because of their occurrence in coastal waters offshore Oregon and Washington, and because they often occur in mixed schools and could be caught together in purse seines.

TABLE 7—TOTAL ESTIMATED M/SI + LEVEL A DUE TO GEAR INTERACTION, 2016–21

Species	Estimated 5-year total, trawl [1]	Estimated 5-year total, hook and line [1]	Estimated 5-year total, seine [1]	Total, all gears
Kogia spp. [2]		1		1
Bottlenose dolphin [3]	1	1		2
Striped dolphin	6	1		7
Short-beaked common dolphin	1	1	1	3
Long-beaked common dolphin	1	1		2
Pacific white-sided dolphin	30		1	31
Northern right whale dolphin	6		1	7
Risso's dolphin	6	1	1	8
Short-finned pilot whale		1		1
Harbor porpoise [4]	3 (CCRA/PSRA/LCRRA)		2 (CCRA/LCRRA)	5
Dall's porpoise	2 (CCRA/PSRA)		1	3
Northern fur seal [5]	5			5
California sea lion	7 (5 CCRA/PSRA/LCRRA)	2 (CCRA/PSRA)	1 (LCRRA)	10
Steller sea lion	7 (5 CCRA/PSRA/LCRRA)	1	1 (LCRRA)	9
Harbor seal [4]	11 (5 CCRA/5 PSRA/LCRRA	1 (PSRA)	1 (LCRRA)	13
Unidentified pinniped	1			1
Unidentified small cetacean	1			1

[1] Please see Table 6 and preceding text for derivation of take estimates. Takes proposed for authorization are not specific to any area, but our estimates are informed by area-specific vulnerability. All takes are expected to occur in the CCRA, except where the gear-specific breakdown of expected takes per area is provided. Note that hook and line surveys are not proposed for LCRRA and only limited seine surveys are proposed for PSRA.

[2] We expect that only one *Kogia* spp. may be taken over the five-year timespan and that it could be either a pygmy or dwarf sperm whale.

[3] Incidental take is expected only from the offshore stock.

[4] Incidental take for these species may be of animals from any stock in California, Oregon, or Washington, but expected vulnerability may be assigned to CCE or Washington inland waters stocks according to the expected take proportions shown.

[5] Incidental take may be of animals from either the eastern Pacific or California stock.

For large whales, beaked whales, and killer whales, observed M/SI is extremely rare for trawl and seine gear and, for most of these species, only slightly more common in longline gear. Although large whale species could become captured or entangled in NWFSC gear, the probability of interaction is extremely low considering the lower level of effort relative to that of commercial fisheries. For example, there were estimated to be three total incidents of sperm whale M/SI in the Hawaii deep-set longline fishery from 2007–11. This fishery has 129 participants, and the fishery as a whole exerts substantially greater effort in a given year than does the NWFSC. In a very rough estimate, we can say that these three estimated incidents between 2007–11 represent an insignificant per-participant interaction rate of 0.005 per year, despite the greater effort. Similarly, there were zero documented interactions from 2007–11 in the Atlantic Ocean, Caribbean, Gulf of Mexico large pelagics longline fishery, despite a reported fishing effort of 8,044 sets and 5,955,800 hooks in 2011 alone (Garrison and Stokes, 2012). With an average soak time of ten to fourteen hours, this represents an approximate minimum of almost sixty million hook hours. For reference, an approximate maximum estimate of NWFSC effort in the CCRA is 52,000 hook-hours per year. Other large whales, beaked whales and killer whales have similarly low rates of interaction with commercial fisheries, despite the significantly greater effort. In addition, large whales, beaked whales, and killer whales generally have, with few exceptions, very low densities in the CCE relative to other species (see Table 10). We believe it extremely unlikely that any large whale, beaked whale, or killer whale would be captured or entangled in NWFSC research gear.

There are a number of additional species with various LOF interaction records where we do not infer vulnerability to NWFSC use of that gear. Pilot whales have demonstrated vulnerability to midwater trawl gear in Atlantic fisheries and to purse seine gear, but we do not infer vulnerability to capture during NWFSC use of these gears because of the species is not abundant in the CCRA (Table 10). Bottlenose dolphins have been captured in purse seines, but they are also very rare in the areas where NWFSC conducts seine surveys. Similarly, we do not infer vulnerability to hook and line gear for Dall's porpoise or fur seals or to trawl gear for elephant seals given the amount of research effort conducted (for hook and line) or the rare nature of fisheries interactions for elephant seals.

Estimated Take Due to Acoustic Harassment

As described previously (''Potential Effects of the Specified Activity on Marine Mammals''), we believe that NWFSC use of active acoustic sources has, at most, the potential to cause Level B harassment of marine mammals. In order to attempt to quantify the potential for Level B harassment to occur, NMFS (including the NWFSC and acoustics experts from other parts of NMFS) developed an analytical framework considering characteristics of the active acoustic systems described previously under ''Description of Active Acoustic Sound Sources,'' their expected patterns of use, and characteristics of the marine mammal species that may interact with them. We believe that this quantitative assessment benefits from its simplicity and consistency with current NMFS acoustic guidance regarding Level B harassment but caution that, based on a number of deliberately precautionary assumptions, the resulting take estimates may be seen as an overestimate of the potential for behavioral harassment to occur as a result of the operation of these systems. Additional details on the approach used and the assumptions made that result in these estimates are described below.

The operating frequencies of active acoustic systems used by NWFSC sources only go down to 27–33 kHz for the trawl monitoring system, which is not one of the predominant sources, and to 38 kHz for the EK60 echosounder (see Table 2 and Table 8). These frequencies are above the hearing range of baleen whales (*i.e.,* mysticetes); therefore, baleen whales would not be expected to perceive signals from NWFSC active acoustic sources, and we would not expect any exposures to these signals to result in behavioral harassment. Baleen whales are not considered further in this section.

The assessment paradigm for active acoustic sources used in NWFSC fisheries research is relatively straightforward and has a number of key simplifying assumptions. NMFS' current acoustic guidance requires in most cases that we assume Level B harassment occurs when a marine mammal receives an acoustic signal at or above a simple step-function threshold. For use of these active acoustic systems, the appropriate threshold is 160 dB re 1 μPa (rms). 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 area of operation.

Quantifying the spatial and temporal dimension of the sound exposure footprint (or "swath width") 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 the relevant threshold for each area. The number of potential incidents of Level B harassment is ultimately estimated as the product of the volume of water ensonified at 160 dB rms or higher 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 across different marine mammal species were made to segregate those that predominately remain in the upper 200 m of the water column versus those that regularly dive deeper during foraging and transit. 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. Note that NWFSC only uses active acoustic systems for data acquisition purposes in the CCRA.

Sound source characteristics—An initial characterization of the general source parameters for the primary active acoustic sources operated by the NWFSC was conducted, enabling a full assessment of all sound sources used by the NWFSC and delineation of Category 1 and Category 2 sources, the latter of which were carried forward for analysis here (see Table 2). This auditing of the active acoustic sources also enabled a determination of the predominant sources that, when operated, would have sound footprints exceeding those from any other simultaneously used 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.

Many of these sources can be operated in different modes and with different output parameters. In modeling their potential impact areas, those features among those given previously in Table 2 (*e.g.,* lowest operating frequency) that would lead to the most precautionary estimate of maximum received level ranges (*i.e.,* largest ensonified area) were used. The effective beam patterns took into account the normal modes in which these sources are typically operated. While these signals are brief and intermittent, a conservative assumption was taken in ignoring the temporal pattern of transmitted pulses in calculating Level B harassment events. Operating characteristics of each of the predominant sound sources were used in the calculation of effective line-kilometers and area of exposure for each source in each survey.

TABLE 8—EFFECTIVE EXPOSURE AREAS FOR PREDOMINANT ACOUSTIC SOURCES ACROSS TWO DEPTH STRATA

Active acoustic system	Effective exposure area: Sea surface to 200 m depth (km^2)	Effective exposure area: Sea surface to depth at which 160-dB threshold is reached (km^2)
Simrad EK60 narrow beam echosounder	0.0142	0.1411
Simrad ME70 multibeam echosounder	0.0201	0.0201
Simrad FS70 trawl sonar	0.008	0.008
Simrad SX90 narrow beam sonar [1]	0.0654	0.1634
Teledyne RD Instruments ADCP, Ocean Surveyor	0.0086	0.0187
Simrad ITI trawl monitoring system	0.0032	0.0032

[1] Exposure area varies greatly depending on the tilt angle setting of the SX90. To approximate the varied usage this system might receive, the exposure area for each depth strata was averaged by assuming equal usage at tilt angles of 5, 20, 45, and 80 degrees.

Among Category 2 sources (Table 2), six predominant sources (Table 8) 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. Estimated effective cross-sectional areas of exposure were estimated for each of the predominant sources using a commercial software package (MATLAB) and key input parameters including source-specific operational characteristics (*i.e.,* frequency, beamwidth, source level, tilt angle, and horizontal and vertical resolution; see Table 2) and environmental characteristics (*i.e.,* temperature, salinity, pH, and latitude). Where relevant, calculations were performed for different notional operational scenarios and the largest cross-sectional area used in estimating take (*e.g.,* see Figure 6.2 of NWFSC's application, which displays a simple visualization of a two-dimensional slice of modeled sound propagation to illustrate the predicted area ensonified to the 160-dB threshold by the nominal EK60 beam pattern assuming side lobes of ensonification).

In determining the effective line-kilometers for each of these predominant sources, 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 are used simultaneously, the one with the largest potential impact zone in each relevant depth strata is considered for use in estimating exposures. For example, when species (*e.g.,* sperm whales) regularly dive deeper than 200 m, the largest potential impact zone was calculated for both depth strata and in some cases resulted in a different source being predominant in one depth stratum or the other. 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 (Table 8; SX90, EK60, and ME70) comprising the total effective line-kilometers, their relative proportions depending on the nature of each survey.

Calculating effective line-kilometers—As described below, based on the operating parameters for each source type, an estimated volume of water ensonified at or above the 160 dB rms threshold was determined. In all cases where multiple sources are operated simultaneously, the one with the largest estimated acoustic footprint was considered to be the effective source. This was calculated for each depth stratum (0–200 m and greater than 200 m), which in some cases resulted in different sources being predominant in each depth stratum for all line-kilometers when multiple sources were in operation; this was accounted for in estimating overall exposures for species that utilize both depth strata (deep divers). The total number of line-kilometers that would be surveyed was determined, as was the relative percentage of surveyed linear kilometers associated with each source type. The total line-kilometers for each vessel, the effective percentages associated with each of the resulting three predominant source types (SX90, EK60, and ME70), and the effective total line-kilometers of operation for each source type are given below.

