UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL MARINE FISHERIES SERVICE
Office of Protected Resources

PETITION FOR PROMULGATION OF REGULATIONS AND REQUEST FOR LETTER OF AUTHORIZATION PURSUANT TO SECTION 101 (a) (5) (A) OF THE MARINE MAMMAL PROTECTION ACT

for the

Taking of Marine Mammals Incidental to Fisheries and Ecosystem Research Conducted and Funded by the Northwest Fisheries Science Center

50 C.F.R. Part 216, Subpart R

July 2022

Submitted by:

National Marine Fisheries Service
Northwest Fisheries Science Center

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ACRONYMS AND ABBREVIATIONS

Acronym/ Abbreviation	Definition
ADCP	Acoustic Doppler Current Profiler
AFSC	Alaska Fisheries Science Center
AMLR	Arctic Marine Living Resources
ASL	above sea level
AUV	Autonomous Underwater Vehicles
AZFP	Acoustic Zooplankton Fish Profiler
BMP	Best Management Practice
CA	California
CalCOFI	California Cooperative Oceanic Fisheries Operations
CCE	California Current Ecosystem
CCRA	California Coast Research Area
Centers	Regional Fisheries Science Centers
CFR	Code of Federal Regulations
cm	centimeter
COAST	Collaborative Optical Acoustical Survey Technology
CPS	Coastal Pelagic Species
CS	Chief Scientist
CTD	Conductivity, Temperature, and Depth
CUFES	Continuous Underway Fish Egg Sampler
CV	Coefficient of Variation
D	Depleted under the MMPA
DAS	days at sea
dB	decibels
dB re 1µPa	decibels relative to one microPascal
DON	Department of the Navy
DPS	Distinct Population Segment
E	Endangered under the ESA
EEZ	Exclusive Economic Zone
ENP	Eastern North Pacific
EO	Executive Order
ESA	Endangered Species Act
ETP	Eastern Tropical Pacific
FAA	Federal Aviation Administration
fm	fathom
FONSI	Finding of No Significant Impact
FR	Federal Register
FREEBYRD	AMLR glider program
ft	feet
GPS	Global Positioning System
HMS	Highly Migratory Species
Hz	hertz
ICUN	International Union for Conservation of Nature

IHA	Incidental Harassment Authorization
in.	inch
IPHC	International Pacific Halibut Commission
ITA	Incidental Take Authorization
ITR	Incidental Take Regulations
kg	kilograms
kHz	kilohertz
km	kilometers
km^2	square kilometers
kts	knots
LCCRA	Lower Columbia River Research Area
LME	Large Marine Ecosystem
LOA	Letter of Authorization
m	meters
mi	miles
mi^2	square miles
mins	minutes
MLLW	Mean low lower water
MMED	Marine Mammal Exclusion Device
MMPA	Marine Mammal Protection Act
M/SI	Mortality/Serious Injury
NEPA	National Environmental Policy Act
NL	not listed under the ESA
NS	Not strategic under the MMPA
nm	nautical mile
NMFS	National Marine Fisheries Service
MML	National Marine Mammal Laboratory
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NWFSC	Northwest Fisheries Science Center
OMAO	Office of Marine Aviation and Operations
OOD	Officer on Deck
OPR	Office of Protected Resources
OR	Oregon
PBR	Potential Biological Removal
PSRA	Puget Sound Research Area
PEA	Programmatic Environmental Impact Statement
PFMC	Pacific Fishery Management Council
ppt	parts per thousand
PSIT	Protected Species Incidental Take
PTS	Permanent Threshold Shift
PVS	Polyvinyl chloride
rms	root mean square
ROV	Remotely Operated Vehicle
RPAS	Remotely Piloted Aircraft Systems
S	Strategic under the MMPA

Secretary	U.S. Secretary of Commerce
TTS	Temporary Threshold Shift
UAS	Uncrewed Aerial Systems
UxS	Uncrewed System
UME	Unusual Mortality Event
U.S.	United States
WA	Washington
VTOL	vertical take-off and landing
XBT	eXpendable BathyThermograph

Acronym/ Abbreviation	Definition
ACDP	Acoustic Doppler Profiler
AMLR	Arctic Marine Living Resources
ASL	above sea level
AUV	Autonomous Underwater Vehicles
AZFP	Acoustic Zooplankton Fish Profiler
BMP	Best Management Practice
CalCOFI	California Cooperative Oceanic Fisheries Operations
CCE	California Current Ecosystem
CFR	Code of Federal Regulations
cm	centimeter
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fm	fathom
FONSI	Finding of No Significant Impact
FR	Federal Register
FREEBYRD	AMLR glider program
ft	feet
GPS	Global Positioning System
HMS	Highly Migratory Species

Hz	hertz
ICUN	International Union for Conservation of Nature
IHA	Incidental Harassment Authorization
in.	inch
ITA	Incidental Take Authorization
ITR	Incidental Take Regulation
kg	kilograms
kHz	kilohertz
km	kilometers
km^2	square kilometers
LME	Large Marine Ecosystem
LOA	Letter of Authorization
m	meters
mi	miles
MLLW	Mean low lower water
mi^2	square miles
MMED	Marine Mammal Exclusion Device
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M/SI	Mortality/Serious Injury
NEPA	National Environmental Policy Act
NL	not listed under the ESA
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OMAO	Office of Marine Aviation and Operations
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PBR	Potential Biological Removal
PEA	Programmatic Environmental Impact Statement
ppt	parts per thousand
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PTS	Permanent Threshold Shift
rms	root mean square
ROV	Remotely Operated Vehicle
RPAS	Remotely Piloted Aircraft Systems
S	Strategic under the MMPA
Secretary	U.S. Secretary of Commerce
SI	serious injury
NWFSC	Southwest Fisheries Science Center
TTS	Temporary Threshold Shift
UAS	Unmanned Aerial Systems
UME	Unusual Mortality Event
U.S.	United States

µPa	microPascal
VTOL	vertical take-off and landing
XBT	eXpendable BathyThermograph

1. DESCRIPTION OF ACTIVITIES

1.1. Nature of Request

The United States (U.S.) government has jurisdiction over the living marine resources in waters of the Exclusive Economic Zone (EEZ), 3 to 200 nautical miles (nm) from the U.S. shoreline. Congress has enacted several statutes authorizing federal agencies to manage and protect living marine resources. The National Oceanic and Atmospheric Administration (NOAA) is responsible for protecting marine finfish and shellfish species and their habitats. Within NOAA, the National Marine Fisheries Service (NMFS) is responsible for conducting science-based management, conservation, and protection of living marine resources within the U.S. EEZ. The Northwest Fisheries Science Center (NWFSC) based out of the Montlake Laboratory and Headquarters near Seattle, Washington is one of six Regional Fisheries Science Centers (Centers) that direct and coordinate the collection of scientific information required for adequate resource protection and fisheries management.

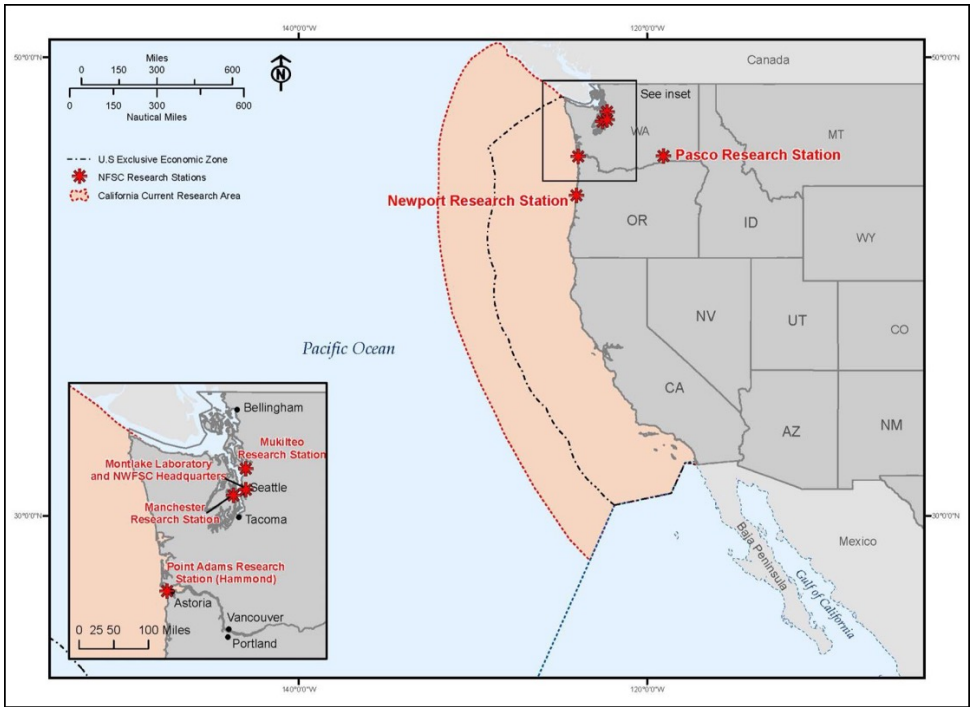
NWFSC scientists conduct fishery-independent research using NOAA-owned and operated vessels or chartered vessels. NWFSC research occurs primarily in U.S. marine waters from Canada to Mexico, including estuaries and freshwater systems of Puget Sound and the major rivers in Washington and Oregon, occasionally extending to marine waters as far north as southeast Alaska. In addition, NWFSC operates research stations in Manchester, Point Adams, Pasco, and Newport (Figures 1-1 through 1-3).

The NWFSC also contributes scientific data for fisheries and marine resource management issues to the West Coast states, the Pacific Fishery Management Council (PFMC), Pacific Salmon Commission, Pacific States Marine Fisheries Commission, Native American tribal governments, stakeholder groups, and international fisheries management organizations. The PFMC has jurisdiction for developing fishery recommendations that cover non-treaty fisheries in the EEZ off Washington, Oregon and California.

NWFSC plans to continue fisheries and ecosystem research for the period 2023-2028 in three defined research areas including the California Current Research Area (CCRA), the Puget Sound Research Area (PSRA), and the Lower Columbia River Research Area (LCRRA), defined as the estuarine and tidally influenced waters of the lower Columbia River below the Bonneville Dam (see Figure 1-3).

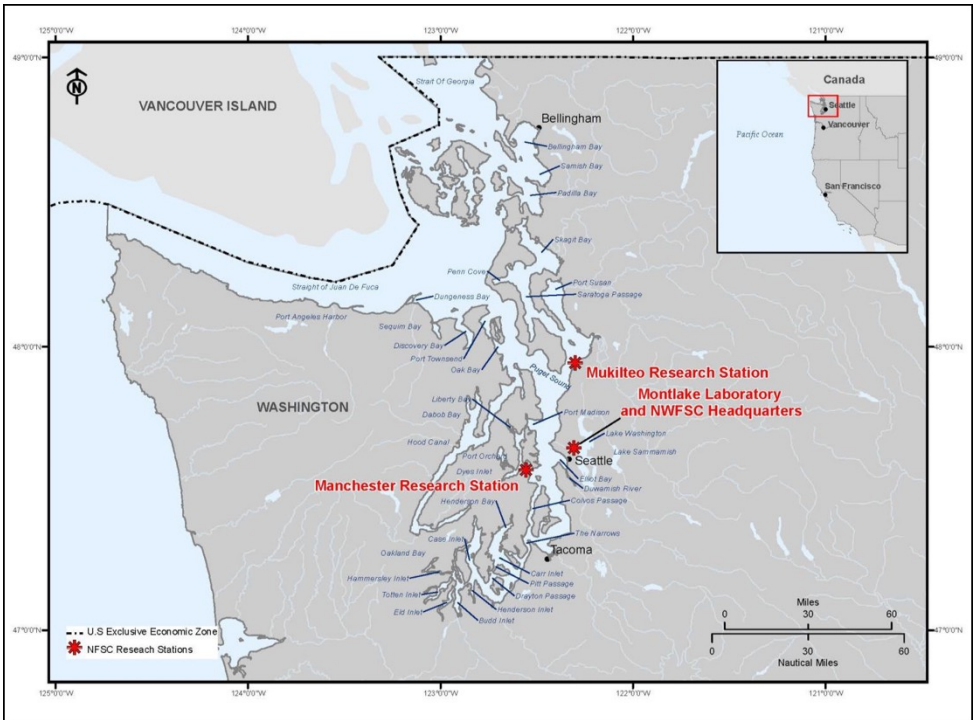
Incidental “taking” of marine mammals is defined by the Marine Mammal Protection Act (MMPA) as to “harass, hunt, capture or kill, or attempt to harass, hunt, capture or kill” marine mammals. Under Section 101(a)(5)(A) of the MMPA, NMFS may promulgate regulations and issue Letters of Authorization (LOAs) for multi-year activities. Thus, the purpose of this request by NWFSC is for NMFS Office of Protected Resources (OPR) to develop regulations and issue annual LOAs over the 5-year period, effective August 29, 2023 through August 28, 2028, allowing for the potential incidental taking of small numbers of marine mammals during fisheries and ecosystem research in the areas shown in Figures 1-1 through 1-3. As described in Section 5, only takes related to non-lethal injury, M/SI and physical disturbance are requested in this application.

FIGURE 1-1. NWFSC RESEARCH FACILITIES AND CALIFORNIA CURRENT RESEARCH AREA BOUNDARIES



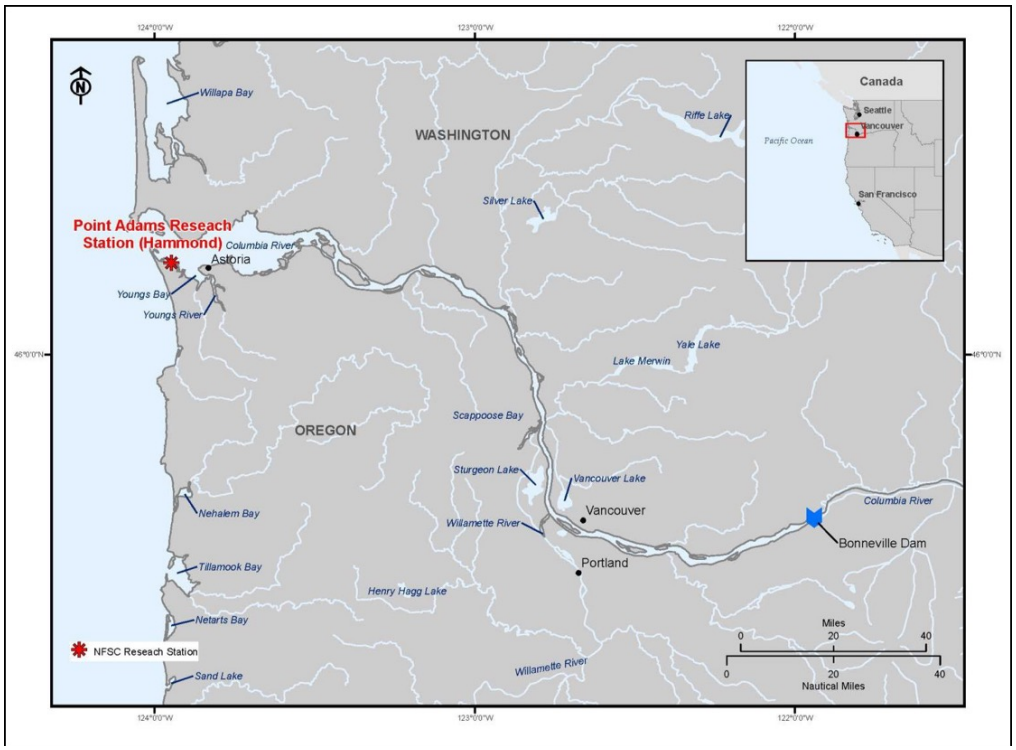
Source: NMFS (2018b)

FIGURE 1-2. PUGET SOUND RESEARCH AREA BOUNDARIES



Source: NMFS (2018b)

FIGURE 1-3. LOWER COLUMBIA RIVER RESEARCH AREA BOUNDARIES



Source: NMFS (2018b)

1.2. Description of the Activity

1.2.1. Definition of Action Area

NMFS defines the outer boundary of an action area for a project as the point where no detectable or measurable effect from the project would occur. For purposes of this request for rulemaking, the Action Area is defined as the three areas where research may occur in the CCRA, PSRA, and LCRRA along the U.S. West Coast (Figures 1-1 through 1-3). As defined, the action area is large, however, research would occur only in small portions of this total area.

1.2.2. Proposed Action

NWFSC proposes to continue fisheries research activities throughout the CCRA, PSRA and LCRRA to produce scientific information necessary for the management and conservation of living marine resources in those areas. Table 1-2 describes the proposed NWFSC research activities, general areas of operation, gear and equipment as well as estimated number of days at sea (DAS) for the period 2023 - 2028. During this period, the need for additional surveys could arise, or some of the identified surveys could be eliminated or reduced in effort. Therefore, research activities described in this application are not specifically limited to the surveys shown in Table 1-2 but would use similar gear and would be commensurate in scope and area of activity.

To minimize risk of encounters with marine mammals that may occur in the action area, NWFSC implements a series of mitigation and monitoring measures which are described in detail in Sections 11 and 13 of this application.

Some NWFSC divisions also conduct directed research on species that are listed as threatened or endangered under the Endangered Species Act (ESA). As such, certain projects may also require separate ESA Section 10 permits for those listed species. For example, within Puget Sound and greater Puget Sound, the following NWFSC projects have separate ESA Section 10 permits (permit # listed here): Movement Studies of Puget Sound Species and Rockfish Projects in Puget Sound (#17062-6R); Salish Sea Studies of Juvenile Salmon and Other Pelagic Species, Intensively Monitored Studies of Juvenile Salmon in Skagit Bay, Elwha Dam Salmon Recovery Studies, and Puget Sound Juvenile Salmon Studies (#1586-5R); Puget Sound Marine Diversity Studies are permitted along with Ocean Lampara Seining (#24367); Fish Contaminants Studies (#23019-2R); and Puget Sound Juvenile Salmon Studies are also permitted under #16702-4R).

Directed research takes authorized under ESA Section 10 permits are not included in the scope of this LOA. However, in compliance with the MMPA, incidental harassment of marine mammals that may occur during these studies is evaluated and accounted for in this application. For projects that also require an ESA Section 10 permit, those specific permit numbers are provided in Table 2-2.

Since publication of the 2018 final rule and subsequent LOAs for NWFSC research (NMFS 2018c), some modifications have been proposed for future surveys. For example, demersal longlines and sablefish pots are proposed for the Bycatch Reduction Research in the CCRA and bottom trawling would be discontinued for this study in Puget Sound. The following list provides a brief summary of discontinued research or gear, modifications to existing research such as new research areas or different gear, and new research proposed beginning in 2023. Only surveys with the potential to take marine mammals by non-lethal injury, M/SI or physical disturbance are included in Table 1-2 and summarized here.

<u>Existing research or gear not carried forward beginning in 2023</u>

- The PNW Harmful Algal Bloom study in the CCRA using plankton nets, a CTD profiler and rosette water sampler would not be conducted beginning in 2023.
- Near Coastal Ocean Purse seining would be discontinued.
- Bottom trawl gear would not be used in the Bycatch Reduction Research study in Puget Sound but is funded and may occur off the coasts of Washington, Oregon and California. Double-rigged shrimp bottom trawls may also still be used for testing.

<u>New research (beginning 2023) with some potential to interact with marine mammals</u>

- Winter Integrated Acoustic and Trawl Survey of Pacific Hake (*Merluccius productus*) and Pilot Winter Hake Survey
- Washington Coastal Kelp Forest Ecology Research
- Salmon Ocean Behavior and Distribution (SOBaD)
- Ocean Acidification Research on Zooplankton and Benthic Crustaceans – Washington and Oregon Coasts and Puget Sound

- Avian Predation Studies
- Habitat Function of Nearshore Ecosystems with Shellfish Aquaculture and Eelgrass
- Non-Native Species studies in Puget Sound and Lake Washington
- Near Coastal Ocean Lampara Seining and remotely operated vehicle (ROV) Surveys
- ROV Nearshore Survey Feasibility Study
- Gear Testing in Support of Groundfish Surveys in Untrawlable Habitat in Puget Sound
- Forage Fish Influence on Salmon Predation Risk and Food Resources
- Remote sensing wetland habitat with Uncrewed Aerial Systems (UAS)
- Surveys of Salmon Predators in the lower Columbia River
- Surveys of Larval Fishes in the lower Columbia River

Changes to existing research (beginning 2023) with potential to interact with marine mammals

- Bycatch Reduction Research – Added potential for nighttime operations, demersal longlines and sablefish pots
- Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat – Added use of commercial vessels, vertical setlines, collection of eDNA samples and potential use of an uncrewed system (UxS)
- Movement Studies of Puget Sound Species – Added retrieval and remote download of detection arrays hydrophones, transducers and a tethered ROV
- Fish Contaminants Studies – Added Washington, Oregon, and California Coasts, the Columbia River Basin, and the lower Willamette River, and the use of baby otter trawls, cast nets, and gillnets
- Lower Columbia River Ecosystem Monitoring – Added the use of a micro purse seine
- Migratory Behavior of Adult Salmon– Added the use of a beach seine
- Salish Sea Studies of Juvenile Salmon and Other Pelagic Species – added a new geographic area (Strait of Juan de Fuca [previously only Puget Sound])
- Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring – added invertebrate prey flux studies in wetland channels using a Neuston net and Acoustic Doppler Current Profiler (ADCP); also added the use of hook and line

TABLE 1-1. NWFSC RESEARCH WITH THE POTENTIAL TO INTERACT WITH MARINE MAMMALS

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
California Current Research Area							
Studies Using Trawl Gear							
1) Bycatch Reduction Research	Research effort to test gear improvements to reduce bycatch of non-target fish species. Current examples include testing low-rise bottom trawls, flexible sorting grates in bottom and midwater trawls, and open escape window bycatch reduction devices in midwater trawls. *Note: bottom trawl is not continued in future research in Puget Sound.*	Southern Oregon to Canada	April - November, Intermittent, 30-90 DAS Daytime operations primarily, with potential nighttime operations	Chartered commercial fishing vessels	Midwater trawl	Net type: Commercial pelagic trawls Net size: Varies Tow speed: 1.5-3.5 knots (kts) Duration: up to 8 hours (hrs) but average 2 hrs Depth: 50-1000 meters (m)	up to 60 midwater trawls/year (yr)
					Bottom trawl	Net type: Double rigged shrimp trawl Net size: Varies Tow speed: 1.5-3.5 kts Set duration: 30-80 mins Depth: 100-300 m	up to 60 shrimp trawls/yr
					Multi-frequency active acoustics.	38-200 kHz; ≤ 224 dB/1µPa	Continuous during cruise
					Demersal Longlines	800-4500 hooks/set	4-5 sets/day
					Sablefish pots	10-100 pots/set	4-5 sets/day
2) Winter Integrated Acoustic and Trawl Survey of Pacific Hake (*Merluccius productus*) and Pilot Winter Hake Survey	The primary purposes of the winter 2016 hake IAT survey were to evaluate the feasibility of conducting a winter spawning hake biomass survey and to collect biological data on hake during winter. Goals included determining the distribution of spawning hake, characterizing aggregations of spawning hake, and describing the biology of hake within those aggregations.	Southern California to Southeast Alaska, including Canada, following the hake	Annually in 2016 and 2017 Daytime and nighttime trawling was used to verify hake aggregations and to collect specimens of hake and other organisms for biological data (length, sex, maturity, age, ovaries, diet, and genetics).	NOAA Ship *Bell M. Shimada*	Midwater trawl	Net type: Aleutian Wing Midwater Trawl Net size: headrope 334 feet (ft). Tow speed: 2.8-3.5 kts Duration: variable Depth: variable	150 trawls/yr
					Various echosounders and sonars.	1.5-200 kHz; ≤ 224 dB/1µPa	Continuous during cruise
					CTD profiler	Gear Type: Sea-Bird SBE 19+ CTD profiler equipped with SBE 43 type oxygen sensor; Surface to near bottom and along tow track; underway CTD may also be used	150 casts/yr
					Methot trawl	Outer net 2.4 m x 2.4 m x 44 feet (ft) long x 2 inch (in.) mesh, inner net 1.4 m x 1.4 m x 43 ft long x 1/8 in. Atlas mesh, Polyvinyl chloride (PVC) collection bucket 2-piece PVC, 6 5/8 in. overall diameter x 16 in. long; Deployed at 20-25 m/min, retrieved at 20 m/min	5-20 trawls/yr

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
						Ship speed towing Methot 2-3 knots (never more than 3.5 kts)	
					UxS	UxS (e.g., Saildrone or similar) equipped with acoustics (38 and 200 kilohertz [kHz]). Acoustic transects are in parallel with survey transects or in extended regions beyond survey area (S, W or inshore)	
					Bottom trawl	Net type: Poly Nor'easter Bottom Trawl (PNE) Net size: footrope 120 ft, headrope 89 ft Tow speed: 2.8-3.5 kts Duration: variable Depth: variable	5-10 trawls/yr; None since 2011
					UCTD profiler	Gear Type: Teledyne Oceanscience Underway Profiling System. Measures conductivity and temperature down to 500 m at a ship speed of 6 kts, along acoustic tracklines.	
3) California Current Ecosystem: Investigations of Hake Ecology and Survey Methods and the California Current	Primary goals: 1) address topics important to "The Integrated Ecosystem and Pacific Hake Acoustic-Trawl Survey" (herein called the "acoustic-trawl survey") in support of the U.S.-Canada International Treaty/Agreement; 2) evaluate specific questions that relate to enhancing/expanding the survey; and 3) collect information that supports ecosystem modeling and management. Research and development and pilot surveys to refine optical-trawl samplers as applied to acoustical and other surveys, including testing hardware and software to assess abundance and species composition in trawls used to sample commercially important groundfish along U.S. West Coast. In addition, collect mobile and stationary EK80 (CW and FM modes) acoustic information on pelagic rockfish and other species (e.g., krill, mesopelagics) backscatter to inform development of potential survey methods, combined with trawling (potentially with open codend) while using stereo camera to monitor species composition.	Oregon, Washington, West coast Vancouver Island; occasionally northern California	Biennially since 2004 in even-numbered years June-Sept 30-40 DAS	NOAA Ship Bell M. Shimada and charter commercial fishing vessel	Midwater trawl	Net type: Aleutian Wing Midwater Trawl Net size: headrope 334 ft Tow speed: 2.8-3.5 kts Duration: variable Depth: down to 500 m	75 trawls/yr (in addition to trawls conducted as part of hake survey)
					CTD rosette	Casts with Niskin bottles to collect environmental DNA (eDNA) samples	100-160 casts/yr
					UxS	UxS (e.g., Saildrone or similar) equipped with acoustics system (38 and 200 kHz)	Acoustic transects in parallel with survey transects or in extended regions beyond survey area (S, W or inshore)
					Methot trawl	Outer net 2.4 m x 2.4 m x 44 ft long x 2 in. mesh, inner net 1.4 m x 1.4 m x 43 ft long x 1/8 in. Atlas mesh, PVC collection bucket 2-piece PVC, 6 5/8 in. overall diameter x 16 in. long; Deployed at 20-25 m/min, retrieved at 20 m/min Ship speed while towing Methot 2-3 kts (never > 3.5 kts)	5-50 trawls/yr

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
4) Groundfish Bottom Trawl Survey	Fisheries independent survey to monitor groundfish distribution and biomass along the U.S. West Coast at depths of 55 to 1280 m.	U.S./Mexico to U.S./Canada border	Annually, May to October At least 190 DAS Daytime operations only	Charter, four commercial trawlers	Bottom trawl with sensors mounted on bottom trawl net	Net type: modified Aberdeen bottom trawl Net size: mouth opening 5 x 15 m Tow speed: 2.2 kts Duration: 15 min Depth: 55-1280 m	737-773 trawls/yr
					Multi-frequency active acoustics	27-200 kHz; ≤ 224 dB/1µPa	Continuous during cruise
					CTD profiler	Gear Type: Sea-Bird SBE 19+ conductivity, temperature, depth profiler equipped with SBE 43 type oxygen sensor; Surface to near bottom and along tow track	737-773 casts/yr
5) Integrated Ecosystem and Pacific Hake Acoustic-Trawl Survey	The primary goal of this survey is to estimate the biomass, distribution, and biological composition of Pacific hake off the west coast of the U.S. and Canada from approximately Point Conception, California (34.5 N) to Dixon Entrance, Alaska (54.7 N). A variety of scientific data relevant to the distribution of Pacific hake and other key species in the California Current Ecosystem would be collected, including acoustic, biologic, and oceanographic data. The survey uses broadband acoustics to assist in classifying mixed schools acoustically. It conducts opportunistic quantitative observations of birds and marine mammals, as well as eDNA sampling. A robotic microscope called the Imaging Flow Cytobot (IFCB) continuously monitors phytoplankton by sampling water from the scientific seawater system while the ship is underway. The survey operates with an ESA section 10 permit for directed research on listed fish species.	34.5 N (Point Conception, California) to 54.7 N (Dixon Entrance, Alaska) from the 50-m isobath to the 1,500-m isobath or to 35 nm offshore (extended S, N and W following hake)	Triennially 1995-2001 and biennially since 2003, with an additional survey in 2012. Biennial surveys in odd-numbered years; June-Sept 70-80 DAS Nighttime operations for oceanographic sampling, eDNA sampling	NOAA Ship *Bell M. Shimada*	Midwater trawl	Net type: Aleutian Wing Midwater Trawl Net size: headrope 334 ft Tow speed: 2.8-3.5 kts Duration: variable Depth: variable	150 trawls/yr
					Multi-frequency active acoustics	1.5-200 kHz; ≤ 224 dB/1µPa	Continuous during cruise
					CTD profiler	Gear Type: Sea-Bird SBE 19+ CTD profiler equipped with SBE 43 type oxygen sensor; Surface to near bottom and along tow track	150 casts/yr
					Methot trawl	Outer net 2.4 m x 2.4 m x 44 ft long x 2 in. mesh, inner net 1.4 m x 1.4 m x 43 ft long x 1/8 in. Atlas mesh, PVC collection bucket 2-piece PVC, 6 5/8 in. overall diameter x 16 in. long; Deployed at 20-25 m/min, retrieved at 20 m/min; ship Speed while towing Methot 2-3 kts (never more than 3.5 kts)	5-20 trawls/yr
					UxS	UxS (e.g., Saildrone or similar) equipped with acoustics system (38 and 200 kHz); Acoustic transects in parallel with survey transects or in extended regions beyond survey area (to S, W or inshore)	
					Bottom trawl	Net type: PNE Net size: footrope 120 ft, headrope 89 ft; Tow speed: 2.8-3.5 kts Duration: variable Depth: variable	5-10 trawls/yr; None since 2011

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
					UCTD profiler	Teledyne Oceanscience Underway Profiling System to measure conductivity and temperature down to 500 m; Ship speed approx. 6 kts along acoustic tracklines	
6) Juvenile Salmon PNW Coastal Survey	Assesses Pacific Northwest coastal ocean condition and the growth, relative abundance, and survival of juvenile salmon during their first summer at sea. eDNA collection.	Newport, OR to Cape Flattery, WA in Continental shelf waters	Annually, May and June 17 DAS (divided between May and June) Daytime operations only	Charter commercial fishing vessel	Surface trawl	Net type: Nordic 264 surface trawl Net with marine mammal excluder device (MMED) size: 30 m wide x 20 m deep Tow speed: 3-4 kts Duration: 30 min Depth: surface down to 30 m 4 acoustic pingers attached to net	100 trawls/yr
					CTD profiler and rosette Water Sampler	Gear Type: Sea-Bird SBE 19+ and SBE 23 CTDs Deployment: Vertical drop Depth: Surface to near bottom or 200 m max.	100 samples/yr
					Bongo net	Net type: Bongo plankton net with 335 µm mesh Net size: two 0.6 m diameter nets Tow speed: 3 kts Duration: 5-6 min Depth: 0-30 m	100 samples/yr
					Vertical plankton net	Net type: ring net with 202 micron (µm) mesh Net size: 0.5 m diameter Tow speed: 0 (vertical tow) Duration: 5-6 min Depth: Surface to near bottom or 100 m max	100 samples/yr
					Water pump	Gear type: Continuous water pump with SBE-45 MicroTSG Thermosalinograph Depth: 3 m	Continuous during cruise
7) Northern Juvenile Rockfish Survey	Measures the spatial abundance of juvenile fishes in coastal marine waters of the northern California Current ecosystem as an index of groundfish recruitment potential.	Cape Mendocino, CA to Cape Flattery, WA	Annually, May- June 15-30 DAS Night operations only	NOAA Ship *Bell M. Shimada*	Midwater trawl	Net type: Modified Cobb trawl with 9.5 mm codend Net size: 12 x 12 m opening, 26 m headrope Tow speed: 2.7 kts Duration: 15 min Depth: 30-40 m	100 trawls/yr
					CTD profiler	Tow speed: 0 Duration: 20-120 min	100 samples/yr
					Various plankton nets (Bongo and Tucker)	Tow speed: 1.5- 2.5 kts Duration: 20-60 min	100 samples/yr

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
					Simrad EK60 Multi-frequency echosounder	38, 70, 120, and 200 kHz; 228 dB/1µPa	Continuous during cruise
8) Video Beam Trawl Collaborative Research	Survey along the continental shelf to assess the seasonal and interannual distribution of young of the year groundfishes and the potential impacts of hypoxia.	Oregon to Washington	Monthly (variable) 20 DAS Daytime operations only	University research vessels, NOAA Ships, chartered commercial fishing vessels	Bottom video beam trawl system	2 m beam trawl with digital video camera system Tow speed: 1-1.5 kts Duration: 10 min	20 - 40 deployments
9) Flatfish Broodstock Collection	Collection of fish for broodstock for aquaculture development by trawls, hook and line, and various methods.	Puget Sound and Washington coast	Intermittent, up to 20 times annually 20 DAS Daytime operations only	Charter fishing vessel, NOAA small boats (Class I & 2)	Bottom trawl	Net type: Commercial bottom trawl Net size: Varies Tow speed: < 3.5 kts Duration: 10 min Depth: > 10 m	6-24 trawls
					Hook and line	Up to 12 lines in the water at once. Barbed circle hooks	18 annually
10) Marine Fish Research Broodstock Collection, Sampling, and Tagging	Collection of fish for broodstock collection, sampling, tagging. For example, sablefish, halibut or hake	Washington Coast	Annual, varied timing, 10 DAS Daytime operations only	Charter fishing vessel	Bottom trawl	Net type: Commercial bottom trawls Net size: Varies Tow speed:1.5-3.5 kts Duration: up to 4 hrs Depth: 50-1000 m	10 trawls/yr
					Pelagic longline	Mainline length: 750-1000 fathoms (fm) Depth: 700-3000 ft Gangion length: Snap gear less than 1 ft Gangion spacing: ~10 ft apart Hook size and type: Circle hooks, barbed No. of hooks and bait: 500 hooks/set; squid Soak time: ~3 hrs	30 sets/yr
					Hook and line deployed by rod and reel	Eight anglers with eight lines in the water at a time. Barbed circle hooks	6 hrs fishing per day, 90 hrs total

