Northwest Fisheries Science Center

Final Supplemental Programmatic Environmental Assessment for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center

January 2026

Abstract

This supplemental programmatic environmental assessment (SPEA) implements the National Environmental Policy Act (NEPA) statute (42 U.S.C. §§ 4321 et seq.) and is being prepared using the National Oceanic and Atmospheric Administration's (NOAA) Policy and Procedures for Compliance with NEPA and Related Authorities as guidance. This SPEA includes the best available information on the Northwest Fisheries Science Center's (NWFSC) proposed research, as planned for the foreseeable future. A draft SPEA was published for public comment in October 2022. This final SPEA tiers from the 2018 Final Programmatic Environmental Assessment for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center (2018 PEA) (NMFS 2018b). The NWFSC has evaluated the analysis in the 2018 PEA and concluded the analysis remains valid.

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NOAA FISHERIES

Prepared for NMFS by

ECO49 Consulting, LLC
(907) 903-9714
https://eco49.com/

Page and time limit certification

NOAA has considered the factors mandated by NEPA; this EA represents NOAA's good-faith effort to prioritize documentation of the most important considerations required by the statute within the congressionally mandated page limits; this prioritization reflects NOAA's expert judgment; and any considerations addressed briefly or left unaddressed were, in NOAA's judgment, comparatively not of a substantive nature that meaningfully informed the consideration of environmental effects and the resulting decision on how to proceed.

This EA represents NOAA's good-faith effort to fulfill NEPA's requirements within the congressionally mandated timeline; the effort is substantially complete; in NOAA's expert opinion, it has thoroughly considered the factors mandated by NEPA; and in NOAA's judgment, the analysis contained in this EA is adequate to inform and reasonably explain NOAA's final decision regarding the proposed action.

Decision-Maker Signature

Reference this document as follows:

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1 INTRODUCTION AND PURPOSE AND NEED

1.1 NOAA's Resource Responsibilities and Role in Fisheries Research

The National Oceanic and Atmospheric Administration (NOAA; see Appendix A for additional acronyms and abbreviations) is responsible for protecting marine resources including 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.

The Northwest Fisheries Science Center (NWFSC) is based in the Montlake Laboratory and Headquarters in Seattle, Washington and also includes five research stations: Mukilteo, Manchester, Point Adams, Pasco, and Newport (Section 1.1 of 2018 PEA). It 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 extends to marine waters as far north as Southeast Alaska. NWFSC research in three specific areas is covered in this analysis including the California Current Research Area (CCRA), Puget Sound Research Area (PSRA), and Lower Columbia River Research Area (LCRRA), defined as the estuarine and tidally influenced waters of the lower Columbia River below the Bonneville Dam (see Section 1.1 of 2018 PEA).

The NWFSC 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. In addition, NWFSC generates and communicates scientific information to support: the restoration of Pacific coastal rivers and estuaries; the recovery of protected species; the establishment of Marine Protected Areas (MPAs); marine spatial planning; and understanding marine ecosystems.

NWFSC research efforts are divided among four research divisions:

- Fishery Resource Analysis and Monitoring Division (FRAM). FRAM provides the scientific basis for the management of West Coast Groundfish stocks and their ecosystems, and conducts comprehensive analyses of data from fishery monitoring, fishery-independent resource surveys, and biological investigations.
- Fish Ecology Division (FED). FED research focuses on the ecological association between commercially and recreationally important marine and anadromous fishery resources and their habitats. Particular emphasis is placed on investigating biotic and abiotic factors that control growth, distribution, and survival of important species and on the processes driving short-term and long-term population fluctuations.

- Conservation Biology Division (CBD). The CBD focuses on preserving the biological diversity of living marine resources and conducts research needed to address critical conservation needs, primarily for the recovery of ESA-listed Pacific salmon populations and depleted stocks of other marine species.
- Environmental and Fisheries Sciences Division (EFSD). EFSD research focuses on assessing natural and human-caused impacts on environmental and human health, and to improve methods for fisheries restoration and production in conservation hatcheries and in aquaculture.