Calculating volume of water ensonified—The cross-sectional area of water ensonified at or above the 160 dB rms threshold 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 * log [range]; such that there would be a 6-dB reduction in sound level for each doubling of distance from the source), a reasonable approximation over the relatively short ranges involved, and accounted for the frequency-dependent absorption coefficient (α at 8 °C and 34 ppt) and beam pattern of these sound sources, which is generally highly directional. 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 (0–200 m and surface to range at which the on-axis received level reaches 160 dB rms). These results, shown in Table 8, were applied differentially based on the typical vertical stratification of marine mammals (see Table 10).

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 ensonified at or above 160 dB rms for the entirety of each survey. For each of the three predominant sound sources, the volume of water ensonified is estimated as the athwartship cross-sectional area (in square kilometers) of sound at or above 160 dB rms (as illustrated in Figure 6.2 of NWFSC's application) multiplied by the total distance traveled by the ship. Where different sources operating simultaneously would be predominant in each different depth strata (*e.g.,* ME70 and EK60 operating simultaneously may be predominant in the shallow stratum and deep stratum, respectively), the resulting cross-sectional area calculated took this into account. Specifically, for shallow-diving species this cross-sectional area was determined for whichever was predominant in the shallow stratum, whereas for deeper-diving species this area was calculated from the combined effects of the predominant source in the shallow stratum and the (sometimes different) source predominating in the deep stratum. This creates an effective total volume characterizing the area ensonified 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.

Marine mammal densities—One of the primary limitations to traditional estimates of behavioral harassment from 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 (*e.g.,* Navy, 2013). 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 were estimated from marine mammal Stock Assessment Reports (Allen and Angliss, 2015; Carretta *et al.,* 2015a) and other sources (Barlow and Forney, 2007; ManTech-SRS Technologies, 2007). There are a number of caveats associated with these estimates:

(1) 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 NWFSC fisheries surveys (detailed previously in ''Detailed Description of Activities'').

(2) The densities used for purposes of estimating acoustic exposures 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 often 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 greater than 200 m) based on gross differences between known generally surface-associated and typically deep-diving marine mammals (*e.g.,* Reynolds and Rommel, 1999; Perrin *et al.,* 2009). Animals in the shallow-diving stratum were assumed, on the basis of empirical measurements of diving with monitoring tags and reasonable assumptions of behavior based on other indicators, to spend a large majority of their lives (*i.e.,* greater than 75 percent) at depths shallower than 200 m. Their volumetric density and thus exposure to sound is therefore limited by this depth boundary. In contrast, species in the deeper-diving stratum were assumed to regularly dive deeper than 200 m and spend significant time at these greater depths. Their volumetric density and thus potential exposure to sound at or above the 160 dB rms threshold is extended from the surface to the depth at which this received level condition occurs (*i.e.,* corresponding to the 0 to greater than 200 m depth stratum).

The volumetric densities are estimates of the three-dimensional distribution of animals in their typical depth strata. For shallow-diving species the volumetric density is the area density divided by 0.2 km (*i.e.,* 200 m). For deeper diving species, the volumetric density is the area density divided by a nominal value of 0.5 km (*i.e.,* 500 m). The two-dimensional and resulting three-dimensional (volumetric) densities for each species in each ecosystem area are shown below.

Using area of ensonification and volumetric density to estimate exposures—Estimates of potential incidents of Level B harassment (*i.e.,* potential exposure to levels of sound at or exceeding the 160 dB rms threshold) are then calculated by using (1) the combined results from output characteristics of each source and identification of the predominant sources in terms of acoustic output; (2) their relative annual usage patterns for each operational area; (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; and (4) determination of a biologically-relevant volumetric density of marine mammal species in each area. Estimates of Level B harassment by acoustic sources are the product of the volume of water ensonified at 160 dB rms or higher for the predominant sound source for each portion of the total line-kilometers for which it is used and the volumetric density of animals for each species. These annual estimates are given below.

We first provide information related to relative annual usage patterns of predominant active acoustic sources. For example, the use of the ME70 and EK60 account for predominant sources during all surveys on the R/V *Bell M. Shimada,* with the EK60 used during one hundred percent of distance traveled (Table 9). When the ME70 is on, it is the dominant source in the 0–200 m depth stratum (0.0201 km^2 cross-sectional ensonified area versus 0.0142 km^2 cross-sectional ensonified area for the EK60; Table 8); therefore, the ME70 is the dominant active acoustic source for twenty percent of the line-kilometers and the EK60 is the dominant active acoustic source for the other eighty percent. However, in the deeper depth stratum, the EK60 is always the dominant source when compared with the ME70 (0.1411 km^2 cross-sectional ensonified area versus 0.0201 km^2 cross-sectional ensonified area for the ME70; Table 8); therefore, the EK60 is the dominant active acoustic source in the deeper depth stratum at all times for the *Shimada.* However, of the total line-kilometers of NWFSC survey activity aboard the *Shimada,* only forty percent are in waters greater than 200 m.

TABLE 9—ANNUAL LINEAR SURVEY KILOMETERS FOR EACH VESSEL AND ITS PREDOMINANT SOURCES WITHIN TWO DEPTH STRATA

Vessel	Line-kms/ vessel	Source	% time source dominant (0–200 m)	Line-km/ dominant source (0–200 m)	% time source dominant (>200 m)	Line-km/ dominant source (>200 m)
Lasker	4,500	SX90	100	4,500	50	2,250
Shimada	18,494	ME70	20	3,699	0	0
	....	EK60	80	14,795	40	7,398

Next, we provide volumetric densities for marine mammals in the CCRA and total estimated takes by Level B harassment, by dominant source and total, for each species in the CCRA (Table 10). We also provide a sample calculation.

We first determine the source-specific ensonified volume of water (*i.e.,* the ensonified volume where we consider a specific source to be predominant and therefore have the potential to harass marine mammals) and then determine source- and species-specific exposure estimates for the shallow and deep (if applicable; Table 10) depth strata. First, we know the estimated source-specific cross-sectional ensonified area within the shallow and deep strata (Table 8) and the number of annual line-kilometers when a given source would be predominant in each stratum and use these values to derive an estimated source-specific ensonified volume. In order to estimate the additional volume of ensonified water in the deep stratum, we first subtract the cross-sectional ensonified area of the shallow stratum (which is already accounted for) from that of the deep stratum. Source- and stratum-specific exposure estimates are the product of these ensonified volumes and the species-specific volumetric densities (Table 10).

To illustrate the process, we focus on the EK60 and the sperm whale.

(1) EK60 ensonified volume; 0–200 m: $0.0142\ km^2 * 14{,}795\ km = 210.1\ km^3$

(2) EK60 ensonified volume; >200 m: $(0.1411\ km^2 - 0.0142\ km^2) * 7{,}398\ km = 938.8\ km^3$

(3) Estimated exposures to sound ≥160 dB rms; sperm whale; EK60: (0.003 sperm whales/km^3 * 210.1 km^3 = 0.7 [rounded to 1]) + (0.003 sperm whales/km^3 * 938.8 km^3 = 3.2 [rounded to 3]) = 4 estimated sperm whale exposures to SPLs ≥160 dB rms resulting from use of the EK60.

TABLE 10—DENSITIES AND ESTIMATED SOURCE-, STRATUM-, AND SPECIES-SPECIFIC ANNUAL ESTIMATES OF LEVEL B HARASSMENT

Species	Shallow	Deep	Area density (animals/ km^2) [1]	Volumetric density (animals/ km^3) [2]	Estimated Level B harassment, 0–200 m			Estimated Level B harassment, >200 m		Total
					EK60	ME70	SX90	EK60	SX90	
Sperm whale	....	X	0.002	0.003	1	0	1	3	1	6

TABLE 10—DENSITIES AND ESTIMATED SOURCE-, STRATUM-, AND SPECIES-SPECIFIC ANNUAL ESTIMATES OF LEVEL B HARASSMENT—Continued

Species	Shallow	Deep	Area density (animals/ km^2) [1]	Volumetric density (animals/ km^3) [2]	Estimated Level B harassment, 0–200 m			Estimated Level B harassment, >200 m		Total
					EK60	ME70	SX90	EK60	SX90	
Kogia spp.		X	0.001	0.002	0	0	1	2	0	3
Cuvier's beaked whale		X	0.004	0.008	2	1	2	7	2	14
Baird's beaked whale		X	0.001	0.002	0	0	1	2	0	3
Mesoplodont beaked whales		X	0.001	0.002	0	0	1	2	0	3
Bottlenose dolphin	X		0.002	0.009	2	1	3	0	0	6
Striped dolphin	X		0.017	0.083	18	6	25	0	0	49
Long-beaked common dolphin	X		0.019	0.096	20	7	28	0	0	55
Short-beaked common dolphin	X		0.309	1.547	325	115	455	0	0	895
Pacific white-sided dolphin	X		0.021	0.105	22	8	31	0	0	61
Northern right whale dolphin	X		0.010	0.049	10	4	14	0	0	28
Risso's dolphin	X		0.010	0.052	11	4	15	0	0	30
Killer whale	X		0.001	0.004	1	0	1	0	0	2
Short-finned pilot whale		X	0.0003	0.001	0	0	0	1	0	1
Harbor porpoise	X		[4] 0.038	0.189	40	14	56	0	0	110
Dall's porpoise	X		0.076	0.378	79	28	111	0	0	218
Guadalupe fur seal	X		[3] 0.007	0.037	8	3	11	0	0	22
Northern fur seal	X		[3] 0.649	3.245	682	241	955	0	0	1,878
California sea lion	X		[3] 0.297	1.484	312	110	437	0	0	859
Steller sea lion	X		[3] 0.060	0.301	63	22	89	0	0	174
Harbor seal	X		[3] 0.056	0.279	59	21	82	0	0	162
Northern elephant seal		X	[3] 0.179	0.358	75	27	105	336	79	622

[1] All density estimates from Barlow and Forney (2007) unless otherwise indicated.
[2] Volumetric density estimates derived by dividing area density estimates by 0.2 km (for shallow species) or 0.5 km (for deep species), corresponding with defined depth strata.
[3] Density estimates derived by NWFSC from SAR abundance estimates and notional study area of 1,000,000 km^2.
[4] ManTech-SRS Technologies (2007) estimated a harbor porpoise density for coastal and inland waters of Washington, which is used as the best available proxy here. There are no known density estimates for harbor porpoises in NWFSC survey areas in the CCRA.