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
Studies Using Other Gears							
13) Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat	An expansion of the Southern CA Bight Hook and Line Survey to sample untrawlable shelf habitats from Pt. Arguello, California to the Washington-Canada border. The primary objective of this survey is to provide an annual index of relative abundance and a time series of biological data for several key species of shelf rockfish (genus Sebastes) from untrawlable habitats and serves as a complement to existing long-term groundfish monitoring surveys, including the West Coast Groundfish Bottom Trawl Survey and the Acoustic Hake Survey.	U.S.-Canada to U.S.-Mexico border	Annually, May – October 250 DAS Daytime operations only	Charter sportfishing vessels (3 to 4 vessels)	Hook and line gear deployed by rod and reel	Rod and reel hooks: 3 anglers; 5 hooks per line; 5 sets per angler per site (75 total hooks per site) Rod and reel soak time: 5 min soak time per set Depth: 15-250 m	1000 sites 75,000 hooks total
					Camera sled, drop cameras	Tethered video camera	1000 deployments
					CTD profiler	Deployment: Vertical drop	1000 casts
15) Washington Coastal Kelp Forest Ecology Research	Scuba- and ROV-based survey of kelp forest sites along the outer Washington Coast and outer Strait of Juan de Fuca to assess community ecology and use of kelp habitat by NMFS-managed groundfish	Washington	Annually, late July / early August, 7 DAS, daytime operations only	Class I R/V Minnow (NWFSC); R/V Tatoosh (Olympic Coast National Marine Sanctuary (NMS)	Scuba, transect tapes	At each site, pairs of scuba divers conduct multiple 30-m transect surveys through stands of kelp, at <10-m depths. Dives typically last 45-60 min.	5 sites, 16 dives per site = 80 dives total
					Tethered ROV	At each site, the ROV would use the same 30-m transects that the divers survey. Typical ROV flight times/transect are <5 min.	5 sites, 4 transects per site, benthic and surface = 40 ROV operations total
18) Salmon Ocean Behavior and Distribution (SOBaD)	Examine the distribution and behavior of salmon in the marine environment using telemetry and surveys	Washington coast, Oregon coast, Lower Columbia River	Year round	Contract vessels, FSV *Bell M. Shimada*	Mooring	Acoustic release bottom moorings for VR2 receiver, Acoustic Zooplankton Fish Profiler (AZFP), Sound traps	Up to 150 stations
					Purse seine	Various net sizes	Up to 75 sets
					Microtrolling (hook and line)	Up to 20 hooks deployed for 20-min.	Up to 2000 deployments
					VR2 receivers	Acoustic receiver that passively listens for tagged animals	Up to 150 stations
					Sound traps	Passive acoustic listening device	Up to 150 stations
					AZFP	Continuous sampling of four frequencies (67.5, 120, 200, and 455 kHz)	Up to 20 stations

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
20) Ocean Acidification Research on Zooplankton and Benthic Crustaceans (e.g., Dungeness crab)	Collection of zooplankton and all life-stages of benthic crustaceans (e.g., adult and juvenile Dungeness crab) for laboratory rearing in ocean acidification experiments.	Washington and Oregon	Year round Spring, summer and fall collection of zooplankton and larval crustaceans. Fall and winter collection of benthic crustaceans (e.g., crab).		Plankton net Light trap Hand nets Divers Commercial crab trap	Plankton net and light trap for zoea and larval crustaceans; commercial crab trap, divers and hand nets for crustaceans.	Crab and light traps: <100 sets/yr. Plankton tows: <75 sets/yrs.
21) Avian predation studies	Examination of seabird diets & foraging movements to determine impacts to salmon and forage species	Coastal Oregon & Washington, including the Columbia River Estuary & Plume, Puget Sound, and the Salish Sea	May-September/Bi-weekly/up to 40 DAS	NOAA Class I, II, or III vessels as appropriate; charter vessels or partner vessels	Hand-held salmon net for live capture; PIT-(Argos) satellite tags or radio tags for telemetry	Salmon net: less than 0.75 m in diameter, hand-held; telemetry tags would be sized to be considered safe payload for bird species	20 samples per month, for a total of 200 per year
Puget Sound Research Area							
Studies Using Trawl Gear							
22) Beam Trawl Survey to Evaluate Effects of Hypoxia	Examined the effects of hypoxia on demersal fish in Hood Canal. A camera was mounted onto a beam trawl and the video was reviewed to measure escape response time to the bottom trawl by various bottomfish.	Five sites in southern Hood Canal and five sites in northern Hood Canal	Summer-Fall, 20 DAS Daytime operations only	Class II NOAA vessels, chartered vessels	Beam trawl with video camera primarily with open cod end. A few tows had a closed cod- end to verify species composition identified in the video.	Net type: beam trawl Net size: 2 m wide, towed along the bottom at varying depths (30, 60 and 90 m) Duration: 10 min.	1 tow/site/season 20 tows total
					CTD profiler	Deployment: Vertical drop	20 casts
23) Movement Studies of Puget Sound Species	Various types of studies of fish movement in Puget Sound using telemetry. Involves live-capture with various gears and SCUBA divers, tagging and release of species, and placement, retrieval, and remote download of detection arrays. Species include sixgill shark, Chinook and coho salmon, lingcod, ratfish, steelhead, English sole, canary rockfish, spiny dogfish, sunflower stars, and jellyfish	Puget Sound	Year-round sampling 50 DAS Daytime operations only	Class I and II NOAA vessels. Charter boats used for hook and line, purse seines Deployment and trawls depending on circumstance	Purse seines	Net type: Herring seine Net size: 1500 x 90 ft Mesh size: variable Set duration: < 1 hr Depth: < 50 m	12/yr
					Hook and line	Up to 12 lines in the water at once. All hooks are barbless.	20 trips per yr
					Demersal longline	Mainline: 600 ft Depth: about 200 ft 30 hooks/set Hooks: 16/0 circle Soak time: 90 min	3 sets, 90 hooks total

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
					SCUBA divers	Divers capture jellies and stars by hand	One collection trip per site
					VR2, VR2AR, VR3 and VR4 passive acoustic receivers	Hydrophones moored on bottom with metal weights (no lines) in some cases we have 1-6 m risers between anchor and instrument and acoustic releases in deep water near fishing location	Continuous for season
					Transducer	Suspended from a small boat 1-3 m from the surface	40/year
					Mobile tracking omnidirectional hydrophone Tethered ROV	Suspended from a small boat 1-3 m from the surface ROV uses same transects as divers and other gears at corresponding depths. ROV flight times/transect <5 mins.	Variable Variable
24) Salish Sea Studies of Juvenile Salmon and Other Pelagic Species	Studies of juvenile salmon and co-occurring fishes (including forage fish), their habitats, and marine pelagic food web conditions in Puget Sound	Greater Puget Sound and Strait of Juan de Fuca	Annually January to December, 60 DAS Daytime operations only	NOAA Class I & II and chartered vessels	Surface trawl	Net type: Kodiak surface trawl Net size: 3.1 x 6.1 m, Tow speed: 1.8-2.2 kts Duration: 10 min Depth: surface to 3 m	220 trawls/yr
					Midwater trawl	Net type: Midwater baby otter trawl or equivalent Duration: 20-60 min Depth: 1 m from surface to 1m from bottom	250 trawls/yr
					Beach Seine	Net type: Beach seine Net size: 3.6 x 1.8-3.0 m (37 m length) Duration: 15 min Depth: surface to 3 m	200 sets/yr
25) Skagit Intensively Monitored Studies of juvenile salmon in Skagit Bay	Assesses conditions in Puget Sound and the growth, relative abundance, and survival of juvenile salmon during early marine entry.	Puget Sound	Annually April to October 30 DAS Daytime operations only	Class I & II NOAA Vessels	Surface trawl	Net type: Kodiak surface trawl Net size: 3.1 x 6.1 m, Tow speed 1.8-2.2 kts Duration: 10 min Depth: surface to 3 m	180 trawls/yr
					CTD Profiler	Gear Type: Sea-Bird SBE: Vertical drop Depth: Surface to near bottom or 200 m max.	200 trawls /yr
					Bongo Net	Net type: Bongo plankton net with 335 µm mesh Net size: two 0.5 m diameter nets Tow speed: 1.5-2 kts Tow Duration: 5-6 min Depth: 0-30 m	14 trawls/yr
					Vertical Plankton Net	Net type: ring net with 202 µm mesh Net size: 0.5 m diameter Tow speed: 0 (vertical tow) Duration: 5-6 min	14 trawls/yr

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
						Tow speed: 0 (vertical tow) Duration: 5-6 min	
					Water Sampler	Gear type: Niskin Bottle Depth: 4 m	200 trawls/yr
Studies Using Other Gears							
26) Elwha Dam Salmon Recovery	Study of potential effects of dam removal on nearshore fish including ESA listed species.	Puget Sound	Monthly 2006 to present 30 DAS Daytime operations only	Class I NOAA vessel	Beach seine	Net type: Beach seine Net size: 140 x 6 ft Mesh size: < 0.25 in. Duration: < 10 min	Up to 200 samples/yr
27) Herring Egg Mortality Survey	Explores spatial variation and drivers of herring egg loss in Puget Sound. Investigating if herring egg loss relates to vegetation types used by herring for spawning substrate, the presence of suspected large herring egg predators (diving ducks and large fish), and metrics of shoreline development.	Puget Sound spawning locations Puget Sound <10m deep. Squaxin Pass, Quartermaster Harbor, Elliot Bay, Port Orchard, Quilcene Bay, Holmes Harbor, Cherry Point	February-May 2013 20 DAS Daytime operations only	R/V *Minnow* and R/V *Noctiluca*	SCUBA divers, predator exclusion cages	Egg collections by hand. Cages are modified conical sablefish pots with doors sewed shut and bottom closure removed. Mesh openings ~ 3 x 3 centimeters (cm). Cages deployed at first visit and retrieved on the last visit to each site (~ 10 days)	~ 600 small vegetation samples with herring eggs taken/site/yr
29) Puget Sound Marine Diversity Studies	Beach seine and ROV sampling of fish, invertebrate, and algal assemblages to document marine biodiversity in Puget Sound and the Salish Sea.	Puget Sound	Approximately monthly year-round, daytime operations only	Class A or Class I (17 ft Whaler or inflatable or other small boat, SCUBA divers, ROV)	Beach seine Benthic settling plates	Net type: Beach seine Net size: 37 m long by 2.4 m wide Mesh size: 10 milimeters (mm)	Up to 100 sets/yr
					UxS or Tethered ROV	Transect operations duration <30min	Up to 50 ROV transects/yr
30) Fish Contaminants Studies	Studies of contaminant concentrations in juvenile Chinook salmon and other non-listed fish from marine, estuarine, and freshwater sites in Puget Sound and the west coast. ESA section 10 permit #23019-2R	Puget Sound, WA coast, OR coast, CA coast, Columbia River basin, Lower Willamette River	February-August 30 DAS Daytime operations only	Class I (17 ft Whaler)	Beach seine	Net type: Beach seine Net size: 37 m long by 2.4 m wide Mesh size: 10 mm Set duration: < 10 min	Up to 100 sets/yr
					Baby otter trawl	Net type: Bottom trawl Net size: 5 m long by 3 m wide 10 kilogram (kg) doors Mesh size: 3 cm Duration: < 10 min	Up to 20 tows/yr
					Cast net	Net type: Surface cast net Net size: 6 to 12 ft diameter Mesh size: 10 to 20 mm	Up to 50 casts/yr
					Gillnet	Net type: Surface gillnet Net size: 100 ft long by 11 ft wide Mesh size: 0.75 in. Set duration: < 20 min	Up to 50 sets/yr

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
31) Puget Sound Juvenile Salmon Studies	Beach seine and fyke trap sampling of fish assemblages to document juvenile salmon use of the Snohomish estuary and pre- restoration conditions at the Qwuloolt levee breach project and adjacent reference areas. ESA section 10 permit #16702-4R and #1586-5R Joint USFWS BiOp Ref. No. 01EOFW00-2017-F-0359 (for bull trout)	Snohomish Estuary	Monthly, twice monthly February to September 50 DAS Daytime operations only	Class A and Class I NOAA Vessels	Beach seine	Net type: Beach seine Net size: 140 x 6 ft Mesh size: < 1 in. Set duration: < 10 min	Up to 400 sets/yr
32) Habitat Function of Nearshore Ecosystems with Shellfish Aquaculture and Eelgrass	Study nearshore areas in Puget Sound to understand how species use different habitat types (eelgrass, aquaculture habitat, bare sediment).	Puget Sound and Strait of Juan de Fuca	Throughout year. Collection primarily spring, summer and fall. Collecting invertebrates (e.g. crab, snail, molluscs) and fishes (future work).	Access nearshore habitats at low tide	Plankton nets benthic pump minnow traps beach seines fyke nets crab traps Collecting invertebrates (e.g. crab, snail, molluscs) and fishes	Seine: 1 m tall, with 6 m wings and a central cod end Mesh size: 3 mm for wings	Trap sets span individual tidal cycles.
33) Non-Native Species Studies	Distribution, abundance and behavior of non-native species in Puget Sound and Lake Washington.	Puget Sound and Lake Washington	Spring, Summer, Fall 15 DAS for hook and line based on 90 hrs total 6 hrs per set.	WDFW vessel, Class A and Class I NOAA Vessels, or shore access	Acoustic telemetry, crab traps , beach seines, minnow traps hook and line fishing	Vemco 69 kHz V8-H tags & VR2AR receivers, Seine:1 m tall, with 6 m wings and a central cod end. Mesh was 3 mm for the wings.Hook and line fishing with bait (herring and squid) or bottom jigs such as darts	50 tagged crabs of even sex ratio, seines & trapping - up to 400 tows & sets/yr; Average 4 hooks/day for 6 hours/day, 90 hrs total
35) Near Coastal Ocean Lampara Seining and ROV Surveys	Study of salmon habitat use in nearshore areas of Puget Sound.	Nearshore throughout Puget Sound	Monthly, Apr – Sept 36 DAS	R/V Minnow	Lampara seine	Net type: Lampara seine	400 sets
					UxS or Tethered ROV	ROV uses same transects as divers and other gears at corresponding depths. ROV operations times/transect <30mins.	6 transects/site, surface and benthic/ transect ~ 100 ROV operations
37) ROV Nearshore Survey Feasibility Study	A Deep Trekker DTG3 mini-ROV was acquired in order to test the feasibility of using this sensor platform to survey flora and fauna in nearshore (<200 m) estuarine and marine systems. The hypothesis is that mini-ROVs are less obtrusive and selective than conventional sampling platforms, e.g., divers and nets, so more biota should be observed. The system is also capable of surveying considerably more area and distance, given its survey flying speed (~0.5m/s) and 8hr battery life. Continuous 4K video is captured on transects as well as digital stills, temperature, heading, date/time and depth. Data are then post-processed in the lab manually or using automated machine learning classification systems.	Duwamish Waterway	Monthly, April - September	NOAA Class I vessels. Can also operate from shore.	UxS or Tethered ROV	ROV flies 5 surface or benthic transects. ROV operations times/transect <30 min.	180 - 240
38) Gear testing in support of groundfish surveys in untrawlable habitat	Ad hoc testing of gear and sampling techniques in support of regional and coastwide groundfish surveys in untrawlable habitats	Puget Sound	Ad hoc throughout year (~10 DAS/yr); Daytime operations only	Vessels of opportunity including R/V Emmett or charter vessels	Towed camera sleds ; drop cameras CTDs ; Niskin bottle deployments for eDNA; hook and line gear deployed by rod and reel; vertical setlines	Camera systems include towed sleds and vertical deployments along the seafloor; CTD and Niskin bottles would be vertical deployments throughout water column; rod and reel gear would use up to 5 hooks per deployment; vertical setlines may include up to 15 hooks per deployment; soak times for both would be <15 min	Variable; 1-20 sets or deployments/ day

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
39) Urban Gradient Surveys	Purpose is to identify relationships between land use practices and properties of streams and nearshore marine ecosystems around Puget Sound. Examine how ecosystem structure (relative abundance of different species) and ecosystem functions (processes connecting species to one another) vary according to the level of urbanization. Focus is on motile epibenthic invertebrates (e.g., shrimps, gastropods, isopods, amphipods) from eelgrass habitats.	Central Puget Sound; five pairs of study sites	Summer 10 DAS Daytime operations only	R/V *Minnow* or shore access	Epibenthic tow sled	Net size: 1 m x 1 m mouth opening Mesh size: 1 mm Duration: 10 min tows in eelgrass beds at 1 m depth.	3-5 samples/site/yr 36-60 samples total
40) Rockfish Projects in Puget Sound	This project collects fin clips from all bottomfish captured during hook and line fishing with a focus on locating and getting genetic samples from ESA-listed rockfish species (yelloweye, canary, and bocaccio rockfish). These are not standardized surveys to quantify abundance or density estimates but are being used to collect size, weight, location, depth, and genetic information from bottom fish species. The intent is to release all fish unharmed.	Puget Sound, San Juan Islands and the Strait of Juan de Fuca	Spring, summer, and fall 35-41 DAS Daytime operations only	Charters: *F/Vs Joker, Venture, Dash One, All Star, Morning Star, Fishfull Thinking II, Malia Kai, Cabazon, Darla Orion, Ann Patrice*	Hook and line	Hook and line fishing with bait (herring and squid) or bottom jigs such as darts. Avg. 4 hooks/day for 18.2 hook-hrs/day.	~750 hook-hrs/yr (target numbers of fishes in each area)
41) Long-term Eelgrass Monitoring	Long-term monitoring of fringe eelgrass habitats began in Puget Sound in 2015. This work is used to quantify growth, pressures, and community structure of eelgrass beds over the next 20 years to monitor for potential changes due to climatic/oceanic conditions and management actions related to shoreline armoring and land-use practices.	Sites within Puget Sound proper and paired across a range of urbanization gradients.	Quarterly 10 DAS Daytime operations only	*R/V Minnow*	SCUBA divers, sediment grabs and water samples in Niskin bottles	Transects would be used to quantify fish, invertebrate, and eelgrass densities. Collection of seagrass, sediments, and water samples would be used to quantify epiphyte loads and sediment quality, and water chemistry.	4 transects/site (~5 sites)/quarter 360 transects/yr
					UxS or Tethered ROV	ROV uses same transects as divers and other gears at corresponding depths. ROV operations times/transect <30 mins.	4 transects per site, benthic and surface, (~5 sites) each quarter 160 ROV operations/yr
Lower Columbia River Research Area							
Studies Using Trawl Gear							
42) Pair Trawl Columbia River Juvenile Salmon Survey	A surface pair trawl with a flow-through PIT tag detector is used to assess passage of tagged juvenile salmon migrating from the upper reaches of the Columbia River basin to the ocean.	Columbia River Estuary (River Kilometer 65 to 85)	March to August 80 DAS 24-hr operations	Two 41-ft utility vessels to deploy net and tow plus small skiff to tend equipment and clear debris	Surface pair trawl (a surface trawl with two mesh wings leading to an open cod-end with a PIT detector array). Flexible antenna array	Net type: Surface trawl modified with open cod end (8 x 10 ft opening) Net size: wings 92 m x 92 m, trawl body 9 m wide x 6 m deep x 18 m long Mesh size: wings 3.8 cm, body 1.8 cm. Tow speed: 1.5 kts Duration: 8-15 hrs Depth: surface to 5 m	800 - 1200 hrs/yr
43) Eulachon Arrival Timing	Determine the arrival timing and distribution of spawning eulachon along the migration corridor in the Columbia River. Samples would be taken for fecundity and other biological data but most fish would be released unharmed.	Columbia River Estuary and Plume	Weekly, November to April 30 DAS Daytime operations only	NOAA Class II and Class III vessels	Pelagic trawl net	Modified cobb trawl with 9.5 mm codend Net size: 12 x12 m opening Tow speed: 2.7 kts Duration: 15 min Depth: 30-40 m	Depends on adult returns Typically no more than 75 combined net & jig samples/yr

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
					Hook and line,	Hook and line type: sabikie/herring jigs	
					Echosounder	Active acoustics: Simrad (or similar) 38-400 kHz split-beam scientific echosounders	
44) Forage Fish Influence on Salmon Predation Risk and Food Resources	Determine the species composition, distribution, and abundance of forage fishes with respect to tidal, seasonal, annual patterns in forage ability to buffer salmon against predation risk and to provide food sources for salmon,	Columbia River Estuary and Plume, Puget Sound/Salish Sea	Year round (estuary, Puget Sound, Salish Sea); May - September (Plume)	NOAA Class II and Class III vessels	Trawl net, hook and line, Simrad (or similar) 38 kHz - 400 kHz split beam scientific echosounders	Net type: purse seine or surface trawl or modified shrimp trawl; hook and line type sabiki/herring jigs;	Variable according to sampling design. No more than 100 combined net & jig samples/yr
Studies Using Other Gears							
45) Columbia River Estuary Tidal Habitats	Study of salmon habitat use and genetic stocks of origin throughout the estuary from the river mouth to Bonneville.	Columbia River Estuary	Quarterly to monthly 25 DAS Daytime operations only	17 ft whaler	Beach seine	Net type: Beach seine Net size: 46 m x 2 m Mesh size: < 25 mm. Set duration: < 10 min	< 100/yr
					Trap nets	Net type: barrier trap Net size: variable Mesh size: < .25 in Set duration: up to 6 hrs soak time	< 50 sets/yr
					CTD	Gear Type: Sea-Bird SBE 19+ CTD, WETstar fluorometer, C-Star transmissometer, and Sea-Bird SBE 43 dissolved oxygen sensor Deployment: Vertical drop Depth: Surface to near bottom or 200 m max	~100/yr
					Electro-fishing	Gear types: 24-volt backpack shocker (shallow tidal fresh wetlands and floodplains); Boat electro- shocker (100 m transects, tidal-fresh channels and backwater areas)	<100 sites/yr
					Remote PIT detection	Gear types: ≤ 6 stationery PIT antennas (up to 8 ft x 40 ft of flexible cable style antennas each) per tidal channel	Continuous operation, ≤ 8 sites/yr
					Fish holding pens	<0.25 in. mesh, 10 ft x 10 ft x 6 ft or smaller for holding fish in flooded wetlands	Episodic, <6 months/yr, 4 sites
					Water level & temperature logger	HOBO U-model and tidbit	Continuous operation, ~12 sites/yr
					Insect fall out traps	Staked plastic tubs (50 cm x 35 cm x 14 cm) with <10% dish soap solution;	Monthly year round, Up to 8 sites, at least 5 replicates/site
					Emergent insect cone traps	Plastic inverted conical traps (0.6 m^2)	

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
					Benthic cores	0.0024 m^2 sediment cores	
46) Effects of Sediment Deposition on Crab Recruitment	Study of how Dungeness Crab respond to dredge spoils being placed in nearshore zone for beach nourishment	Nearshore Columbia River Mouth Area	Periodic, August to November 15 DAS Daytime operations only	Various NOAA or charter vessels	Video transects	Tethered benthic video sled	
					Acoustic telemetry	Bottom moored Vemco VR2AR receivers, V9-2H transmitters (96kHz)	30+ receivers, up to 100 tags/yr
					"CamPod"	Video drop camera	5-6 replicate deployments
47) Lower Columbia River Ecosystem Monitoring	Study of habitat occurrence and health of juvenile salmon and their prey in the Lower Columbia Estuary.	Columbia River Estuary	Monthly, February- December 16 DAS Daytime operations only	17 ft whaler	Beach seine	Net type: Beach seine Net size: 37 m long x 2.4 m wide Mesh size: 10 mm Set duration: < 10 min	up to 200/year
					Plankton net	Net type: Neuston Net size: 1m x 3 m Mesh size: 250 µm Set duration: 100 m/ ~ 5 min	50 /year
					Micro-purse seine	Net type: purse seine Net size: 100 ft long x 10 ft wide Mesh size: <1 in. Set duration: < 10 min	50/year
48) Migratory Behavior of Adult Salmon	The objective of the work is to catch fish unharmed and to tag and release them in order to determine the migratory rate of adult Chinook salmon destined for upper river spawning sites. Study conducted by cooperative research partners affiliated with commercial fisheries.	Columbia River Estuary (to Bonneville Dam)	Spring to fall (as needed to make tagging goals) 50 DAS max Daytime operations only	Various commercial fishing vessels	Tangle net (non-lethal capture of fish), beach seine or trap. Catch, tag, and release only	Tangle net size: 600 x 40 ft Mesh size: 4.25 in Duration: 25-45 min. Beach seine net size 1080 x 40 ft mesh size: 3-3 ¼ in. Trap with lead of 265 ft Mesh size of 3- 3 ¼ in. reducing to 2 ½ in. mesh for the holding/collection area	Up to 150 sets/yr
50) Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring	Study of salmon habitat use in the lower Columbia River estuary focusing on determining benefits that juvenile salmon obtain from restoring wetland habitats.	Columbia River Estuary, Bonneville Dam to mouth	Bi-weekly, March to October, 32 fishing days Daytime operations only	R/V *Pelican* and a skiff	Purse seine	Net type: Purse seine Net size: 500 x 30 ft Mesh size: 0.34 in. (net body), 0.25 in. (bunt) Set duration: Generally < 1 hr	90 sets/yr
					CTD profiler	Gear Type: Sea-Bird SBE 19+ CTD Deployment: Vertical drop Depth: Surface to near bottom or 20 m max.	90 samples/yr
			Quarterly, March to December.	17 ft Whaler	Beach seine	Net type: beach seine Net size: 150 x 6 ft Mesh size: < 1 in. Set duration: < 10 min	2 sites/day 2-3 hauls/site 16 sampling days/yr
			Daytime operations only	17 ft Whaler	Trap nets	Net type: barrier trap Net size: variable Mesh size: < 0.25 in. Set duration: up to 6 hrs soak time	

Survey Name	Description	General Area of Operation	Season/Frequency/Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
				Two small boats, 17 ft Whaler plus larger tow boat	Small surface trawl	Net type: surface trawl Net size: 10 x 20 ft Mesh size: 1.0 in. (net body), 0.5-in. bag Set duration: Generally 15 min	
	Invertebrate prey flux	Wetland tidal channels		17 ft Whaler	Neuston net ADCP	1.0 x 0.4 m neuston net; 350 µm mesh Sonteq IQ ADCP 3 millihertz (mHz)	~10 samples/d; ~40 trips/yr Time series of various length
51) Remote Sensing Wetland Habitat with Uncrewed Aerial Vehicles	Using drones equipped with LiDAR, hyperspectral, RGB, and/or thermal cameras to map various habitats.	Columbia River wetlands; Willapa Bay, Grays Harbor tidelands	Daytime operations (usually)	Small vessel when required	Vertical Take Off and Landing (VTOL) drones of various configuration	OCI hyperspectral camera; Forward Looking Infrared (FLIR) thermal imager; Sony RGB; Phoenix Light Detection and Ranging (LiDAR) System miniRANGER	Low tide periods; sites usually samples in 1 d.
52) Surveys of Salmon Predators	Visual and acoustic surveys for marine bird, mammal, and large fish predators	Columbia River, Estuary, and Plume/nearshore	March-September (river, estuary); May-September (nearshore). Survey frequency and DAS depend on target predator(s) and salmon stocks of interest	NOAA Class I, II, or III vessels; Land-based survey sites	Binoculars/rangefinders; active acoustics	Simrad (or similar) 38 kHz - 400 kHz split beam echosounders	Visual, acoustic sampling continuous or at set intervals during daytime hrs (e.g. every 30 min)
53) Surveys of Larval Fishes	Use of plankton nets to determine species distribution and abundance in the Columbia River, Estuary, and Plume/nearshore (including eulachon)	Columbia River, Estuary, and Plume/nearshore	Year round/weekly/up to 75 DAS/yr	NOAA Class I, II, or III vessels	Ring nets, neuston nets,or similar hand-deployed nets; active acoustics	Nets: less than 1 m in diameter/width Fine mesh 300 - 500 µm Simrad 38 kHz - 400 kHz split beam echosounder (or similar)	Variable; no more than 500/yr

2. DATES, DURATION, AND REGION OF ACTIVITY

2.1. Dates and Durations of Activities

Fisheries and ecosystem research conducted and funded by NWFSC is proposed for the period 2023 - 2028. While these surveys are planned over the next 5-year period, not every survey may occur each year. The number and extent of surveys depends on available funding and other factors, which is subject to change from year to year. However, for the purposes of this LOA application, information on the types of surveys (i.e., description), area of operation, season/frequency, gear used, and level of effort such as number of tows or casts is provided in Table 1-2 for the full suite of activities that may occur during the 5-year period 2023–2028. This precautionary approach allows NWFSC to estimate the potential for interacting with marine mammals during this period and to calculate potential takes as described in Section 6 of this application. As described in Section 5, NWFSC is only requesting non-lethal Level A, M/SI due to potential entanglement and physical disturbance takes.

2.2. Region of Activity

As shown in Figures 1-1 through 1-3, and described in Section 1-1, NWFSC conducts research in three research areas along the Pacific coast of the U.S. including the CCRA, PSRA and LCRRA. These research areas encompass marine and estuarine waters of the Pacific Ocean, Puget Sound, and the lower Columbia River below Bonneville Dam.

3. SPECIES AND NUMBERS OF MARINE MAMMALS IN THE ACTION AREAS

Tables 3-1 lists the marine mammal species managed by NMFS that may be encountered by NWFSC research activities in the CCRA, PSRA, and LCRRA. The table provides the most recent publicly available abundances based on Carretta *et al.* (2022) and the 2018 final rule (83 FR 36370). Only marine mammal species for which non-lethal injury, M/SI due to potential entanglement or physical disturbance takes are requested are described in this section. Species found in NWFSC research areas but for which takes are not anticipated (indicated in Table 3-1 right column as 'N') are not discussed further.

TABLE 3-1. MARINE MAMMAL SPECIES MANAGED BY NMFS IN NWFSC RESEARCH AREAS

Species and Stock or DPS	CCRA	PSRA	LCRRA	2018 Final Rule Abundance	Current Estimated Abundance[1]	Injury, M/SI or Physical Disturbance Takes Possible? (Y/N)
ESA-listed Marine Mammal Species or DPSs						
Sperm Whale *(Physeter microcephalus)* Eastern North Pacific Stock (E,D)	X			1,997	1,997	N
Humpback Whale *(Megaptera novaeangliae)* CA/OR/WA Stock (E,D)	X	X		1,918	4,784	N
Blue Whale *(Balaenoptera musculus musculus)* Eastern North Pacific Stock (E,D)	X			1,647	1,898	N
Fin Whale *(Balaenoptera physalus velifera)* CA/OR/WA Stock (E,D)	X			9,029	11,065	N
Sei Whale *(Balaenoptera borealis borealis)* Eastern North Pacific Stock (E,D)	X			519	519	N
Gray Whale *(Eschrichtius robustus)* Western North Pacific Stock (E,D)	X	X		NR	290	N
Killer Whale *(Orcinus orca)* Eastern North Pacific Southern Resident Stock (E,D)	X	X		83		N
Guadalupe Fur Seal (T,D) *(Arctocephalus townsendi)*	X			20,000	34,187	N
Non-listed Marine Mammal Species or DPSs						
Harbor Porpoise *(Phocoena phocoena)*						
Morrow Bay Stock	X	**X**		2,917	4,191	Y
Monterey Bay Stock	X			3,715	3,760	
San Francisco/Russian River Stock	X			9,886	7,777	
Northern CA/Southern OR Stock	X			35,769	24,685	

Species and Stock or DPS	CCRA	PSRA	LCRRA	2018 Final Rule Abundance	Current Estimated Abundance[1]	Injury, M/SI or Physical Disturbance Takes Possible? (Y/N)
Northern OR/WA Coast Stock	X		X	21,487	21,487	
WA Inland Waters Stock		X		11,233	11,233	
Dall's Porpoise *(Phocoenoides dalli)*	X	X		25,750	16,498	Y
Pacific White-Sided Dolphin *(Lagenorhynchus obliquidens)*						
CA/WA/OR Stock	X	X		26,814	34,999	Y
Risso's Dolphin *(Grampus griseus)*	X			6,336	6,336	Y
Common Bottlenose Dolphin *(Tursiops 3-2runcates 3-2runcates)*						Y
CA Coastal Stock	X			453	453	
CA/OR/WA Offshore Stock	X			1,924	3,477	
Striped Dolphin *(Stenella coeruleoalba)*	X			29,211	29,988	Y
Short-beaked Common Dolphin *(Delphinus delphis)*	X			969,861	1,056,308	Y
Long-beaked Common Dolphin *(Delphinus capensis)*	X			101,305	83,379	Y
Northern Right Whale Dolphin *(Lissodelphis borealis)*	X			26,556	29,285	Y
Killer Whale *(Orsinus orca)*						
Eastern North Pacific Northern Resident	X	X	X	261	302	N
West Coast Transient	X	X	X	243	349	
Eastern North Pacific Offshore Stock	X			240	300	
Short-finned Pilot Whale *(Globicephala macrorhynchus)*	X			836	836	Y
Baird's Beaked Whale *(Berardius bairdii)*	X			2,697	1,363	N
Curvier's Beaked Whale *(Ziphius cavirostris)*	X			3,274	3,274	N
Hubbs' Beaked Whale[3] *(Mesoplodon carlhubbsi)*	X			3,044	3,044	N
Blainville's Beaked Whale[3] *(Mesoplodon densirostris)*						
Ginko-toothed Beaked Whale[3] *(Mesoplodon ginkodens)*						
Perrin's Beaked Whale[3] *(Mesoplodon perrini)*						

Species and Stock or DPS	CCRA	PSRA	LCRRA	2018 Final Rule Abundance	Current Estimated Abundance[1]	Injury, M/SI or Physical Disturbance Takes Possible? (Y/N)
Lesser (Pygmy) Beaked Whale[3] *(Mesoplodon peruvianus)*						
Stejneger's Beaked Whale[3] *(Mesoplodon stejnegri)*						
Pygmy or Dwarf Sperm Whale[2] *(Kogia breviceps or K. sima)*	X			4,111	4,111	Y
Minke Whale *(Balaenoptera acutorostrata)*	X	X		636	915	N
Gray Whale *(Eschrichtius robustus)*						
Eastern North Pacific Stock	X	X		20,990	26,960	N
California Sea Lion *(Zalophus californianus)*	X	X	X	296,750	257,606	Y
Steller Sea Lion[3] *(Eumetopias jubatus monteriensis)*						
Eastern DPS	X	X	X	41,638	43,201	Y
Northern Fur Seal *(Callorhinus ursinus)*						
Eastern Pacific Stock	X			237,561	626,618	Y
California Stock	X			14,050	14,050	
Northern Elephant Seal *(Mirounga angustirostris)*						
California Breeding Stock	X	X		179,000	187,386	N
Harbor Seal *(Phoca vitulina richardsii)*						
California Stock	X			30,968	30,968	
OR/WA Coast Stock	X		X	24,732	24,732	
WA Northern Inland Waters Stock		X		11,036	11,036	Y
Southern Puget Sound Stock		X		1,568	1,568	
Hood Canal stock		X		1,088	1,088	

Note : E = endangered, T= threatened; D = depleted under the MMPA

[1]Source Carretta *et al.* (2022). Appendix 2

[2]*K. breviceps* abundance used.

[3]Source: Muto *et al.* (2021)

4. AFFECTED SPECIES STATUS AND DISTRIBUTION

As shown in Table 3-1, while eight ESA-listed marine mammal species or DPSs have the potential to be encountered during surveys in the CCRA only two have the potential to be taken by Level A (i.e., capture or non-lethal injury during trawl)or physical disturbance: Eastern North Pacific (ENP) sperm whales and CA/OR/WA humpback whales. CA/OR/WA humpback whales also have the potential to be encountered in the PSRA. Table 3-1 also lists the non-ESA-listed species and their respective stocks or DPSs that have the potential to be encountered in any of the three research areas. However, only 15 of these non-listed species, stocks, or DPSs have the potential to be taken by Level A non-lethal injury, M/SI due to potential entanglement or physical disturbance during NWFSC surveys. The following subsections provide detailed information on life histories for the ESA-listed and non-listed species that may be taken during NWFSC research.