Additional details regarding these divisions and their specific missions can be found in Section 1.2 of the 2018 *Final Programmatic Environmental Assessment (PEA) for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center* (2018 PEA) (NMFS 2018b).

1.2 Scope of the NEPA Analysis

The NWFSC previously analyzed the potential environmental effects of fisheries and ecosystem research and in March 2018 published the 2018 PEA hereby incorporated by reference. A Finding of No Significant Impact (FONSI) was signed on March 27, 2018. Concurrent with the 2018 PEA, NWFSC applied to NMFS for regulations and a five-year Letter of Authorization (LOA) for the incidental taking of marine mammals pursuant to Section 101(a)(5)(A) of the MMPA. NMFS published the final rule on July 27, 2018 (83 Federal Register [FR] 36370) and subsequently issued an LOA (83 FR 47135, September 18, 2018) authorizing the taking marine mammals incidental to NWFSC fisheries research through August 2023. Concurrent with development of this SPEA, in July 2022, the NWFSC submitted an application for authorization of incidental take for research activities occurring in the period 2023-2028. Office of Protected Resources OPR published notice of receipt of the application and requested public comment on February 28, 2023 (88 FR 12662). That application is in the rulemaking process.

The 2018 PEA (NMFS 2018b) provides baseline descriptions of the physical, biological and human environments and analyses of the potential consequences of alternative approaches to fisheries and ecosystem research. The 2018 PEA and final rule provide the analytical framework to evaluate future research activities. Thus, the intent of this Supplemental PEA (SPEA) is to evaluate potential direct, indirect and reasonably foreseeable effects of new research or changes in research since 2018 that were not analyzed in the 2018 PEA. This SPEA includes the best available information on proposed research in the foreseeable future. Where necessary, updates to certain information on species abundance, stock status or other relevant components of the affected environment that may result in different conclusions from the 2018 PEA are presented herein.

NWFSC's proposed research program activities are expected to continue to result in only minimal and temporary reductions in prey from the removal of small amounts of krill and other forage fish, with no other impacts anticipated to EFH identified for Pacific Coast Salmon, Coastal Pelagic Species, and Highly Migratory Species. Consistent with our prior EFH consultation, we determined that only Pacific Coast Groundfish EFH is likely to be adversely affected by the continuation of NWFSC research activities; specifically, activities

that use bottom-trawling and bottom-contact gear types within groundfish EFH. Based on the scope and nature of the proposed NWFSC research, which is described in detail in Section 2, and considering the mitigation measures still in effect, the proposed action has not been substantially revised, as compared to previous research activities, in a way that is expected to adversely affect EFH. Nor is the proposed research anticipated to change in ways that would cause additional adverse impacts to EFH in the future.

Since 2016, there have been multiple updates to the fishery management plans (FMPs) for species managed under the MSA on the west coast (i.e., Pacific Coast Groundfish, Pacific Coast Salmon, Coastal Pelagic Species, and Highly Migratory Species), including changes to designated groundfish, rockfish, cowcod, salmon, and EFH conservation areas, and bycatch reduction areas. The WCR recently completed an ESA Section 7 consultation analyzing the impacts of the groundfish fishery that incorporated recent changes to these conservation areas (NMFS 2024b). Sections 1.3.9 through 1.3.12 of that Opinion describe multiple recent changes to groundfish conservation areas, including Amendments 28 and 32. These amendments opened additional fishing opportunities in new areas and depths and with some additional gear types, and also established new closure areas, gear restrictions, and EFH conservation areas. In particular, Amendment 32 opened additional fishing access for non-trawl fisheries within the coastwide Non-Trawl Rockfish Conservation Area and the Cowcod Conservation Area in the Southern California Bight. Amendment 32 also established new EFH conservation areas off of Oregon, which prohibit non-trawl bottom contact gear, and created a new type of closure, a Groundfish Exclusion Area or GEA, in the Southern California Bight , which is intended to mitigate the impacts to sensitive areas from certain groundfish fishing activity (https://www.fisheries.noaa.gov/s3/2023-11/ComplianceGuide-Amendment32-groundfish-nontrawl.pdf).