Estimated Take Due to Physical Disturbance

Estimated take due to physical disturbance could potentially happen in the PSRA and LCRRA, and would result in no greater than Level B harassment. It is likely that some pinnipeds will move or flush from known haul-outs into the water in response to the presence or sound of NWFSC vessels or researchers, as a result of unintentional approach during survey activity. Behavioral responses may be considered according to the scale shown in Table 11 and based on the method developed by Mortenson (1996). We consider responses corresponding to Levels 2–3 to constitute Level B harassment.

TABLE 11—SEAL RESPONSE TO DISTURBANCE

Level	Type of response	Definition
1	Alert	Seal head orientation or brief movement in response to disturbance, which may include turning head towards the disturbance, craning head and neck while holding the body rigid in a u-shaped position, changing from a lying to a sitting position, or brief movement of less than twice the animal's body length.
2	Movement	Movements away from the source of disturbance, ranging from short withdrawals at least twice the animal's body length to longer retreats over the beach.
3	Flight	All retreats (flushes) to the water.

The NWFSC has estimated potential incidents of Level B harassment due to physical disturbance (Table 12) by considering the number of seals believed to potentially be present at affected haul-outs and the number of visits expected to be made by NWFSC researchers. The number of haul-outs disturbed and number of animals assumed to be on those haul-outs was determined by NWFSC on the basis of anecdotal evidence from researchers. Although not all individuals on ''disturbed'' haul-outs would necessarily actually be disturbed, and some haul-outs may experience some disturbance at distances greater than expected, we believe that this approach is a reasonable effort towards accounting for this potential source of disturbance.

TABLE 12—ESTIMATED ANNUAL LEVEL B HARASSMENT OF PINNIPEDS ASSOCIATED WITH DISTURBANCE BY RESEARCHERS

Species	Location	Estimated total number of animals on potentially disturbed haul-outs	Number of visits per year	Estimated annual Level B harassment
Harbor seal	Puget Sound	1,440	8	11,520
	Columbia River	3,000	25	75,000
California sea lion	Puget Sound	350	8	2,800

Summary of Estimated Incidental Take

Here we provide a summary of the total proposed incidental take authorization on an annual basis, as well other information relevant to the negligible impact analysis. Table 13 shows information relevant to our negligible impact analysis concerning the total annual taking that could occur for each stock from NMFS' scientific research activities when considering incidental take previously authorized for SWFSC (80 FR 58982; September 30, 2015) and take proposed for authorization for NWFSC. As footnoted in Table 13, the indicated level of take could occur to any species or stock for those species with multiple stocks (*e.g.,* Northern fur seal) or considered as a group (*e.g.,* Mesoplodont beaked whales). However, the harbor porpoise and harbor seal each have multiple stocks spanning the three NWFSC research areas, and we provide further detail regarding our consideration of potential take specific to stocks that may occur in the PSRA and LCRRA. Many stocks do not occur in those research areas and, therefore, would not be vulnerable to interaction with research gear deployed in those areas.

For harbor porpoise, we propose to authorize a total of five takes by M/SI + Level A for all stocks combined over the five-year period of validity for these proposed regulations. For the purposes of the negligible impact analysis, we assume that all of these takes could potentially be in the form of M/SI; PBR is not intended for assessment of the significance of harassment. These takes could occur to any stock; however, our proposed take authorization is informed by reasonable expectation regarding species vulnerability to gear used in the three research areas. Of the five total takes, we expect that two might occur in the CCRA, one in the PSRA, and two in the LCRRA. Therefore, corresponding with the relationship between stock ranges and the location of NWFSC research activities, the likely maximum takes that could accrue to any harbor porpoise stock from California to southern Oregon would be two, while the northern Oregon/Washington coast stock could potentially accrue four takes because it is vulnerable to the takes expected in either the CCRA or LCRRA. In Table 13 below, the proposed total take authorization column reflects the total of four takes that could occur in either the CCRA or LCRRA (and the one take expected in the PSRA, which would occur to the Washington inland waters stock). However, the estimated maximum annual take column reflects the annualized stock-specific risk, *i.e.,* any stock in the CA-southern OR grouping is expected to be vulnerable to a maximum of two takes over the five-year period (0.4/year) while the northern OR/WA coast stock could be vulnerable to as many as four takes over the five years (0.8/year). This stock-specific accounting does not change our expectation that a total of five takes would occur for all stocks combined but informs our stock-specific negligible impact analysis.

Similarly, the harbor seal has separate designated stocks that may occur in all three research areas. We propose to authorize a total of thirteen takes by M/SI + Level A for all harbor seal stocks combined, and expect that five of these may occur in the CCRA, six in the PSRA, and two in the LCRRA. Therefore, while we would expect that a maximum of five takes could accrue to the California stock, as many as seven takes could occur for the Oregon/Washington coastal stock (which is the only stock that may occur in the LCRRA). Although NMFS has split the former Washington inland waters stock of harbor seals into three separate stocks, we do not have sufficient information to assess stock-specific risk in the PSRA. Separately, we have estimated that 162 incidents of acoustic harassment may occur for harbor seals due to NWFSC use of active acoustic systems (in the CCRA only) and that, due to the physical presence of researchers, individual harbor seals on haul-outs (as many as 3,000) may be disturbed up to 25 times per year in the LCRRA. Therefore, as shown in Table 13, the California stock of harbor seals is vulnerable to only the estimated 162 acoustic harassment takes, but the OR/WA coast stock would be vulnerable to both the acoustic harassment takes as well as the physical disturbance takes. However, note that the percent of estimated population is calculated considering the number of individuals anticipated to be disturbed rather than the number of incidents of disturbance.

We previously authorized take of marine mammals incidental to fisheries research operations conducted by the SWFSC (see 80 FR 58982 and 80 FR 68512). This take would occur to some of the same stocks for which we propose to authorize take incidental to NWFSC fisheries research operations. Therefore, in order to evaluate the likely impact of the take by M/SI proposed for authorization in this rule, we consider not only other ongoing sources of human-caused mortality but the potential mortality authorized for SWFSC. As used in this document, other ongoing sources of human-caused (anthropogenic) mortality refers to estimates of realized or actual annual mortality reported in the SARs and does not include authorized or unknown mortality. Below, we consider the total taking by M/SI proposed for authorization for NWFSC and previously authorized for SWFSC together to produce a maximum annual M/SI take level (including take of unidentified marine mammals that could accrue to any relevant stock) and compare that value to the stock's PBR value, considering ongoing sources of anthropogenic mortality (as described in footnote 4 of Table 13 and in the following discussion). PBR and annual M/SI values considered in Table 13 reflect the most recent information available (*i.e.,* final 2014 and draft 2015 SARs, as appropriate).

TABLE 13—SUMMARY INFORMATION RELATED TO NWFSC PROPOSED ANNUAL TAKE AUTHORIZATION, 2016–21

Species [1]	Proposed total annual Level B harassment authorization [2]	Percent of estimated population abundance	Proposed total M/SI [3] authorization, 2016–21	SWFSC total M/SI authorization, 2015–20	Estimated maximum annual M/SI [4]	PBR minus annual M/SI (%) [5]	Stock trend [6]
Sperm whale	6	0.3	0	0	0	n/a	?
Kogia spp.	3	0.5	1	1	0.4	2.7 (14.8)	?
Cuvier's beaked whale	14	0.2	0	0	0	n/a	↓
Baird's beaked whale	3	0.4	0	0	0	n/a	?
Mesoplodont beaked whales	3	0.4	0	0	0	n/a	↓
Bottlenose dolphin (offshore stock)	6	0.6	2	9	2.6	3.5 (74.3)	?
Striped dolphin	49	0.4	7	12	4.2	82 (5.1)	?
Long-beaked common dolphin	55	0.1	2	12	3.2	596.2 (0.5)	↑
Short-beaked common dolphin	895	0.2	3	12	3.4	3,376 (0.1)	?
Pacific white-sided dolphin	61	0.2	31	35	13.6	159.2 (8.5)	?
Northern right whale dolphin	28	0.3	7	10	3.8	44.4 (8.6)	?
Risso's dolphin	30	0.5	8	12	4.4	37.4 (11.8)	?
Killer whale [7]	2	0.8	0	0	0	n/a	?
Short-finned pilot whale	1	0.1	1	1	0.4	4.6 (8.7)	?
Harbor porpoise (CA-southern OR stocks) [7]	110	3.8	4	5	1.8	20.4 (8.8)	?
Harbor porpoise (Northern OR/WA coast)					2.2	148 (1.5)	?
Harbor porpoise (WA inland waters)	0	n/a	1	0	0.2	60.8 (0.3)	?
Dall's porpoise	218	0.5	3	5	2	256.6 (0.8)	?
Guadalupe fur seal	22	0.3	0	0	0	n/a	↑
Northern fur seal [6]	[8] 1,878	0.3	5	5	2.4	449.4 (0.5)	↑
California sea lion	3,659	0.4	10	25	7.6	8,815 (0.1)	↑
Steller sea lion	174	[8] 0.3	9	10	4.4	1,552.7 (0.3)	↑
Harbor seal (CA)	75,162	0.6	5	9	3.2	1,598 (0.2)	→
Harbor seal (OR/WA coast)		12.8	2		1.8	Unknown	→
Harbor seal (WA inland waters)	11,520	10.5	6	0	1.2	Unknown	→
Northern elephant seal	622	0.3	5	5	2.2	4,873.2 (0.1)	↑
Unidentified small cetacean	n/a	n/a	1	1	n/a	n/a	n/a
Unidentified pinniped	n/a	n/a	1	2	n/a	n/a	n/a

Please see Tables 7, 10, and 12 and preceding text for details.

[1] For species with multiple stocks or for species groups (*Kogia* spp. and Mesoplodont beaked whales), indicated level of take could occur to individuals from any stock or species except as indicated in table.