4.1. ESA-Listed Marine Mammal Species or DPSs

4.1.1. Sperm Whales Eastern North Pacific Stock

Description: The sperm whale (*Physeter microcephalus*) is the largest toothed whale species and the most sexually dimorphic cetacean in body length and weight (Rice *et al.* 1984) (Whitehead 2002). Adult females can reach 12 m in length, while adult males measure as much as 18 m in length (Jefferson *et al.* 2015). The head is large (comprising about one-third of the body length) and squarish. The lower jaw is narrow and under slung. The blowhole is located at the front of the head and is offset to the left. Sperm whales are brownish gray to black in color with white areas around the mouth and often on the belly. The flippers are relatively short, wide, and paddle-shaped. There is a low rounded dorsal hump and a series of bumps on the dorsal ridge of the tailstock and the surface of the body behind the head tends to be wrinkled (Jefferson *et al.* 2015).

Status and Trends: Sperm whales are formally listed as endangered under the ESA, and consequently the Eastern North pacific (ENP) stock is automatically considered as a depleted and strategic stock under the MMPA. Estimates of sperm whale abundance were 3,140 (CV=0.40) in 2005 and only 300 (CV=0.51) in 2008; this 10-fold difference is likely due to study design (Carretta *et al.* 2021). The current best estimate of sperm whale abundance in the California Current based on the most recent survey (2014) is 1,997 (CV= 0.57) animals (Carretta *et al.* 2021; Carretta *et al.* 2022). This estimate is corrected for diving animals not seen during surveys. The minimum population estimate is 1,270 whales and the Potential Biological Removal (PBR)[1] is 2.5 whales per year (Carretta *et al.* 2022).

Whaling removed at least 436,000 sperm whales from the North Pacific between 1800 and the end of commercial whaling (Carretta *et al.* 2021). There has been a prohibition on taking sperm whales in the North Pacific since 1988, but large-scale pelagic whaling stopped in 1980. Moore and Barlow (2014; as

[2]On September 8, 2016, NMFS issued a final rule that revised the global listing status of the humpback whale by dividing the species into 14 distinct DPSs. Of these 14 DPS, NMFS listed four. The endangered Central America DPS and the threatened Mexico DPS occur within the CCE and are considered discrete. Calambokidis et al. (2017 as reported in Carretta et al. 2019) reported that approximately 70% of whales photographed in the breeding grounds of these two DPSs have been matched to California and Oregon waters.

cited in Carretta *et al.* (2021)) reported that sperm whale abundance appeared stable from 1991 to 2008 and additional data from a 2014 survey does not change that conclusion.

Distribution and Habitat Preferences: With the exception of humans and killer whales, few animals on earth are as widely distributed as sperm whales (Whitehead 2009). As summarized in Carretta *et al.* (2022), sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer but the majority are thought to be south of 40^{o} N in winter. Sperm whales are found year round in California waters but they reach peak abundance from April through mid-June and from the end of August through mid-November. They were seen in every season except winter (Dec.-Feb.) in Washington and Oregon. Of 176 sperm whales that were marked with Discovery tags off southern California in winter 1962-70, only three were recovered by whalers: one off northern California in June, one off Washington in June, and another far off British Columbia in April. Recent summer/fall surveys in the eastern tropical Pacific show that although sperm whales are widely distributed in the tropics, their relative abundance tapers off markedly westward towards the middle of the tropical Pacific (near the IWC stock boundary at 150o W) and tapers off northward towards the tip of Baja California.

Behavior and Life History: Females reach sexual maturity at about age 9 when roughly 9 m long and they give birth about every 5 years; gestation is 14-16 months (Whitehead 2009). Males are larger during the first 10 years and continue to grow well into their 30s, finally reaching physical maturity at about 16 m. The sperm whale consumes numerous varieties of deep water fish and cephalopods. Sperm whales forage during deep dives that routinely exceed a depth of 400 m and duration of 30 mins. They are capable of diving to depths of over 2,000 m with durations of over 60 min. Sperm whales spend up to 83 percent (%) of daylight hours underwater. Males do not spend extensive periods of time at the surface. In contrast, females spend prolonged periods of time at the surface (1 to 5 hrs daily) without foraging (Whitehead 2009). An average dive cycle consists of about a 45 min dive with a 9 min surface interval. The average swimming speed is estimated to be 2.5 km/hr (Whitehead 2009).

4.1.2. Humpback Whales California/Washington/Oregon Stock

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

Status and Trends: As described in Carretta *et al.* (2022) the California/Oregon/Washington Stock includes humpback whales from two feeding groups: California-Oregon and Washington-southern British Columbia. The relationship of MMPA stocks to ESA DPSs is complex. The California-Oregon feeding group includes whales from the Mexico and Central America DPSs and it is estimated that most Central America DPS whales use California-Oregon waters for feeding (NOAA 2016a, Wade et al. 2016, Wade 2017; as cited in Carretta *et al.* (2022)). The northern Washington and southern British Columbia

feeding group includes primarily threatened Mexico DPS whales, with smaller numbers from the unlisted Hawaii DPS (see Section 4.2.15) and endangered Central America DPS. Most humpbacks that feed in California and Oregon waters in summer originate from the threatened Mexico DPS, while a much smaller fraction originate from the endangered Central American DPS (Wade *et al.* 2016; Wade 2017)[2].

The current best estimate of abundance is 4,973 (CV=0.048) whales, based on the most-recent 4 years (2015-2018) of mark-recapture data that accounts for heterogeneity of capture probabilities, (Calambokidis and Barlow 2020 as cited in Carretta *et al.* (2022)). This estimate is calculated using identifications from California and Oregon waters but it likely includes a smaller number of whales from Washington state waters since there is interchange with that area. The minimum population estimate for humpback whales in the California/Oregon/Washington stock is 4,776 whales with PBR in U.S. waters of 28.7 (Carretta *et al.* 2022).

On April 21, 2021, NMFS designated critical habitat for three ESA-listed DPSs of humpback whales (86 FR 21082): the endangered Western North Pacific DPS; the threatened Mexico DPS; and the endangered Central America DPS (Figure 4-1). Specific areas designated as critical habitat for the Central America DPS of humpback whales contain approximately 48,521 nm^2 of marine habitat in the North Pacific Ocean within the portions of the California Current Ecosystem off the coasts of Washington, Oregon, and California. These designated critical habitat areas are within the NWFSC research areas.

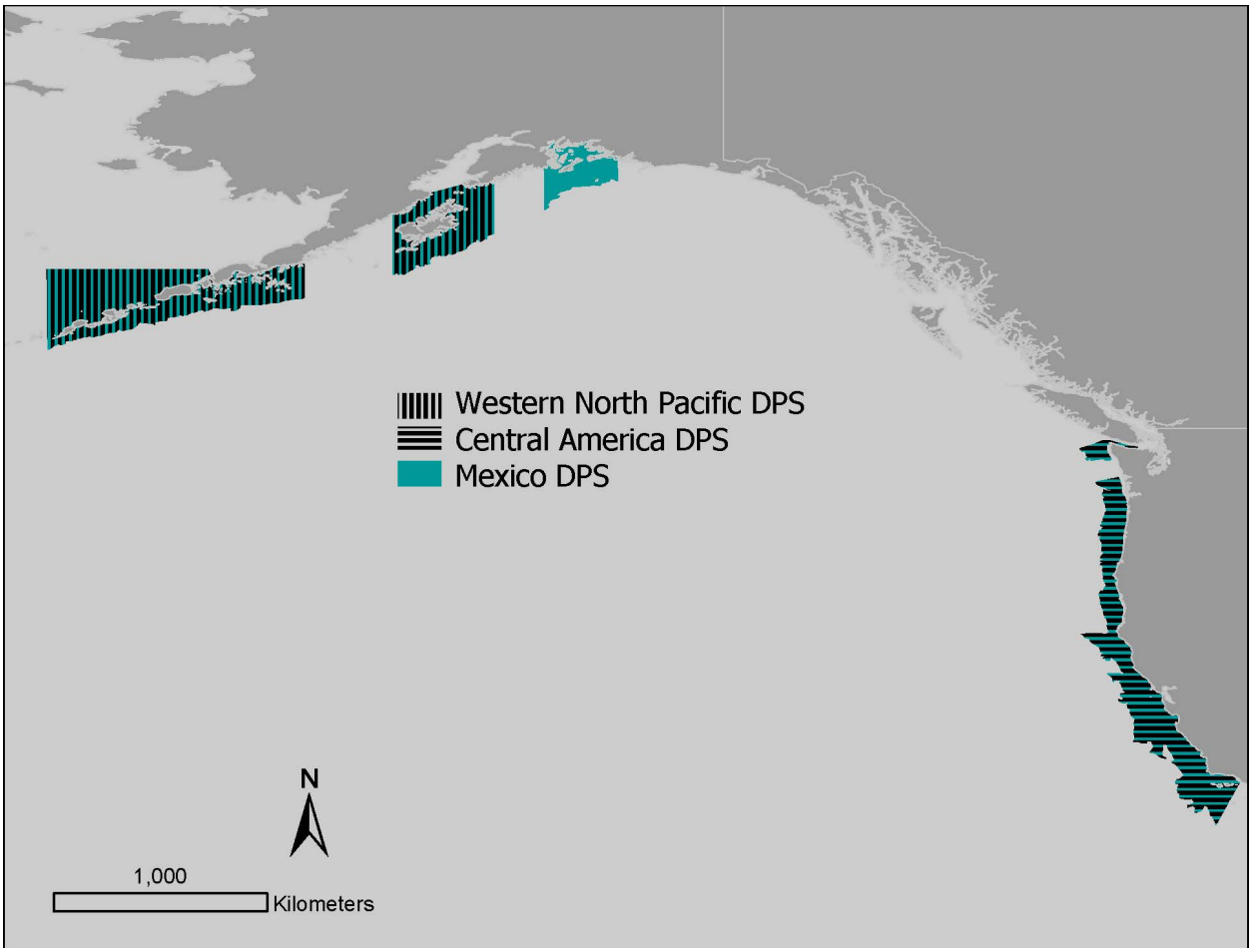
Distribution: Humpback whales are found in all oceans of the world and are highly migratory from high latitude feeding grounds to low latitude calving areas. They are typically found in coastal or shelf waters in summer and close to islands and reef systems in winter (Clapham 2009). About 10% of the whales that were identified off Oregon were also photographed off northern Washington. The results from these surveys showed that humpback whales fed off the Washington coast near the edges of the continental slope or deep canyons from May through September, with the highest numbers in June and July (Calambokidis *et al.* 2004).

Behavior and Life History: Humpback whales are known for their aerial behaviors and complex songs. They breed in warm tropical waters after an 11 month gestation period; calves likely feed independently after 6 months. Humpback whales feed on euphausiids and various schooling fishes, including herring, capelin, sand lance, and mackerel (Clapham 2009)). Although humpback whales have been recorded to dive as deep as about 500 m, on the feeding grounds they spend the majority of their time in the upper 122 m of the water column. On the wintering grounds they dive deeper to 176 m or greater. Like other large mysticetes, they are a "lunge feeder" taking advantage of dense prey patches and engulfing as much food as possible in a single gulp (Carretta *et al.* 2022). They also blow nets, or curtains, of bubbles around or below prey patches to concentrate the prey in one area, then lunge with mouths open through the middle (Clapham 2009).

[2]On September 8, 2016, NMFS issued a final rule that revised the global listing status of the humpback whale by dividing the species into 14 distinct DPSs. Of these 14 DPS, NMFS listed four. The endangered Central America DPS and the threatened Mexico DPS occur within the CCE and are considered discrete. Calambokidis et al. (2017 as reported in Carretta et al. 2019) reported that approximately 70% of whales photographed in the breeding grounds of these two DPSs have been matched to California and Oregon waters.

[3]https://www.fisheries.noaa.gov/national/marine-life-distress/2013-2017-california-sea-lion-unusual-mortality-event-california

FIGURE 4-1. HUMPBACK WHALE CRITICAL HABITAT



Source: https://www.fisheries.noaa.gov/resource/map/humpback-whale-critical-habitat-maps-and-gis-data Accessed June 1, 2022

Carretta *et al.* (2022) reported a total of 172 human-related interactions with humpback whales from 2015-2019. These records include serious injuries, non-serious injuries, and mortality involving pot/trap fisheries (n=81), unidentified fishery interactions (68), gillnet fisheries (11), vessel strikes (10), hook and line fisheries (1) and marine moorings debris (1). Ten humpback whales (7 deaths and 2 serious injuries) were reported struck by vessels between 2015 and 2019 (Carretta *et al.* 2022). Average annual serious injury and mortality of humpback whales due to observed vessel strikes is 1.76 whales per year (Carretta *et al.* 2022).

4.2. Non-Listed Marine Mammal Species, Stocks, or DPSs

4.2.1. Harbor Porpoises Morro Bay, Monterey Bay, San Francisco-Russian River, Northern California-Southern Oregon, and Washington Inland Stocks

Description: Harbor porpoises (*Phocoena phocoena*) are short and stocky and are one of the smaller porpoises. On average females are about 1.6 m and 60 kg in size, while males average 1.4 m and 50 kg (Bjørge and Tolley 2009). They are dark gray dorsally and the chin and ventral surfaces are white. Harbor porpoises have a small triangular dorsal fin that is easily recognized when swimming.

Status and Trends: Four stocks are recognized within the CCE geographic area: Morro Bay, Monterey Bay, San Francisco-Russian River, and Northern California-Southern Oregon. Harbor porpoise in California are not listed as threatened or endangered under the ESA nor as depleted under the MMPA.

Previous estimates of abundance for California harbor porpoise were based on aerial surveys conducted between the coast and the 50-fathom (fm) isobath during 1988-95 (Forney 1999; as cited in Carretta *et al.* (2022)). These early estimates did not include the abundance of individuals found in deeper waters. Starting in 1999, aerial surveys extended farther offshore (to the 200 m depth contour or a minimum of 27.8 km from shore) in the region of Monterey Bay and Morro Bay to provide a more complete abundance estimate.

Generally, the range of the following three stocks are very nearshore and the range does not overlap with the distribution of the NWFSC fisheries research surveys. The only stock potentially impacted by the surveys as indicated by the range overlap between the distribution of the porpoise and the surveys is the Northern California/Southern Oregon stock. Harbor porpoise stocks are not considered "strategic" under the MMPA. There are no known habitat issues of particular concern for any of the stocks.

Abundance: *Morro Bay*: The most recent estimate of abundance for the Morro Bay stock is 4,191 (Coefficient of Variation [CV]=0.56) harbor porpoises (Carretta *et al.* 2022). The minimum population estimate is 2,698 animals with a PBR of 65 animals. There has been an increasing trend in porpoise abundance in the Morro Bay stock since 1988, perhaps partly due to emigration of animals from the Monterey Bay stock.

Monterey Bay: The most recent estimate of abundance for the Monterey Bay stock is 3,760 (CV=0.56) harbor porpoises (Carretta *et al.* 2022). The minimum population estimate is 2,421 animals with a PBR of 35 animals. The abundance of this stock has not essentially changed since the 2018 final rule (83 FR 36370)

San Francisco-Russian River: The most recent estimate of abundance for the San Francisco-Russian River stock is 7,777 (CV=0.62) harbor porpoises (Carretta *et al.* 2022). The minimum population estimate is 4,811 animals with a PBR of 73 animals. The stock shows reduced abundance since the 2018 final rule (83 FR 36370).

Northern California-Southern Oregon: The most recent estimate of abundance for the northern California/southern Oregon stock is 24,685 (CV=0.41) harbor porpoises (Carretta *et al.* 2022). The minimum population estimate for this stock is 17,713 animals with a PBR of 354 animals The stock shows reduced abundance since the 2018 final rule (83 FR 36370).

Northern Oregon Washington Coast: The most recent estimate of abundance for the northern California/southern Oregon stock is 21,487 (CV=0.44) harbor porpoises (Carretta *et al.* 2022). The minimum population estimate for this stock is 15,123 animals with a PBR of 151 animals. The stock abundance has not been updated since the 2018 final rule (83 FR 36370).

Washington Inland Waters: The most recent estimate of abundance for the northern California/southern Oregon stock is 11,223 (CV=0.37) (Carretta *et al.* 2022). The minimum population estimate for this stock is 8,303 animals with a PBR of 66 animals. The stock abundance has not been updated since the 2018 final rule (83 FR 36370).

Distribution and Habitat Preferences: Harbor porpoises are found throughout the coastal waters of the North Pacific, North Atlantic, and Black Sea. In the eastern North Pacific they are distributed from Point Conception, California to Alaska and across to Russia (Carretta *et al.* 2020). Along the west coast of North America, harbor porpoise are not panmictic or migratory, and their movements are sufficiently restricted such that genetic differences have evolved. They are typically found in groups of 1-3 individuals often consisting of a female-calf pair but larger groups are not uncommon (Bjørge and Tolley 2009). Harbor porpoise frequent inshore areas, shallow bays, estuaries, and harbors. Harbor porpoise in the CCRA are not migratory and their movement is sufficiently restricted such that genetic differences have evolved (Carretta *et al.* 2020) with small-scale subdivision within the U.S. portion of this range (Chivers et al. 2007 as reported in Carretta *et al.* (2020)).

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

4.2.2. Dall's Porpoises California/Oregon/Washington Stock

Description: Dall's porpoises (*Phocoenoides dalli*) are a stocky, medium sized porpoise with a wide-based dorsal fin that white along the dorsal edge. The tail stock is deepened and there is a noticeable beak; the flippers and fluke are small (Jefferson *et al.* 2015). Males are somewhat larger than females but both may reach a length of about 2.2 m and weigh about 150 kilograms (kg) or more. The body is black with a large white flank patch that extends to the level of the dorsal fin. They are extremely fast in the water and are often misidentified as 'baby killer whales' (Osborne *et al.* 1988).

Status and Trends: There are two recognized stocks found in the North Pacific: the Alaska stock and the California/Oregon/Washington stock. Only the latter stock is expected to be potentially affected by NWFSC research activities. The best abundance estimate of Dall's porpoises is taken from 2018 transect line efforts which estimated 16,498 animals (V = 0.608) (Carretta *et al.* 2022). The minimum population estimate is 10,286 Dall's porpoises with a PBR of 99 animals (Carretta *et al.* 2022). The distribution and abundance of Dall's porpoises off California, Oregon and Washington varies considerably at both seasonal and interannual time scales but the population size of Dall's porpoises within the California Current survey area has been relatively stable from 1996 to 2008, contracting and expanding with the

extent of suitable habitat (Carretta *et al.* 2022). Dall's porpoises are not listed under the ESA, nor are they considered strategic or depleted under the MMPA.

Distribution and Habitat Preferences: The species is found only in temperate waters of the North Pacific and adjacent seas (Jefferson *et al.* 2015). Dall's porpoises are seen in shelf, slope and offshore waters off California, Oregon and Washington (Carretta *et al.* 2022). Sighting data suggest that north-south movements occur between these states as oceanographic conditions change, both on seasonal and inter-annual time scales.

Dall's porpoises occur in small groups, although aggregations of at least 200 individuals have been reported. Dall's porpoises occur only rarely in groups of mixed species, although they are sometimes seen in the company of harbor porpoises and gray whales (Jefferson *et al.* 2015). This is an oceanic species found along the continental shelf and in inland and coastal waters. This species has seasonal inshore-offshore and north-south movements but these movements are poorly understood (Jefferson *et al.* 2015).

Behavior and Life History: Calves are born in summer, and gestation is thought to be about one year (Osborne *et al.* 1988; Jefferson *et al.* 2015). Dall's porpoises apparently feed at night. Prey species in the inland waters of British Columbia and Puget Sound include squid and schooling fishes (Walker *et al.*). Dall's porpoise equipped with dive recorders dove to about 94 m in water that exceeded 200 m while feeding in Puget Sound inland waters. Dive duration was about 1.3 mins (Jefferson *et al.* 2015).

4.2.3. Pacific White-sided Dolphins

Description: Pacific white-sided dolphins (*Lagenorhynchus obliquidens*) are medium-sized. Adults range from 1.7 m to 2.5 m long and weigh 75-198 kg; males are slightly larger than females (Black 2009). They are boldly marked with a dark gray or black dorsal surface, light gray sides and light gray 'suspender stripes' anterior. The dorsal fin is falcate to lobate with a rounded tip; it has a darker leading edge with light gray color covering two thirds of the posterior portion; the flukes are all dark (Black 2009).

Status and Trends: Although there is clear evidence that two forms of Pacific white-sided dolphins occur in the North Pacific, the there are no known differences in color pattern, and it is not currently possible to distinguish animals without genetic or morphometric analyses. Geographic stock boundaries appear dynamic and poorly understood. Therefore, morphometrics cannot be used to differentiate the two forms (Carretta *et al.* 2022).

The best estimate of Pacific white-sided dolphin abundance is taken as the estimate from 2018 or 34,999 (CV=0.222) animals (Carretta *et al.* 2022). The minimum population estimate is 29,090 animals and the PBR is 279 (Carretta *et al.* 2022). The distribution and abundance of Pacific white-sided dolphins off California, Oregon and Washington varies considerably at both seasonal and interannual time scales (Forney and Barlow 1998, Becker et al. 2012, 2020, Barlow 2016; all as cited in Carretta *et al.* (2022) but no long-term trends have been identified. Pacific white sided dolphins are not considered listed under the ESA, nor are they strategic or depleted under the MMPA.

Distribution: Pacific white-sided dolphins are one of the most abundant pelagic species of dolphin found in cold-temperate North Pacific waters. In the eastern Pacific it occurs as far west as Amchitka Island in the central Aleutian Islands through the Gulf of Alaska and down to 20°N, just south of Baja California

(Black 2009). This species does not migrate but exhibits seasonal shifts in distribution related to oceanographic variability. Pacific white-sided dolphins are endemic to temperate waters of the North Pacific Ocean and are common both on the high seas and along the continental margins. Off the U.S. west coast, Pacific white-sided dolphins have been seen primarily in shelf and slope waters. Sighting patterns from recent aerial and shipboard surveys conducted in California, Oregon and Washington suggest seasonal north-south movements, with animals found primarily off California during the colder water months and shifting northward into Oregon and Washington as water temperatures increase in late spring and summer (Carretta *et al.* 2022). They typically inhabit productive continental shelf and slope waters generally within 185 km of shore (Black 2009). They frequent some areas with complex bathymetry such as Monterey Bay, CA, an area where deep submarine canyons approach shore.

Behavior and Life History: As summarized from Black (2009) calving occurs from May to September. Age and length of maturation varies by area with females becoming sexually mature at 8-11 years with a 4- to 5-year calving interval. These are highly social dolphins and are avid bow riders that commonly occur in groups of less than a hundred but can form herds of over a thousand animals. They often associate with other dolphins typically Risso's, commons, and northern right-whale dolphins and porpoises and occasionally feed near humpback whales. Killer whales (*Orcinus orca*) appear to be a significant predator. Prey species include cephalopods (30 species known to be consumed) and schooling fishes (at least 60 species) (Black 2009). The estimate of mortality and serious injury (M/SI) for Pacific white-sided dolphin in the California drift gillnet fishery for the five most recent years of monitoring, 2015-2019, is 4.0 animals (CV=0.37) per year (Carretta *et al.* 2022).

4.2.4. Risso's Dolphins

Description: Risso's dolphins (*Grampus griseus*) are large dolphins with adults of both sexes reaching up to 4 m in length; there is no evidence of sexual dimorphism (Baird 2009). The anterior body is robust tapering to a relatively narrow tail stock with a relatively small dorsal fin. The bulbous head has a distinct vertical crease along the anterior surface of the melon (Baird 2009). Color patterns change with age; older animals are covered with linear scars and may appear whitish on the dorsal and lateral surfaces. The dorsal fin is falcate and black in color (Baird 2009). They are often confused with killer whales due to the large size of their dorsal fin.

Status and Trends: As oceanographic conditions vary, Risso's dolphins may spend time outside the U.S. EEZ, and therefore a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of Risso's dolphin abundance is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters, 6,336 (CV=0.32) animals (Barlow 2016 as referenced in Carretta *et al.* (2021), The minimum population estimate is 4,817, and the PBR for Risso's dolphins is 46 animals, and no long term trends in abundance have been identified (Carretta *et al.* 2021).

Historically, Risso's dolphin mortality has been documented as a result of interactions with the squid purse seine fishery off Southern California (Heyning et al. 1994, as cited in Carretta *et al.* (2021)). The cause of mortality is likely from animals killed intentionally to protect catch or gear, rather than incidental mortality. Intentional takes by fisheries are now illegal under the 1994 Amendment to the

MMPA. No habitat issues are known to be of concern for this species. They are not listed as threatened or endangered under the ESA nor as depleted under the MMPA.

Distribution: Risso's dolphins exhibit a world-wide distribution in tropical and warm-temperate waters. Risso's dolphins are commonly seen on the continental shelf in the Southern California Bight and in continental slope and offshore waters off of California, Oregon and Washington (Carretta *et al.* 2021). Risso's dolphins that are observed off California during the colder water months are thought to shift northward into Oregon and Washington as the water warms in late spring and summer. They seem to prefer temperate and tropical waters in steep edged habitat between 400- and 1000-m deep. In the Pacific they can be found as far north as the Gulf of Alaska and the Kamchatka Peninsula and south to Tierra del Fuego and New Zealand (Baird 2009).

Behavior and Life History: As summarized in Baird (2009), Risso's dolphins are relatively gregarious, and typically travel in groups of 10-50 individuals; the largest group reported had over 4,000 individuals. They have been observed bow riding in front of gray whales and are often seen surfing in swells. Gestation is 13-14 months and calving intervals are about 2.4 years with peak calving during winter in the eastern North Pacific. Sexual maturity for females is thought to be 8-10 years of age and males 10-12 years of age. They feed almost exclusively on squid, likely at night (Baird 2009).

4.2.5. Common Bottlenose Dolphins California Coastal and California/Oregon/Washington Offshore Stocks

Description: Bottlenose dolphins (*Tursiops truncatus truncatus*) are large animals that vary in color from light gray to charcoal. The common bottlenose dolphin is characterized by a medium-length stocky beak that is clearly distinct from the melon (Jefferson *et al.* 2008). The dorsal fin is tall and falcate. There are striking regional variations in body size, with adult lengths from 1.9 to 3.8 m (Wells and Scott 2009).

Status and Trends: Two stocks of common bottlenose dolphins are recognized in the western North Pacific Ocean: California coastal stock and California/Oregon/Washington offshore stock (Carretta *et al.* 2021). Based on significant differences in genetics and cranial morphology, the California coastal stock is recognized as distinct from the California/Oregon/Washington offshore stock (Lowther-Thielking et al. 2015; as cited in Carretta *et al.* (2021)).

California coastal bottlenose dolphins can be found within about 1 km of shore from central California south to Mexico (Carretta *et al.* 2021). Estimates of the California coastal stock population date back to the 1980s (Dudzik et al. 2006 as cited in Carretta *et al.* (2021)). The current best abundance estimate for this stock is 453 (CV=0.06) animals, with a minimum population estimate of 346 and a PBR of 3.3 (Carretta *et al.* 2021).

Bottlenose dolphins from the California/Oregon/Washington offshore stock have been found offshore at distances of more than a few km throughout the Southern California Bight (Carretta *et al.* 2021). The current best abundance for this stock is taken as the estimate from 2018 or 3,477 (CV=0.696) animals (Carretta *et al.* 2022). Bottlenose dolphins are not listed under the ESA nor are they considered a strategic stock or depleted under the MMPA.

Distribution: Bottlenose dolphins are distributed world-wide in tropical and warm-temperate waters that range from about 10 to 32^{o} C. They inhabit temperate and tropical shorelines, adapting to a variety

of marine and estuarine habitats, even ranging into rivers (Wells and Scott 2009). They are primarily coastal but do occur in pelagic waters, near oceanic islands and over the continental shelf. Oceanographic events appear to influence the distribution of animals along the coasts of California and Baja California as indicated by a change in residency patterns along Southern California and a northward range extension into central California after the 1982-83 El Niño is known (Carretta *et al.* 2021).

Sighting records off California and Baja California suggest that offshore bottlenose dolphins are continuous in these two regions; based on aerial surveys and shipboard surveys no seasonality in distribution is apparent (Carretta *et al.* 2022). Offshore bottlenose dolphins are not restricted to U.S. waters but cooperative management agreements with Mexico exist only for the tuna purse seine fishery and not for other fisheries that may take this species (e.g., gillnet fisheries) (Carretta *et al.* 2022).

Behavior and Life History: Births have been reported from all seasons with peaks during spring-summer months. Females may give birth as late as their 48th year. A large variety of fish and squid forms most of the diet and varies by region, although they do seem to prefer sciaenids (drums and croakers), scombrids (mackerels and tunas), and mugilids (mullets) (Wells and Scott 2009). Most consumed fish are bottom dwellers. Sharks are probably the primary predators of bottlenose dolphins. As summarized in DON (2008), dive durations as long as 15 mins are recorded for trained individuals but typical dives are shallower and of a much shorter duration. Mean dive durations of Atlantic bottlenose dolphins typically range from 20 to 40 seconds at shallow depths and can last longer than 5 mins during deep offshore dives. Offshore bottlenose dolphins regularly dive to 450 m and possibly as deep as 700 m.

4.2.6. Striped Dolphin

Description: The striped dolphin (*Stenella coeruleoalba*) is uniquely marked with black lateral stripes from eye to flipper and eye to anus. There is also a white V-shaped “spinal blaze” originating above and behind the eye and narrowing to a point below and behind the dorsal fin (Archer 2009). These dolphins have a dark cape and white belly; the lateral field is usually darker than the ventral. They are relatively robust dolphin with a long, slender beak and prominent dorsal fin. The longest specimen was 2.56 m and the heaviest was 156 kg but mean maximum body length in the eastern pacific is 2.4 m for males and 2.2 m for females (Archer 2009).

Status and Trends: The abundance of striped dolphins in this region is variable among years and may be affected by oceanographic conditions (Carretta *et al.* 2022). The best estimate of striped dolphin abundance is from 2018 of 29,988 (CV=0.299) animals (Carretta *et al.* 2022). The minimum population estimate is 23,448 striped dolphins with a PBR of 225 striped dolphins per year (Carretta *et al.* 2022). The distribution and abundance of striped dolphins off California, Oregon and Washington varies interannually (Barlow 2016, Becker et al. 2012, 2020; as cited in Carretta *et al.* (2022)) but no long-term trends have been identified. This species is not listed as threatened or endangered under the ESA nor as depleted under the MMPA.

Distribution: Striped dolphins are distributed worldwide in cool-temperate to tropical zones. On recent surveys extending about 300 nm offshore of California, they were sighted within about 100-300 nm from the coast. No sightings have been reported for Oregon and Washington waters but striped dolphins have stranded in both states (NMFS 2018b). Based on sighting records off California and Mexico, striped dolphins appear to have a continuous distribution in offshore waters of these two

regions (Carretta *et al.* 2022). Striped dolphins are usually found beyond the continental shelf, typically over the continental slope out to oceanic waters and are often associated with convergence zones and waters influenced by upwelling. The species feeds on a variety of pelagic and benthopelagic fish and squid.

Behavior and Life History: As summarized from Archer (2009), mating is seasonal and gestation lasts 12-13 months. Females become sexually mature between 5 and 13 years of age and between 7 and 15 years of age for males. Striped dolphins are acrobatic and perform a variety of aerial behaviors but they do not commonly bow ride. They often feed in pelagic or benthopelagic zones along the continental slope or just beyond it in oceanic waters. A majority of their prey possesses luminescent organs, suggesting that striped dolphins may be feeding at great depths, possibly diving to 200 to 700 m to reach potential prey. Striped dolphins may feed at night in order to take advantage of the deep scattering layer's diurnal vertical movements (Archer 2009).

4.2.7. Short-Beaked Common Dolphin

Description: As summarized in DON (2008) and Perrin (2009), short-beaked common dolphins (*Delphinus delphis*) are slender and moderately robust, with moderate length beaks and a tall slightly falcate dorsal fin. The beak is shorter than in long-beaked common dolphins, and the melon rises from the beak at a steeper angle. Short-beaked common dolphins are distinctively marked with a V-shaped saddle caused by a dip in the cape below the dorsal fin, yielding an hourglass pattern on the side of the body. The back is dark brownish-gray, the belly is white, and the anterior flank patch is tan to cream in color. The lips are dark, and there is a dark stripe from the eye to the apex of the melon and another one from the chin to the flipper (the latter is diagnostic to the genus). There are often variable light patches on the flippers and dorsal fin. Length ranges between about 2.3 m (females) and 2.6 m (males).

Status and Trends: Short-beaked common dolphins are the most abundant cetacean off California; they are widely distributed between the coast 300 nm offshore. As oceanographic conditions vary, short-beaked common dolphins may spend time outside the U.S. EEZ, and abundance estimates off California change on seasonal and interannual time scales. The best estimate of short-beaked common dolphin abundance is from 2018 of 1,056,308 (CV = 0.207) animals (Carretta *et al.* 2022). The minimum population estimate is 888,971 with a PBR of 8,889 dolphins per year. Abundance has been shown to increase during warm-water periods (Dohl et al. 1986, Forney and Barlow 1998, Barlow 2016; as cited in Carretta *et al.* (2022). Estimated abundances increased beginning in 2014; the survey that year was conducted during extremely warm ocean conditions (Bond et al. 2015; as cited in Carretta *et al.* (2022)) and resulted in the largest abundance estimate since large-scale surveys began in 1991. The 2018 estimate is also elevated compared with earlier surveys. No habitat issues are known to be of concern for this species. They are not listed as threatened or endangered under the ESA nor considered strategic or depleted under the MMPA.

Distribution: Short-beaked common dolphins occur worldwide from about 40-60^{o} N to about 50^{o} S (Perrin 2009). Historically, they were reported primarily south of Pt. Conception but have been commonly recorded as far north as 42^{o}N (Carretta et al. 2012). The short-beaked common dolphin is found in coastal and offshore waters along the eastern Pacific coast from Peru to Vancouver Island. During summer and fall, short-beaked common dolphins primarily occur along the outer coast in waters

deeper than 200 m and to a lesser extent in water depths between 100 m and 200 m south of 42°N, and seaward of the 100 m water depth north of 42° N. In winter and spring, animals typically stay south of the 13°C isotherm (Perrin 2009). They are rarely observed Puget Sound (DON 2008). Separate northern, central, and southern stocks associated with different upwelling areas are recognized in the management of incidental mortality in tuna fisheries (Perrin 2009).

Behavior and Life History: Large pods of hundreds to thousands of individuals have been observed and are often associated with other marine mammal species (Perrin 2009). Gestation is 10-11.7 months with a calving interval of 1-3 years depending on location (Perrin 2009). Age at sexual maturity varies by region from 3 years to 7-12 years for males and 2-4 and 6-8 years for females. Cooler water populations exhibit more seasonality in reproduction (Perrin 2009). Data are limited on dive behavior but dives to 200 m are possible; most dives range from 9-50 m but foraging dives up to 200 m have been recorded off southern California (DON 2008).

4.2.8. Long-Beaked Common Dolphins

Description: As might be assumed by the species names, the beak is longer in long-beaked common dolphins (*Delphinus capensis*) as compared to short-beaked common dolphins, and the melon rises from the beak at a steeper angle Perrin (2009). In California, they tend to be longer and heavier than the short-beaked common dolphin. Both species have similar markings. Length ranges between about 2.3 m (females) and 2.6 m (males).

Long-beaked common dolphins were recognized as a distinct species in the 1990s (Heyning and Perrin 1994; Rosel et al. 1994; as cited in Carretta *et al.* (2022) but researchers have suggested that *Delphinus capensis* is an invalid species; the Society of Marine Mammalogy now provisionally recognizes animals from this stock as the subspecies *Delphinus delphis bairdii* (Carretta *et al.* 2022). It is possible that this stock will eventually be recognized as a separate species but further taxonomic analyses are required.