Although we anticipate some fishing effort will shift into the newly opened areas, fishery observer data are not yet available to show how, or to what degree, effort may have shifted into these areas. Additionally, the newly opened areas have been opened to only non-trawl gear types, and though some of these are bottom-contact, because new EFH conservation areas were also established, specifically to mitigate for the impacts of bottom-contact gear in groundfish fishery activities, these Amendments and other FMP changes that have occurred since 2016 do not appear to have substantially changed the status of EFH within the action area. Therefore, these revisions since the time of the last EFH consultation do not appear to present new information that would affect the basis for NMFS's existing EFH Conservation Recommendations.

We anticipate that the PFMC and WCR will continue to revise FMPs in the future, opening new areas and closing others in response to recovering or declining fishery stocks and the best available information on the status of EFH. Future Amendments would not inherently constitute new information that would affect the basis for NMFS's EFH Conservation Recommendations. But will be evaluated, as they are issued, to determine whether those actions reach the threshold to require reinitiation of consultation. See 50 CFR 600.920(l). Similarly, future changes in the proposed action will be evaluated to confirm that NWFSC's research activities have not been substantially revised in a manner that may adversely affect EFH or that may affect the basis for NMFS's EFH Conservation Recommendations.

Some NWFSC divisions also conduct directed research that may be covered under separate permits and may undergo separate NEPA analysis. For example, the Juvenile Salmon Pacific Northwest (PNW) Coastal Survey and the Salmon Ocean Behavior and Distribution (SOBaD) study operate under ESA Section 10 permits for directed research on ESA-listed fish (#1410-13M and #22369-2M, respectively). Where applicable, Section 10 permit numbers are cross-referenced to NWFSC projects covered in this SPEA (see Section 2 and Table 2-2).

Within Puget Sound and greater Puget Sound, several NWFSC projects operate under ESA Section 10 permits for directed research on listed fish including: Movement Studies of Puget Sound Species (#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 (all under #1586-5R); Puget Sound Marine Diversity Studies and Near Coastal Ocean Lampra Seining and ROV Surveys (#24367); Fish Contaminants Studies (#23029-2R); and Migratory Behavior of Adult Salmon (#1586-5R). The Puget Sound Juvenile Salmon Studies also operate under permit #16702-4R and a U.S. Fish and Wildlife Service (USFWS) tribal permit for bull trout.

Within the LCRRA, the Pile Dike Passive Integrated Transponder (PIT) Detection Survey is permitted under #24375, along with the Pair Trawl Columbia River Juvenile Salmon Survey Is permitted under #25256. The Columbia River Estuary Tidal Habitat Survey, the Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring, and Lower Columbia River Ecosystem Monitoring study are all permitted under ESA Section 10 permit #22944. Details for all of these studies are provided in Table 2-2.

1.3 Purpose and Need

The federal action analyzed in this SPEA is the proposed continuation of NWFSC fisheries research. The purpose of NWFSC fisheries research is to produce scientific information necessary for the management and conservation of living marine resources off the U.S. west coast. NWFSC's research is needed to promote both the long-term sustainability of the resource and the recovery of threatened or endangered species, while generating social and economic opportunities and benefits from their use.

1.4 Action Area

The Action Area is defined as the area within which all direct and indirect effects of NWFSC's fisheries research may occur. As shown in Section 1.1 of the 2018 PEA, the 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.

1.5 Public Review and Comment

An NOA for the draft SPEA was published on December 19, 2022 (87 FR 77555). Public comments on the draft SPEA were accepted through January 18, 2023. No public comments on the draft SPEA were submitted. However, the USFWS did provide agency comments on the draft SPEA. USFWS's comments have been addressed directly to the USFWS and are reflected in this final SPEA.