[2] Level B harassment totals include estimated take due to acoustic harassment and, for harbor seals and California sea lions, estimated take due to physical disturbance. Active acoustic devices are not used for data acquisition in the PSRA; therefore, no takes by acoustic harassment are expected for stocks that occur entirely or largely in inland waters (*e.g.,* resident killer whales). Takes by physical disturbance for pinniped species represent repeated takes of smaller numbers of individuals (*e.g.,* we expect as many as 1,440 harbor seals in the PSRA to be harassed on as many as eight occasions). The "percent of estimated population" column represents this smaller number of individuals taken rather than the total number of take incidents.

[3] As explained earlier in this document, gear interaction could result in mortality, serious injury, or Level A harassment. Because we do not have sufficient information to enable us to parse out these outcomes, we present such take as a pool. For purposes of this negligible impact analysis we assume the worst case scenario (that all such takes result in mortality).

[4] This column represents the total number of incidents of M/SI that could potentially accrue to the specified species or stock as a result of NMFS' fisheries research activities and is the number carried forward for evaluation in the negligible impact analysis (later in this document). To reach this total, we add one to the total for each pinniped or cetacean that may be captured in trawl gear in the CCRA. This represents the potential that the take of an unidentified pinniped or small cetacean could accrue to any given stock captured in that gear in that area. The proposed take authorization is formulated as a five-year total; the annual average is used only for purposes of negligible impact analysis. We recognize that portions of an animal may not be taken in a given year.

[5] This value represents the calculated PBR less the average annual estimate of ongoing anthropogenic mortalities (*i.e.,* total annual human-caused M/SI, which is presented in the SARs) (see Table 3). For the Pacific-white sided dolphin, harbor seal, and California sea lion, we subtract the annual average of mortalities occurring incidental to NWFSC fisheries research during 2007–11 from the total human-caused M/SI prior to calculating this value, as we explicitly account for predicted future mortalities incidental to NWFSC fisheries research via the estimated maximum annual M/SI + Level A column. In parentheses, we provide the estimated maximum annual M/SI expressed as a percentage of this value.

[6] See relevant SARs for more information regarding stock status and trends. Interannual increases may not be interpreted as evidence of a trend. Based on the most recent abundance estimates, harbor seal stocks may have reached carrying capacity and appear stable. A time series of stock-specific abundance estimates for harbor porpoise shows either increasing or stable estimates, but it is not statistically valid to infer a trend.

[7] These species have multiple stocks that may be affected. Values for "percent of estimated population" and "PBR—annual M/SI" (where relevant) calculated for the stock with the lowest population abundance and/or PBR (as appropriate). This approach assumes that all indicated takes would accrue to the stock in question, which is a very conservative assumption. Stocks in question are the offshore killer whale, Morro Bay harbor porpoise, and California northern fur seal.

[8] A range is provided for Steller sea lion abundance. We have used the lower bound of the given range for calculation of this value.

[8] Calculated on the basis of relative abundance; *i.e.,* of 1,878 total estimated incidents of Level B harassment, we would expect on the basis of relative abundance in the study area that 98 percent would accrue to the Pribilof Islands/Eastern Pacific stock and two percent would accrue to the California stock.

Analyses and Preliminary Determinations

Negligible Impact Analysis

Introduction—NMFS has defined ''negligible impact'' in 50 CFR 216.103 as ''. . . an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.'' A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.,* population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be ''taken'' by mortality, serious injury, and Level A or Level B harassment, we consider other factors, such as the likely nature of any behavioral responses (*e.g.,* intensity, duration), the context of any such responses (*e.g.,* critical reproductive time or location, migration), as well as effects on habitat. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status (*i.e.,* the environmental baseline).

Consistent with the 1989 preamble for NMFS' implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into these analyses via their impacts on the environmental baseline (*e.g.,* as reflected in the regulatory status of the species, population size and growth rate where known, other ongoing sources of human-caused mortality, and specific consideration of take by M/SI + Level A previously authorized for other NMFS research activities).

In 1988, Congress amended the MMPA, with provisions for the incidental take of marine mammals in commercial fishing operations. Congress directed NMFS to develop and recommend a new long-term regime to govern such incidental taking (see MMC, 1994). The need to set allowable take levels incidental to commercial fishing operations led NMFS to suggest a new conceptual means for assuring that incidental take does not cause any marine mammal species or stock to be reduced or to be maintained below the lower limit of its Optimum Sustainable Population (OSP) level. That concept, potential biological removal (PBR), was incorporated in the 1994 amendments to the MMPA, wherein Congress enacted MMPA sections 117 and 118, establishing a new regime governing the incidental taking of marine mammals in commercial fishing operations and stock assessments.

PBR, which is defined by the MMPA (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,'' is one tool that can be used to help evaluate the effects of M/SI on a marine mammal stock. OSP is defined by the MMPA (16 U.S.C. 1362(9)) as ''the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element.'' A primary goal of the MMPA is to ensure that each stock of marine mammal either does not have a level of human-caused M/SI that is likely to cause the stock to be reduced below its OSP level or, if the stock is depleted (*i.e.,* below its OSP level), does not have a level of human-caused mortality and serious injury that is likely to delay restoration of the stock to OSP level by more than ten percent in comparison with recovery time in the absence of human-caused M/SI.

PBR, a parametric concept that relates survivorship to population size, was developed in consideration of the principle given by Holt and Talbot (1978): ''Management decisions should include a safety factor to allow for the facts that knowledge is limited and institutions are imperfect'' (Taylor, 1993). PBR values are calculated by NMFS as the level of annual removal from a stock that will allow that stock to equilibrate within OSP at least 95 percent of the time, and is the product of factors relating to the minimum population estimate of the stock (N_{min}); the productivity rate of the stock at a small population size; and a recovery factor. Determination of appropriate values for these three elements incorporates significant precaution, such that application of the parameter to the management of marine mammal stocks may be reasonably certain to achieve the goals of the MMPA. For example, calculation of N_{min} incorporates the precision and variability associated with abundance information and is intended to provide reasonable assurance that the stock size is equal to or greater than the estimate (Barlow *et al.,* 1995). In general, the three factors are developed on a stock-specific basis in consideration of one another in order to produce conservative PBR values that appropriately account for both imprecision that may be estimated as well as potential bias stemming from lack of knowledge (Wade, 1998).

PBR was not designed as an absolute threshold limiting human activities, but as a means to evaluate the relative impacts of those activities on marine mammal stocks. Specifically, assessing M/SI relative to a stock's PBR may signal to NMFS the need to establish take reduction teams in commercial fisheries and may assist NMFS and existing take reduction teams in the identification of measures to reduce and/or minimize the taking of marine mammals by commercial fisheries to a level below a stock's PBR. That is, where the total annual human-caused M/SI exceeds PBR, NMFS is not required to halt fishing activities contributing to total M/SI but rather may prioritize working with a take reduction team to further mitigate the effects of fishery activities via additional bycatch reduction measures. In addition, PBR alone is not used to authorize or deny authorization of commercial fisheries that may incidentally take marine mammals.

Since the introduction of PBR, NMFS has used the concept almost entirely within the context of implementing sections 117 and 118 and other commercial fisheries management-related provisions of the MMPA, including those within section 101(a)(5)(E) related to the taking of ESA-listed marine mammals incidental to commercial fisheries (64 FR 28800; May 27, 1999). The MMPA requires that PBR be estimated in stock assessment reports and that it be used in applications related to the management of take incidental to commercial fisheries (*i.e.,* the take reduction planning process described in section 118 of the MMPA and the determination of whether a stock is ''strategic'' [16 U.S.C. 1362(19)]), but nothing in the MMPA requires the application of PBR outside the management of commercial fisheries interactions with marine mammals. Although NMFS has not historically applied PBR outside the context of sections 117, 118, and 101(a)(5)(E), NMFS recognizes that as a quantitative tool, PBR may be useful in certain instances for evaluating the impacts of other human-caused activities on marine mammal stocks.

Our use of PBR here (for NWFSC fisheries research activities) does not make up the entirety of our impact assessment, but rather is being utilized as a known, quantitative metric for evaluating whether the proposed activities are likely to have a population-level effect on the affected marine mammal stocks. Here, we calculate a metric that incorporates information regarding ongoing anthropogenic mortality into the PBR value; *i.e.,* PBR minus the reported annual anthropogenic mortality estimate (also referred to as ''residual PBR''; Wood *et al.,* 2012). We first consider maximum potential incidental M/SI for NMFS research relative to this metric for each affected stock (see Table 13), in consideration of NMFS' defined significance threshold for M/SI (ten percent of PBR [69 FR 43338; July 20, 2004]). By considering the maximum potential incidental M/SI in relation to PBR and other ongoing sources of anthropogenic mortality, we ensure that the potential incremental addition of M/SI through NMFS' fisheries research activities does not pose a risk to the stock that bears further consideration here. We also consider the interaction of those removals with incidental taking of that stock by harassment pursuant to the specified activity (*i.e.,* NWFSC fisheries research activities).

Therefore, for those stocks with total incidental M/SI less than the significance threshold (*i.e.,* ten percent of residual PBR), we consider the effects of the specified activity to represent an insignificant incremental increase in ongoing anthropogenic M/SI and need not consider other factors in making a negligible impact determination except in combination with additional incidental take by harassment. For those stocks with incidental M/SI exceeding the significance threshold, we will consider additional factors that may either increase or reduce the level of concern related to the significance of a given level of taking—such as implementation of mitigation measures or additional population stressors—in addition to considering the interaction of those removals with incidental taking of that stock by harassment.

Analysis—Please see Table 13 for information related to this analysis. The large majority of stocks that may potentially be taken by M/SI + Level A (18 of 21) fall below the significance threshold, while an additional four stocks do not have current PBR values and therefore are evaluated using other factors. We first consider stocks expected to be affected only by behavioral harassment and those stocks that fall below the significance threshold. Next, we consider those stocks above the significance threshold (*i.e., Kogia* spp.; the offshore stock of bottlenose dolphin, and Risso's dolphin) and those without PBR values (harbor seals along the Oregon and Washington coasts and in Washington inland waters).