Status and Trends: Along the U.S. west coast, long-beaked common dolphin distribution overlaps with that of the short-beaked common dolphin, and historical records have not distinguished between these species (Carretta *et al.* 2022). While the distribution and abundance of long-beaked common dolphins off California varies inter-annually and seasonally, long-beaked common dolphins are commonly found within about 50 nm of the coast from Baja California northward to about central California. The best-estimate of abundance is from 2018 of 83,379 (CV=0.216) animals. The minimum population estimate is 69,636 and the PBR is 668 per year for the California stock (Carretta *et al.* 2022). They are not listed as threatened or endangered under the ESA nor as strategic or depleted under the MMPA.

Distribution: California waters represent the northern limit for this stock (Carretta *et al.* 2022). The ratio of strandings of long-beaked to short-beaked common dolphin in southern California has varied, suggesting that the proportions of each species present change with changing ocean conditions. The long-beaked species seems to prefer shallower and warmer water and generally occurs closer to shore than the short-beaked form (Perrin 2009).

Behavior and Life History: As described for short-beaked common dolphins, long-beaked dolphins are usually found in large pods of hundreds to thousands and are often associated with other marine mammal species (Perrin 2009). Other traits are as described above for the short-beaked common dolphin.

4.2.9. Northern Right-Whale Dolphins

Description: Right-whale dolphins (*Lissodelphis borealis*) are slender, sleek dolphins known for their distinctive black and white color patterns and lack of a dorsal fin. The northern right-whale dolphin is mainly black with a white ventral patch that runs from the fluke notch to the throat region; there is another white patch on the ventral tip of the rostrum and the underside of the flipper (Lipsky 2009). They can grow to 3 m in length and 116 kg; and males tend to be larger than females.

Status and Trends: As northern right-whale dolphins may spend time outside the U.S. EEZ, NMFS considers a multi-year average abundance estimate the most appropriate for management within U.S. waters. The most recent estimate of northern right whale dolphin abundance (26,556 with correction factors [CV=0.44]) is the geometric mean of estimates from 2008 and 2014 summer/autumn vessel-based line-transect surveys (Barlow 2016 as cited in Carretta et al. 2019). The minimum population estimate for 2008-2014 is 18,608 dolphins and the PBR is 179 dolphins per year (Carretta et al. 2019). Long term trends have not been identified.

No habitat issues are known to be of concern for this species. They are not listed as threatened or endangered under the ESA nor are they considered strategic or depleted under the MMPA.

Distribution: Northern right-whale dolphins are endemic to temperate waters of the North Pacific Ocean. Off the U.S. west coast, they are primarily observed in shelf and slope waters (Carretta *et al.* 2022). Right-whale dolphins prefer cool temperate and subarctic waters in the North Pacific. They tend to be offshore oceanic cetaceans and are rarely observed inshore (Lipsky 2009). Barlow (2016; as cited in Carretta *et al.* (2022)) observed that these dolphins are found primarily off California during the colder water months and shift northward into Oregon and Washington as water temperatures increase in late spring and summer.

Behavior and Life History: Sexual maturity in northern right whale dolphins occurs at about 10 years of age (Lipsky 2009). Although calving seasonality is unknown, small calves are seen in winter and early spring. They tend to be gregarious and travel in groups of up to 2,000-3,000 in the North Pacific. Males may attain sexual maturity between 212 and 220 cm in length and females at about 200 cm but few data are available on age, growth, and reproduction (Lipsky 2009). The diet primarily includes squid and mesopelagic fish. No dive data are available.

4.2.10. Short-Finned Pilot Whale

Description: Short-finned pilot whales (*Globicephala macrorhynchus*) are black or dark gray, with a robust body and thick tailstock. The melon is exaggerated and bulbous and there is either no beak or a barely discernable one (Olson 2009). The species exhibits sexual dimorphism with adult males being larger than females (average length 6 m) and the broad-based dorsal fin of a male is larger than that of a female (Olson 2009).

Status and Trends: The abundance of short-finned pilot whales along the west coast of the U.S. is variable and influenced by prevailing oceanographic conditions. After the strong El Niño event that occurred in1982-83, short-finned pilot whales virtually disappeared from the U.S. west coast; despite increased survey efforts in the region, sightings and fishery takes are rare and have primarily occurred during warm-water years (Julian and Beeson 1998, Carretta et al. 2004, Barlow 2016 as cited in Carretta *et al.* (2021)). This species spends time outside the U.S. EEZ as oceanographic conditions change; therefore a multi-year average abundance estimate is the most appropriate for management within U.S. waters. The most recent estimate of short-finned pilot whale abundance based on 2008 and 2014 summer/autumn vessel-based line-transect surveys of California, Oregon, and Washington waters is 836 (CV=0.79) animals (Carretta *et al.* 2021). This estimate includes new correction factors for animals missed during the surveys. The minimum population estimate is 466 and the PBR is calculated as 4.5 whales per year (Carretta *et al.* 2021). It is not known whether the animals observed more recently are part of the same population that was documented off Southern California before the mid-1980s or belong to a different, wide-ranging pelagic population. Therefore, no inferences can be drawn regarding trends in abundance of short-finned pilot whales off California, Oregon and Washington (Carretta *et al.* 2021). Short-finned pilot whales are not listed as threatened or endangered under the ESA or considered as strategic or depleted under the MMPA.

Distribution: The short-finned pilot whale is found in tropical to warm temperate seas. It usually does not range north of 50° N or south of 40° S (Olson 2009). Along the west coast of North America, sightings of short-finned pilot whales north of Point Conception are uncommon but there are infrequent sightings off Oregon and Washington. Worldwide, pilot whales usually are found over the continental shelf break, in slope waters, and in areas of high topographic relief but movements over the continental shelf and close to shore near oceanic islands can occur (Olson 2009).

Behavior and Life History: Pilot whales are very social and may travel in pods of up to hundreds of animals; they may often occur with other cetaceans. The groups are relatively stable and female based (DON 2008). Sexual maturity occurs at 9 years for females and 17 years for males. The mean calving interval is 4 to 6 years (Olson 2009). Pilot whales are deep divers; the maximum dive depth measured is about 971 m (Baird *et al.* 2002). Short-finned pilot whales feed on squid and fish. Stomach content analysis of pilot whales in the Southern California Bight consisted entirely of cephalopods (Olson 2009). The most common prey item identified is *Loligo opalescens*, which has been documented in spawning concentrations at depths of 20-55 m.

4.2.11. Pygmy or Dwarf Sperm Whale

Description: *Kogia spp.* (*K. breviceps or K. sima*) are porpoise-like cetaceans with a distinctive under-slung lower jaw. Pygmy sperm whales reach a maximum length of about 3.8 m and weight of 450 kg (McAlpine 2018). Adults are bluish-gray to blackish-brown dorsally and light below. On the side of the head between the eye and the flipper there is a crescent shaped light colored mark referred to as a "false gill."

Status and Trends: Most sightings of *Kogia spp*. in the CCE are only identified to genus due to their cryptic nature. Based on previous sighting surveys and historical stranding data, it is likely that recent ship survey sightings were of pygmy sperm whales; *K. breviceps* rather than dwarf sperm whales (*K. sima*) (Carretta *et al.* 2021). Overall sightings along the U.S west coast are rare (Carretta *et al.* 2021) possibly reflecting on their pelagic distribution, small size and cryptic nature. All *Kogia spp*. sightings are considered *K. breviceps* or pygmy sperm whales for purposes of this LOA application.

The best estimate of abundance *Kogia spp.* is 4,111 (CV=1.12) animals based on the geometric mean of 2008 and 2014 shipboard line-transect surveys (Carretta *et al.* 2021). Only 3% of Kogia groups were estimated to have been detected on the trackline during 1991-2014 surveys (Barlow 2016 as cited in Carretta *et al.* (2021)). The minimum population estimate for California, Oregon, and Washington waters is 1,924 animals and the PBR is 19 pygmy sperm whales per year. No habitat issues are known to be of concern for this genus. They are not listed as threatened or endangered under the ESA nor as strategic or depleted under the MMPA.

Distribution: Pygmy sperm whales are distributed worldwide in tropical and temperate waters of the oceans (McAlpine 2018). Pygmy sperm whales are observed mostly along the continental shelf edge and over deeper waters off the shelf. However, along the U.S. west coast, sightings of the whales have been rare, likely a due to their pelagic distribution and small size rather than their true abundance (Carretta *et al.* 2021).

Behavior and Life History: As summarized in DON (2008), pygmy sperm whales feed on cephalopods, deep-sea fish, and shrimps. They can dive for up to 25 min. Median dive times of around 11 mins have been documented. A satellite-tagged pygmy sperm whale released off Florida was found to make long nighttime dives, presumably indicating the whale was foraging on squid in the deep scattering layer (Scott *et al.* 2001). Most sightings are brief; these whales are often difficult to approach and they actively avoid aircraft and vessels. There is no information on the breeding behavior of this species.

4.2.12. California Sea Lion

Description: California sea lions (*Zalophus californianus*) are highly sexually dimorphic; males weigh approximately 350 kg and are about 2.4 m long as compared to females which are about 100 kg and 1.8 m (Heath and Perrin 2009). Male and female pups weigh 6-9 kg. Adult males are usually dark brown but can range from light brown to black; females are dark brown to black (Heath and Perrin 2009). Males typically have a distinguishing sagittal crest on top of the head often topped with white fur.

Status and Trends: The California sea lion population was estimated from 1975-2014 time series pup counts (Lowry et al. 2017; as reported in Carretta *et al.* (2021)), along with mark-recapture estimates of survival rates (DeLong et al. 2017, Laake et al. 2018; as reported in Carretta *et al.* (2021)). Population size along the U.S. west coast was estimated in 2014 to be 257,606 animals, corresponding to a pup count of 47,691 animals (Lowry et al. 2017 and Laake et al. 2018; as cited in Carretta *et al.* (2021)). The minimum population size is 233,515 animals and the PBR is 14,011 California sea lions per year Carretta *et al.* (2021).

Age- and sex-specific survival rates of California sea lions were estimated by DeLong et al. (2017 as reported in Carretta *et al.* (2021)), and female survivorship exceeds that of males. Annual pup survival was reported as 0.600 and 0.574 for females and males, respectively. Maximum annual survival rates

corresponded to animals 5 years of age (0.952 and 0.931 for females and males, respectively). Survival of pups and yearlings have been shown to decline with increasing sea surface temperatures (Carretta *et al.* 2021).

Elevated strandings of California sea lion pups have been occurring in Southern California since January 2013. This event was declared a UME specifically for pup and yearling California sea lions (Carretta *et al.* 2021). NMFS identified changes in the availability of sardines to be a contributing factor to the large number of strandings. California sea lions in the U.S. are not listed as endangered or threatened under the ESA or as strategic or depleted under the MMPA.

Distribution: California sea lions breed on islands located in southern California, western Baja California, and the Gulf of California (Carretta *et al.* 2021). In response to changes in prey availability as summarized in DON (2008) their distribution shifts to the northwest in fall and to the southeast during winter and spring. In the non-breeding season, adult and subadult males migrate northward along the coast to central and northern California, Oregon, Washington, and Vancouver Island, and return south the following spring. Males are occasionally sighted well offshore, while females and juveniles tend to stay closer to the rookeries. They also enter bays, harbors, and river mouths and often haul out on man-made structures such as piers, jetties, offshore buoys, and oil platforms (Riedman 1990). California sea lions in the Puget Sound haul out on log booms and U.S. Navy submarines, and are often seen rafted off river mouths (Jeffries *et al.* 2000). They are occasionally sighted up to several hundred kilometers offshore. California sea lions frequently travel up river systems in search of prey (NMFS 2018a) and are common at Bonneville Dam, 230 miles upriver from the mouth of the Columbia River (NMFS 2016b), where they consume migrating salmon during winter and spring.

Behavior and Life History: California sea lion numbers ashore increase rapidly in May when males establish breeding territories. Birth to a single pup occurs between May and June, and pups are weaned in about 10-12 months (Heath and Perrin 2009). While near rookeries in California, females typically feed over the continental shelf, traveling within 54 km from the islands though they are known to travel as far north as Monterey Bay to feed during the breeding season (Antonelis et al. 1990; Melin and DeLong 2000 as cited in Heath and Perrin (2009)). California sea lions feed primarily on Pacific whiting, Pacific herring, salmonids, dogfish sharks, and squid. Dives off rookeries in California typically last about 2 mins but can be as long as 10 mins; dive depths average about 26-98 m but can be well over 200 m (Heath and Perrin 2009). Females are known to dive to a maximum depth of 482 m for up to 16 mins while foraging during the non-breeding period (Melin *et al.* 2008).

4.2.13. Steller Sea Lion Eastern DPS

Description: Steller sea lions (*Eumetopias jubatus monteriensis*) exhibit significant sexual dimorphism; the average length of males is 2.8 m and females are 2.4 m in length (Loughlin 2009). Estimated average weight of males is 566 kg and females are about 263 kg. Pup weight at birth is 16-23 kg and may be slightly larger in the western part of their range. Pups are born with a wavy, chocolate brown fur that molts after 3-6 months. Adult fur color varies between a light buff to reddish brown with most of the under parts and flippers a dark brown to black; naked parts of the skin are black. Both sexes become

[3] https://www.fisheries.noaa.gov/national/marine-life-distress/2013-2017-california-sea-lion-unusual-mortality-event-california

blonder with age. Adult males have long, coarse hair on the chest, neck, and shoulders which are massive and muscular (Loughlin 2009).

Status and Trends: Counts used in population analyses for the contiguous U.S. are from surveys conducted in 2014 n Washington (NMFS and Washington Department of Fish and Wildlife, unpubl. data as cited in (Muto *et al.* 2021)) and 2017 surveys of Oregon and California (NMFS and Oregon Department of Fish and Game, unpubl. data as cited in (Muto *et al.* 2021)). The total count estimate of pups and non-pups for the U.S. portion of the eastern stock of Steller sea lions (excluding Canada) is 43,201 (32,510 non-pups plus 10,691 pups) and is considered to be N_{MIN} and PBR is 2,592 (Muto *et al.* 2021). On 4 December 2013, the eastern DPS of Steller sea lions was removed from the list of threatened species under the ESA; therefore NMFS does not consider this stock to be depleted under the MMPA (Muto *et al.* 2021).

Distribution: Steller sea lions occur throughout the North Pacific Ocean rim from Japan to southern California (Muto *et al.* 2021). They are widely dispersed outside of the breeding season (late May to July) following prey availability. Steller sea lions tend to prefer isolated offshore rocks and islands to breed and rest. Although rookeries and rest sites occur in many areas, principally on exposed rocky shorelines and wave-cut platforms, the locations used are specific and change little from year to year (Loughlin 2009). The eastern stock of Steller sea lions has historically bred on rookeries located in Southeast Alaska, British Columbia, Oregon, and California. However, within the last 10 years a new rookery has become established on the outer Washington coast at the Carroll Island and Sea Lion Rock complex, where >100 pups were born in 2015 (R. DeLong and P. Gearin, pers. comm. as cited in Muto *et al.* (2021)). Adult Steller sea lions tend to return to their birth island to breed but range widely (some yearlings have been seen > 1,000 km from their birth rookery) during their first few years and the non-breeding season (Loughlin 2009).

Behavior and Life History: Steller sea lions breed from late May to early July at rookeries located on remote islands and rocks throughout their range. One pup is born annually after a 9-month gestation period. As with most pinnipeds, embryo implantation typically is delayed 3 months. Pups are weaned prior to the breeding season but some may remain with their mothers for 2-3 years (Loughlin 2009). They are opportunistic predators, feeding primarily on a wide variety of fishes and cephalopods. Compared to other pinnipeds, Steller sea lions tend to make relatively shallow dives, with few dives recorded to depths greater than 250 m. Maximum depths recorded for individual adult females in summer are in the range from 100 to 250 m; maximum depth in winter is greater than 250 m. The maximum depth measured for yearlings in winter was 72 m and average depths are near 18 m and in shallow near-shore waters (Loughlin 2009).

4.2.14. Northern Fur Seal California Breeding Stock

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

Status and Trends: Two separate stocks of northern fur seals are recognized within U.S. waters: an Eastern Pacific stock and a California stock (including San Miguel Island and the Farallon Islands). The Eastern Pacific stock breeds in Alaska waters and adult females and pups move into the North Pacific Ocean and often to the waters offshore of Oregon and California (Muto *et al.* 2022). The most recent estimate for the Eastern Pacific stock is 626,618 northern fur seals with a minimum population estimate of 530,376 and a PBR of 11,403 (Muto *et al.* 2022). The most recent population estimate for the entire stock of California northern fur seals, which incorporates estimates from San Miguel Island and the Farallon Islands in 2013, is 14,050 (Carretta *et al.* 2021). The total minimum population size is 7,524 northern fur seals and the PBR for the stock is 451 animals per year (Carretta *et al.* 2021). The Eastern Pacific and California northern fur seal stocks are not considered to be depleted under the MMPA or listed as threatened or endangered under the ESA.

Distribution: NMFS (2007) summarized the northern fur seal distribution. They are endemic to the North Pacific Ocean. During the winter the southern limit of their range extends across the Pacific Ocean from southern California to the Okhotsk Sea and Honshu Island, Japan. In the spring most northern fur seals migrate north to breeding colonies in the Bering Sea. The largest breeding colonies are located on the Pribilof Islands of St. Paul and St. George and compose approximately 74 % of the worldwide fur seal population. Other breeding colonies are located in the Commander Islands (Russia) in the western Bering Sea and on Robben Island (Russia) in the Okhotsk Sea that compose approximately 15 and 9 % of the population, respectively. Small breeding colonies are also located on the Kuril Islands in the western North Pacific, Bogoslof Island in the central Aleutian Islands, and on San Miguel Island off the southern California coast. The subpolar continental shelf and shelf break from the Bering Sea to California provide feeding grounds for the seals while out at sea. Highest fur seal densities in the open ocean occur in association with major oceanographic frontal features such as sea mounts, valleys, canyons and along the continental shelf break (NMFS 2007). Fur seals from San Miguel Island may also spend their winter months feeding at sea in the eastern North Pacific Ocean. Northern fur seals are primarily pelagic in the winter months but occasionally haul-out onto land for brief periods.

Behavior and Life History: Northern fur seals are the most pelagic of pinnipeds with females spending all but 35 days per year at sea and males 45 days (Gentry 2009). From November to March they remain north of about 35^{o} N latitude without coming ashore. In March and April they gather along continental shelf breaks and begin to migrate to their respective breeding islands. Males come ashore and acquire breeding territories in late May and June and most pups are born in July, nursed for about 4 months and weaned in October or November. They are a highly migratory species and typically return to their natal sites to breed (Gentry 2009).

Rockfishes, northern anchovy, and squid were prominent in fur seal stomachs off Washington during February and March (NMFS 2007). Dive behavior of northern fur seals is well studied and shows that females from the Pribilof Islands often dive to 200 m or more for at least 5-6 mins with some as long as 11 mins. Similar foraging behavior has been documented for fur seals foraging from San Miguel Island, California (Gentry 2009).

4.2.15. Harbor Seal California and Oregon/Washington Coastal, Washington Inland Waters, Southern Puget Sound, and Hood Canal Stocks

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

Status and Trends: A complete count of all harbor seals in California is impossible because not all haul out simultaneously. A complete pup count is also not possible because harbor seal pups enter the water almost immediately after birth (Carretta *et al.* 2021). Population size is estimated by counting the number of seals ashore during the peak haul-out period (May to July) and by multiplying this count by a correction factor. The California stock of harbor seals is estimated to number 30,968 seals with a minimum population estimate of 27,348 seals; the calculated PBR is 1,641 (Carretta *et al.* 2021).

The most recent population estimate for the Oregon/Washington coastal stock was 24,732 in 1999. Population estimates for the Washington Northern Inland Waters stock (11,036), Southern Puget Sound stock (1, 568) and Hood Canal stock (1,088) are also from 1999 (Carretta *et al.* 2021) . Because these estimates are more than 8 years old, no current information on minimum abundance is available and therefore, PBR cannot be calculated (Carretta *et al.* 2021). Harbor seals are not considered to be depleted under the MMPA or threatened or endangered under the ESA.

Distribution: The species is widespread in temperate and arctic waters of the northern hemisphere of both the Atlantic and Pacific Oceans; it is the most widespread of any pinniped. It occurs year-round in Washington. They occur principally in the near shore zone. Harbor seals use hundreds of sites to rest or haulout along the coast and inland waters, including intertidal sand bars and mudflats in estuaries, intertidal rocks and reefs, sandy, cobble, and rocky beaches, islands, log-booms, docks, and floats in all marine areas of the state. Group sizes typically range from small numbers of animals on some intertidal rocks to several thousand animals found seasonally in coastal estuaries (Burns 2009).

Behavior and Life History: Harbor seals are considered a non-migratory species, breeding and feeding in the same area throughout the year (Burns 2009). They give birth on shore and nurse their single pup for 4 to 5 weeks. After the pups are weaned, they disperse widely in search of food. Pupping seasons vary by geographic region, with pups born in coastal estuaries from mid-April through June; Olympic Peninsula coast from May through July; San Juan Islands and eastern bays of Puget Sound from June through August; southern Puget Sound from mid-July through September; and Hood Canal from August through January (Jeffries *et al.* 2000). Breeding occurs in the water shortly after the pups are weaned. Common prey include sole, flounder, sculpins, hake, cod, herring, squid, octopus, and, to a lesser degree, salmon (Orr *et al.* 2004). Harbor seals can dive to over 400 m and stay submerged over 20 mins but the average depth is less than 100 m and lasts about 2 mins (Eguchi and Harvey 2005).

5. TYPE OF INCIDENTAL TAKE AUTHORIZATION REQUESTED

The NWFSC is petitioning NMFS for regulations pursuant to Section 101(a) (5) (A) of the MMPA, 16 USC Section 1371.101 (a) (5), and 50 CFR Section 216, Subpart I, effective August 29, 2023 through August 28, 2028 to allow the potential incidental taking of small numbers of marine mammals incidental to the research activities. The types of incidental taking requested in this application include:

- Mortality or serious injury (M/SI). NMFS interprets the regulatory definition of serious injury (i.e., any injury that will likely result in mortality) as any injury that is "more likely than not" to result in mortality, or any injury that presents a greater than 50 % chance of death to a marine mammal. A serious injury must contribute to the death or likely death of the animal to be classified as such. Level A takes could also occur if a marine mammal is captured or entangled (i.e., during a trawl survey) and although the animal may be released alive, non-lethal injury is possible.
- Level B takes due to physical disturbance or disturbance from presence of researchers and vessels.

NWFSC is not requesting takes due to:

- Level A take associated with auditory injury or permanent threshold shift (PPT). PPT is not possible from acoustic gear used for research;
- Level B harassment (i.e., behavioral disturbance or temporary threshold shift [TTS]) is also discounted given the types of acoustic equipment used in research (see Section 6.3 for rationale).

NWFSC surveys use gear that has the potential to take marine mammals through non-lethal Level A or M/SI, including mid-water trawl nets and pelagic longlines (see Table 1-2). Lethal or non-lethal incidental takes of marine mammals are possible during the use of the modified Cobb mid-water trawl, Nordic 264 surface trawl net, and purse seines. These gear types are used during or in conjunction with the several NWFSC studies (see Table 1-2). Marine mammals can also become entangled or captured in purse seines and tangle nets or hooked or entangled during the use of longline and hook and line gear, which has the potential to result in lethal or non-lethal M/SI takes.

Given the numerous pinniped haulouts in Puget Sound, animals hauled out or in the water nearby may be disturbed by the physical presence of NWFSC researchers or research vessels in estuarine and nearshore coastal areas; therefore, the potential for Level B harassment due to the presence of researchers is accounted for in Section 6. Physical disturbance of cetacean species due to the presence of researchers is not anticipated however, physical disturbance of harbor porpoises is accounted for in take estimates as described in more detail in Section 6.

6. TAKE ESTIMATES FOR MARINE MAMMALS

Authorization for incidental takes is requested for activities described in Section 2. To determine the potential for interaction during NWFSC research activities, a variety of factors are considered including a summary of historical interactions between marine mammals and NWFSC research (specifically the period since 2018), historical marine mammal interactions between commercial fisheries that may use the same gear, and other biological factors such as feeding behavior or propensity to travel in groups. This section also describes the rational for discounting Level B harassment due to acoustic sources used by NWFSC (see Section 6.3). Finally, potential takes associated with non-auditory Level B harassment due to the physical presence of researchers or vessels is described in this section.

6.1. Injury and Mortality Due to Research

Marine mammals can suffer injury or mortality due to research vessel strikes or encounters with research gear such as trawl nets or longlines that could result in entanglement or capture. As described in the 2018 PEA (NMFS 2018b), no collisions with large whales have been reported from any NWFSC fisheries research activities. Transit speeds during research surveys vary from 6-14 kts but average 10 kts. The vessel's speed during active sampling is typically 2-4 kts due to sampling design and these much slower speeds along with mitigation measures to watch for marine mammals during gear towing essentially eliminate the risk of ship strikes. Takes of marine mammals due to ship strike are not requested and are not discussed further. The following subsections discuss historical encounters with NWFSC research gear and discusses the types of research gear used by NWFSC that could potentially injury or result in mortality of marine mammals. Section 6.4.1 defines and enumerates the requested takes due to M/SI.

6.1.1. Historical Level A and M/SI Takes During NWFSC Research

As summarized in Section 4.2.4 and Table 4.2.14 of the 2018 PEA (NMFS 2018b), from 1999-2014 forty takes of marine mammals occurred during NWFSC research trawling efforts which involved Pacific white sided dolphins, Steller sea lions, California sea lions, harbor seals and northern fur seals. Starting in 2014, MMEDs have been and are still used on all Nordic 264 trawls. Since 2018, no M/SI takes of marine mammals due to interactions with Nordic 264 trawl research gear have been recorded (NWFSC 2019, 2020, 2021, 2022). Up until 2018, NWFSC had no history of marine mammal takes in hook and line gear (including longlines, rod and reel, and trolling deployments), purse seine or tangle net gear (NMFS 2018b). However, on Sept 28, 2021, a California sea lion was taken during a hook and line survey from a contracted ship in the vicinity of Catalina Island (NWFSC 2022). The sea lion swallowed the hook and was observed swimming away with two additional hooks and a lead sinker dangling from its mouth. A California sea lion (believed to be the same one) was observed later without the gear in its mouth. The take was entered into the PSIT data base as "injured" (i.e., Level A non-lethal take). No other M/SI or Level A takes were recorded for any other NWFSC surveys over the period 2018-2021 (NWFSC 2019, 2020, 2021, 2022).

6.1.2. Bottom, Mid-water, and Surface Trawls

Capture or entanglement in research trawl gear may occur whenever marine mammals are swimming near the gear, either intentionally while foraging or unintentionally while migrating. Any animal captured in a net is at risk of drowning unless it can be quickly freed. Animals can also be captured or entangled in netting or tow lines. Lines wrapped around the animal or its fins can immobilize or injure it by cutting into or through blubber, muscles and bone or by constricting blood flow or severing appendages. Immobilization can cause immediate drowning or internal injuries. The animal's ability to feed may also be affected by gear entanglement (Andersen *et al.* 2008). Interaction that does not result in the immediate death of the animal by drowning can also cause injury (i.e., Level A harassment) or serious injury.

While the use of bottom trawls during the Bycatch Reduction Study has been discontinued in Puget Sound, it may still occur off the coasts of Washington, Oregon and California, and the double rigged shrimp bottom trawl may also still be used. Other studies using bottom trawls include: the Integrated Acoustic and Trawl Surveys (including winter) of Pacific Hake (*Merluccius productus*); the Groundfish Bottom Trawl Survey; Flatfish Broodstock Collection and Marine Fish Research Broodstock Collection Sampling and Tagging; Beam Trawl Survey to Evaluate Effects of Hypoxia; and the Fish Contaminants Studies. Details on the specific gear used, timing and duration of these surveys are provided in Table 1-2.

As noted in the 2018 Final Rule (82 FR 36370), NWFSC has had no historical interactions of marine mammals with research bottom trawling. In addition, the List of Fisheries for 2021 (NOAA 2021) categorizes commercial bottom trawl fisheries for halibut, sea cucumbers, shrimp, and groundfish fisheries in California, Washington and Oregon as Category III or having "remote likelihood of or no known interactions" with marine mammals. This designation is also relevant for research surveys using bottom trawl gear.

As shown in Table 1-2, many NWFSC studies employ midwater or surface trawls, which together are termed pelagic trawls to differentiate from bottom trawls. Similar to bottom trawls, marine mammals can be caught or entangled in pelagic trawl lines and nets. Modified midwater Cobb nets are used in the Northern Juvenile Rockfish and Eulachon Arrival Timing surveys. Commercial pelagic trawls are used in Bycatch Reduction Research, and the Aleutian wing midwater trawl is used in the Integrated Acoustic and Trawl Survey of Pacific Hake (including the winter survey), Pilot Winter Hake Survey, and the CCE Investigations of Hake Ecology and Survey Methods and the California Current. A baby otter trawl is towed at midwater depths in the Salish Sea Studies of Juvenile Salmon and Other Pelagic Species study. The Nordic 264 surface trawl is used in the Juvenile Salmon PNW Coastal Survey. Table 1-2 provides details on the gear, timing and location of these surveys.

Very few marine mammal interactions have occurred with pelagic trawls other than the Nordic 264 (81 FR 38516). For example, compared to the Nordic 264 trawl, takes of marine mammals by modified Cobb trawl have been historically small. While the Nordic 264 rope trawl is intended to fish at the surface, the Cobb trawl is typically fishing at 30 m headrope depth; thus it is rarely at the surface aside from the deployment and retrieval stages. Fishing at depth, at slower speeds, and for shorter duration, along with having a smaller opening and mesh size, minimize marine mammal encounters with the modified-Cobb. As described in section 6.1.1, the use of MMEDs on Nordic 264 trawls (required since 2014) has greatly

reduced incidental captures of marine mammals by this type of gear, with no interactions reported since 2018.

However, to be precautionary and because there is still a risk of marine mammal interactions with any type of trawl gear, Level A harassment or M/SI takes of marine mammals by trawl gear (not differentiated between bottom, midwater or surface trawls) are being requested in this application (see Section 6.4.1).

6.1.3. Purse, Lampara, and Beach Seines

Seine nets hang vertically in the water with the bottom edge held down by weights and the top edge buoyed by floats. Purse seines are deployed from a vessel capture schooling pelagic fish species by encircling them and then closing the net opening. Marine mammals can be caught in the net while feeding on the targeted species (possibly in groups consisting of several species) or entangled in associated lines. A lampara seine is a type of purse seine or surrounding net but does not have the purse string[4]. Beach seines are deployed in shallow water from shore by crews in small boats.

While the Near Coastal Ocean Purse Seine survey is not planned for future research, the SOBaD study uses purse seines of various sizes with up to 75 sets a year along the Washington and Oregon coasts and in the Lower Columbia River. The Movement Studies of Puget Sound Species study uses purse seines designed to collect herring while the Forage Fish Influence on Salmon Predation Risk and Food Resources could potentially use a purse seine in the Lower Columbia River estuary, Puget Sound and Salish Sea. A micro-purse seine is used up to 50 times a year in the Lower Columbia River Ecosystem Monitoring Survey. A lampara seine is used in the Near Coastal Ocean Lampara Seining and ROV Surveys. Beach seines are used in several Puget Sound studies including: Salish Sea Studies of Juvenile Salmon and Other Pelagic Species; Elwha Dam Salmon Recovery studies; Fish Contaminants Studies; Puget Sound Juvenile Salmon Studies; and the Habitat Function of Nearshore Ecosystems with Shellfish Aquaculture and Eelgrass. The Columbia River Estuary Tidal Habitats, Lower Columbia River Ecosystem Monitoring, Migratory Behavior of Adult Salmon, and the Benefits of Wetland Restoration to Juvenile Salmon studies also use beach seines. Details on the gear, timing, duration, and locations of these surveys are provided in Table 1-2.

As described for bottom trawling (see Section 6.1.2), the List of Fisheries for 2021 (NOAA 2021) categorizes commercial purse seine fisheries in California, Washington and Oregon as Category III or having "remote likelihood of or no known interactions" with marine mammals. Within the last five years, the limited entry commercial purse seine fishery for anchovy, sardines and tuna in California have documented takes of California sea lions and harbor seals while the California squid purse seine fishery reported takes of long-beaked and short-beaked common dolphins (NOAA 2021). These species have been observed to enter operational purse seines to depredate the catch, then exit the net unharmed (83 FR 36370). Pinnipeds are adept at jumping into and out of these nets without getting entangled. However, as summarized in Section 6.1, there have historically been very few research takes of marine mammals in research purse seines which are smaller and towed for shorter durations. While beach seines could entangle pinnipeds in relatively shallow water near haulouts, they are not set within 200 m of hauled out pinnipeds and thus are unlikely to be a risk of non-lethal Level A or M/SI to these animals.

[4] https://www.fao.org/fishery/en/geartype/201 Accessed June 30, 2022

No takes of marine mammals during NWFSC research using beach seines have been recorded since 2018.

To be precautionary in 2018, NMFS authorized takes associated with the use of seine gear by the NWFSC for some species in the CCE even though the LOF reported no record of interaction with commercial fisheries (83 FR 36370). The rule did not differentiate the type of seine gear involved in the takes requested. Due to the continued proposed use of purse seine gear by NWFSC and following the precautionary approach applied by NMFS in 2018 for similar NWFSC research, takes for marine mammals by seines (not differentiated by type) are included in this LOA application (see Section 6.4.1).

6.1.4. Longlines and Hook and Line Surveys

Longlines are strings of baited hooks that are either anchored to the bottom (to target groundfish) or are free-floating (to target pelagic species). Marine mammals may be hooked or entangled in longline gear resulting in interactions that could cause 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). 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.

Hook and line is a general term fishing methods that employ short fishing lines with hooks. This gear is similar to methods commonly used by recreational fishers using bait or lures in various ways to attract target species. This type of gear has less potential for marine mammal interaction but the use of baited hooks in the presence of marine mammals 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 (81 FR 38516). The 2021 List of Fisheries categorizes Washington Oregon and California longline/hook and line commercial fisheries as Category III (NOAA 2021).

NWFSC studies that use longlines include: Bycatch Reduction Research; Marine Fish Research Broodstock Collection, Sampling, and Tagging; and Movement Studies of Puget Sound Species. Hook and line gear is used in: Flatfish Broodstock Collection, Marine Fish Research Broodstock Collection, Sampling, and Tagging; the Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat, the SOBaD study; the Movement Studies of Puget Sound Species study; Gear Testing in Support of Groundfish Surveys in Untrawlable Habitat; and Rockfish Projects in Puget Sound. Details on the gear, timing, duration, and locations of these surveys are provided in Table 1-2.

As described in Section 6.1.1, until 2021 NWFSC had no history of marine mammal takes in longline or hook and line gear. However, in 2021 a California sea lion was taken during a hook and line survey in the vicinity of Catalina Island (NWFSC 2022). The 2018 final rule (83 FR 36370) authorized two takes of California sea lions by longline or hook and line gear over the 5-year period and one take each for Steller sea lions and harbor seals. No takes of cetaceans have occurred during NWFSC longline or hook and line surveys. Following a similar approach, takes are requested in the event certain species become entangled with longline or hook and line gear. Section 6.4.1 of this application provides details on the takes requested due to interactions with NWFSC longline or hook and line gear.

6.1.5. Gillnets and Tangle Nets

Gillnets have vertical panels of netting buoyed with floats at the top and weighted at the bottom. Fish are caught by the gills in the netting. Tangle nets are similar to gillnets but are considered to be more selective and less lethal to fish than gillnets because of smaller mesh sizes that allow fish to be caught by nose or jaw which allow fish to be resuscitated (81 FR 38516). As described for purse seines, animals can be caught in the gillnet itself or entangled in the net or lines associated with the net.