As described in greater depth previously (see ''Acoustic Effects''), we do not believe that NWFSC use of active acoustic sources has the likely potential to cause any effect exceeding Level B harassment of marine mammals. In addition, for the majority of species, the proposed annual take by Level B harassment is very low in relation to the population abundance estimate (less than one percent). We have produced what we believe to be precautionary estimates of potential incidents of Level B harassment. The procedure for producing these estimates, described in detail in ''Estimated Take Due to Acoustic Harassment,'' represents NMFS' best effort towards balancing the need to quantify the potential for occurrence of Level B harassment due to production of underwater sound with a general lack of information related to the specific way that these acoustic signals, which are generally highly directional and transient, interact with the physical environment and to a meaningful understanding of marine mammal perception of these signals and occurrence in the areas where NWFSC operates. The sources considered here have moderate to 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. In addition, some of these sources 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 impacts on marine mammals in comparison with the quantitative estimates that guide our proposed take authorization.

In addition, otariid pinnipeds are less likely than other taxa to perceive acoustic signals generated by NWFSC or, given perception, to react to these signals than the quantitative estimates indicate. This group of pinnipeds has reduced functional hearing at the higher frequencies produced by active acoustic sources considered here (*e.g.,* primary operating frequencies of 40–180 kHz) and, based purely on their auditory capabilities, the potential impacts are likely much less than we have calculated as these relevant factors are not taken into account.

As described previously, there is some minimal potential for temporary effects to hearing for certain marine mammals, but most effects would likely be limited to temporary behavioral disturbance. Effects on individuals that are taken by Level B harassment will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring), reactions that are considered to be of low severity (*e.g.,* Southall *et al.,* 2007). Individuals may move away from the source if disturbed, but because the source is itself moving and because of the directional nature of the sources considered here, there is unlikely to be even temporary displacement from areas of significance and any disturbance would be of short duration. Although there is no information on which to base any distinction between incidents of harassment and individuals harassed, the same factors, in conjunction with the fact that NWFSC survey effort is widely dispersed in space and time, indicate that repeated exposures of the same individuals would be very unlikely. For these reasons, we do not consider the proposed level of take by acoustic disturbance to represent a significant additional population stressor when considered in context with the proposed level of take by M/SI + Level A for any species.

Similarly, disturbance of pinnipeds on haul-outs by researchers approaching on foot or in small vessels (as is expected for harbor seals in the lower Columbia River and Puget Sound and for California sea lions in Puget Sound) are expected to be infrequent and cause only a temporary disturbance on the order of minutes. As noted previously, monitoring results from other activities involving the disturbance of pinnipeds and relevant studies of pinniped populations that experience more regular vessel disturbance indicate that individually significant or population level impacts are unlikely to occur. When considering the individual animals likely affected by this disturbance, only a small fraction (less than fifteen percent) of the estimated population abundance of the affected stocks would be expected to experience the disturbance.

For *Kogia* spp. and Risso's dolphin, maximum total potential M/SI due to NMFS' fisheries research activity (SWFSC and NWFSC combined) approaches fifteen and twelve percent of residual PBR, respectively. There are no other known sources of anthropogenic M/SI for *Kogia* spp. The only known source of other anthropogenic mortality for Risso's dolphin is in commercial fisheries, but such take is considered to be insignificant and approaching zero mortality and serious injury. For example, PBR for Risso's dolphin is currently set at 39 and the annual average of known ongoing anthropogenic M/SI is 1.6, yielding a residual PBR value of 37.4. The maximum combined annual average M/SI incidental to NMFS fisheries research activity is 4.4, or 11.8 percent of residual PBR.

M/SI incidental to NMFS' fisheries research activities could be as much as 74 percent of residual PBR for the offshore stock of bottlenose dolphin, assuming a worst-case scenario in which take of an unidentified cetacean is applied to this stock. Fisheries bycatch of this stock occurs on an annual basis, though this ongoing level of M/SI is accounted for. The majority of takes in commercial fisheries from 2007–11 were due to interactions with the California drift gillnet fishery, and it is possible that these interactions have declined since the use of acoustic pingers was required. Any level of removals up to PBR could occur while still allowing the stock to reach or maintain its optimum sustainable population, as indicated in the definition of the PBR metric. Nevertheless, given the small PBR value, fluctuation in the amount of incidental take could result in unsustainable levels of removal from the stock. If bycatch in commercial fisheries increases, or other sources of mortality are recorded for this stock, we will use the adaptive management provisions of the proposed regulations to prescribe increased mitigation sufficient to reduce the likelihood of incidental take in NMFS fisheries research activities. No population trends are known for these three stocks.

PBR is unknown for harbor seals on the Oregon and Washington coasts and in Washington inland waters (comprised of the Hood Canal, southern Puget Sound, and Washington northern inland waters stocks). The Hood Canal, southern Puget Sound, and Washington northern inland waters stocks were formerly a single inland waters stock. Both the Oregon/Washington coast and Washington inland waters stocks of harbor seal were considered to be stable following the most recent abundance estimates (in 1999, stock abundances were estimated at 24,732 and 13,692, respectively). However, a Washington Department of Fish and Wildlife expert (S. Jeffries) stated an unofficial abundance of 32,000 harbor seals in Washington (Mapes, 2013). Therefore, it is reasonable to assume that at worst, the stocks have not declined since the last abundance estimates. Ongoing anthropogenic mortality is estimated at 10.6 harbor seals per year for the coastal stock and 13.4 for inland waters seals; therefore, we reasonably assume that the maximum potential annual M/SI incidental to NMFS' fisheries research activities (1.8 and 1.2, respectively) is a small fraction of any sustainable take level that might be calculated for either stock. For the reasons stated above, we do not consider the proposed level of take by acoustic and physical disturbance for harbor seals to represent a significant additional population stressor when considered in context with the proposed level of take by M/SI.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the planned mitigation measures, we preliminarily find that the total marine mammal take from NWFSC's fisheries research activities will have a negligible impact on the affected marine mammal species or stocks. In summary, this finding of negligible impact is founded on the following factors: (1) The possibility of injury, serious injury, or mortality from the use of active acoustic devices may reasonably be considered discountable; (2) the anticipated incidents of Level B harassment from the use of active acoustic devices and physical disturbance of pinnipeds consist of, at worst, temporary and relatively minor modifications in behavior; (3) the predicted number of incidents of potential mortality are at insignificant levels (*i.e.,* below ten percent of residual PBR) for a majority of affected stocks; (4) consideration of additional factors for *Kogia* spp. and Risso's dolphin do not reveal cause for concern; (5) total maximum potential M/SI incidental to NMFS fisheries research activity for bottlenose dolphin, considered in conjunction with other sources of ongoing mortality, is currently sustainable because it is below the residual PBR level; (6) available information regarding two harbor seal stocks indicates that total maximum potential M/SI is sustainable; and (7) the presumed efficacy of the planned mitigation measures in reducing the effects of the specified activity to the level of least practicable adverse impact. In addition, no M/SI is proposed for authorization for any species or stock that is listed under the ESA or considered depleted under the MMPA. In combination, we believe that these factors demonstrate that the specified activity will have only short-term effects on individuals (resulting from Level B harassment) and that the total level of taking will not impact rates of recruitment or survival sufficiently to result in population-level impacts.

Small Numbers Analysis

Please see Table 13 for information relating to this small numbers analysis. The total amount of taking proposed for authorization is less than one percent for a large majority of stocks. The total amount of taking for remaining stocks ranges from four to thirteen percent.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed mitigation measures, we preliminarily find that small numbers of marine mammals will be taken relative to the populations of the affected species or stocks.

Proposed Monitoring and Reporting

In order to issue an incidental take authorization for an activity, section 101(a)(5)(A) of the MMPA states that NMFS must set forth ''requirements pertaining to the monitoring and reporting of such taking.'' The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for incidental take authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area.

Any monitoring requirement we prescribe should improve our understanding of one or more of the following:

- Occurrence of marine mammal species in action area (*e.g.,* presence, abundance, distribution, density).
- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) Action or environment (*e.g.,* source characterization, propagation, ambient noise); (2) affected species (*e.g.,* life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.,* age, calving, or feeding areas).
- Individual responses to acute stressors, or impacts of chronic exposures (behavioral or physiological).
- How anticipated responses to stressors impact either: (1) Long-term fitness and survival of an individual; or (2) population, species, or stock.
- Effects on marine mammal habitat and resultant impacts to marine mammals.
- Mitigation and monitoring effectiveness.

NWFSC plans to make more systematic its training, operations, data collection, animal handling and sampling protocols, etc. in order to improve its ability to understand how mitigation measures influence interaction rates and ensure its research operations are conducted in an informed manner and consistent with lessons learned from those with experience operating these gears in close proximity to marine mammals. It is in this spirit that we propose the monitoring requirements described below.

Visual Monitoring

Marine mammal watches are a standard part of conducting fisheries research activities, and are implemented as described previously in ''Proposed Mitigation.'' Dedicated marine mammal visual monitoring occurs as described (1) for some period prior to deployment of most research gear; (2) throughout deployment and active fishing of all research gears; (3) for some period prior to retrieval of longline gear; and (4) throughout retrieval of all research gear. This visual monitoring is performed by trained NWFSC personnel with no other responsibilities during the monitoring period. Observers record the species and estimated number of animals present and their behaviors, which may be valuable information towards an understanding of whether certain species may be attracted to vessels or certain survey gears. Separately, marine mammal watches are conducted by watch-standers (those navigating the vessel and other crew; these will typically not be NWFSC personnel) at all times when the vessel is being operated. The primary focus for this type of watch is to avoid striking marine mammals and to generally avoid navigational hazards. These watch-standers typically have other duties associated with navigation and other vessel operations and are not required to record or report to the scientific party data on marine mammal sightings, except when gear is being deployed or retrieved.

In the PSRA and LCRRA only, the NWFSC will monitor any potential disturbance of hauled-out pinnipeds, paying particular attention to the distance at which different species of pinniped are disturbed. Disturbance will be recorded according to the three-point scale, representing increasing seal response to disturbance, shown in Table 11.

Training

NWFSC anticipates that additional information on practices to avoid marine mammal interactions can be gleaned from training sessions and more systematic data collection standards. The NWFSC will conduct annual trainings for all chief scientists and other personnel who may be responsible for conducting dedicated marine mammal visual observations to explain mitigation measures and monitoring and reporting requirements, mitigation and monitoring protocols, marine mammal identification, recording of count and disturbance observations (relevant to AMLR surveys), completion of datasheets, and use of equipment. Some of these topics may be familiar to NWFSC staff, who may be professional biologists; the NWFSC shall determine the agenda for these trainings and ensure that all relevant staff have necessary familiarity with these topics. The first training such will include three primary elements:

First, the course will provide an overview of the purpose and need for the authorization, including mandatory mitigation measures by gear and the purpose for each, and species that NWFSC is authorized to incidentally take.