Gillnets are only used by the NWFSC for the Fish Contaminants Studies in Puget Sound, the Washington, Oregon and California coasts, and the lower Columbia and Willamette rivers, as well as during the Migratory Behavior of Adult Salmon study in the Lower Columbia River. Details on the gear, timing, duration, and locations of these surveys are provided in Table 1-2.

Commercial drift gillnet fisheries in California and Puget Sound waters are considered to be Category II, defined as having a risk of M/SI greater than 1% but less than 50% of the species' PBR (NOAA 2021). The NWFSC does not use commercial drift gillnets in its fisheries research program (81 FR 38516). However, marine mammal interactions with gillnets are well documented (Reeves et al., 2013; Lewison et al., 2014; Zollett, 2009; as cited in 81 FR 38516). Considering the documented risk to marine mammals due to gillnets, the 2018 final rule (83 FR 36370) inferred vulnerability to seine and tangle net gear in the CCRA and LCRRA. Level A non-lethal and M/SI takes for tangle net gear considered part of takes for seine nets as described in Section 6.4.1.

6.1.6. All Other Gear Types

As shown in Table 1-2, MWFSC uses a variety of trap nets and pots to conduct research. However, there is not a reasonable potential for non-lethal injury or M/SI of marine mammals due to these gear types used by the NWFSC (83 FR 36370). Therefore, these gears are not considered further in this application. All other gears used in NWFSC fisheries research (e.g., a variety of water sampling devices, transducers, hydrophones, towed cameras, plankton nets [including methot trawls], hand deployed cast nets CTDs, ROVs, UxS, SCUBA, etc.) do not have the potential for marine mammal interactions and are also not considered further.

6.2. Physical Disturbance Due to Research

There are numerous pinniped haulouts in Puget Sound and animals hauled out or in the water nearby may be disturbed by the physical presence and sounds of researchers in the vicinity. Pinnipeds also use Lower Columbia River waters. With the exception of harbor porpoises, physical disturbance of cetacean species is not anticipated.

Pinnipeds may move or flush from known haulouts into the water in response to the presence or sound of NWFSC vessels or researchers in the PSRA and LCRRA. Physical disturbance due to researchers in the CCRA is not anticipated. Disturbance of pinnipeds as a result of unintentional approaches during survey activity in the PSRA and LCRRA would not rise above Level B harassment. The 2018 final rule (83 FR 36370) identified three levels of response to physical disturbance: 1) Alert – changing position, brief movement of head, and craning head or neck; 2) Movement – moving away from the source or retreating over the beach; and 3) Flight – all movement (flushes) into the water. NMFS considers levels 2

and 3 to be Level B harassment. Section 6.4.2 defines and enumerates takes requested due to physical disturbance.

The current final rule for NWFSC fisheries research (83 FR 36370) allows for physical disturbance takes of harbor seals in Puget Sound and the Columbia River, as well as for California sea lions in Puget Sound (see Table 6-1). As shown in the Table 6-1, actual Level B disturbance takes of harbor seals and California sea lions from 2018-2021 were well below the authorized take levels. However, as shown in the table, Steller sea lion and harbor porpoise Level B disturbance takes have been documented during NWFSC research. These takes are unaccounted for in the MMPA authorization as only takes of harbor seals and California sea lions were authorized (83 FR 36370). In 2019, one of the Steller sea lions and six harbor porpoises were observed within 200 yards of surface trawl operations during the Intensively Monitored Studies of Juvenile Salmon in Skagit Bay (PSRA) and were recorded as takes; the other Steller sea lion that year was disturbed during the Pair Trawl Columbia River Juvenile Salmon Survey in the LCCRA (NWFSC 2020). In 2018, four of the Steller sea lions were taken during tangle net sampling where seal bomb deterrents were used in the Migratory Behavior of Adult Salmon study in the LCCRA and two were taken during the Pair Trawl Columbia River Juvenile Salmon Survey in the LCCRA (NWFSC 2019).

TABLE 6-1. TOTAL ANNUAL LEVEL B TAKES BY PHYSICAL DISTURBANCE 2018-2021

Species	2018-2023 Authorized Annual Level B DisturbanceTake[1]	Recorded Physical Disturbance Takes[2,3]			
		2018	2019	2020[4]	2021
Harbor Seal[5]	86,520	3	25	0	0
California Sea Lion[6]	2,800	93	16	0	145
Steller Sea Lion	-	6	2	0	4
Harbor Porpoise	-	0	6	0	0

[1]83 FR 36371
[2]NWFSC (2019, 2020, 2021, 2022).
[3]Takes may be over reported as the same animal may have been reported twice during the 6-hr observation period.
[4]The 2020 field season was severely limited due to COVID and no takes were reported.
[5]Total for Puget Sound and Columbia River.
[6]Puget Sound only.

6.3. Echosounders and Sonar

The impacts of anthropogenic sound on marine mammals have been summarized in numerous, books, articles and reports including: Richardson *et al.* (1995), National Research Council NRC (2005), Southall *et al.* (2007) and Southall *et al.* (2019). The distance to which anthropogenic sounds are audible depends on the level of ambient sound, anthropogenic sound source levels, frequency, ambient sound levels, the propagation characteristics of the environment, and sensitivity of the marine mammal (Richardson *et al.* 1995). Animals exposed to natural or anthropogenic sound may experience physical and behavioral effects, ranging in magnitude from none to severe (Southall *et al.* 2007).

Marine mammals exposed to high intensity sound repeatedly or for prolonged periods could experience hearing threshold shift, resulting in the loss of hearing sensitivity at certain frequency ranges (Kastak *et al.* 1999; Schlundt *et al.* 2000; Finneran *et al.* 2002; Finneran *et al.* 2005). Threshold shift results in

permanent threshold shift (PTS), where loss of hearing sensitivity is unrecoverable, or temporary threshold shift (TTS), in which case an animal may recover hearing sensitivity over time (Southall *et al.* 2007).

In April 2020, NMFS published interim recommendations (Guan 2020) for sound sources such as multi-beam echosounders and sonar equipment used in geophysical surveys which are similar to those used by NWFSC. For example, NWFSC researchers use acoustic equipment with various frequency ranges including some as low as 1.5 kHz. The EK60 commonly used in NWFSC research operates at frequencies of 38, 70, 120 and 200 kHz, and the EK80 ranges from 10-500 kHz. While these frequencies are in the range of cetaceans, phocids and otariids shown in Table 6-2, given the highly directional and narrow beam widths of this equipment, NMFS does not anticipate animals would be exposed to underwater sound levels resulting in injury, and the potential for Level B exposures is also reduced.

Based on information in Crocker and Fratantonio (2016), NMFS developed a user tool to estimate the distances potentially ensonified by echosounders. Assuming a source level of 226 decibels referenced at 1 micropascal at 1 meter (dB re 1 µPa at 1 m), frequency of 18 kHz beam width of 7°, and water depth of 200 m, underwater sound from an EK60 echosounder exceeding the behavioral threshold limit of 160 decibels (dB) would only extend approximately 12 m from the source. The distance remains about the same for all EK60 frequencies and would be even less for the higher frequency emitted by the EK80. Considering the mitigation measures to observe for and avoid marine mammals within close proximity to research vessels during research activities, the potential sound levels and effects of this type of equipment on marine mammals are considered *de minimus* and no Level B takes due to acoustic harassment are requested.

TABLE 6-2. GENERALIZED HEARING RANGES FOR MARINE MAMMAL HEARING GROUPS IN WATER

Hearing Group	Hearing Range
Low-frequency cetaceans (e.g. baleen whales)	7 Hz to 35kHz
Mid-frequency cetaceans (e.g. killer whales)	150 Hz to 160 kHz
High-frequency cetaceans (e.g. dolphins)	275 Hz to 160 kHz
Phocids (e.g. seals)	50 Hz to 86 kHz
Otariids and other non-phocid marine carnivores (e.g. sea lions)	60 Hz to 39 kHz

Source: NMFS (2018d).

6.4. Take Requests

6.4.1. Mortality or Serious Injury Takes

6.4.1.1. Trawl Gear

As described in Section 6.1.1, since 2014 NWFSC research trawls have had no non-lethal Level A or M/SI interactions with marine mammals. While MMEDs have not been proven to completely eliminate the risk of marine mammal capture in trawl nets (Chilvers 2008; as cited in NMFS (2016a)), the use of MMEDs on Nordic 264 surface trawls does reduce the potential for these interactions. Previous to 2014 when MMEDs became a standard mitigation measure, five species were commonly taken: Pacific white-sided dolphins, California sea lions, Steller sea lions, harbor seals, and northern fur seals.

To be precautionary and following approach in the 2018 final rule (83 FR 36370), even though recent takes have not occurred due to interactions with NWFSC trawl gear, the sum total of historical takes (since 1999) by research trawl gear is considered here as shown in Table 6-4 for Pacific white-sided dolphins, California sea lions, Steller sea lions, harbor seals, and northern fur seals. Considering data from the 2021 List of Fisheries (NOAA 2021) and SWFSC historical gear interaction information (NMFS 2020), vulnerability to trawl gear in the CCRA for Risso's dolphins, striped dolphins, short- and long-beaked common dolphins, northern right whale dolphins, Dall's porpoise, harbor porpoise, and bottlenose dolphins (offshore stock only) is inferred. As described in the 2018 final rule (83 FR 36370) three of these species have a similar susceptibility for interactions with NWFSC research trawl gear as Pacific white-sided dolphin (Risso's, striped, and northern right whale dolphin) and the other species are assumed to have lower risk of interaction. These assumptions are reflected in the take estimates for trawl gear shown in Table 6-4.

6.4.1.2. Hook and Line Gear

Until 2021, NWFSC had no history of marine mammal takes in hook and line gear (including longlines) or seine gear (NMFS 2018b). As noted in Section 6.1.1, an assumed non-lethal take of a California sea lion occurred during a hook and line survey from a contracted ship in the vicinity of Catalina Island (NWFSC 2022). No other California Sea lion takes have been documented prior to that incident; therefore this is assumed to be a relatively rare occurrence and mitigation measures described in Section 11 further reduce the potential for California sea lion takes in hook and line gear. However, to be precautionary as shown in Table 6-4, three takes of California Sea lions (two in the CCRA and one in the PSRA) are requested over the 5-year period. This is increased from a total of two Level A or M/SI takes of California Sea lions in hook and line gear (one each in the CCRA and PSRA) authorized in the 2018 final rule (83 FR 36370).

To determine vulnerability for other marine mammals to be entangled with hook and line gear , the process is the same as is described in Section 6.4.1.1 for trawl gear (83 FR 36370). Based on the 2021 List of Fisheries (NOAA 2021) and SWFSC historical gear interactions (NMFS 2020), it is inferred that Risso's, bottlenose, striped, and short- and long-beaked common dolphins; *Kogia spp*.; short-finned pilot whales; and Steller sea lions would be vulnerable to hook and line gear interactions in the CCRA. Also due to their likely presence in areas of the PSRA where hook and line gear is used in research (hook and

line gear is not used in the LCRRA), there is the potential for a harbor seal to be taken by hook and line gear in the PSRA. These estimates are shown in Table 6-4.

TABLE 6-3. ESTIMATED MORTALITY AND SERIOUS INJURY (NON-LETHAL LEVEL A OR M/SI) DUE TO GEAR INTERACTION[1]

Common Name	5-Year Trawl Takes	5-Year Hook and Line Takes	5-Year Seine Takes	5-Year Total Non-Lethal or M/SI Take
Cetaceans				
Sperm Whale	0	1	0	1
Humpback Whale	0	1	0	1
Harbor Porpoise[2]	3 *1-CCRA/1-PSRA/1-LCRRA*	0	3 *1-CCRA/1-PSRA/1-LCRRA*	6
Dall's Porpoise	2 *1-CCRA/1-PSRA*	0	2 *1-CCRA/1-PSRA*	4
Pacific White-sided Dolphin	30	0	1	31
Risso's Dolphin	6	1	1	8
Bottlenose Dolphin[3]	1	1	0	2
Striped Dolphin	6	1	0	7
Short-beaked Common Dolphin	1	1	1	3
Long-beaked Common Dolphin	1	1	0	2
Northern Right Whale Dolphin	6	0	1	7
Short-finned Pilot Whale	0	1	0	1
Kogia spp.[4]	0	1	0	1
Unidentified small cetacean	1	0	0	1
Pinnipeds				
California Sea Lion	7 *5-CCRA/1-PSRA/1-LCRRA*	3 *2-CCRA/1-PSRA*	4 *2-PSRA/2-LCRRA*	14
Steller Sea Lion[5]	7 *5-CCRA/1-PSRA/1-LCRRA*	1	2 *1-PSRA/1-LCRRA*	10
Northern Fur Seal[6]	5	0	0	5
Harbor Seal[2]	11 *5-CCRA/5-PSRA/1-LCRRA*	1 *PSRA*	2 *1-PSRA/1-LCRRA*	14
Unidentified pinniped	1	0	0	1

[1]Takes requested for authorization are not specific to any area. All takes are expected to occur in the CCRA, except where noted.
[2]Incidental take may be of animals from any stock in California, Oregon, or Washington but may be from California and Oregon coastal stocks (CCRA) or Washington inland waters stocks (PSRA or LCRRA) depending on where the interaction takes place.
[3]CA offshore stock only; NWFSC research has very little overlap with the distribution of the coastal stock of bottlenose dolphin
[4]One *Kogia* spp. may be taken over the five-year timespan; it could be either a pygmy or dwarf sperm whale.
[5]Eastern DPS only
[6]Incidental take may be of animals from either the eastern Pacific or California stock.

It should be noted that in July of 2021 a vessel conducting the Alaska Fisheries Science Center's (AFSC's) Alaska Longline Survey entangled a sperm whale (AFSC 2022). The preliminary determination was that a non-lethal injury occurred because the animal self-released and all gear was accounted for after the event. On August 4, 2021, a vessel conducting an International Pacific Halibut (IPHC) survey in Ernest Sound in Southeast Alaska entangled a humpback whale. The encounter resulted in live release but the whale swam away with line wrapped near its dorsal fin (AFSC 2021). The risk of interactions between

NWFSC surveys and these species is considered negligible considering that NWFSC's use of longline gear is limited compared to longlines used by AFSC and IPHC. In addition, the in the areas where NWFSC conducts a limited amount of longline, interactions with these species are not expected and there is no history of interactions with these species. For these reasons, takes due to longline surveys are not requested for sperm or humpback whales. .

Species with no records of historical interaction with NWFSC research gear and no documented non-lethal or M/SI takes in relevant commercial fisheries or relevant research efforts by other Centers are not considered further in this application; non-lethal injury or M/SI takes are only requested for species as shown in Table 6-4.

6.4.1.3. Seine Gear

NWFSC has no history of marine mammal takes from seine gear (NMFS 2018b; NWFSC 2019, 2020, 2021, 2022). Therefore, the process to determine potential non-lethal or M/SI takes due to NWFSC use of seine gear is the same as is described in Section 6.4.1.1 for trawl gear (83 FR 36370). Based on the 2021 List of Fisheries (NOAA 2021), vulnerability to seine and tangle net gear in the CCRA or LCRRA is inferred from commercial fisheries interactions with short-beaked common dolphins, harbor seals, and California sea lions. Long-beaked common dolphins are not considered to be vulnerable because they are rare in Oregon and Washington waters where seine surveys such as the SOBad survey (75 sets per year) are conducted (83 FR 36370).

In addition, the 2018 final rule (83 FR 36370) attributed a reasonable potential for takes of species in the CCRA or LCRAA for which there were no records of interaction in commercial fisheries gears (NOAA 2021). For example, several species have the potential to interact with NWFSC seine surveys in the Columbia River plume, where there are no corresponding commercial seine fisheries. These species include Dall's porpoises, Pacific white-sided dolphins, Risso's dolphins, northern right whale dolphins, Steller sea lions, and harbor porpoises. Harbor porpoises may have greater vulnerability to take in seine gear 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 (83 FR 36370). Estimated takes of these species are shown in Table 6-4.

Seine gear had been used infrequently in the PSRA (e.g., twelve purse seine sets during the Movement Studies of Puget Sound Species), and for this reason in the 2018 final rule (83 FR 36370) no takes by seine were identified in the PSRA. However, two new studies using seine nets have been proposed for Puget Sound: the Forage Fish Influence on Salmon Predation Risk and Food Resources Study and the Near Coastal Ocean Lampara Seining and ROV Surveys (up to 400 sets of lampara seines per year). Although the move-on rule (see Section 11) would be applied if any small cetacean is seen within 500 m of the planned set, to be precautionary disturbance takes for future research are requested for harbor porpoises, Dall's porpoises, California sea lions, Steller sea lions, and harbor seals (see Table 6-4).

6.4.2. Physical Disturbance Takes

As described in Section 6.2, since 2018 takes due to physical disturbance by researchers have been recorded for harbor seals, California sea lions, Steller Sea lions and harbor porpoises. As shown in Table

6-1, with the exception of Steller sea lions and harbor porpoises, recorded takes are at least an order of magnitude below levels authorized by the 2018 final rule (83 FR 36370).

To estimate incidents of Level B harassment due to physical disturbance, the 2018 final rule (83 FR 36370) considered the number of pinnipeds believed to potentially be present at affected haul-outs and the number of visits expected to be made by NWFSC researchers. The number of haulouts disturbed and number of animals assumed to be on those haulouts was determined by NWFSC on the basis of anecdotal evidence from researchers. The 2018 final rule (83 FR 36370) assumed eight and 25 annual visits by researchers to Puget Sound and Columbia River, respectively. The final rule also assumed that 1,400 and 3,000 harbor seals could be hauled out and potentially disturbed by researches in Puget Sound and the Columbia River, respectively, and that 350 hauled out California sea lions could be affected in Puget Sound.

This application assumes that the anecdotal numbers of potentially hauled out California sea lions and harbor seals reported in the 2018 final rule (83 FR 36370) have not changed. However, because actual observed disturbance of harbor seals and California sea lions is so much lower than authorized disturbance takes of these animals (86,520 authorized annual takes versus 2 and 25 annual observations of disturbance since 2018 for harbor seals and 145 or fewer annual takes of California Sea lions compared to 2,800 authorized annual takes; see Section 6.2), it is assumed that only 10 % of hauled out harbor seals or California sea lions could move from the source or be flushed into the water (Levels 2 or 3 as described in Section 6.2) and thus, taken by any survey. This assumption is consistent with the approach used in the final rule for *Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Northeast Fisheries Science Center and Ecosystem Research* (86 FR 58434). Even with this 10 % reduction, the number of potentially disturbed harbor seals or California sea lions shown in Table 6-5 are sufficiently high to be very precautionary.

Proposed new surveys may increase visits to both PSRA and LCRRA. While one survey is discontinued, seven new surveys are proposed for the PSRA; in the LCRRA four studies have been added. The 2018 rule assumed that eight annual visits to the PSRA would be conducted for 13 surveys and in the LCRRA that 25 visits would be required for eight surveys. Based on this assumption and with the changes to proposed studies, it is assumed that PSRA visits could increase to 12 per year and LCCRA visits could increase to 38 per year. These increased visits are reflected in the take estimates shown in Table 6-5.

As described in Section 6.2 and shown Table 6-1, takes of Steller sea lions and harbor porpoises have been recently recorded in the PSRA and LCRRA. The takes have been associated with the Pair Trawl Columbia River Juvenile Salmon Survey and Migratory Behavior of Adult Salmon Survey in the LCCRA and the Intensively Monitored Studies of Juvenile Salmon in Skagit Bay in the PSRA. These surveys would continue and estimated physical disturbance takes for Steller sea lions and harbor porpoise based on the past history as shown in Table 6-5.

TABLE 6-4. ANNUAL LEVEL B ESTIMATED DISTURBANCE TAKES

Species	Location	Number of Potentially Disturbed Animals	Number of Researcher Visits per Year (days)	Estimated takes due to level B Physical Disturbance[1]
Harbor seal[2]	PSRA	144	12	1,728
	LCRRA	300	38	11, 400
	Total			**13,128**
California sea lion	PSRA	35	12	420
Steller sea lion[3]	PSRA	N/A	N/A	8
	LCRRA	N/A	N/A	8
	Total			**16**
Harbor Porpoise[4]		N/A	N/A	6

[1]Estimated takes equal the potential number of disturbed animals times the number of visits and assume that an animal can only be taken once per day.

[2]While 1,440 and 3,000 harbor seals in PSRA and LCRRA, respectively, and 350 California sea lions in the PSRA could be hauled out during surveys, it is assumed that only 10 % of hauled out pinnipeds could be flushed or disturbed sufficiently to reach Level B disturbance.

[3]Takes of Steller sea lions are based on historical takes in the Intensively Monitored Studies of Juvenile Salmon in Skagit Bay (PSRA) Pair Trawl Columbia River Juvenile Salmon Survey in the LCCRA and the Migratory Behavior of Adult Salmon in the LCCRA , no on numbers of hauled out animals (see Section 6.2).

[4]Harbor porpoise takes are based on historical takes in the Intensively Monitored Studies of Juvenile Salmon in Skagit Bay (PSRA). See section 6.2.

6.5. Total Takes Requested

Table 6-6 summarizes the total non-lethal injury (Level A), M/SI and physical disturbance takes requested over the 5-year period of the LOA.

TABLE 6-5. TOTAL TAKES REQUESTED 2023 TO 2028

Common Name	5-Year Total Level A (Non-Lethal) or M/SI Takes	5-year Total Physical Disturbance Takes
Cetaceans		
Sperm Whale	1	0
Humpback Whale	1	0
Harbor Porpoise[1]	6	30
Dall's Porpoise	4	0
Pacific White-sided Dolphin	31	0
Risso's Dolphin	8	0
Bottlenose Dolphin[2]	2	0
Striped Dolphin	7	0
Short-beaked Common Dolphin	3	0
Long-beaked Common Dolphin	2	0
Northern Right Whale Dolphin	7	0
Short-finned Pilot Whale	1	0
Kogia spp.[3]	1	0
Unidentified small cetacean	1	0
Pinnipeds		
California Sea Lion	14	2,100
Steller Sea Lion[4]	10	80
Northern Fur Seal[5]	5	0
Harbor Seal[1]	14	65,640
Unidentified pinniped	1	0

[1]Incidental take may be of animals from any stock in California, Oregon, or Washington and may be from California and Oregon coastal stocks (CCRA) or Washington inland waters stocks (PSRA or LCRRA) depending on where the interaction occurs.
[2]CA offshore stock only; NWFSC research has very little overlap with the distribution of the coastal stock of bottlenose dolphin
[3]One *Kogia* spp. may be taken over the five-year timespan; it could be either a pygmy or dwarf sperm whale.
[4]Eastern DPS only
[5]Incidental take may be of animals from either the eastern Pacific or California stock.

7. ANTICIPATED IMPACT OF THE ACTIVITY ON SPECIES AND STOCKS

Only takes for non-lethal Level A injury, M/SI and Level B physical disturbance of marine mammals are being requested in this application. The MMPA and its implementing regulations have not provided a clear operational definition of "take by harassment" especially for minor, temporary behavioral disturbance such as the physical disturbance discussed herein. There is general recognition that minor and brief changes in behavior generally do not have biologically significant consequences for marine mammals and do not "rise to the level of taking" (NRC 2005). Therefore, only Level A non-lethal injury or M/SI takes are considered in assessing anticipated impacts to species and stocks (Table 7-1).

TABLE 7-1. MORTALITY AND SERIOUS INJURY TAKE REQUESTS RELATIVE TO POTENTIAL BIOLOGICAL REMOVAL

Common Name	Total Annual Level A or M/SI Take	PBR[1]	Abundance[1]	Annual Level A or M/SI Take as Percentage (%) of Abundance
Cetaceans				
Sperm Whale	0.2	2.5	1,997	0.010%
Humpback Whale[2]	0.2	28.7	4,973	0.004%
Harbor Porpoise[3]	1.2	35	3,760	0.032%
Dall's Porpoise	0.8	99	16,498	0.005%
Pacific White-sided Dolphin	6.2	279	34,999	0.018%
Risso's Dolphin	1.6	46	6,336	0.025%
Bottlenose Dolphin[4]	0.4	20	3,477	0.012%
Striped Dolphin	1.4	225	29,988	0.005%
Short-beaked Common Dolphin	0.6	8,889	1,056,308	0.000%
Long-beaked Common Dolphin	0.4	668	83,379	0.000%
Northern Right Whale Dolphin	1.4	163	29,285	0.005%
Short-finned Pilot Whale	0.2	4.5	836	0.024%
Kogia spp.[5]	0.2	19.2	4,111	0.005%
Pinnipeds				
California Sea Lion	2.8	14,011	257,606	0.001%
Steller Sea Lion[5]	2	2,572	43,201	0.005%
Northern Fur Seal[7]	1	451	14,050	0.007%
Harbor Seal[8]	2.8	1,641	30,968	0.009%

[1]Source Carretta *et al.* (2022). Appendix 2.
[2]CA/WA/OR stock.
[3]Incidental take may be of animals from any stock in California, Oregon, or Washington. PBR and abundance for the smallest stock (Monterey Bay) used as worst-case.
[4]CA offshore stock only.
[5]Takes could be from either *K. breviceps* or *K. sima* but only PBR and abundance of *K.breviceps* is available
[6]Eastern DPS only; source for abundance and PBR is (Muto *et al.* 2021)
[7]Incidental take may be of animals from either the eastern Pacific or California stock. PBR for the smaller California stock is used as a worst-case.
[8]Incidental take may be of animals from any stock in California, Oregon, or Washington. PBR and abundance is shown for the California stock because abundance estimates for the other stocks are more than eight years old and PBR is unknown.

NWFSC fisheries research activities have the potential to cause M/SI of marine mammals in the CCRA, PSRA and LCRRA. However, as shown in Table 7-1 takes relative to abundance and PBR of affected populations are very low. PBRs for all species affected are orders of magnitude above estimated annual M/SI takes and the estimated takes never exceed 0.04% of the population, even when the smallest stock abundance is considered (e.g., harbor seals).

Based on this information NWFSC activities: 1) would have a negligible impact on the affected species or stocks of marine mammals (based on the likelihood that the activities will not affect annual rates of recruitment or survival); and 2) would not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence or commercial uses.

8. ANTICIPATED IMPACTS ON SUBSISTENCE USES

The Makah Indian Tribe has requested authorization to hunt eastern North Pacific gray whales (*Eschrichtius robustus*). The right to take whales at usual and accustomed grounds is a Makah tradition secured by the 1855 Treaty of Neah Bay. This would be the only approved subsistence hunting of marine mammals in the action area.

The U.S. Ninth Circuit Court of Appeals ruled in 2004 that to pursue any treaty rights for whaling, the Makah Tribe must comply with the process prescribed in the MMPA for authorizing take of marine mammals otherwise prohibited by the MMPA's moratorium on take. Under the MMPA, "take" means to harass, hunt, capture, or kill any marine mammal or attempt such actions.

On February 14, 2005, NMFS received a request from the Makah for a waiver of the MMPA's take moratorium. The Tribe requested a waiver allowing the harvest of 20 eastern north Pacific (ENP) gray whales every 5 years and a limit of 7 strikes per hunting season, presuming that a struck whale would die. On April 5, 2019, NMFS published a proposed rule to issue a waiver under the MMPA and proposed regulations governing the hunting of ENP gray whales by the Makah Tribe for a 10-year period and a related notice of hearing before an administrative law judge to consider the waiver and proposed regulations (84 FR 13604).

The ENP gray whale stock is not listed as threatened or endangered under the ESA and it is not a strategic stock under the MMPA. Gray whales migrate north though the CCE. However, most NWFSC survey activity occurs offshore and is unlikely to interact with coastal species such as gray whales migrating north. For this reason, NWFSC research is not likely to have any effect on subsistence hunting of whales throughout the action area.

The Makah Tribe also considers salmon (Chinook, coho) and steelhead important subsistence resources. The tribe manages and operates the Makah National Fish Hatchery in Neah Bay, Washington located in the Strait of Juan de Fuca to raise and stock these species for the Tsoo-Yess River where they subsistence fish[5]. While some NWFSC research is conducted in the Strait of Juan de Fuca, it is not focused on salmon or steelhead and no NWFSC occurs in the Tsoo-Yess River used for subsistence by the Makah tribe. Considering there would be little to no interaction with fish used for subsistence by the Makah tribe, the effects of NWFSC research on subsistence fishing is considered negligible.

[5] https://www.fws.gov/fish-hatchery/makah; Accessed July 15, 2022.

9. ANTICIPATED IMPACTS ON HABITAT

Impacts on habitat due to NWFSC research could occur though changes to the benthic environment due to trawling and changes in prey availability to marine mammals. In addition, critical habitat has been designated for two species that may occur in the region as described in Section 9.3.

9.1. Impacts to Physical Habitat

NWFSC conducts bottom trawling in the CCRA, which may result in some physical damage to 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 as cited in 83 FR 36370). 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 likely 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) (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). Relatively small areas would be impacted by NWFSC bottom trawling. However, because research surveys are conducted are not in the exact same locations, they would not result in repeated disturbances in any given area. NWFSC activities is not expected to effect water quality. Consequently the potential for NWFSC research to impact the quality of physical habitat sufficiently to affect the survival of or availability of prey for marine mammals is considered to be discountable for all species.

9.2. Changes in Food Availability Due to Research Survey Removal of Prey and Discards

The 2018 PEA analyzed the potential impacts of prey removals on marine mammal species and determined that the total amount of these species taken in research surveys is very small relative to their overall biomass in the area (NMFS 2018b).

While some NWFSC research cruises sample zooplankton on which baleen whales such as humpback sei whales and blue whales feed, the biomass of plankton collected is negligible and would have no effect on prey availability for these whales. NWFSC may also remove a relatively small number of salmon during research. Salmon are an important species for some marine mammals including, in particular, the Southern Resident killer whale DPS as well as sea lions. On July 29, 2021, incidental catch of 78 Chinook salmon occurred during tow 33 of the 2021 Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey. The incident occurred approximately 20 km offshore of Eureka, California (40° 46.66'N, 124° 27.14'W). This event was considered rare and unexpected. In addition to this incidental and unanticipated catch of 78 Chinook salmon, NWFSC also conducts directed research on salmon species throughout the action area. As described in Section 1.2.2, directed research may require separate ESA Section 10 permits. For example, within Puget Sound and greater Puget Sound, the following NWFSC projects have separate ESA Section 10 permits (permit # listed here): Movement Studies of Puget Sound Species and Rockfish Projects in Puget Sound (#17062-6R); Salish Sea Studies of Juvenile Salmon and Other Pelagic Species, Intensively Monitored Studies of Juvenile Salmon in Skagit Bay, Elwha Dam

Salmon Recovery Studies, and Puget Sound Juvenile Salmon Studies (#1586-5R); Puget Sound Marine Diversity Studies are permitted along with Ocean Lampra Seining (#24367); Fish Contaminants Studies (#23019-2R); and Puget Sound Juvenile Salmon Studies are also permitted under #16702-4R). Table 1-2 lists the Section 10 permits for directed research that may involve salmon. The 2016 BiOp for NWFSC research {NMFS, 2016 #3092} analyzed catch of salmon with respect to their importance as prey for Southern Resident killer whales.

The 2016 BiOp concluded "Given the total quantity of prey available to Southern Resident killer whales throughout their range, this annual reduction in prey of is extremely small. Because this reduction is so small, there is also a low probability that any of the Chinook salmon that would have survived if there were no NWFSC research surveys could be intercepted by the killer whales in any case due to the whales' vast range. Thus, the magnitude of prey reduction associated with NWFSC research, assuming all captures actually lead to mortality and prey removal, is insignificant compared to the overall amount of prey that is expected to be available for ESA-listed species in the action area"{NMFS, 2016 #3092}. There are no reasonable changes in NWFSC research that would alter this conclusion and therefore, catch of salmon is not likely to affect the Southern Resident killer whale DPS.

Pacific hake are preyed upon by California sea lions, northern fur seals, harbor seals, northern elephant seals, Pacific white-sided dolphins, northern right whale dolphins, Dall's porpoises, and sperm whales (Fiscus 1979). Table 9-1 shows the 2021 NWFSC research catch of Pacific hake compared to the estimated stock biomass. As shown in the table, research removals are a very small percentage of total biomass and are not expected to affect prey availability.

TABLE 9-1. PREY BIOMASS REMOVED DURING 2021 NWFSC RESEARCH SURVEYS

Prey Species	Estimated 2021 Stock Biomass (mt)	2021 Research Catch[1] 2021 (mt)	Research Catch as a Percent of Biomass
Pacific Hake	1,524,640	21	0.001%

Source: Julia Clemons, NMFS/NWFSC

In addition to the small total biomass taken, research surveys tend to target smaller size classes of fish than are preferred by marine mammals. Research catches are also distributed over a wide area because of the random sampling design covering large sampling 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. For these reasons it is determined that removal of prey biomass during NWFSC surveys would not change food availability and would have no effect on overall prey sources for marine mammals.

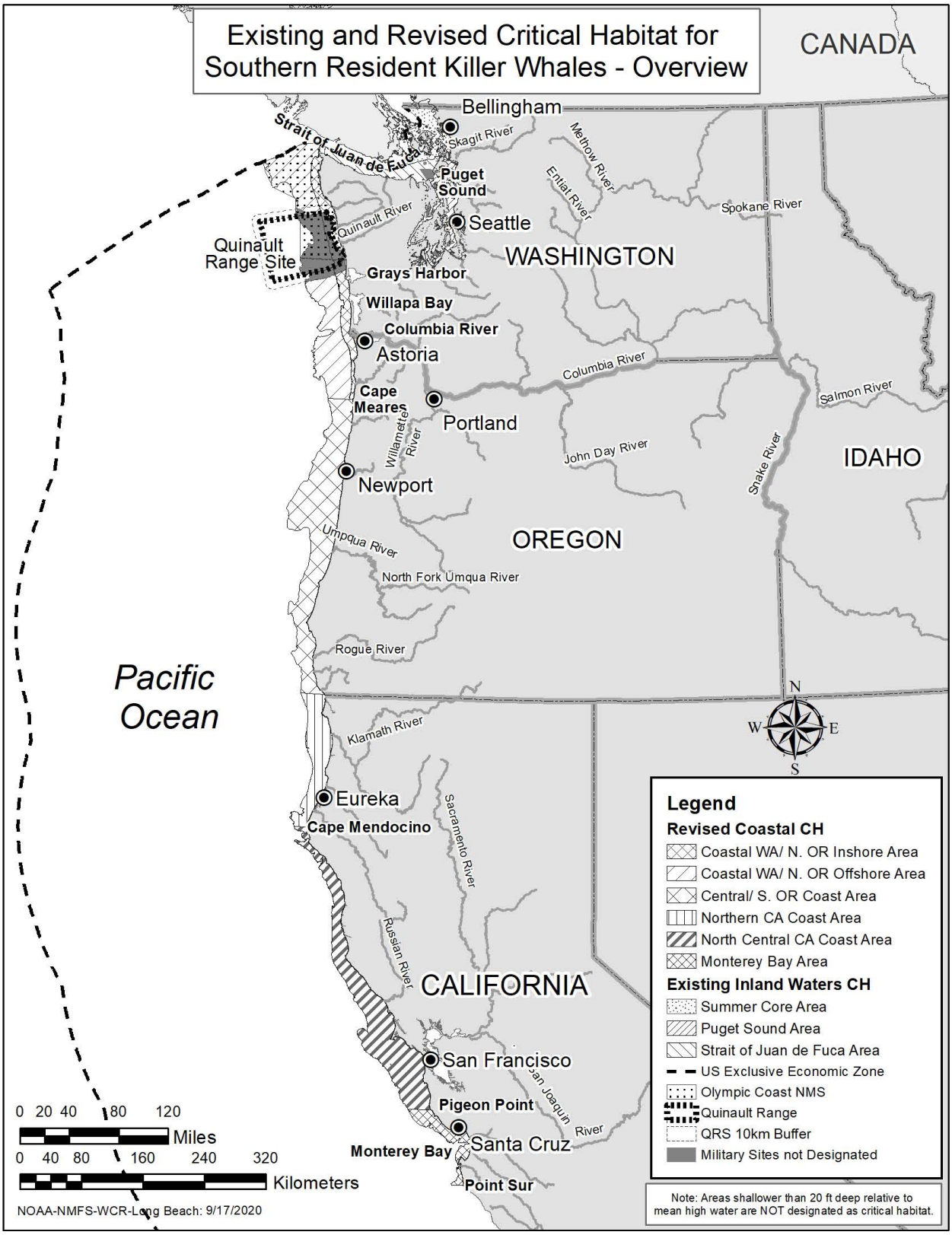
9.3. Critical Habitat Designations

As discussed in Section 4.1.2, critical habitat has been recently designated for certain humpback whale DPSs. As shown in Figure 4-1, designated critical habitat areas for Central American DPS of humpback whales is within the NWFSC research area. On August 2, 2021, NMFS revised critical habitat for the southern resident DPS of killer whales (86 FR 41668). The revision added six additional coastal areas totaling 41,204 km^2 and excluded the Quinault range site from the designation (Figure 9-1). These areas lie within areas of NWFSC research but the research is not expected to impact individual SRKWs (no

takes are requested). Critical habitat has not been designated any other ESA-listed species shown in Table 3-1 (NMFS 2016a).

Based on the analysis provided in Sections 9-1 and 9-2, NWFSC research activities are unlikely to modify or adversely affect designated critical habitat for Central American DPS of humpback whales or SRKWs.

FIGURE 9-1. REVISED CRITICAL HABITAT FOR SOUTHERN RESIDENT KILLER WHALES



Source: https://media.fisheries.noaa.gov/2021-07/map-srkw-ch-overview-fedreg-final7.pdf?null=. Accessed June 1, 2021

10. ANTICIPATED EFFECTS OF HABITAT IMPACTS ON MARINE MAMMALS

As stated in Section 9, the proposed activities are not anticipated to result in impacts to marine mammal habitat nor to the food resources on which they depend. Therefore, long-term adverse impacts to marine mammals resulting from loss of or modification to marine mammal habitats as a result of the proposed activities are not expected.

11. MITIGATION MEASURES

Mitigation measures for NWFSC surveys proposed over the period 2023-2028 are shown in Table 11-1. NWFSC considers the current suite of mitigation and monitoring measures to be necessary to avoid adverse interactions with protected species and still allow NWFSC and its cooperating partners to fulfill their scientific missions. The mitigation measures currently used during research are also proposed to continue under this LOA, with specific additions as noted in italics that would be newly implemented for the period 2023-2028 (see Table 11-1).

In addition to these mitigation measures, NWFSC has implemented a number of handling, data collection and reporting protocols to minimize potential harm to protected species incidentally taken during fisheries research activities. In general, protocols have been prepared for use on commercial fishing vessels. Because many parallels exist between commercial fishing operations and NWFSC fisheries research, NWFSC is adopting these protocols for use on its surveys on NOAA and charter vessels. 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 would also increase the information on which "serious injury" determinations are based and improve scientific knowledge about protected species that interact with fisheries research gears and the factors that contribute to these interactions. Specific handling procedures for Marine Mammals are provided in Appendix B.

TABLE 11-1. PROPOSED MITIGATION AND MONITORING MEASURES

Type of Survey	Mitigation and Monitoring Measure
General Measures Applicable to All Surveys	● Coordination and Communication: In advance of each survey, coordination with the NOAA Office of Marine and Aviation Operations (OMAO) or other relevant parties to ensure clear understanding of the mitigation measures and the manner of their implementation. Conduct briefings at the outset of each survey and as necessary with the ship's crew. Chief scientist (CS) to coordinate with Officers on Deck (OOD) or equivalent to ensure procedures are understood. ● Vessel speed: if vessel crew or dedicated observers sight protected species that may intersect the vessel, they will immediately communicate with the bridge for appropriate course alteration or speed reduction as possible. When transiting between sampling stations, NWFSC research vessels will cruise at 6-14 kts but average about 10 kts. ● Protected Species Training: Conduct a formalized protected species training program for all crew members that are part of NWFSC-affiliated research and cooperative research. Training will include topics such as monitoring and sighting protocols, species identification, decision-making factors avoiding take, procedures for handling and documenting protected species interactions, and reporting requirements. ● Review written protocols for avoiding adverse interactions with protected species make them fully consistent with training materials and guidance. In addition, review informational placards and reporting procedures and update as necessary. ● Incorporate specific language into vessel and cooperating partner contracts that stipulates all training requirements, operating procedures and reporting requirements.
Surveys Using Trawl Gear	● For all trawl surveys (surface, midwater and bottom), the OOD, CS (or other member) and crew standing watch on the bridge will scan for protected species using

Type of Survey	Mitigation and Monitoring Measure
	binoculars during all daytime operations. The goal is 360-degree monitoring coverage around the vessel. ● For all trawl surveys, the period of protected species monitoring will begin about 10 min before the vessel is on station and extends continuously until the net has been retrieved. Scan the surrounding waters with the naked eye and rangefinding binoculars. the monitoring period for protected species begins before the vessel arrives on station and extends continuously through gear deployment, typically for over 30 min on all trawl types. ● The CS must confirm with the captain or the bridge that no marine mammals or other protected species have been seen within 500 m of the ship or appear to be approaching the ship during a 10-min period prior to the deployment of any trawl gear. ● For surface trawls using the Nordic 264 trawl, two pairs of acoustic signaling devices known as "pingers" are installed near the net opening, one on either side. Acoustic pingers, when submerged, emit an underwater pulse of sound, or "ping". The intent of these devices is to discourage protected species from entering the net. All Nordic 264 trawl nets will be fitted with MMEDs. ● If protected species are sighted within 500 m of the vessel and are considered at risk of interaction before setting the gear, the OOD may decide to implement the "move-on" rule and transit to a different section of the sampling area. If Orcas are observed at any distance within any research area, the "move-on" rule is applied. In lieu of moving on, the vessel can remain on site for 10 mins to see if the animals move. If animals do move on, the monitors will watch for another 10 mins and if there are no other sightings the gear can be deployed. Trawl gear will not be deployed if protected species are sighted near the ship unless there is no risk of interaction as determined by the OOD or CS. ● For pair trawl gear used only in the Columbia River Estuary, use deterrents such as poppers or screamers to drive pinnipeds from the open net. An occasional animal nearby is tolerated but pinnipeds intent on approaching the net will be deterred. ● Video cameras have been added during calibration and experimental tows of the Groundfish Bottom Trawl survey. This is intended to facilitate fisheries research but also provides information on any protected species that may enter the net. ● After moving on, monitoring protocols continue as reconnaissance of the new location is conducted and any other scientific gear is deployed (CTDs, bongos, etc.), a period of at least 10 mins since moving to the new location. If protected species are still visible from the vessel and appear at risk, the OOD may decide to move again or skip the station. The OOD and CS may discuss strategies for avoid takes of these species. ● If trawling is delayed because of protected species presence, trawl operations only resume when the animals have no longer been sighted or are no longer at risk. ● Conduct trawl operations upon arrival on station to the extent practicable. ● Continue visual monitoring while gear is deployed. If protected species are sighted before gear retrieval, the CS, watch leader, or OOD will determine the best action to minimize interactions with animals. ● During nighttime operations, observe with the naked eye and any available vessel lighting. ● If deploying bongo plankton or other small net prior to trawl gear, continue visual observations until trawl gear is ready to be deployed.

Type of Survey	Mitigation and Monitoring Measure
Surveys Using Trawl Gear (con't)	● Care will be taken when emptying the trawl, including opening the cod end as close as possible to the deck of the checker (or sorting table) in order to avoid damage to protected species that may be caught in the gear but are not visible upon retrieval. ● Conduct standard tow durations of no more than 30 mins excluding deployment and retrieval at target depths for less than 3 nm. ● Clean gear prior to deployment. Empty gear as quickly as possible to ensure no protected species are entangled.
Puget Sound Surface (Kodiak) Tow Net	● This gear is a small net towed at slow speeds, close to shore only in Puget Sound. ● If only pinnipeds are observed in the area, deploy and retrieve the net as specified by the research design. However, if any cetaceans are observed within about 500 m or appear to be approaching a site from farther out, abandoned the site or hold to determine the behavior of the protected species. ● If killer whales are observed at any distance, the net will not be deployed, and the move-on rule will be implemented.
Tangle Net Gear (only used in Columbia River)	● Rotate sampling locations daily and avoid sampling near haulouts to avoid pinnipeds. ● If pinniped presence near the sampling nets cannot be controlled, discontinue sampling or the day at that location. ● Use poppers or screamers to deter pinnipeds if they approach within about 200 m, a practice allowed under MMPA Section 109(h). ● If pinniped presence in the vicinity of tangle net surveys is so abundant as to be uncontrollable through deterrence, sampling is discontinued for a given day.
Purse Seine Surveys	● Crew keep watch for protected species before and during sets. If an observer is on board, the observer informs the CS and captain of any protected species detected near or at the sampling station. ● If pinnipeds are in the immediate area where the net is to be set, the set is delayed until the animals move out of the area or the station is abandoned. However, if small numbers of pinnipeds (less than five) are seen in the vicinity but do not appear to be in the direct way of the setting operation, the net may be set. If the net is already deployed, it would not be opened if pinnipeds are present. ● If any dolphins or porpoises are observed within 500 m of the vessel, the net will not be set until the animals move further away. If any dolphins or porpoises are observed in the net, the net will be immediately opened to let the animals go. ● If killer whales are seen at any distance, the net will not be set and the move-on rule is implemented. Other whales are very rare in Puget Sound but sightings would elicit the same response as killer whales. ● *Requirements also apply to the Lampara seine study that has been added*.
Beach Seine Gear	● Visually survey the area for protected species prior to set. ● Do not make the set if hauled out pinnipeds are within 200 m. Lift and remove the gear from the water if protected species are observed to be interacting with it.

Type of Survey	Mitigation and Monitoring Measure
Longline Surveys, and Hook and Line or Rod and Reel Surveys	● Conduct visual monitoring at least 30 mins prior to the setting the gear. ● Implement the "move on" rule if any protected species are present near the vessel and appear to be at risk of interactions. The "move on" rule is not required for pinnipeds for hook and line surveys in Puget Sound due to their abundance in the area making this measure impracticable. ● Deploy gear as soon as possible upon arrival on station (depending on marine mammal presence). Maintain visual monitoring throughout deployment and gear retrieval. ● If setting operations have been halted due to the presence of the protected species, setting can resume only if no protected species have been observed for at least 30 mins. ● If protected species are detected in the area and are at risk of entanglement, haul-back of the gear may be postponed until the officer on watch determines that it is safe to proceed. ● Chumming is prohibited. Bait must be removed from hooks during longline retrieval and retained on the vessel until all gear is removed from the area. no discards of offal or spent bait will occur while longline gear is in the water. ● Monitoring and baiting procedures for hook and line and rod and reel gear are the same as those for longline gear.
Pot and Trap Gear	● *Use of weighted lines is required for crab traps.* ● *If beach traps are used, fit them with aluminum bars to prevent protected species from entering the holding/collection area.*
Plankton Nets, Small-mesh Towed Nets, Oceanographic and Water Sampling Devices, eDNA Collection, and Video Cameras	● These gear types are not considered to pose risk to protected species because of their small size, slow deployment speeds, and structure. Therefore, no specific mitigation measures are required. However, the officer on watch and crew will monitor for any unusual circumstances that may arise at a sampling site and use professional judgment and discretion to avoid any potential risks to protected species during deployment .
Uncrewed Systems (UxS) (Aerial and Underwater Systems)	● Use of UAS must comply with applicable Federal Aviation Administration (FAA) regulations. ● UAS only to be flown by an experienced operator. ● UAS altitudes may range up to 400 ft above ground level depending on the method of use (i.e., flying transects or targeting specific species) or species involved. UASs will not be flown directly over pinniped haulouts. ● UAS flights will be line of sight in accordance with FAA regulations and in accordance with applicable sections of NOAA's UAS Policy 220-1-5 (NOAA 2019). ● Use of USVs such as Saildrones or ROVs pose minimal risk to protected species but researchers must follow standard avoidance measures before deployment.

Type of Survey	Mitigation and Monitoring Measure
Handling Procedures for Incidentally Captured Individuals	● Handling Procedures: Implement NWFSC established protocols to reduce interaction with protected species following a step-wise order; 1) ensure health and safety of crew; depending on how and where an animal is hooked or entangled, take action to prevent further injury to the animal; 3) take action to increase the animal's chance of survival; and 4) record detailed information on the interaction, actions taken and observations of the animal throughout the incident. ● Captured live or injured protected species are released from research gear and returned to the water as soon as possible with no gear or as little gear remaining on the animal as possible. Animals are released without removing them from the water if possible. Data collection is conducted in such a manner as not to delay release of the animal(s) and should include species identification, sex identification if genital region is visible, estimated length, disposition at release (e.g., live, dead, hooked, entangled, amount of gear remaining on the animal, etc.) and photographs. The CS or crew should collect as much data as possible from hooked or entangled animals, considering the disposition of the animal; if it is in imminent danger of drowning, it should be released as quickly as possible. Biological samples could only be collected in accordance with section 109(h)(1) of the MMPA for live/dead protected species (non-listed) or under a directed scientific research and enhancement permit. ● If a large whale is alive and entangled in fishing gear, the vessel should immediately call the U.S. Coast Guard (USCG) at Very High Frequency (VHF) Ch. 16 and/or the appropriate Marine Mammal Health and Stranding Response Network. Entangled whales may be reported to the NOAA Fisheries entanglement reporting hotline (1-877-767-9425). ● The Chief Scientist will submit data on all captured animals to marine mammal experts at the appropriate NMFS Science Center who will use specific criteria to determine whether the injury is considered serious (i.e., more likely than not to result in mortality). If insufficient data has been collected for any reason, the marine mammal experts may not be able to determine the severity of the injury. However, the marine mammal experts may use other types of information to assign the injury to either lethal or non-lethal categories.

12. MITIGATION MEASURES TO PROTECT SUBSISTENCE USES

As described in Section 8, in 2019 NMFS published a proposed rule to issue a waiver under the MMPA and proposed regulations governing the hunting of ENP gray whales by the Makah Tribe for a 10-year period. Mitigation measures described in Section 11 would protect gray whales in the rare event that their distribution overlaps with NWFSC surveys in the CCE.

13. MONITORING AND REPORTING

13.1. Monitoring

Marine mammal monitoring measures are described Table 11-1. Marine mammal watches are a standard part of fisheries research activities, particularly when using gears such as longlines, purse seines and mid-water trawls that may or are known to interact with marine mammals. While underway, watches are generally conducted by vessel crew or members of the scientific party (those navigating or working on the vessel and other crew) at all times when the vessel is being operated. These individuals are referred to as 'watch-standers'. The primary focus for this type of watch is to avoid striking marine mammals and to generally avoid navigational hazards. The watch-standers do not record or report marine mammal sightings except when gear is being deployed or retrieved. In most cases, these watches are not conducted by dedicated staff; these personnel may have other duties associated with navigation and other vessel operations.

Observing and monitoring for marine mammals is conducted prior to deploying longlines, purse seines and trawl gear, and continues until gear is returned on board. Observations and monitoring are conducted by dedicated scientists with no other responsibilities during the watch period. If marine mammals are sighted within 500 m of the purse seine survey location or within 1 nm of the longline or mid-water trawl survey location then the sampling station is either moved, delayed until the mammals have moved from the area, or canceled. However, if small numbers of pinnipeds (generally less than five) are seen in the vicinity but do not appear to be in the direct way of the setting operation, the purse seine may be set. Observers record the number of each species and their behaviors. This information can be valuable in understanding whether some species may be attracted to vessels or gears.

13.2. Reporting

Generally, reporting will discuss the activities that were conducted, the results of the monitoring program, and the implementation of mitigation measures including:

- Summary of the activity (dates, times, and specific locations, project actions, durations and sources actually completed) and any changes from the activities proposed in the application;
- Summary of mitigation implementation;
- Detailed monitoring results as well as a comprehensive summary including:
    - Number, species, and relevant information regarding marine mammals observed and estimated exposures/takes;
    - Description of observed marine mammal behaviors (during presence or absence of activities);
    - Environmental conditions when observations were made.
- Assessment of the effectiveness of mitigation and monitoring measures.
- NWFSC will coordinate with the local Northwest Regional Stranding Coordinator and the NMFS Stranding Coordinator to report any unusual marine mammal behavior and any stranding, beached (alive or dead), or floating marine mammals that are encountered during field research

activities. In addition, Cruise Leaders or Chief Scientists provide reports to NWFSC leadership and to the OPR by event, survey leg and cruise. When marine mammals interact with the gear and are killed or released alive, the report fully describes any observations of the animals, the context (vessel speed 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 the OPR to better evaluate the conditions under which takes are most likely occur and potentially avoid some of these situations in the future.

For this purpose, NMFS has established a formal Level A incidental take reporting system, the PSIT database, requiring that incidental takes of protected species be reported within 48 hours of the occurrence. PSIT generates automated messages to agency leadership and other relevant staff alerting them about the event. Information about the circumstances of the event are added to the PSIT database. The PSIT and Chief Scientist reports provide valuable real-time reporting and help with disseminating information while also serving to archive information that could be mined later to evaluate why takes occur, which species seem particularly vulnerable (or not) and what gear types have higher likelihood of interactions, etc. While a single reporting mechanism is most desirable, NWFSC plans to continue uploading data to the PSIT database as well as documenting species interactions in the form of reports as described here.

NWFSC would will submit a report of all takes of marine mammals, including geographic coordinates of activities at the time of the observation, closest approach of mammals to research activities, and any required mitigation measures implemented. Table 13-1 provides contact information and protocols.

In the unanticipated event that unauthorized take occurs or if a stranded, injured, sick or dead animal not associated with NWFSC is encountered, NWFSC would implement the following procedures.

Unauthorized Take

- If a marine mammal is determined by the Cruise Leader or Chief Scientist to have been disturbed, harassed, harmed, injured, or killed (e.g., is injured or killed as a direct or indirect result of this action), NWFSC will report the incident to NMFS within one business day, with information submitted to Jolie.Harrison@noaa.gov and the Regional Stranding Coordinator. Reporting will include:
    - number of animals of each species affected;
    - date, time, and location of each event (provide geographic coordinates);
    - description of the event;
    - if a vessel struck a marine mammal, the contact information for the observer on duty or Chief Scientist on duty; and
    - Photographs or video footage of the animal(s) (if available).

Stranded, Injured, Sick or Dead Marine Mammal (not associated with the Project)

- If an observer, Cruise Leader or Chief Scientist observe an injured, sick, or dead marine mammal (i.e., stranded marine mammal), they will notify the Regional Marine Mammal Stranding Hotline at 866-767-6114. Photos and available data to aid NMFS in determining how to respond to the

stranded animal will be provided. If possible, data submitted to NMFS in response to stranded marine mammals will include date/time, location of stranded marine mammal, species and number of stranded marine mammals, description of the stranded marine mammal's condition, event type (e.g., entanglement, dead, floating), and behavior of live-stranded marine mammals.

- Marine mammals entangled in derelict gear (not associated with NWFSC research) will be reported to the Derelict Gear Hotline: 1-855-542-1964.

Illegal Activities

- If an observer, Cruise Leader or Chief Scientist observe marine mammals being disturbed, harassed, harmed, injured, or killed (e.g., feeding or unauthorized harassment), these activities will be reported to NMFS Region Office of Law Enforcement at (1-800-853-1964).

TABLE 13-1. SUMMARY OF AGENCY CONTACT INFORMATION

Reason for Contact	Contact Information
Notification of Project Commencement	NMFS OPR Chief of Permits Division
Notification of Project Completion	NMFS OPR Chief of Permits Division
Unauthorized Take	NMFS OPR Chief of Permits Division, NMFS ESA Division
Stranding/Injury/Mortality (no associated with Project activities)	NMFS Regional Stranding Coordinator, NMFS OPR
Vessel Strike (by Project vessel)	NMFS Regional Stranding Coordinator, NMFS OPR
Monthly Reporting	NMFS OPR Permits Division, NMFS ESA Division
Annual or Comprehensive Reporting	NMFS OPR Permits Division, NMFS ESA Division
Number of Takes Met or Exceeded for Any Marine Mammal	NMFS OPR

14. SUGGESTED MEANS OF COORDINATION

NMFS provides annual funding to universities, research institutions, federal laboratories, private companies, and independent researchers around the world to study marine mammals. NWFSC actively participates on Take Reduction Teams and in Take Reduction Planning, and conducts a variety of studies, convenes workshops and engages in other activities aimed at developing effective bycatch reduction technologies, gears and practices.

To reduce marine mammal takes over time, NWFSC maximizes efficient use of charter and NOAA ship time, and engages in operational planning with the Southwest Fisheries Science Center to delineate respective research responsibilities and reduce duplication of effort between the Centers. NWFSC implements an adaptive management approach to evaluating actual takes of marine mammals and continues to revisit mitigation measures. In consultation with Office of Protected Resources, if actual takes exceed those requested in Section 6.4 of this application, NWFSC may request changes to current mitigation measures to improve efficacy or to implement additional measures to reduce take levels.

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Appendix A

NWFSC Research Gear and Vessel Descriptions

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1. Trawl nets

A trawl net 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 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' (Figures A-1 and A-2). For many trawl nets, 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. Typically, the mouth of a trawl net is held open vertically using floatation on the upper edge, or "headrope", and weights on the lower edge, or "footrope". For other types of trawls, the horizontal spread of the net is maintained by a beam (beam trawl; Figure A-3) or the distance between two towing vessels (pair trawl; Figure A-4).

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. The duration of the tow depends on the purpose of the trawl, the catch rate, and the target species. Commercial trawl vessels may travel at speeds between two and five knots while towing the net for up to several hours, whereas the majority of NWFSC trawl surveys involve tow speeds from 1.5 to 3.5 knots and tow durations from 10 to 30 minutes. 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 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. At the end of the tow, the net is retrieved and the contents of the codend are emptied onto the deck or sorting table.

Some NWFSC research surveys use "pelagic" trawls, which are designed to operate either near the surface or at various depths within the water column, and other surveys use "bottom" trawls (see Table 2.2-1 in the Final PEA for survey protocol and net details). Examples of NWFSC trawl gear fished at the surface include the Nordic 264, Kodiak surface trawl, and paired surface trawls. Examples of NWFSC trawl gear fished lower in the water column include the Modified Cobb mid-water trawl and the Aleutian wing mid-water trawl. Pelagic trawl nets are not designed to contact the seafloor and do not have bobbins or roller gear on the footrope. Bottom trawl nets have footropes with rollers or other ground gear designed for particular sea floor conditions to maximize the capture of target species living close to the bottom and minimize damage to the gear while moving across uneven surfaces (Figure A-1). Examples of NWFSC bottom trawl nets include the modified Aberdeen trawl, Poly Nor'easter trawl, paired shrimp trawl, and beam trawls

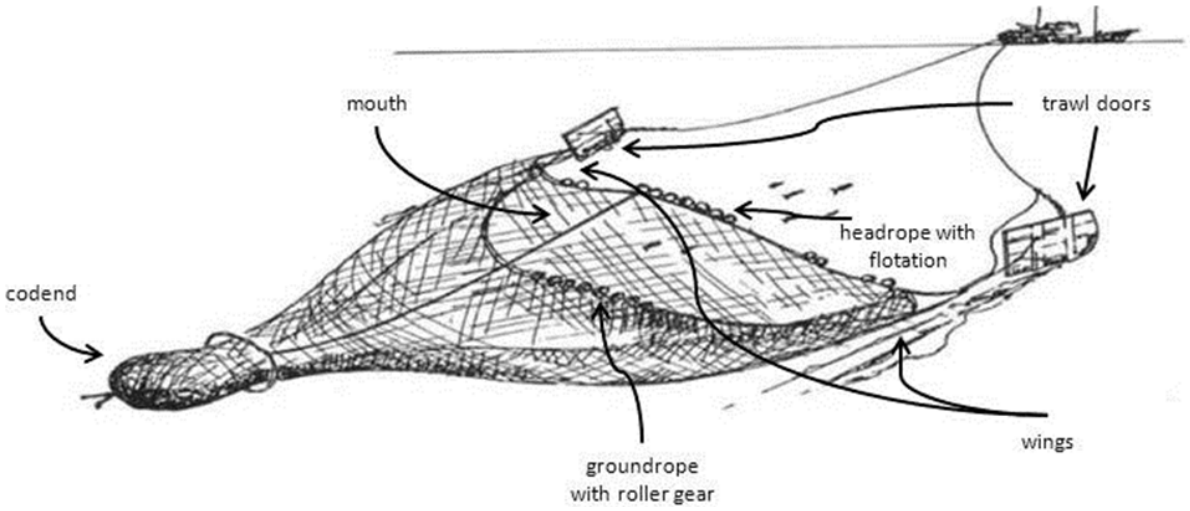


Figure A-1. Bottom trawl illustration

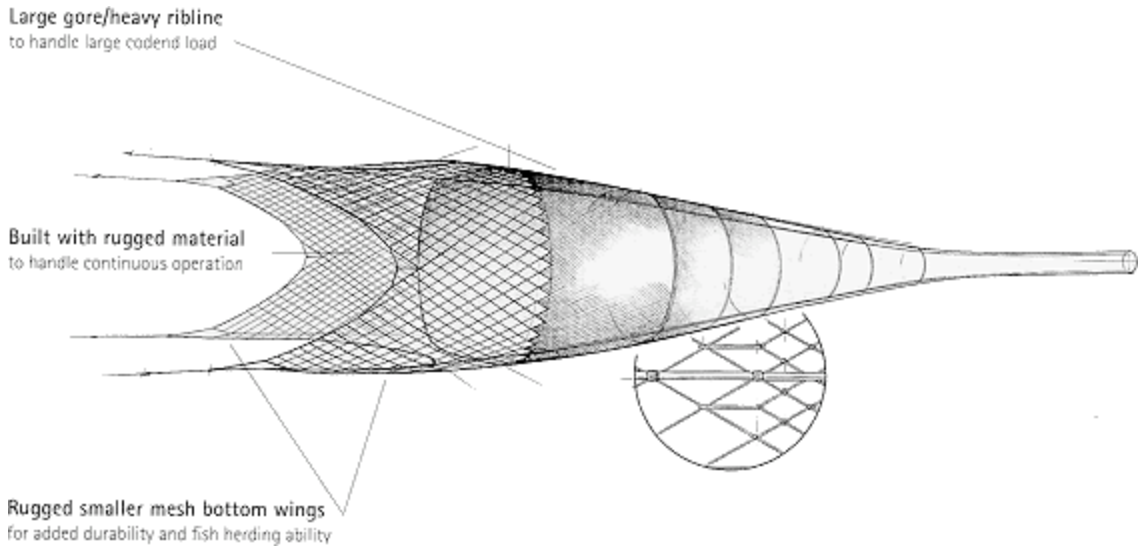


Figure A-2. Aleutian wing trawl illustration

Figure A-3. Beam trawl illustration

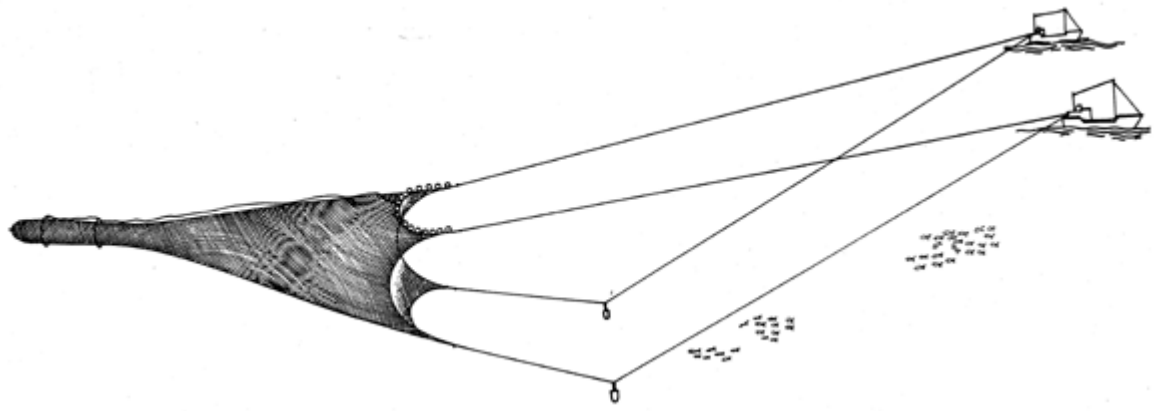


Figure A-4. Pair trawl illustration

Most NWFSC research trawlers employ a single trawl net to catch fish. The Bycatch Reduction Research Survey uses a double rigged trawl. In this method, the vessel tows two small trawl nets simultaneously rather than a single large one.

Marine mammals can become entangled by trawl gear with risks differing widely among species. Many species of marine mammals forage and swim at mid-water depths and all species come to the surface to breathe and rest, putting them at risk of being captured or entangled in pelagic trawls. Species that forage on or near the seafloor are at risk of being captured or entangled in bottom trawl netting or tow lines. There is also potential for marine mammals to interact with bottom trawl equipment near the surface of the water, as the gear is retrieved from fishing depth and brought aboard the vessel.

Recently, considerable effort has been made to develop excluder devices that allow marine mammals to escape from the net while allowing retention of the target species (e.g. Dotson et al. 2010). Marine mammal excluder devices (MMEDs) generally consist of a large rigid grate positioned in the intermediate portion of the net forward of the codend and above or below an "escape panel" constructed into the net panel (Figure A-5). The angled grate is intended to guide marine mammals through the escape panel and prevent them from being caught in the codend (Dotson et al. 2010). Different configurations of MMEDs are currently being tested on Nordic 264 nets used in the PNW Juvenile Salmon Survey.

Several NWFSC surveys use trawls with an open codend. These surveys have a reduced impact to marine organisms because they use equipment to detect or record target species and eliminate the need to capture organisms. The Pair Trawl Columbia River Juvenile Salmon Survey uses a surface pair trawl with an open codend equipped with a passive integrated transponder (PIT) detector array (discussed in detail in Section 12) to assess the passage of tagged juvenile salmon migrating from the Columbia River basin to the ocean. Another survey uses a 2-meter beam trawl with a digital video camera system (discussed further in Section 13). The trawl has an open codend and the video camera documents what goes into the net since there is no catch. A different survey also uses a 2-meter beam trawl with a video camera. In this survey, the beam trawl primarily has an open codend but a few tows are conducted with a closed codend to verify species composition identified in the video.

(Dotson et al. 2010)

Figure A-5 Marine Mammal Excluder Device installed in Nordic 264 pelagic trawl net.

2. Plankton nets

NWFSC research activities include the use of several plankton sampling nets which employ very fine mesh to sample plankton from various parts of the water column. NWFSC plankton nets employ mesh sizes from 20 to 500 micrometers. Plankton sampling nets usually consist of fine mesh attached to a rigid frame. The frame spreads the mouth of the net to cover a known surface area. Many plankton nets have a removable collection container at the codend where the sample is concentrated. When the net is retrieved, the collecting bucket can be detached and easily transported to a laboratory. Plankton nets may be towed through the water horizontally, vertically, or at an oblique angle. Often, plankton nets are equipped with instruments such as flow meters or pitch sensors to provide researchers with additional information about the tow or to ensure plankton nets are deployed consistently.

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

A bongo net (Figure A-6) looks like two ring nets whose frames are yoked together and allows replicate samples to be collected concurrently. Bongo nets are towed through the water at an oblique angle to sample plankton over a range of depths. During each plankton tow, the bongo net is deployed to the desired depth and is then retrieved at a controlled rate so that the volume of water sampled is uniform across the range of depths. In shallow areas, sampling protocol is adjusted to prevent contact between the bongo nets and the seafloor. A collecting bucket, attached to the codend of the net, is used to contain the plankton sample. Some bongo nets can be opened and closed with 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.

Credit: Morgan Busby, Alaska Fisheries Science Center

Figure A-6. Bongo net

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

Neuston nets are designed to capture members of the neuston, the collective term for the organisms that inhabit the water's surface. Neuston nets have a rectangular frame and are towed horizontally at the top of the water column.

3. Epibenthic tow sled

An epibenthic tow sled is an instrument that is designed to collect organisms that live on bottom sediments (Figure A-7). It consists of a fine mesh net attached to a rigid frame with runners to help it move along the substrate. The sled is towed along the bottom at the sediment-water interface, scooping up benthic organisms as it goes. NWFSC uses an epibenthic tow sled with a 1 meter by 1 meter opening and 1-millimeter mesh to collect epibenthic invertebrates in shallow eelgrass beds in Central Puget Sound.

Credit: University of South Carolina

Figure A-7. Epibenthic tow sled

4. Seine nets

A seine is a fishing net that generally hangs vertically in the water with its bottom edge held down by weights and its top edge buoyed by floats. NWFSC uses several types of seines including purse seines,

beach seines, and pole seines. A purse seine is a large wall of netting deployed around an entire area or school of fish. A purse seine has rings along the bottom of the net through which a drawstring cable is threaded. Once a school of fish is located, the vessel encircles the school with the net. The cable is then pulled in, 'pursing' the net closed on the bottom, preventing fish from escaping by swimming downward (Figure A-8). The catch is harvested by either hauling the net aboard or bringing it alongside the vessel. Purse seines can reach more than 6,500 feet in length and 650 feet in depth, varying in size according to vessel, mesh size, and target species (NOAA Fisheries 2014). The purse seines employed by NWFSC are between 500 and 1,500 feet in length, between 30 and 90 feet in depth, and have mesh sizes ranging from 0.45 inches to 1.3 inches depending on the location in the net.

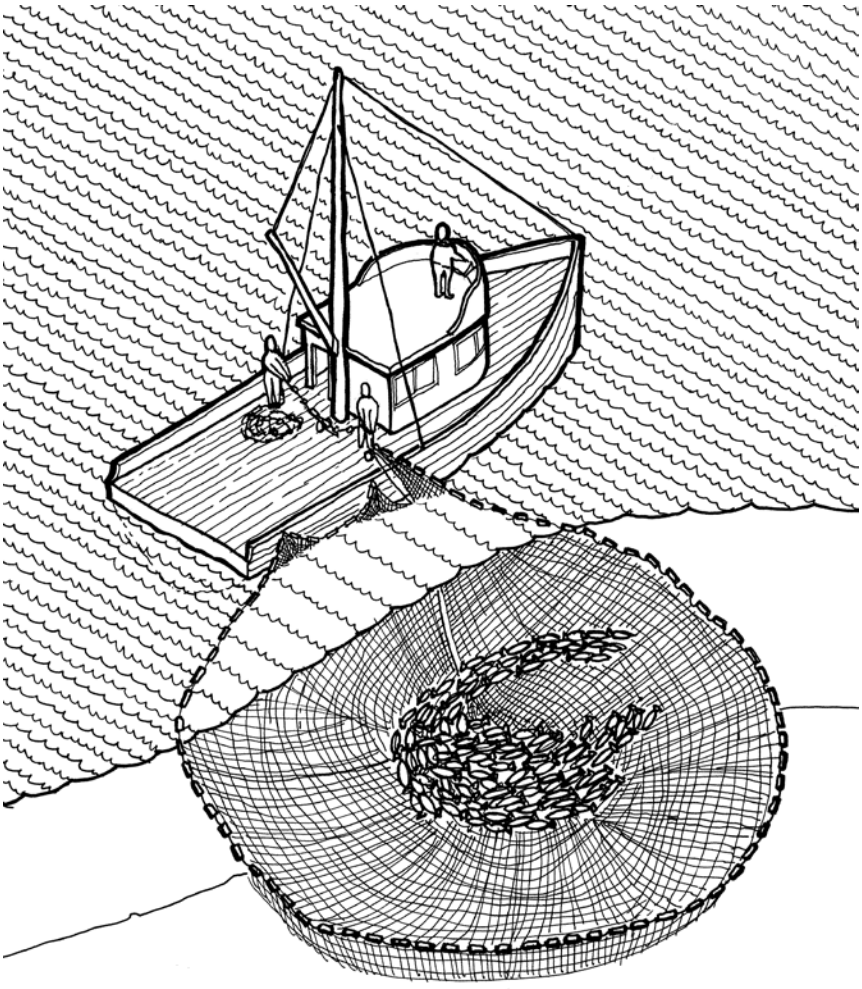


Figure A-8. Purse seine illustration

Beach seines are deployed from shore to surround all fish in a nearshore area. When setting the net, one end is fastened to the shore while the other end is set out in a wide arc and brought back to the beach. A beach seine can be deployed by hand or with the help of a small boat. When the net is set, each side is pulled in simultaneously, herding the fish toward the beach (Figure A-9). During the entire operation, the headrope with floats stays on the surface and the weighted footrope remains in contact with the bottom to

prevent fish from escaping the area enclosed by the net. The beach seines used in NWFSC research are 6 to 8 feet in depth and 120 to 150 feet in length, with mesh sizes of less than 1 inch.