Second, the training will provide detailed descriptions of reporting, data collection, and sampling protocols. This portion of the training will include instruction on how to complete new data collection forms such as the marine mammal watch log, the incidental take form (*e.g.,* specific gear configuration and details relevant to an interaction with protected species), and forms used for species identification and biological sampling. The biological data collection and sampling training module will include the same sampling and necropsy training that is used for the West Coast Regional Observer training.

NWFSC will also dedicate a portion of training to discussion of best professional judgment (which is recognized as an integral component of mitigation implementation; see ''Proposed Mitigation''), including use in any incidents of marine mammal interaction and instructive examples where use of best professional judgment was determined to be successful or unsuccessful. We recognize that many factors come into play regarding decision-making at sea and that it is not practicable to simplify what are inherently variable and complex situational decisions into rules that may be defined on paper. However, it is our intent that use of best professional judgment be an iterative process from year to year, in which any at-sea decision-maker (*i.e.,* responsible for decisions regarding the avoidance of marine mammal interactions with survey gear through the application of best professional judgment) learns from the prior experience of all relevant NWFSC personnel (rather than from solely their own experience). The outcome should be increased transparency in decision-making processes where best professional judgment is appropriate and, to the extent possible, some degree of standardization across common situations, with an ultimate goal of reducing marine mammal interactions. It is the responsibility of the NWFSC to facilitate such exchange.

Handling Procedures and Data Collection

Improved standardization of handling procedures were discussed previously in ''Proposed Mitigation.'' In addition to the benefits implementing these protocols are believed to have on the animals through increased post-release survival, NWFSC believes adopting these protocols for data collection will also increase the information on which ''serious injury'' determinations (NMFS, 2012a, b) are based and improve scientific knowledge about marine mammals that interact with fisheries research gears and the factors that contribute to these interactions. NWFSC personnel will be provided standard guidance and training regarding handling of marine mammals, including how to identify different species, bring an individual aboard a vessel, assess the level of consciousness, remove fishing gear, return an individual to water and log activities pertaining to the interaction.

NWFSC will record interaction information on either existing data forms created by other NMFS programs or will develop their own standardized forms. To aid in serious injury determinations and comply with the current NMFS Serious Injury Guidelines (NMFS, 2012a, b), researchers will also answer a series of supplemental questions on the details of marine mammal interactions.

Finally, for any marine mammals that are killed during fisheries research activities, scientists will collect data and samples pursuant to Appendix D of the NWFSC DEA, ''Protected Species Handling Procedures for NWFSC Fisheries Research Vessels.''

Reporting

As is normally the case, NWFSC will coordinate with the relevant stranding coordinators for any unusual marine mammal behavior and any stranding, beached live/dead, or floating marine mammals that are encountered during field research activities. The NWFSC will follow a phased approach with regard to the cessation of its activities and/or reporting of such events, as described in the proposed regulatory texts following this preamble. In addition, Chief Scientists (or cruise leader, CS) will provide reports to NWFSC leadership and to the Office of Protected Resources (OPR). As a result, when marine mammals interact with survey gear, whether killed or released alive, a report provided by the CS will fully describe any observations of the animals, the context (vessel and conditions), decisions made and rationale for decisions made in vessel and gear handling. The circumstances of these events are critical in enabling NWFSC and OPR to better evaluate the conditions under which takes are most likely occur. We believe in the long term this will allow the avoidance of these types of events in the future.

The NWFSC will submit annual summary reports to OPR including: (1) Annual line-kilometers surveyed during which the EK60, ME70, SX90 (or equivalent sources) were predominant (see ''Estimated Take by Acoustic Harassment'' for further discussion), specific to each region; (2) summary information regarding use of all hook and line, seine, and trawl gear, including number of sets, hook hours, tows, etc., specific to each research area and gear; (3) accounts of all incidents of marine mammal interactions, including circumstances of the event and descriptions of any mitigation procedures implemented or not implemented and why; (4) summary information related to any disturbance of pinnipeds, including event-specific total counts of animals present, counts of reactions according to the three-point scale shown in Table 11, and distance of closest approach; and (5) a written evaluation of the effectiveness of NWFSC mitigation strategies in reducing the number of marine mammal interactions with survey gear, including best professional judgment and suggestions for changes to the mitigation strategies, if any. The period of reporting will be annually, beginning one year post-issuance of any LOA, and the report must be submitted not less than ninety days following the end of a given year. Submission of this information is in service of an adaptive management framework allowing NMFS to make appropriate modifications to mitigation and/or monitoring strategies, as necessary, during the proposed five-year period of validity for these regulations.

NMFS has established a formal incidental take reporting system, the Protected Species Incidental Take (PSIT) database, requiring that incidental takes of protected species be reported within 48 hours of the occurrence. The PSIT generates automated messages to NMFS leadership and other relevant staff, alerting them to the event and to the fact that updated information describing the circumstances of the event has been inputted to the database. The PSIT and CS reports represent not only valuable real-time reporting and information dissemination tools, but also serve as an archive of information that may be mined in the future to study why takes occur by species, gear, region, etc.

NWFSC will also collect and report all necessary data, to the extent practicable given the primacy of human safety and the well-being of captured or entangled marine mammals, to facilitate serious injury (SI) determinations for marine mammals that are released alive. NWFSC will require that the CS complete data forms and address supplemental questions, both of which have been developed to aid in SI determinations. NWFSC understands the critical need to provide as much relevant information as possible about marine mammal interactions to inform decisions regarding SI determinations. In addition, the NWFSC will perform all necessary reporting to ensure that any incidental M/SI is incorporated as appropriate into relevant SARs.

Adaptive Management

The regulations governing the take of marine mammals incidental to NWFSC fisheries research survey operations would contain an adaptive management component. The inclusion of an adaptive management component will be both valuable and necessary within the context of five-year regulations for activities that have been associated with marine mammal mortality.

The reporting requirements associated with this proposed rule are designed to provide OPR with monitoring data from the previous year to allow consideration of whether any changes are appropriate. OPR and the NWFSC will meet annually to discuss the monitoring reports and current science and whether mitigation or monitoring modifications are appropriate. The use of adaptive management allows OPR to consider new information from different sources to determine (with input from the NWFSC regarding practicability) on an annual or biennial basis if mitigation or monitoring measures should be modified (including additions or deletions). Mitigation measures could be modified if new data suggests that such modifications would have a reasonable likelihood of reducing adverse effects to marine mammals and if the measures are practicable.

The following are some of the possible sources of applicable data to be considered through the adaptive management process: (1) Results from monitoring reports, as required by MMPA authorizations; (2) results from general marine mammal and sound research; and (3) any information which reveals that marine mammals may have been taken in a manner, extent, or number not authorized by these regulations or subsequent LOAs.

Impact on Availability of Affected Species for Taking for Subsistence Uses

There are no relevant subsistence uses of marine mammals implicated by these actions. Therefore, we have determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act (ESA)

There are multiple marine mammal species listed under the ESA with confirmed or possible occurrence in the proposed specified geographical region (see Table 3). The proposed authorization of incidental take pursuant to the NWFSC's specified activity would not affect any designated critical habitat. OPR has initiated consultation with NMFS' West Coast Regional Office under section 7 of the ESA on the promulgation of five-year regulations and the subsequent issuance of LOAs to NWFSC under section 101(a)(5)(A) of the MMPA. This consultation will be concluded prior to issuing any final rule.

National Environmental Policy Act (NEPA)

The NWFSC has prepared a Draft Environmental Assessment (EA; *Draft Programmatic Environmental Assessment for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center*) in accordance with NEPA and the regulations published by the Council on Environmental Quality. It is posted on the Internet at: *www.nmfs.noaa.gov/pr/permits/incidental/research.htm.* We have independently evaluated the Draft EA and are proposing to adopt it. We may prepare a separate NEPA analysis and incorporate relevant portions of NWFSC's EA by reference. Information in NWFSC's application, EA and this notice collectively provide the environmental information related to proposed issuance of these regulations for public review and comment. We will review all comments submitted in response to this notice as we complete the NEPA process, including a decision of whether to sign a Finding of No Significant Impact, prior to a final decision on the incidental take authorization request.

Request for Information

NMFS requests interested persons to submit comments, information, and suggestions concerning the NWFSC request and the proposed regulations (see **ADDRESSES**). All comments will be reviewed and evaluated as we prepare final rules and make final determinations on whether to issue the requested authorizations. This notice and referenced documents provide all environmental information relating to our proposed action for public review.

Classification

Pursuant to the procedures established to implement Executive Order 12866, the Office of Management and Budget has determined that this proposed rule is not significant.

Pursuant to section 605(b) of the Regulatory Flexibility Act (RFA), the Chief Counsel for Regulation of the Department of Commerce has certified to the Chief Counsel for Advocacy of the Small Business Administration that this proposed rule, if adopted, would not have a significant economic impact on a substantial number of small entities. NMFS is the sole entity that would be subject to the requirements in these proposed regulations, and NMFS is not a small governmental jurisdiction, small organization, or small business, as defined by the RFA. Because of this certification, a regulatory flexibility analysis is not required and none has been prepared.

This proposed rule does not contain a collection-of-information requirement subject to the provisions of the Paperwork Reduction Act (PRA) because the applicant is a federal agency. Notwithstanding any other provision of law, no person is required to respond to nor shall a person be subject to a penalty for failure to comply with a collection of information subject to the requirements of the PRA unless that collection of information displays a currently valid OMB control number. These requirements have been approved by OMB under control number 0648–0151 and include applications for regulations, subsequent LOAs, and reports.

List of Subjects in 50 CFR Part 219

Exports, Fish, Imports, Indians, Labeling, Marine mammals, Penalties, Reporting and recordkeeping requirements, Seafood, Transportation.

Dated: June 6, 2016.

Samuel D. Rauch III,

Deputy Assistant Administrator for Regulatory Programs, National Marine Fisheries Service.

For reasons set forth in the preamble, 50 CFR part 219 is proposed to be amended as follows:

PART 219—REGULATIONS GOVERNING THE TAKING AND IMPORTING OF MARINE MAMMALS

■ 1. The authority citation for part 219 continues to read as follows:

Authority: 16 U.S.C. 1361 *et seq.*

Subpart D [Reserved]

■ 2. Add and reserve subpart D.