Credit: Paul Olsen, NOAA Fisheries

Figure A-9. A beach seine being pulled in

A pole seine is a rectangular net that has a pole on either end to keep the net rigid and act as a handle for pulling the net in (Figure A-10). 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 pole seine used by NWFSC is 40 feet long, 6 feet tall, and has mesh smaller than 1 inch.

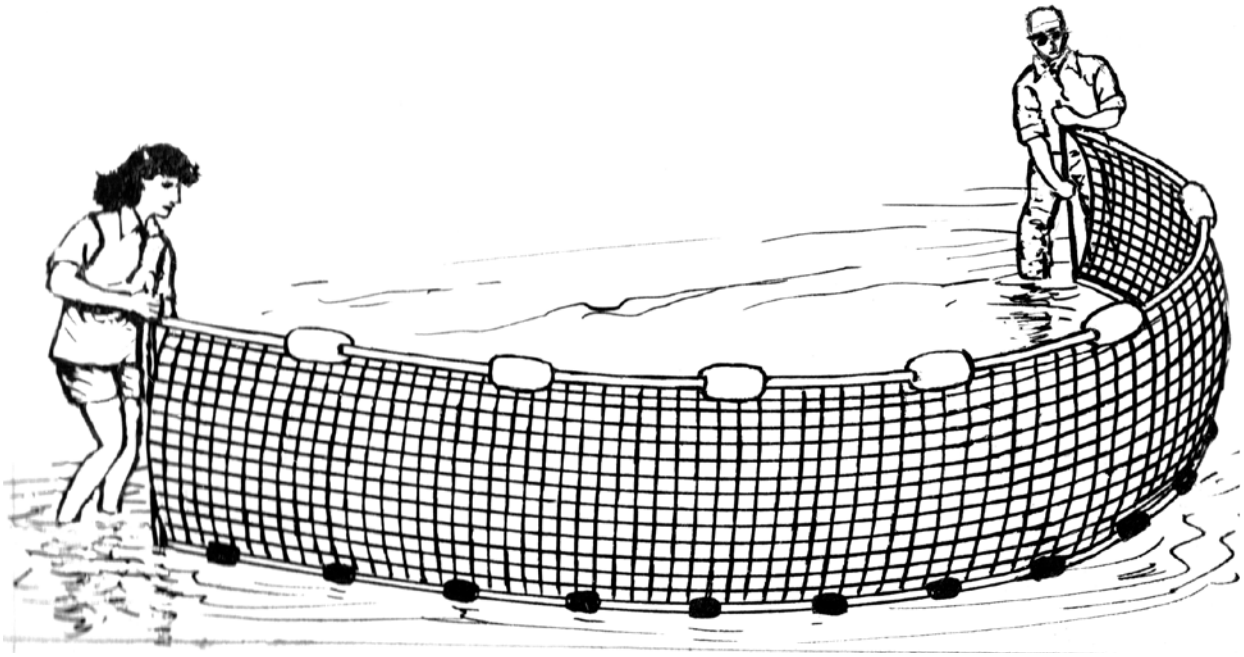


Figure A-10. Pole seine

5. Tangle net

Tangle nets are vertical panels of nylon netting and are normally set in a straight line (Figure A-11). The top of the net is buoyed with floats and the bottom of the net is weighted to maintain the net's vertical position. Tangle nets are designed for non-lethal capture of fish. The smaller mesh of a tangle net prevents fish from entering the net beyond the operculum (gill cover); instead, fish are caught by the nose or jaw. This allows fish to continue respiring and reduces their risk of injury. NWFSC uses a 600- by 40-foot tangle net with 4.25-inch mesh to catch adult salmon in the Columbia River Estuary.

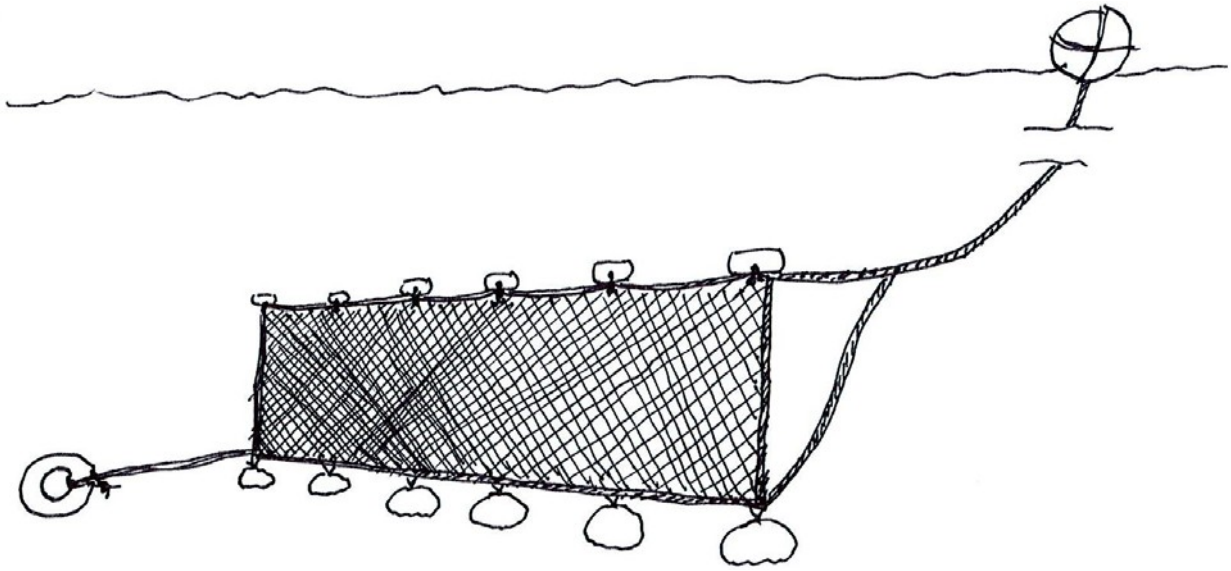


Figure A-11. Diagram of a tangle net, shown upright

6. Fish traps and pots

Fishing pots and traps are three-dimensional structures that permit fish and other organisms to enter the enclosure but make it difficult for them to escape. Traps and pots allow commercial fishers and researchers to capture live fish and can allow them to return bycatch to the water unharmed. Traps and pots also allow some control over species and sizes of fish that are caught. The trap entrance can be regulated to control the maximum size of fish that enter. The size of the mesh in the body of the trap can regulate the minimum size that is retained. In general, the fish species caught depend on the type and characteristics of the pot or trap used. Fishing traps and pots used by NWFSC include fyke traps and sablefish pots. A fyke trap consists of a trap or bag that can be conical, cylindrical, rectangular, or a floating box that are held open by frames or hoops (Figure A-12). Fyke traps are often outfitted with wings and/or leaders to guide fish towards the entrance of the actual trap. NWFSC sets fyke traps with 0.25-inch mesh for up to 6 hours in the Snohomish and Columbia river estuaries. Fyke nets are used in estuarine wetland types of habitats. The NWFSC traps channels that range in width from less than 3 ft to 15 ft. 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. A fyke trap is fixed on the bottom with anchors or stakes or sand bags. Usually the wings and mouth of the trap float or stick out of the water so fish cannot evade capture by swimming over the trap.

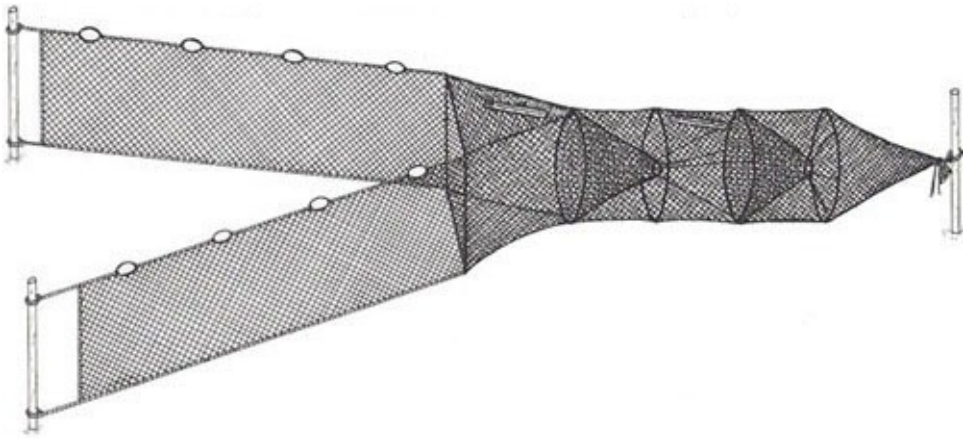


Figure A-12. Fyke trap

The NWFSC employs a limited number of conical sablefish pots (Figure A-13) to catch fish for broodstock. These pots consist of a conical-frustum-shaped frame covered in nylon netting with one or more funnel-shaped entrance tunnels. The sablefish pots used by NWFSC are 4 feet in diameter, have a soak time of 8 hours, and they are baited with squid and herring to lure fish into the pots. Sablefish pots rest on the seafloor and are often attached by a rope to a buoy at the water's surface. If a series of pots is set, a groundline may be used to connect the pots to each other to aid in pot deployment and retrieval. Modified sablefish pots are also used as predator exclusion cages for the Herring Egg Mortality Survey in Puget Sound.

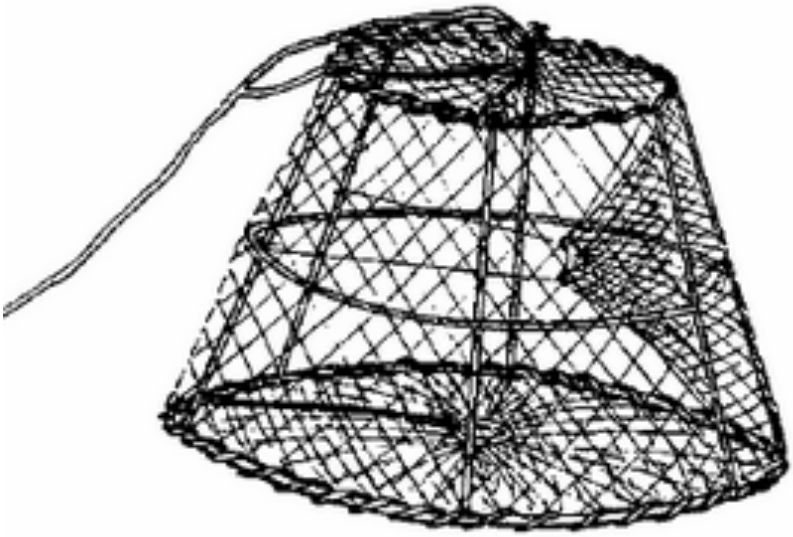


Figure A-13. Illustration of a conical sablefish pot

7. Insect traps and benthic corers

As part of the Columbia River Estuary Tidal Habitats survey, NWFSC uses insect fallout traps, emergent insect cone traps, and benthic corers to sample invertebrate prey items potentially available to juvenile salmon. Insect fallout traps measure the quantity and diversity of wetland insects falling on the surface of the water. An insect fallout trap consists of a plastic box filled approximately halfway with soapy water. The containers used by NWFSC measure 50 by 35 by 14 centimeters and have a less than 10 percent dish soap solution. The containers are surrounded by four stakes to prevent the trap from floating away while allowing it to float vertically with the tides (Roegner et al. 2004).

Emergent insect cone traps are designed to capture insects as they metamorphose from aquatic nymph to terrestrial adult. The traps used by NWFSC look like inverted plastic funnels with a collection container attached to the top to contain the emerged insects (Figure A-14). Each trap is anchored in the water and collects all insects that emerge in the 0.6-m^2 area directly below the mouth of the funnel.

Benthic corers are used to collect sediment and associated benthic invertebrate samples (Figure A-14). A common type of benthic corer consists of a plastic cylinder that is pressed vertically into the sediment. Then the corer has been inserted far enough into the substrate, the top of the cylinder is capped and the corer along with the sediment sample can be pulled out far enough to cap the bottom of the tube. The corer used by NWFSC collects a sample with a 0.0024-m^2 surface area.

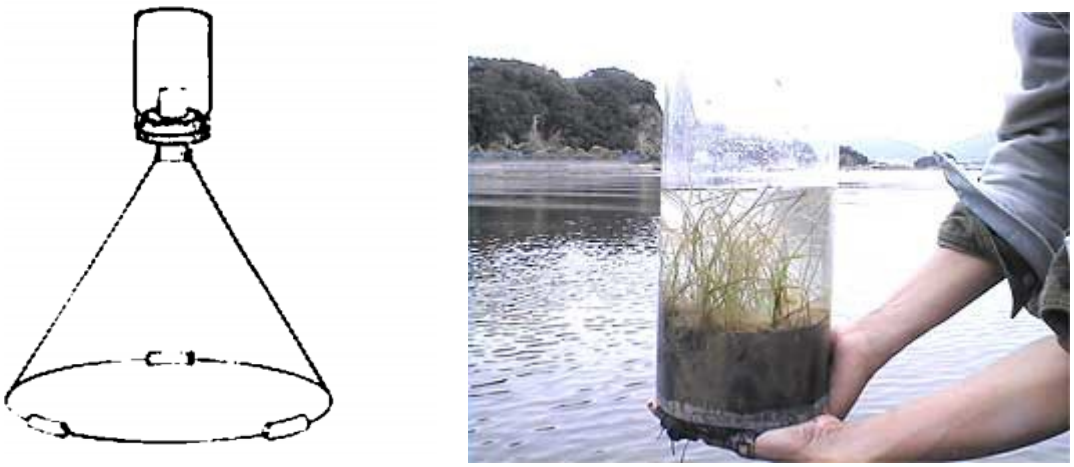


Figure A-14. An illustration of an emergent insect cone trap (left) and an example of a benthic corer with a sediment sample (right)

8. Hook-and-line Gear

Under the Status Quo, the NWFSC used rod and reel hook-and-line gear for the Southern California Groundfish Surveys that occurred within untrawlable areas. Under the Preferred Alternative, that project has been expanded to occur all along the West Coast and has been renamed, “Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat”. Hook-and-line gear deployed from rod and reel was also used

for fish movement studies in Puget Sound on sixgill shark, Chinook and Coho salmon as well as lingcod. Barbed or barbless circle hooks are used depending on the needs of the research to retain or release fish with minimal injury (Figure A-15).

Figure A-15. Barbed and barbless circle hooks

Longline fishing is a type of hook-and-line gear in which baited hooks attached to a mainline or 'groundline' are deployed from a vessel (Figure A-16). The length of the longline and the number of hooks depend on the species targeted, the size of the vessel used, and the purpose of the fishing activity. Commercial longlines can be over 100 kilometers long and can have thousands of hooks attached, however longlines used for research purposes are much shorter. The longline gear NWFSC uses for collection of fish for broodstock consists of 500 hooks attached to a mainline approximately 750-1000 fathoms in length. Hooks are attached to the longline by thinner lines called a 'gangions.' The length of the gangions and the distance between each gangion depends on the purpose of the research. For NWFSC broodstock collection, the gangions are less than one foot in length and are attached to the mainline at intervals of about 10 feet.

Longline research gear can be deployed either suspended in the water column with floats (pelagic gear) or anchored to the bottom (Figure A-16) with the hooks either resting on the bottom or floating just above the seafloor (demersal gear). The NWFSC uses pelagic gear in the CCRA and demersal gear in the PSRA. Demersal longline gear has weights to hold the mainline down and buoys to provide flotation and keep the baited hooks suspended in the water. Flag buoys (or 'high flyers') equipped with radar reflectors, radio transmitters, and/or light sources are often attached to each end of the mainline to enable the crew to find the longline gear for retrieval.

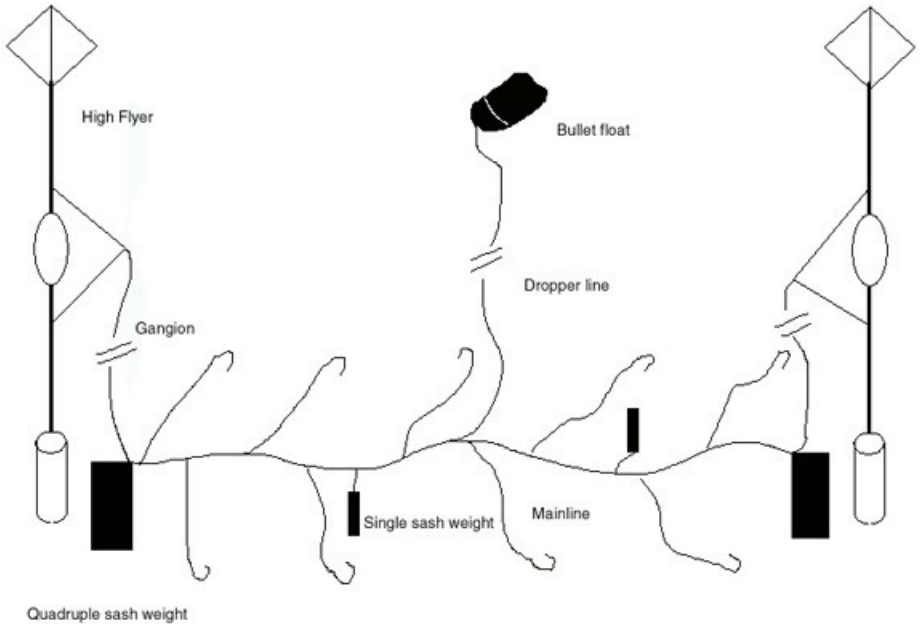


Figure A-16 Schematic example of bottom longline gear.

The time between deployment and retrieval of the longline gear is the 'soak time.' Soak time is an important parameter for calculating fishing effort and may be an important part of the research protocol. The optimal soak time maximizes the catch of target species while minimizing bycatch and minimizing damage to hooked target fish that may result from sharks or other predators. Soak time can also be an important factor for controlling longline interactions with protected species. Marine mammals, turtles, and other protected species may be attracted to bait, or to fish caught on the longline hooks. Protected species may become caught on longline hooks or entangled in the longline while attempting to feed on the catch before the longline is retrieved.

Birds may be attracted to the baited longline hooks, particularly while the longline gear is being deployed from the vessel. Birds may get caught on the hooks, or entangled in the gangions while trying to feed on the bait. Birds may also interact with longline gear as the gear is retrieved.

9. Electrofishing

Electrofishing is a common scientific survey method that uses electricity to momentarily stun fish or force them to involuntarily swim towards an electrical field to make them easier to capture. This method is used to sample fish populations to determine abundance, density, and species composition. NWFSC researchers use both backpack electrofishing units (Figure A-17) and boat-based electrofishing to collect fish. Both types of electrofishing use a power source to create electrical currents that flow from the positive electrode (anode) through the water to the negative electrode (cathode). When stunned fish are immobilized or move toward the anode, they are quickly captured with a dip net and placed in a bucket or holding tank. The fish can then be identified, measured, and released. Electrofishing does not result in permanent harm to the fish, which recover within a few minutes.

Credit: NOAA Fisheries West Coast Region

Figure A-17. A backpack electrofishing crew.

The person on the left is operating the backpack electroshocker and holding the anode in the water. The person on the right is using a dip net to collect stunned fish.

10. Active Acoustic Sources used in NWFSC Fisheries Surveys

A wide range of active acoustic sources 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. Table A-1 shows important characteristics of these sources used on NOAA research vessels conducting NWFSC fisheries surveys, followed by descriptions of some of the primary general categories of sources, including all those for which acoustic takes of marine mammals are calculated in the LOA application.

Table A-1 Output Characteristics for Predominant NWFSC Acoustic Sources

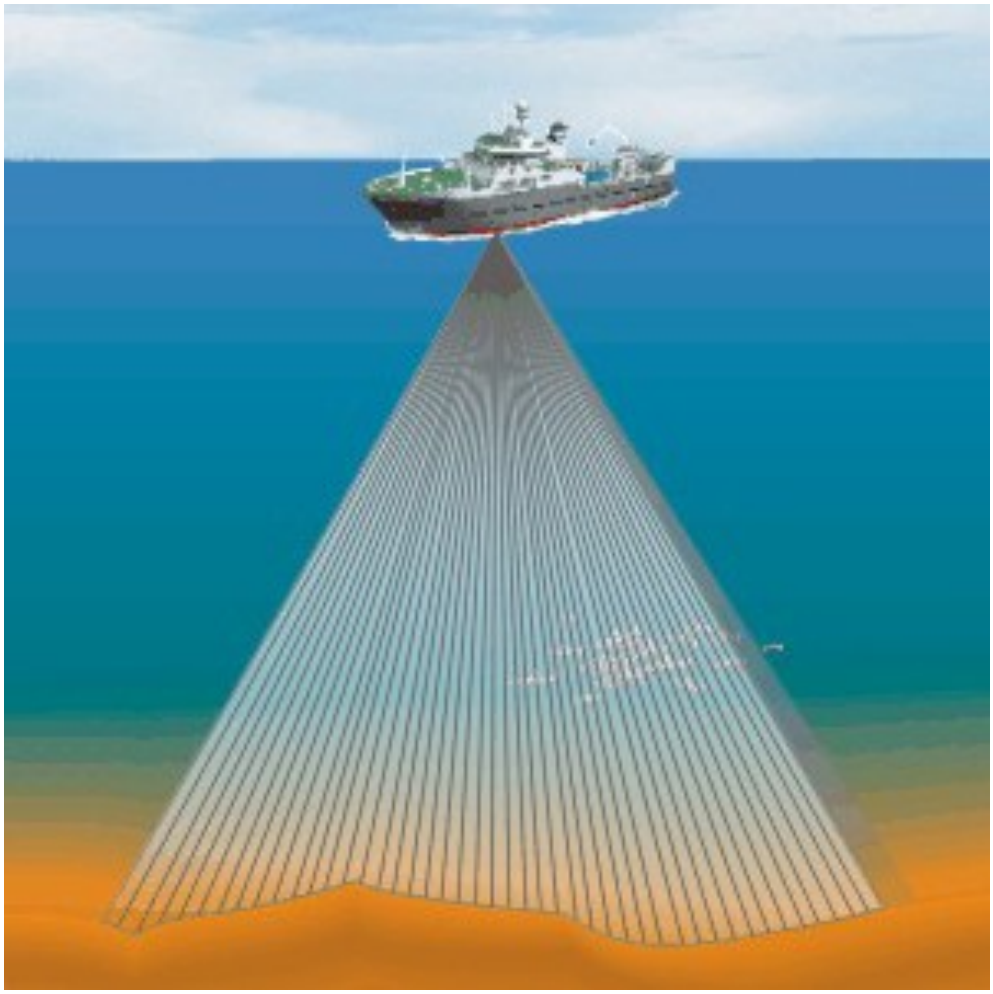
Abbreviations: kHz = kilohertz; dB re 1 µPa at 1 m = decibels referenced at one micro Pascal at one meter; ms = millisecond; Hz = hertz

Acoustic system	Operating frequencies (kHz)	Maximum source level (dB re 1 µPa at 1 m)	Single ping duration (ms) and repetition rate (Hz)	Orientation/ Directionality	Nominal beam width (degrees)
Simrad EK60 narrow beam echosounder	18, 38, 70, 120, 200 kHz	224	1 ms @ 1 Hz	Downward looking	11°
Simrad ME70 multibeam echosounder	70-120 kHz	205	2 ms @ 1 Hz	Downward looking	140°
RDI ADCP Ocean Surveyor	75 kHz	223.6	External trigger	Downward looking (30° tilt)	40° x 100°
Simrad ITI trawl monitoring system	27-33 kHz	<200	0.05-0.5 Hz	Downward looking	40° x 100°
Simrad FS70 trawl sonar	330 kHz	216	1 ms @ 120 kHz	Third wire trawl sonar for monitoring net opening and fishing conditions	5° x 20°
Simrad SX90 omni-directional multibeam sonar	70-120 kHz	206	2 ms @ 1 Hz	Downward omni-directional	0°-90° tilt angle from vertical (average)

Multibeam echosounder and sonar

Multibeam echosounders (Figure A-18) and sonars work by transmitting acoustic pulses into the water then measuring the time required for the pulses to reflect and return to the receiver and the angle of the reflected signal. The depth and position of the reflecting surface can be determined from this information, provided that the speed of sound in water can be accurately calculated for the entire signal path.

The use of multiple acoustic 'beams' allows coverage of a greater area compared to single beam sonar. The sensor arrays for multibeam echosounders and sonars are usually mounted on the keel of the vessel and have the ability to look horizontally in the water column as well as straight down. Multibeam echosounders and sonars are used for mapping seafloor bathymetry, estimating fish biomass, characterizing fish schools, and studying fish behavior. This gear generally emits frequencies from 38 to 200 kHz at less than 228 dB/1 µPa.



Credit: Simrad

Figure A-18. Conceptual image of a multibeam echosounder

Multi-frequency single-beam active acoustics

Similar to multibeam echosounders, multi-frequency split-beam sensors are deployed from NOAA survey vessels to acoustically map the distributions and estimate the abundances and biomasses of many types of fish; characterize their biotic and abiotic environments; investigate ecological linkages; and gather information about their schooling behavior, migration patterns, and avoidance reactions to the survey vessel. The use of multiple frequencies allows coverage of a broad range of marine acoustic survey activity, ranging from studies of small plankton to large fish schools in a variety of environments from shallow coastal waters to deep ocean basins. Simultaneous use of several discrete echosounder frequencies facilitates accurate estimates of the size of individual fish, and can be used for species identification based on differences in frequency-dependent acoustic backscattering between species. The NWFSC uses devices that transmit and receive at four frequencies ranging from 30 to 200 kHz.

ADCP

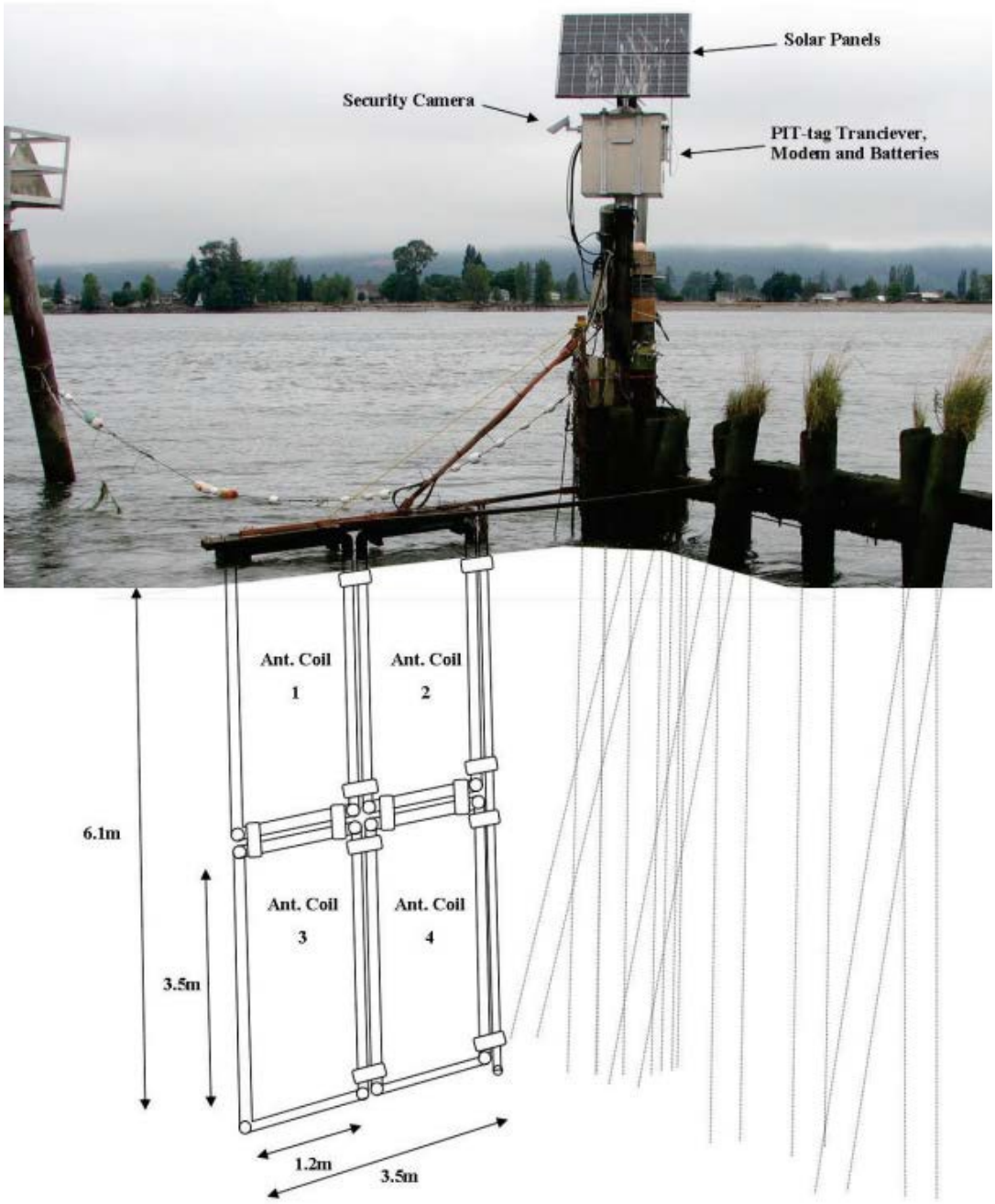
An Acoustic Doppler Current Profiler (ADCP) is a type of sonar used for measuring water current velocities simultaneously at a range of depths. An ADCP instrument can be mounted to a mooring or to the bottom of a boat. The ADCP works by transmitting "pings" of sound at a constant frequency into the water. As the sound waves travel, they ricochet off particles suspended in the moving water, and reflect back to the instrument (WHOI 2011). Sound waves bounced back from a particle moving away from the profiler have a slightly lowered frequency when they return and 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 (WHOI 2011).

11. Acoustic telemetry

Acoustic telemetry for fisheries research employs acoustic tags which are small, sound-emitting devices allowing the detection of fish or aquatic invertebrates. An acoustic tag, or transmitter, is an electronic device usually implanted or externally attached to an aquatic organism. A tag transmits short ultrasonic signals (typically 69 kHz) either at regular intervals or as a series of several pings that contain a digital identifier code (which allows researchers to identify individual fish) and sometimes physical data (e.g., temperature). An acoustic receiver detects and decodes transmissions from acoustic tags. NWFSC uses Vemco VR2 receivers moored in fixed locations to detect the presence or absence of coded tags. For the Effects of Dredging on Crab Recruitment survey, NWFSC uses V9-2H transmitters to track Dungeness crab movements. These tags have a battery life of 100 to 280 days.

12. PIT tags and antennas

The passive integrated transponder (PIT) is a type of radio frequency identification used extensively in fisheries research. A PIT tag consists of an integrated circuit chip, capacitor, and antenna coil encased in glass. PIT tags vary in size and shape depending on the study animal. Generally, tags are cylindrical in shape, about 8-32 mm long, and 1-4 mm in diameter. PIT tags can be inserted in fish or other organisms via large-gauge hypodermic needles. Unlike acoustic tags (described in Section 13), PIT tags are dormant until activated and do not require an internal source of power. To activate the tag, a low-frequency radio signal is emitted by a scanning device that generates a close-range electromagnetic field. The tag then sends a unique alpha-numeric code back to the reader, allowing researchers to identify specific individuals (Smyth and Nebel 2013). NWFSC uses stationary PIT detection antennas in the Columbia River Estuary to detect migrating adult and juvenile salmon (Figure A-19). NWFSC also uses a PIT detector array attached to a surface pair trawl with an open codend (described in Section 1) which is towed at a depth of 5 meters for 8 to 15 hours at a speed of 1.5 knots in the Columbia River Estuary to assess the passage of migrating juvenile salmon.



Credit: NWFSC

Figure A-19. Configuration of antennas for a PIT tag detector on a pile dyke in the Columbia River Estuary

13. 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 (Figure A-20) is a lightweight, three-legged platform equipped with a video system and adequate illumination. The frame holds a 35-millimeter 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.

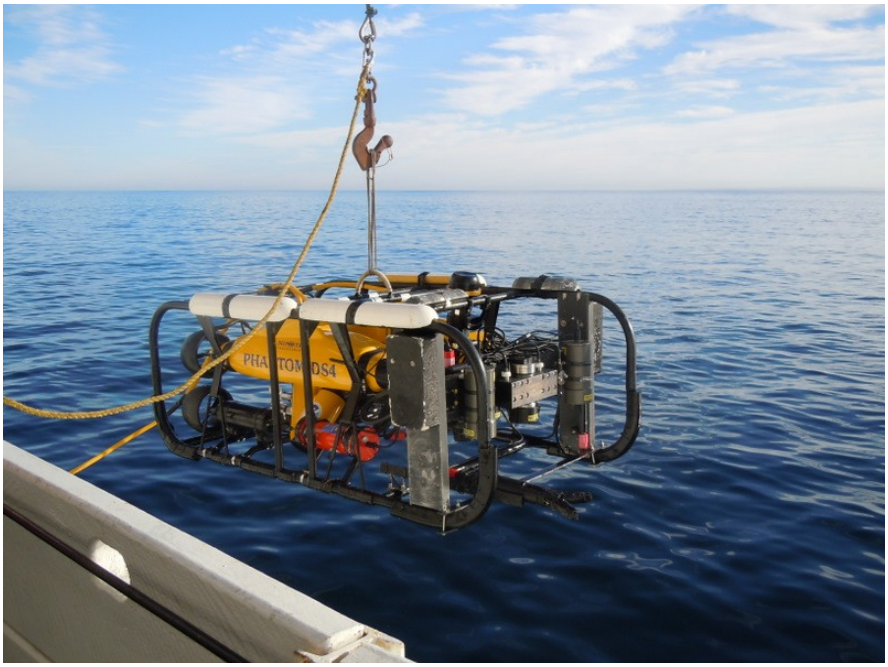
Credit: Northwest Atlantic Fisheries Organization

Figure A-20. A CamPod being deployed from a vessel

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.

The video beam trawls used by NWFSC are similar to video camera sleds. Video beam trawls consist of a video camera system attached to a beam trawl (described in Section 1) which is towed along the seafloor at speeds of 1 to 1.5 knots. NWFSC uses video beam trawls to assess the seasonal and interannual distribution of young of the year groundfishes as well as the potential effects of hypoxia on groundfish.

NWFSC uses a video ROV (Figure A-21) 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.



Credit: Southwest Fisheries Science Center

Figure A-21. A remotely operated vehicle (ROV) being deployed from a vessel

14. CTD profiler and rosette water sampler

'CTD' stands for conductivity, temperature, and depth. A CTD profiler measures these and other parameters, and is the primary research tool for determining chemical and physical properties of seawater. A shipboard CTD is made up of a set of small probes attached to a large (1 to 2 meters in diameter) metal rosette wheel (Figure A-22). 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 vessel. 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. The duration of a CTD cast varies depending on water depth. The data collected at different depths are often called a depth profile, and are plotted with the value of the variable of interest on the x- axis and the water depth on the y-axis. Depth profiles for different variables can be compared in order to glean information about physical, chemical, and biological processes occurring in the water column.

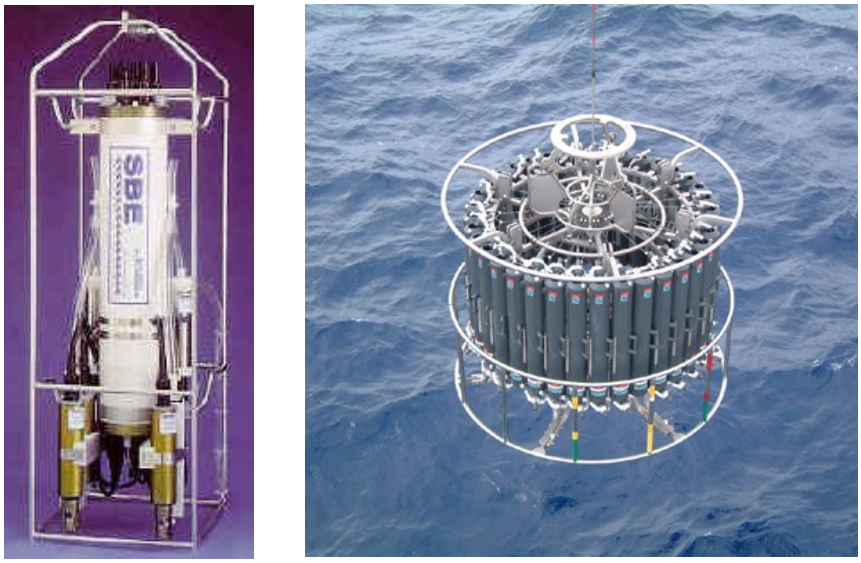


Figure A-22. Sea-Bird 911 plus CTD profiler (left) and CTD profiler deployment on a sampling rosette (right)

Conductivity is measured as a proxy for salinity, or the concentration of salts dissolved in seawater. Salinity is expressed in 'practical salinity units' which represent the sum of the concentrations of several different ions. Salinity is calculated from measurements of conductivity. Salinity influences the types of organisms that live in a body of water, as well as physical properties of the water. For instance, salinity influences the density and freezing point of seawater.

Temperature is generally measured using a high-sensitivity thermistor protected inside a thin walled stainless steel tube. The resistance across the thermistor is measured as the CTD profiler is lowered through the water column to give a continuous profile of the water temperature at all water depths.

The depth of the CTD sensor array is continuously monitored using a very sensitive electronic pressure sensor. Salinity, temperature, and depth data measured by the CTD instrument are essential for characterization of seawater properties. CTD profilers can be outfitted with instruments such as fluorometers, transmissometers, and dissolved oxygen sensors to measure additional water quality parameters. A fluorometer measures fluorescence and can be used to detect chlorophyll-a concentrations, an indicator of phytoplankton biomass. A transmissometer measures the transmission of light through water, which is essential to the productivity of oceans. Transmittance is reduced when light is scattered and absorbed by suspended particles, phytoplankton, bacteria, and dissolved organic matter. Dissolved oxygen sensors measure the amount of oxygen gas that is dissolved in seawater. Dissolved oxygen affects ocean chemistry and is essential for many marine organisms such as fish and invertebrates. Dissolved oxygen concentrations are impacted by environmental conditions such as temperature, salinity, turbidity, and plankton blooms.

15. Thermosalinograph and water pump, water level and temperature loggers

The CTD is not the only tool NWFSC uses to collect water quality parameters. Onboard the research vessel for the Juvenile Salmon Pacific Northwest Coastal Survey, NWFSC uses a continuous water pump with an SBE-45 MicroTSG thermosalinograph to measure sea surface conductivity and temperature. The pump continuously pumps seawater from a depth of 3 meters near the bow of the research vessel to the thermosalinograph which sends the temperature and conductivity data to a shipboard computer. The importance of conductivity and temperature measurements is described in Section 14.

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. NWFSC uses a 3 by 4 centimeter device called a TidbiT to measure and record water temperatures. To log water levels, NWFSC uses a Hobo U-model water level data logger. These devices record measurements at user defined intervals and generally have the memory and battery power to record thousands of measurements over several years.

16. NWFSC Vessels Similar to What May Be Used for Survey Activities

NMFS employs NOAA-operated research vessels, chartered vessels, and vessels operated by cooperating agencies and institutions to conduct research, depending on the survey and type of research. The following vessel descriptions are provided as examples of vessels similar to what may be used during research. Depending on availability it is possible that these specific vessels are not used in research, however NWFSC would use vessels similar in size and power to those described herein.

Figure A-23. R/V *Bell M. Shimada*

New to NOAA in 2010, the R/V *Bell M. Shimada* (Figure A-23) is one of the most technologically advanced fisheries vessels in the world. Many of the advances are focused on making the boat quieter and reducing disturbance to marine life. The vessel is fourth in the series of new fisheries survey vessels built for NOAA by VT Halter Marine, Inc. R/V *Bell M. Shimada* is home ported in Newport, OR and is shared by the SWFSC and the NWFSC. The vessel is 209 feet in length with a diesel electric drive system with two 1,508-horsepower propulsion motors and one 14.1-foot propeller. The deck has an oceanographic winch, two stern trawl winches, and two A-Frame winches. The ship can cruise at 12 knots. The R/V *Bell M. Shimada* can accommodate 39 crewmembers, including 15 scientists. The technologies on the boat offer scientists the ability to monitor fish populations without altering their behavior, allowing accurate data collection.

Figure A-24. R/V *Pelican*

The R/V *Pelican* (Figure A-24) is a 39-foot aluminum pontoon boat owned by NWFSC and is specifically designed for purse seining. It has a pilothouse, a flat back deck, and mast and boom for purse seining. There are no rails on the starboard side to facilitate deployment of the purse seine. The vessel is propelled by an inboard gas engine and has a separate gas engine, surface mounted on the aft port side, to run the water system as well as the hydraulics for the purse seine winch. R/V *Pelican* and accompanying skiff, R/V *Tule*, are used exclusively for studying salmon habitat-use in the Lower Columbia River estuary.

Credit: NOAA

Figure A-25. R/V *Noctiluca*

The R/V *Noctiluca* is a 26-foot NMFS vessel with a center console (Figure A-25). This aluminum skiff, made by Pacific Boats, has a draft of 2 feet and a beam of 8.5 feet. The vessel is propelled by a 225- horsepower Honda outboard engine and has a 9.9-horsepower Honda kicker motor.

Credit: NWFSC

Figure A-26. R/V *Minnow*

The R/V *Minnow* is a 21-foot NMFS vessel made by Workskiff (Figure A-26). The vessel has a 2.5-foot draft, an 8-foot beam, an aluminum hull, and a T-top center console. It is propelled by a 135-horsepower Honda outboard engine and has an 8-horsepower Honda kicker motor.

Figure A-27. R/V *Tule*

The R/V *Tule* is a 19-foot Magnum-brand aluminum skiff with a 90-horsepower Honda outboard engine (Figure A-27). It has a center console and a hefty towing post in the back for pulling in a purse seine. The skiff accompanies the purse seiner R/V *Pelican*. Both vessels are used exclusively for studying salmon habitat-use in the Lower Columbia River estuary.

Credit: David Fox, Oregon Department of Fish & Wildlife

Figure A-28. R/V *Elakha*

The R/V *Elakha* is a 54-foot, aluminum-hulled vessel owned by Oregon State University (Figure A-28). The vessel was built by Rozema Boat Works in Mount Vernon, WA and is propelled by a Caterpillar 3176B 6-cylinder diesel engine, capable of up to 600 horsepower. The R/V *Elakha* is home ported in Newport, OR and has a draft of 5 feet and a beam of 16.5 feet. It is outfitted with an A-frame, a winch, a transducer well, and other scientific equipment.

Figure A-29. M/V *Forerunner*

The M/V *Forerunner* is a 50-foot, steel-hulled vessel owned by Clatsop Community College (CCC) in Astoria, Oregon (Figure A-29). Originally launched as a commercial fishing vessel in 1969, CCC acquired M/V *Forerunner* in 1974. The vessel underwent a major overhaul in 2010. M/V *Forerunner* has a draft of 6.5 feet and is propelled by a 335-horsepower engine (CCC 2013).

17. Aircraft and Other Observation Platforms

Unmanned aerial systems (UAS) can be used to conduct aerial surveys and can reduce disturbance to marine mammals due to human, vessel, or manned aircraft presence. Using UAS to conduct aerial surveys also may increase the number of aerial surveys and could improve population assessments. The types of UAS that may be used include vertical take-off and lift (VTOL, e.g., quadrocopters, hexacopters) or small fixed wing UAS. Quadcopters/hexacopters are approximately 0.5 m square and 2 kg. These types, as well as others that may be used, are extraordinarily quiet with sound levels equivalent to a whisper (less than 5 dB) at 30m. Figure B-20 depicts a quadcopter.

Figure B-19 Aircraft used for research

Other observation platforms

- Underwater Autonomous Vehicles (UAVs)
- Unmanned Surface Vehicles (USVs) - saildrones and buoyancy compensated gliders.
- Light-Weight Instrumented Buoys
- Moored Instrument Arrays

USVs such as the saildrone may be used for collecting oceanographic and other data during research cruises. As an example of such equipment, the Saildrone vehicle consists of a narrow seven-meter-long hull, a five-meter-tall wing, and a keel with a 2.5-meter draft. Saildrone USVs weigh approximately 750 kg and can be launched and recovered from a dock. Figure B-20 depicts other observation platforms including buoys, instrument arrays, and saildrone.

Bouncy compensated gliders (Figure B-21) use hydrodynamic wings to convert vertical motion into horizontal motion, moving forward with very low power consumption (Petritoli et al. 2019). While not as fast as conventional AUVs, the glider, using buoyancy-based propulsion, offers increased range and endurance compared to motor-driven vehicles and missions may extend to months and to several thousands of kilometers in range.

Figure B-20 Other observation platforms developed and used by SWFSC.

Appendix B

NWFSC Protected Species Handling Procedures

Contents

1. Marine Mammal Handling Guidelines and Data Collection

The following describes handling procedures for incidentally caught marine mammals including data collection on captured animals. Specific data collection requirements may vary somewhat by survey, but have been developed to be responsive to all relevant permits and legislation (e.g., Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), and Magnuson-Stevens Act (MSA)). Animals that are captured may be alive, seriously injured or dead. A priority is to return a marine mammal that is still alive to the water as soon as possible. Of paramount importance is the safety of the scientists and crew. Any actions taken to record data, collect samples, etc., on captured marine mammals should all be performed only after an evaluation of the risks involved to personal safety Unacceptable human risk is not authorized in assisting marine mammals (e.g., observers are prohibited from entering the water to aid a marine mammal).A marine mammal may come aboard looking dead when it is in fact in shock and can suddenly wake up. This presents a serious safety risk to any science or vessel crew. Marine mammals can also carry microbes creating the risk off potential disease transmission and care should be taken if handling a marine mammal.

No collection of tissue samples or carcasses will be conducted unless authorized under the MMPA.

Marine Mammal Sampling Protocol for Incidental Takes during NWFSC Research Cruises

Marine Mammals that Are Living When Brought Aboard. If a marine mammal is brought aboard that is alive (even if injured), the goal should be to return the animals to the water as rapidly as possible. Once the risks and safety issues have been properly assessed and managed, identify the animal to species if possible, assess the condition (noting any injuries), take pictures from different angles, and then release the animal (see data sheet).

Marine Mammals that are Dead When Brought Aboard. If a marine mammal is brought aboard that is dead, the following is recommended for data collection on the animal. If possible, the easiest way to obtain detailed information on incidentally killed marine mammals is to simply put the carcass in a freezer and allow NWFSC marine mammal staff to process the animal after arrival of the ship into port. This is preferable to being worked up while at sea because:

1. Information/samples collected from untrained individuals makes the data highly suspect.
2. Collection of information/samples is time consuming. Necropsy of a marine mammal can be a messy/bloody procedure, potentially exposing untrained individuals to zoonotic pathogens.
3. Necropsy of a marine mammal requires sharp knives to be used on a moving platform, which can be a safety issue.
4. The most information can be gained through a full necropsy by a trained marine mammal biologist on land.

For retained carcasses, **assign a field id**, i.e. BMS20110731.01 (ship, date. carcass number for that day). In this example the specimen was collected aboard the Bell M Shimada on July 31, 2011 and is the first animal collected on that day. Attach a tag with a zip tie around the flukes or flipper (on pinnipeds).

However, if there is absolutely no space in the freezer to place the animal (or no freezer available), the following minimum information should be collected (cetaceans, #1-8, for pinnipeds, #1-6) and recorded on the accompanying data sheet:

1. **Assign a field id** as described above and label all samples with this id.

2. **Photos.** (lateral body, head, genital region)
3. **Species ID.**
4. **Total Standard Length** from tip of upper jaw to fluke notch (cetaceans) or tip of nose to tip of tail (pinnipeds), see diagram on following page. Straight length is preferable to curvilinear. It is assumed length is straight. Please note if it is curvilinear.
5. **Girth.** Maximum girth is collected for cetaceans and axillary girth is collected for pinnipeds. See diagrams on the following pages. If there is no dorsal fin on a cetacean (e.g. northern right whale dolphins) take axillary girth.
6. **Sex**. Take photos of genital region. (In cetaceans, anus and genital slit are almost continuous in females, but are clearly separate in males. In pinnipeds, two openings in between the rear flippers indicates female, one in between rear flippers and one on belly indicates male. See photos on following page).
7. **Skin Sample.** (3 x 0.5 cm is sufficient), frozen in whirlpack or vial. In pinnipeds, skin (not fur) is available at the end of the flippers.
8. **Blubber Sample.** With thin layer of muscle attached, 4 x 4 in, wrapped in foil, frozen. For cetaceans, this is collected from left lateral side just anterior of dorsal fin (where max. girth is taken).
9. **Head Sample.** The head should simply disarticulate once you cut through the blubber, muscle and esophagus. Start cutting one fist length posterior to the blowhole. You do not need to cut through any bone to get the head off.

Measuring standard total length = tip of upper jaw to fluke notch

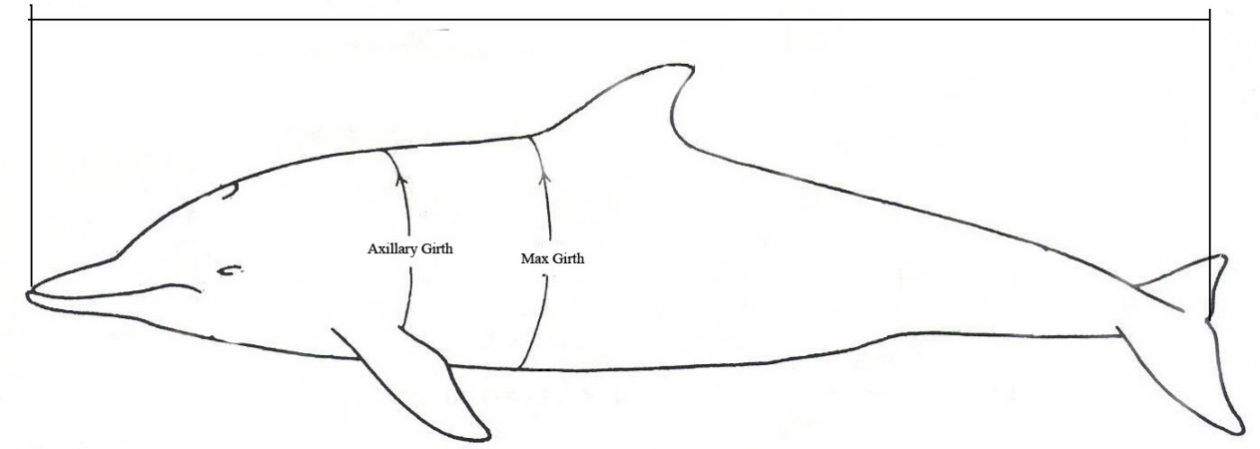


Figure 4-7. Female delphinid

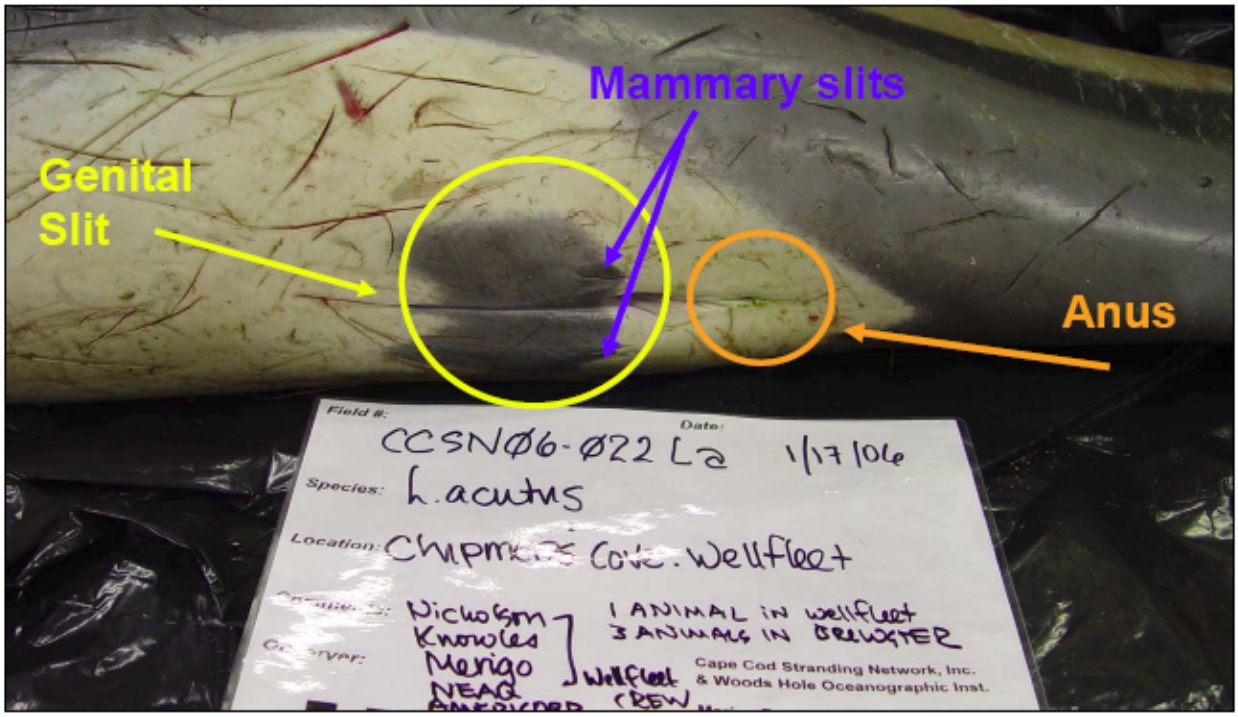
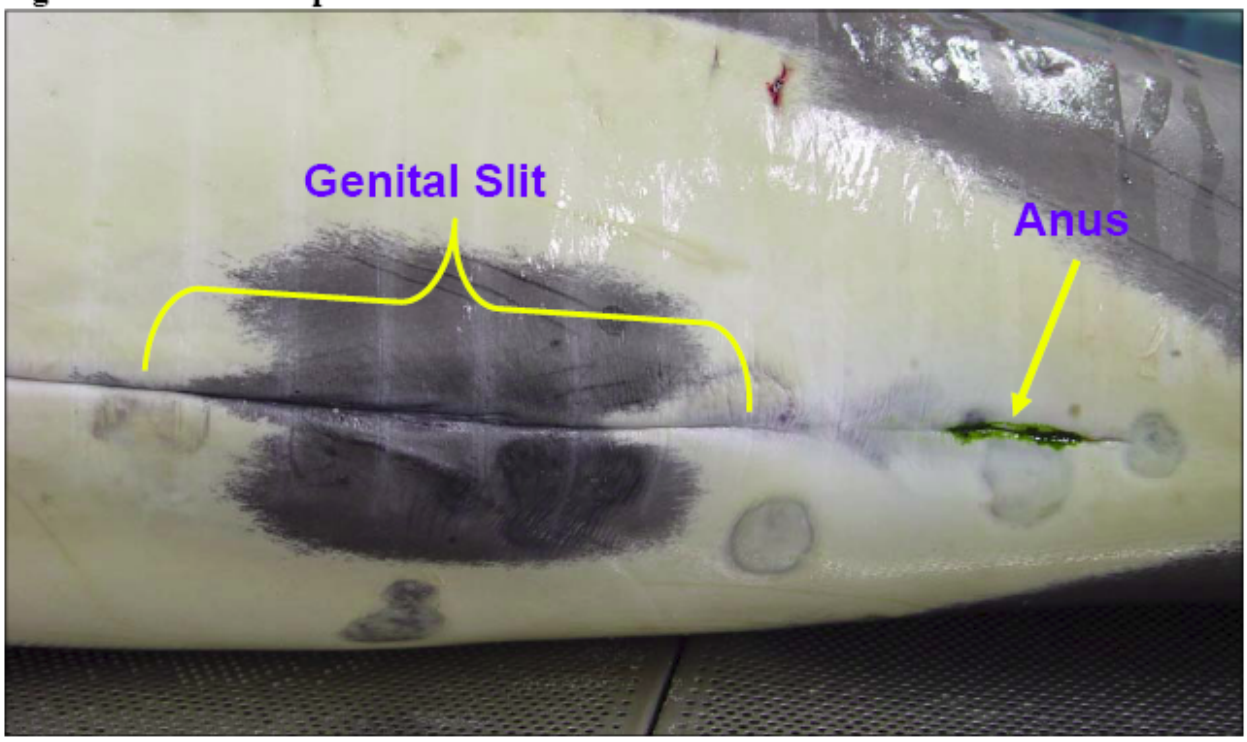


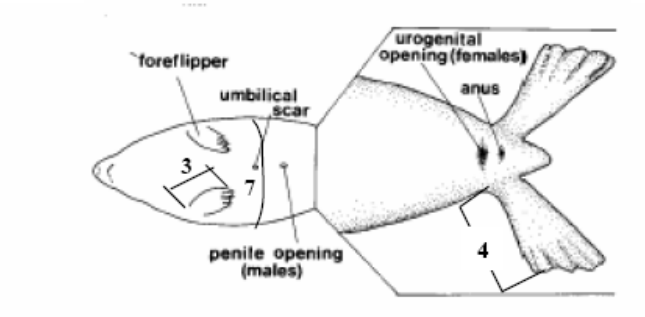
Figure 4-8. Male delphinid



Standard straight length: tip of nose to tip of tail

Curvilinear length: tip of nose to tip of tail (only use if straight length not possible)

Girth measurement



Strandings and Disentanglement

The National Marine Mammal Health and Stranding Response Program (MMHSRP) has developed protocols and guidance on responding to marine mammals that are stranded or in distress (including entangled animals), release protocols, and requirements for training. If an entangled animal is encountered, the appropriate NMFS Regional Marine Mammal Stranding Coordinator should be contacted as soon as possible. The list of Regional Stranding Coordinators is provided in Appendix 1. In some cases, vessel captains may be required by law to attempt disentanglement; it is the responsibility of a vessel captain to understand and carry out any legal requirements. If disentanglement is attempted, standard procedures on mitigating the risks to the animal and persons aboard the vessel should be followed. Such protocols are outside the scope of this document, but further information and copies of related materials can be obtained from:

Marine Mammal Health and Stranding Response Program
National Marine Fisheries Service Office of Protected Resources
Marine Mammal and Sea Turtle Conservation Division, F/PR21315 East-West Highway
Silver Spring, MD 20910
http://www.nmfs.noaa.gov/pr/health/
Phone: (301) 713-2322
Fax: (301) 427-2522

Stranding response resources and publications can be obtained from:
http://www.nmfs.noaa.gov/pr/health/publications.htm

NMFS Regional Strandings Coordinators

Northwest (WA, OR)
Brent Norberg, Stranding Coordinator
National Marine Fisheries Service
7600 Sand Point Way NE
Seattle, WA 98115
Phone: (206) 526-6550; Fax: (206) 526-6736

Lynne Barre, Assistant Stranding Coordinator
7600 Sand Point Way NE
Seattle, WA 98115
Phone: (206) 526-4745; Fax: (206) 526-6736

Southwest (CA)
Joseph Cordaro, Stranding Coordinator
Sarah Wilkin, Stranding Coordinator
National Marine Fisheries Service
501 West Ocean Boulevard, Suite 4200
Long Beach, CA 90802-4213
Phone: (562) 980-4017; Fax: (562) 980-4027
Large Whale Entanglement Hotline: 1-877-SOS-WHALE (1-877-767-9425)

Figure 1. Data sheet for recording information about a marine mammal take (one sheet per animal).

MARINE MAMMAL SPECIMEN DATA
INCIDENTAL RESEARCH TAKES ONLY

Collection Date:
Collector:
Vessel and Survey Name:
Net Type:
Field ID (ship initials-yymmdd.xx where xx is specimen number):
Species:
Locality:
Lat/Long of Capture:
Site Description (e.g., Station Name)
Sex☹ Male/Female/Unknown)
Length (cm) (see pictures above appropriate length measurements):
Girth (cm):

Brief History of Take:
- Date of Death:
- Time of Death:
- Location of Take:

ADDITIONAL DATA COLLECTED: Yes No
Photographs:
Carcass:
Head:
Skin:
Blubber:

EXTERNAL EXAMINATION: Provide as much detail as possible
General condition (lesions, deformities, appearance, color):
Parasites:
Mouth / Teeth:
Eyes:
Blowhole / Nostrils:
Anus and Urogenital openings:
Mammary slits / glands:
Fins / Flukes / Flippers:

2. Seabird Handling Procedures and Data Collection

Seabirds may be incidentally caught in most gears. While it is highly likely birds will be dead in nets, especially those that are towed, it is possible that living birds maybe caught in a net as well as in some other gear types, especially hook and line gears. Again, as with marine mammals, there may be safety issues processing a captured seabird. This includes bites and scratches from a live bird and potential diseases on both living and dead birds.

The NWFSC has a salvage permit from the U.S. Fish and Wildlife Service for birds incidentally caught during NWFSC fisheries research activities (Number MB40092B-0).

Seabird that is Brought Aboard Alive (processing should consider safety issues). If a live bird is captured by any research gear, then first disentangle or unhook the bird if hook and line. If the bird is **not** listed under the Endangered Species Act, then use the following procedure:

1. Identify the bird if possible to species and sex.
2. Photograph the bird. If possible take the following pictures- overall dorsal, overall ventral, close up of head/beak, bands or tags, and any wounds, marks, damage.
3. Describe condition of bird including any damage (wounds, scars).
4. Check for presence of bands or tags and note number and location of any.
5. Comment on response of bird after release (did it fly immediately, for example).

Seabird that is Brought Aboard Dead.

1. Identify the bird if possible to species and sex.
2. Photograph the bird. If possible take the following pictures- overall dorsal, overall ventral, close up of head/beak, bands or tags, and any wounds, marks, damage.
3. Describe condition of bird including any damage (wounds, scars).
4. Check for presence of bands or tags and note number and location of any.
5. Retain bird, assuming it is fresh- (i.e. caught by the survey and not dead for other reasons). Prepare a label with bird species, vessel name, and id number (date followed by ship initials-yymmdd.xx) and place bird and label in large bag.

If a live bird is brought aboard that is federally protected under ESA (e.g., short -tailed albatross or marbled murrelet), then use the following protocol.

Immediately try to contact National Marine Fisheries Service, U.S. Coast Guard, or U.S. Fish and Wildlife Service. They will contact an expert to give you advice in the handling and release of the bird.

National Marine Fisheries Service (NMFS)
(808) 944-2200

U.S. Coast Guard (USCG)
08240.0 KHz (Daytime ITU Channel 816)
12242.0 KHz (Daytime ITU Channel 1205)
04134.0 KHz (Nightime ITU Channel 424)
06200.0 KHz (Nightime ITU Channel 601)

1. If caught in hook and line, stop vessel to reduce tension on the line and bring bird aboard using a dip net.
2. Wrap the bird's wings and feet with a clean towel to protect its feathers from oils or damage.
3. Remove any entangled lines from the bird and determine if the bird is dead or alive. If dead, follow procedure for processing dead birds. If alive, place bird in a safe, enclosed place and immediately contact NMFS, USCG or USFWS. If unable to make contact for 24-48 hours, determine if the bird is lightly, moderately, or deeply hooked (see description below).
4. If bird is deeply hooked, keep bird in a safe, enclosed place until further instructed. Do NOT release the bird.
5. If bird is lightly or moderately hooked, remove hook by cutting the barb and backing hook out.
6. Allow bird to dry for 1/2 hour to 4 hours in a safe, enclosed place. Refer to Release Guidelines.
7. Record information in the short-tailed albatross recovery data form.

Bird Condition:
Lightly Hooked: Hook is clearly visible on bill, leg or wing.
Moderately Hooked: Hooked in the mouth or throat with hook visible.
Deeply Hooked: Hook has been swallowed and is located inside the bird's body below the neck.

The bird is ready for release if it meets ALL of the following criteria:

- Stands on both feet with toes pointed forward
- Holds its head erect and responds to sound and motion
- Breathes without making noise
- Flaps and retracts wings to normal folding position
- Feathers are dry

If any of these conditions are not met, the bird cannot be released.

Figure 2. Data sheet for recording information about a seabird take (one sheet per animal).

SEABIRD SPECIMEN DATA
INCIDENTAL RESEARCH TAKES ONLY

Collection Date:
Collector:
Vessel and Survey Name:
Net Type:
Field ID (bag label) (ship initials-yymmdd.xx):
Species:
Locality:
Lat/Long of Capture:
Site Description (e.g., Station Name):
Sex☹ Male/Female/Unknown)
Length (cm) (longest length, bill to feet)

Brief History of Take:
- Date of Take
- Time of Take:
- Location of Take:
- Comments

ADDITIONAL DATA COLLECTED:
Photographs:
Carcass Obtained:
Head:
Skin:

EXTERNAL EXAMINATION: Provide as much detail as possible
General condition (lesions, deformities, appearance, color):
Tags/Bands/Marks:
Parasites:
External Marks:

3. ESA-listed Fish Handling Guidelines and Data Collection

Handling procedures for fish will only focus on incidental take of ESA-listed species. Protocols should be in place to process and handle directed take of listed species as part of Section 10 permits. There are a number of listed species that could be caught by NWFSC gears. Some of these can be challenging to differentiate, even for experts.

Sturgeon

Green sturgeon are listed under the ESA while white sturgeon are not. If a green sturgeon is brought aboard as an incidental take, first identify the fish to species if possible and determine if is alive or dead. If dead, record data using the data sheet in Figure 3 such as capture date and time, survey, vessel and so on. Take photographs of the specimen from several angles. Freeze the entire specimen if possible. If the specimen cannot be frozen, take a fin clip off the dorsal fin or tail (size of a dime) and preserve in alcohol. If the specimen is alive, record fork length, take photographs, and release the fish as quickly as possible.

Salmonids

Incidentally caught salmon can range in size from several inches to over a meter and include six different species. Given that most incidental takes of salmonids will be with gear that are not effective for catching salmon, numbers should be low. In general, juvenile and subadults will be dead or severely injured after being caught in a trawl. Conversely, most salmonids caught on hook and line should be alive. Fish identification sheets will be provided all surveys along with a measuring board and vials for fin clips. Some populations of Chinook, Coho, sockeye and steelhead are listed under ESA. We assume that incidental take of salmonids will be low (< 5 per haul) and thus the following guidelines are appropriate. The following are handling and data recording procedures for salmonids:

1. Adults of any species (>450 mm tail fork length [FL]) – identify the specimen, measure fork length, record if adipose is missing, take a fin clip (dorsal or caudal) and put in labeled vial, and release as quickly as possible.
2. Juveniles and sub adults (<450 mm FL) – Assuming there is a freezer or some sort of cold storage available, identify the specimen, kill it humanely and put in individually labelled bag. If the specimen cannot be retained, identify the specimen, record capture information, measure fork length, take fin clip, and release.

Rockfish

In Puget Sound, several species of rockfish are listed under ESA: Boccaccio, yelloweye rockfish, and canary rockfish. Because these fish typically live at considerable depths, they are likely to be dead or seriously injured when brought onto the boat. Thus, we recommend that unless the fish is clearly alive, that the fish be killed and then frozen whole with a label (see Figure 3 for data to be recorded).

Smelt

The southern population segment of eulachon are listed under ESA as threatened. Therefore, any eulachon caught incidentally should be assumed to be listed. While small catches of eulachon are possible, it is also possible that a survey may catch 100's to 1000's in individual hauls. If logistically possible (e.g., there is freezer space), small catches of eulachon (<20) should be frozen whole in a labeled bag (see Figure 4). In the event of a large catch (>20) and freezing fish is possible, put 20

individual eulachon into a labeled bag and freeze. Either count and release the rest of the fish or estimate total numbers using some subsampling procedure and then release the fish. If preserving specimens is not possible, then count or estimate numbers in the haul, record fork length of up to 20 eulachon in a haul and release them.

Figure 3. Data sheet for incidental takes of sturgeon, salmonids, and rockfish.

Survey	Date	Time	Location	Fish ID	Length	Species	Clipped Yes/No	Disposition

Figure 4. Data sheet for eulachon (one for any haul with eulachon).

Collection Date	Collector	Vessel and Survey Name	Net Type	Field ID	Locality	Lat/Long of Capture	Site Description (e.g., Station Name)	Total Catch of Eulachon	Method used to Estimate Total Catch	Disposition of Fish (released, frozen):

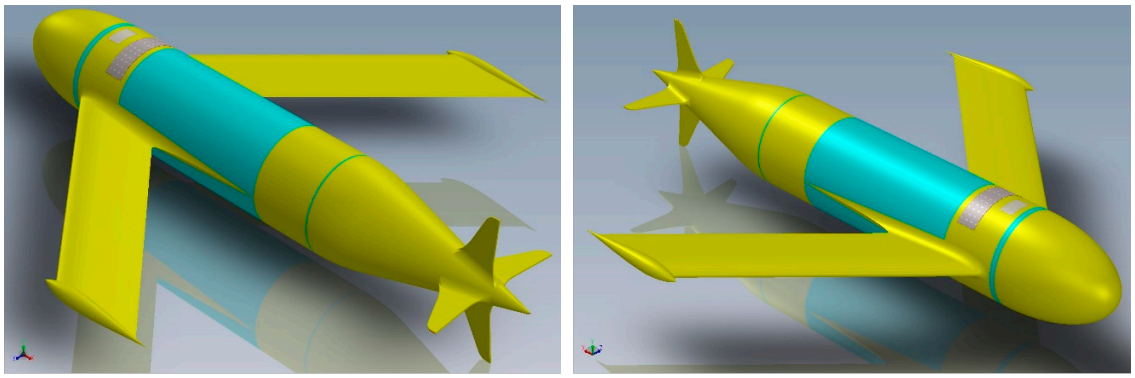


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Figure B-21 Example of a buoyancy compensated glider.

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