■ 3. Add subpart E to part 219 to read as follows:

Subpart E—Taking Marine Mammals Incidental to Northwest Fisheries Science Center Fisheries Research in the California Current

Sec.

§ 219.41 Specified activity and specified geographical region.

(a) Regulations in this subpart apply only to the National Marine Fisheries Service's (NMFS) Northwest Fisheries Science Center (NWFSC) and those persons it authorizes or funds to conduct activities on its behalf for the taking of marine mammals that occurs in the area outlined in paragraph (b) of this section and that occurs incidental to research survey program operations.

(b) The taking of marine mammals by NWFSC may be authorized in a Letter of Authorization (LOA) only if it occurs within the California Current Ecosystem, including Puget Sound and the Columbia River.

§ 219.42 Effective dates.

Regulations in this subpart are effective from [EFFECTIVE DATE OF FINAL RULE] through [DATE 5 YEARS AFTER EFFECTIVE DATE OF FINAL RULE].

§ 219.43 Permissible methods of taking.

(a) Under LOAs issued pursuant to §§ 216.106 and 219.47 of this chapter, the Holder of the LOA (hereinafter ''NWFSC'') may incidentally, but not intentionally, take marine mammals within the area described in § 219.41(b) of this chapter by Level B harassment associated with use of active acoustic systems and physical or visual disturbance of hauled-out pinnipeds and by Level A harassment, serious injury, or mortality associated with use of hook and line gear, trawl gear, and seine gear, provided the activity is in compliance with all terms, conditions, and requirements of the regulations in this subpart and the appropriate LOA.

§ 219.44 Prohibitions.

Notwithstanding takings contemplated in § 219.41 and authorized by a LOA issued under §§ 216.106 and 219.47 of this chapter, no person in connection with the activities described in § 219.41 of this chapter may:

(a) Violate, or fail to comply with, the terms, conditions, and requirements of this subpart or a LOA issued under §§ 216.106 and 219.47 of this chapter;

(b) Take any marine mammal not specified in such LOAs;

(c) Take any marine mammal specified in such LOAs in any manner other than as specified;

(d) Take a marine mammal specified in such LOAs if NMFS determines such taking results in more than a negligible impact on the species or stocks of such marine mammal; or

(e) Take a marine mammal specified in such LOAs if NMFS determines such taking results in an unmitigable adverse impact on the species or stock of such marine mammal for taking for subsistence uses.

§ 219.45 Mitigation requirements.

When conducting the activities identified in § 219.41(a) of this chapter, the mitigation measures contained in any LOA issued under §§ 216.106 and 219.47 of this chapter must be implemented. These mitigation measures shall include but are not limited to:

(a) General conditions: (1) NWFSC shall take all necessary measures to coordinate and communicate in advance of each specific survey with the National Oceanic and Atmospheric Administration's (NOAA) Office of Marine and Aviation Operations (OMAO) or other relevant parties on non-NOAA platforms to ensure that all mitigation measures and monitoring requirements described herein, as well as the specific manner of implementation and relevant event-contingent decision-making processes, are clearly understood and agreed upon.

(2) NWFSC shall coordinate and conduct briefings at the outset of each survey and as necessary between ship's crew (Commanding Officer/master or designee(s), as appropriate) and scientific party in order to explain responsibilities, communication procedures, marine mammal monitoring protocol, and operational procedures.

(3) NWFSC shall coordinate as necessary on a daily basis during survey cruises with OMAO personnel or other relevant personnel on non-NOAA platforms to ensure that requirements, procedures, and decision-making processes are understood and properly implemented.

(4) When deploying any type of sampling gear at sea, NWFSC shall at all times monitor for any unusual circumstances that may arise at a sampling site and use best professional judgment to avoid any potential risks to marine mammals during use of all research equipment.

(5) NWFSC shall implement handling and/or disentanglement protocols as specified in the guidance that shall be provided to NWFSC survey personnel.

(b) For all research surveys using trawl, hook and line, or seine gear in Puget Sound, the move-on rule mitigation protocol described in paragraph (c)(3) shall be implemented upon observation of killer whales at any distance.

(c) Trawl survey protocols: (1) NWFSC shall conduct trawl operations as soon as is practicable upon arrival at the sampling station.

(2) NWFSC shall initiate marine mammal watches (visual observation) a minimum of ten minutes prior to beginning of net deployment, but shall also conduct monitoring during pre-set activities including trackline reconnaissance, CTD casts, and plankton or bongo net hauls. Marine mammal watches shall be conducted by scanning the surrounding waters with the naked eye and rangefinding binoculars (or monocular). During nighttime operations, visual observation shall be conducted using the naked eye and available vessel lighting.

(3) NWFSC shall implement the move-on rule mitigation protocol, as described in this paragraph. If one or more marine mammals are observed within 500 m of the planned location in the ten minutes before setting the trawl gear, and are considered at risk of interacting with the vessel or research gear, or appear to be approaching the vessel and are considered at risk of interaction, NWFSC shall either remain onsite or move on to another sampling location. If remaining onsite, the set shall be delayed. If the animals depart or appear to no longer be at risk of interacting with the vessel or gear, a further ten minute observation period shall be conducted. If no further observations are made or the animals still do not appear to be at risk of interaction, then the set may be made. If the vessel is moved to a different section of the sampling area, the move-on rule mitigation protocol would begin anew. If, after moving on, marine mammals remain at risk of interaction, the NWFSC shall move again or skip the station. Marine mammals that are sighted further than 500 m from the vessel shall be monitored to determine their position and movement in relation to the vessel to determine whether the move-on rule mitigation protocol should be implemented. NWFSC may use best professional judgment in making these decisions.

(4) NWFSC shall maintain visual monitoring effort during the entire period of time that trawl gear is in the water (*i.e.,* throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, NWFSC shall take the most appropriate action to avoid marine mammal interaction. NWFSC may use best professional judgment in making this decision.

(5) If trawling operations have been suspended because of the presence of marine mammals, NWFSC may resume trawl operations when practicable only when the animals are believed to have departed the area. NWFSC may use best professional judgment in making this determination.

(6) When conducting surface trawls using the Nordic 264 net, dedicated crew with no other tasks shall conduct required marine mammal monitoring. Marine mammal monitoring shall be staffed in a stepwise process, with a minimum of two observers beginning pre-set monitoring and increasing to a minimum of four observers prior to and during gear deployment. During the tow, a minimum of three observers shall conduct required monitoring.

(7) NWFSC shall implement standard survey protocols to minimize potential for marine mammal interactions, including maximum tow durations at target depth and maximum tow distance, and shall carefully empty the trawl as quickly as possible upon retrieval. Trawl nets must be cleaned prior to deployment.

(8) NWFSC must install and use a marine mammal excluder device at all times when the Nordic 264 trawl net is used.

(9) NWFSC must install and use acoustic deterrent devices whenever the Nordic 264 trawl net is used, with two pairs of the devices installed near the net opening. NWFSC must ensure that the devices are operating properly before deploying the net.

(10) For use of the Kodiak surface trawl in Puget Sound, trawl survey protocols described in this section apply only to cetaceans.

(11) Trawl survey protocols described in this section do not apply to use of pair trawl gear in the Columbia River.

(d) Hook and line (including longline) survey protocols: (1) NWFSC shall deploy hook and line gear as soon as is practicable upon arrival at the sampling station.

(2) NWFSC shall initiate marine mammal watches (visual observation) no less than thirty minutes prior to both deployment and retrieval of longline gear. Marine mammal watches shall be conducted by scanning the surrounding waters with the naked eye and rangefinding binoculars (or monocular). During nighttime operations, visual observation shall be conducted using the naked eye and available vessel lighting.

(3) NWFSC shall implement the move-on rule mitigation protocol, as described in this paragraph. If one or more marine mammals are observed within 500 m of the planned location in the ten minutes before gear deployment, and are considered at risk of interacting with the vessel or research gear, or appear to be approaching the vessel and are considered at risk of interaction, NWFSC shall either remain onsite or move on to another sampling location. If remaining onsite, the set shall be delayed. If the animals depart or appear to no longer be at risk of interacting with the vessel or gear, a further thirty minute observation period shall be conducted. If no further observations are made or the animals still do not appear to be at risk of interaction, then the set may be made. If the vessel is moved to a different section of the sampling area, the move-on rule mitigation protocol would begin anew. If, after moving on, marine mammals remain at risk of interaction, the NWFSC shall move again or skip the station. Marine mammals that are sighted further than 500 m from the vessel shall be monitored to determine their position and movement in relation to the vessel to determine whether the move-on rule mitigation protocol should be implemented. NWFSC may use best professional judgment in making these decisions.

(4) NWFSC shall maintain visual monitoring effort during the entire period of gear deployment and retrieval. If marine mammals are sighted before the gear is fully deployed or retrieved,

NWFSC shall take the most appropriate action to avoid marine mammal interaction. NWFSC may use best professional judgment in making this decision.

(5) If deployment or retrieval operations have been suspended because of the presence of marine mammals, NWFSC may resume such operations when practicable only when the animals are believed to have departed the area. NWFSC may use best professional judgment in making this decision.

(6) NWFSC shall implement standard survey protocols, including maximum soak durations and a prohibition on chumming.

(7) For hook and line surveys in Puget Sound, but not including longline surveys, hook and line survey protocols described in this section apply only to cetaceans.

(e) Seine survey protocols: (1) NWFSC shall conduct seine operations as soon as is practicable upon arrival at the sampling station.

(2) NWFSC shall conduct marine mammal watches (visual observation) prior to beginning of net deployment. Marine mammal watches shall be conducted by scanning the surrounding waters with the naked eye and rangefinding binoculars (or monocular).

(3) NWFSC shall implement the move-on rule mitigation protocol, as described in this paragraph for use of purse seine gear. If one or more small cetaceans (*i.e.,* dolphin or porpoise) or five or more pinnipeds are observed within 500 m of the planned location before setting the seine gear, and are considered at risk of interacting with the vessel or research gear, or appear to be approaching the vessel and are considered at risk of interaction, NWFSC shall either remain onsite or move on to another sampling location. If remaining onsite, the set shall be delayed. If the animals depart or appear to no longer be at risk of interacting with the vessel or gear, a further ten minute observation period shall be conducted. If no further observations are made or the animals still do not appear to be at risk of interaction, then the set may be made. If the vessel is moved to a different area, the move-on rule mitigation protocol would begin anew. If, after moving on, marine mammals remain at risk of interaction, the NWFSC shall move again or skip the station. Marine mammals that are sighted further than 500 m from the vessel shall be monitored to determine their position and movement in relation to the vessel to determine whether the move-on rule mitigation protocol should be implemented. NWFSC may use best professional judgment in making these decisions.

(4) NWFSC shall maintain visual monitoring effort during the entire period of time that seine gear is in the water (*i.e.,* throughout gear deployment, fishing, and retrieval). If marine mammals are sighted before the gear is fully removed from the water, NWFSC shall take the most appropriate action to avoid marine mammal interaction. NWFSC may use best professional judgment in making this decision.

(5) If seine operations have been suspended because of the presence of marine mammals, NWFSC may resume seine operations when practicable only when the animals are believed to have departed the area. NWFSC may use best professional judgment in making this determination.

(6) If any cetaceans are observed in a purse seine net, NWFSC shall immediately open the net and free the animals.

(7) NWFSC shall not make beach seine sets within 200 m of any hauled-out pinniped, and shall immediately remove the gear from the water upon observation of any marine mammal attempting to interact with the gear.

§ 219.46 Requirements for monitoring and reporting.

(a) NWFSC shall designate a compliance coordinator who shall be responsible for ensuring compliance with all requirements of any LOA issued pursuant to §§ 216.106 and 219.47 of this chapter and for preparing for any subsequent request(s) for incidental take authorization.

(b) Visual monitoring program: (1) Marine mammal visual monitoring shall occur prior to deployment of trawl, seine, and hook and line gear, respectively; throughout deployment of gear and active fishing of research gears (not including longline soak time); prior to retrieval of longline gear; and throughout retrieval of all research gear.

(2) Marine mammal watches shall be conducted by watch-standers (those navigating the vessel and/or other crew) at all times when the vessel is being operated.

(c) Training: (1) NWFSC must conduct annual training for all chief scientists and other personnel who may be responsible for conducting dedicated marine mammal visual observations to explain mitigation measures and monitoring and reporting requirements, mitigation and monitoring protocols, marine mammal identification, completion of datasheets, and use of equipment. NWFSC may determine the agenda for these trainings.

(2) NWFSC shall also dedicate a portion of training to discussion of best professional judgment, including use in any incidents of marine mammal interaction and instructive examples where use of best professional judgment was determined to be successful or unsuccessful.

(3) NWFSC shall coordinate with NMFS' Southwest Fisheries Science Center (SWFSC) regarding surveys conducted in the California Current Ecosystem, such that training and guidance related to handling procedures and data collection is consistent.

(d) Handling procedures and data collection: (1) NWFSC must develop and implement standardized marine mammal handling, disentanglement, and data collection procedures. These standard procedures will be subject to approval by NMFS' Office of Protected Resources (OPR).

(2) When practicable, for any marine mammal interaction involving the release of a live animal, NWFSC shall collect necessary data to facilitate a serious injury determination.

(3) NWFSC shall provide its relevant personnel with standard guidance and training regarding handling of marine mammals, including how to identify different species, bring an individual aboard a vessel, assess the level of consciousness, remove fishing gear, return an individual to water, and log activities pertaining to the interaction.

(4) NWFSC shall record such data on standardized forms, which will be subject to approval by OPR. NWFSC shall also answer a standard series of supplemental questions regarding the details of any marine mammal interaction.

(e) Reporting: (1) NWFSC shall report all incidents of marine mammal interaction to NMFS' Protected Species Incidental Take database within 48 hours of occurrence and shall provide supplemental information to OPR upon request. Information related to marine mammal interaction (animal captured or entangled in research gear) must include details of survey effort, full descriptions of any observations of the animals, the context (vessel and conditions), decisions made, and rationale for decisions made in vessel and gear handling.

(2) Annual reporting: (i) NWFSC shall submit an annual summary report to OPR not later than ninety days following the end of a given year. NWFSC shall provide a final report within thirty days following resolution of comments on the draft report.

(ii) These reports shall contain, at minimum, the following:

(A) Annual line-kilometers surveyed during which the EK60, ME70, SX90 (or equivalent sources) were predominant and associated pro-rated estimates of actual take;

(B) Summary information regarding use of all hook and line, seine, and trawl gear, including number of sets, hook hours, tows, etc., specific to each gear;

(C) Accounts of all incidents of marine mammal interactions, including circumstances of the event and descriptions of any mitigation procedures implemented or not implemented and why;

(D) A written evaluation of the effectiveness of NWFSC mitigation strategies in reducing the number of marine mammal interactions with survey gear, including best professional judgment and suggestions for changes to the mitigation strategies, if any;

(E) Final outcome of serious injury determinations for all incidents of marine mammal interactions where the animal(s) were released alive; and

(F) A summary of all relevant training provided by NWFSC and any coordination with SWFSC or NMFS' West Coast Regional Office.

(f) Reporting of injured or dead marine mammals:

(1) In the unanticipated event that the activity defined in § 219.41(a) clearly causes the take of a marine mammal in a prohibited manner, NWFSC personnel engaged in the research activity shall immediately cease such activity until such time as an appropriate decision regarding activity continuation can be made by the NWFSC Director (or designee). The incident must be reported immediately to OPR and the West Coast Regional Stranding Coordinator, NMFS. OPR will review the circumstances of the prohibited take and work with NWFSC to determine what measures are necessary to minimize the likelihood of further prohibited take and ensure MMPA compliance. The immediate decision made by NWFSC regarding continuation of the specified activity is subject to OPR concurrence. The report must include the following information:

(i) Time, date, and location (latitude/longitude) of the incident;

(ii) Description of the incident;

(iii) Environmental conditions (*e.g.,* wind speed and direction, Beaufort sea state, cloud cover, visibility);

(iv) Description of all marine mammal observations in the 24 hours preceding the incident;

(v) Species identification or description of the animal(s) involved;

(vi) Status of all sound source use in the 24 hours preceding the incident;

(vii) Water depth;

(viii) Fate of the animal(s); and

(ix) Photographs or video footage of the animal(s).

(2) In the event that NWFSC discovers an injured or dead marine mammal and determines that the cause of the injury or death is unknown and the death is relatively recent (*e.g.,* in less than a moderate state of decomposition), NWFSC shall immediately report the incident to OPR and the West Coast Regional Stranding Coordinator, NMFS. The report must include the information identified in paragraph (f)(1) of this section. Activities may continue while OPR reviews the circumstances of the incident. OPR will work with NWFSC to determine whether additional mitigation measures or modifications to the activities are appropriate.

(3) In the event that NWFSC discovers an injured or dead marine mammal and determines that the injury or death is not associated with or related to the activities defined in § 219.41(a) (*e.g.,* previously wounded animal, carcass with moderate to advanced decomposition, scavenger damage), NWFSC shall report the incident to OPR and the West Coast Regional Stranding Coordinator, NMFS, within 24 hours of the discovery. NWFSC shall provide photographs or video footage or other documentation of the stranded animal sighting to OPR.

§ 219.47 Letters of Authorization.

(a) To incidentally take marine mammals pursuant to these regulations, NWFSC must apply for and obtain an LOA.

(b) An LOA, unless suspended or revoked, may be effective for a period of time not to exceed the expiration date of these regulations.

(c) If an LOA expires prior to the expiration date of these regulations, NWFSC may apply for and obtain a renewal of the LOA.

(d) In the event of projected changes to the activity or to mitigation and monitoring measures required by an LOA, NWFSC must apply for and obtain a modification of the LOA as described in § 219.48 of this chapter.

(e) The LOA shall set forth:

(1) Permissible methods of incidental taking;

(2) Means of effecting the least practicable adverse impact (*i.e.,* mitigation) on the species, its habitat, and on the availability of the species for subsistence uses; and

(3) Requirements for monitoring and reporting.

(f) Issuance of the LOA shall be based on a determination that the level of taking will be consistent with the findings made for the total taking allowable under these regulations.

(g) Notice of issuance or denial of an LOA shall be published in the **Federal Register** within thirty days of a determination.

§ 219.48 Renewals and modifications of Letters of Authorization.

(a) An LOA issued under §§ 216.106 and 219.47 of this chapter for the activity identified in § 219.41(a) shall be renewed or modified upon request by the applicant, provided that:

(1) The proposed specified activity and mitigation, monitoring, and reporting measures, as well as the anticipated impacts, are the same as those described and analyzed for these regulations (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section), and

(2) OPR determines that the mitigation, monitoring, and reporting measures required by the previous LOA under these regulations were implemented.

(b) For an LOA modification or renewal requests by the applicant that include changes to the activity or the mitigation, monitoring, or reporting (excluding changes made pursuant to the adaptive management provision in paragraph (c)(1) of this section) that do not change the findings made for the regulations or result in no more than a minor change in the total estimated number of takes (or distribution by species or years), OPR may publish a notice of proposed LOA in the **Federal Register**, including the associated analysis of the change, and solicit public comment before issuing the LOA.

(c) An LOA issued under §§ 216.106 and 219.47 of this chapter for the activity identified in § 219.41(a) may be modified by OPR under the following circumstances:

(1) Adaptive Management—OPR may modify (including augment) the existing mitigation, monitoring, or reporting measures (after consulting with NWFSC regarding the practicability of the modifications) if doing so creates a reasonable likelihood of more effectively accomplishing the goals of the mitigation and monitoring set forth in the preamble for these regulations.

(i) Possible sources of data that could contribute to the decision to modify the mitigation, monitoring, or reporting measures in an LOA:

(A) Results from NWFSC's monitoring from the previous year(s).

(B) Results from other marine mammal and/or sound research or studies.

(C) Any information that reveals marine mammals may have been taken in a manner, extent or number not authorized by these regulations or subsequent LOAs.

(ii) If, through adaptive management, the modifications to the mitigation, monitoring, or reporting measures are substantial, OPR will publish a notice of proposed LOA in the **Federal Register** and solicit public comment.

(2) Emergencies—If OPR determines that an emergency exists that poses a significant risk to the well-being of the species or stocks of marine mammals specified in LOAs issued pursuant to §§ 216.106 and 219.47 of this chapter, an LOA may be modified without prior notice or opportunity for public comment. Notice would be published in the **Federal Register** within thirty days of the action.

§ 219.49 [Reserved]

§ 219.50 [Reserved]

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