2 DESCRIPTION OF ALTERNATIVES

The 2018 Preferred Alternative (NMFS 2018b) established the framework for NWFSC's fisheries research since 2018 and is the basis for the No Action Alternative analyzed in this SPEA. Thus, alternatives evaluated in this SPEA include No Action Alternative (i.e., the continuation of NWFSC research activities as described in the 2018 PEA), as Alternative 1, and Alternative 2 (referred to as the Preferred Alternative in this document) represents modifications to research described in the PEA or new research activities that are planned for the foreseeable future. Appendix B summarizes research surveys, by gear type, as a simple comparison of alternatives. Sections 2.1 and 2.2 describe each alternative, including a description of activities, areas of operation, specific gears, number of estimated days-at-sea (DAS), and number of sampling tows. Additional descriptions of typical vessels and gear used during NWFSC surveys are incorporated by reference from the 2018 PEA.

2.1 Alternative 1 (No Action Alternative)

The No Action Alternative includes NWFSC research and issuance of authorization under the MMPA as described in the 2018 PEA. Research activities, equipment, gear, and sample sizes would not change from that described in the 2018 PEA (NMFS 2018b).

2.2 Alternative 2 (Preferred Alternative)

The Preferred Alternative includes all of the research activities described in the No Action Alternative plus certain modifications to surveys conducted under the No Action Alternative and additional studies that were not previously analyzed in the 2018 PEA (NMFS 2018b). These new and modified activities and proposed gear are highlighted in this section and effects are analyzed in Section 4.3 for the No Action Alternative and in Section 4.4 for the Preferred Alternative. An example of a modification to a survey conducted under the No Action Alternative that is included in the Preferred Alternative is a change to the Bycatch Reduction Research in the CCRA, to which demersal longlines and sablefish pots have been added. In addition, some surveys would be discontinued or certain gear types would no longer be used for certain surveys as listed below.

2.2.1 Discontinued Research or Gear Under the Preferred Alternative (2023 and Beyond)

- Bottom trawl gear would not be used for the Bycatch Reduction Research in Puget Sound under the Preferred Alternative. Bottom trawls may be conducted off the coasts of Washington and Oregon and California. Double-rigged shrimp bottom trawls may also still be used for testing.
- The PNW Harmful Algal Bloom study in the CCRA using plankton nets, a Conductivity, Temperature, and Depth (CTD) profiler and rosette water sampler would be discontinued under the Preferred Alternative.
- Near Coastal Ocean Purse Seining would be discontinued under the Preferred Alternative.

2.2.2 Changes to Existing Research to be Conducted Under the Preferred Alternative

- Bycatch Reduction Research – Added potential for nighttime operations, demersal longlines and sablefish pots.
- Fish Contaminants Studies – Expanded to include other non-listed fish from marine, estuarine and freshwater locations. 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 gill nets.
- 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 or traps.
- Movement Studies of Puget Sound Species – Added retrieval and remote download of detection arrays hydrophones, transducers and a tethered ROV. Also added the collection of steelhead smolts for telemetry studies evaluating if corner pontoon "fillets" on the Hood Canal Bridge are effective at reducing fish passage time and increasing steelhead survival. Wild steelhead smolts will be collected from the trap box using hand nets near the Washington Department of Fish and Wildlife (WDFW)-maintained weir at Big Beef Creek. These fish along with hatchery raised smolts will be tagged and tracked.
- 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.
- Salish Sea Studies of Juvenile Salmon and Other Pelagic Species – added a new geographic area (Strait of Juan de Fuca [previously only Puget Sound]).

2.2.3 New Projects Added for the Preferred Alternative

- Washington Coastal Kelp Forest Ecology Research.
- Deep-sea Coral Habitat Surveys via Remotely Operated Vehicles (ROVs) or Autonomous Underwater Vehicles (AUVs).
- Environmental Sample Processor (ESP) Mooring.
- Salmon Ocean Behavior and Distribution (SOBaD).
- Green Sturgeon Movements at Willapa Bay, WA.
- Ocean Acidification Research on Zooplankton and Benthic crustaceans (e.g., Dungeness crab) - 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.
- Temperature monitoring in Puget sound tributaries.
- Near Coastal Ocean Lampara Seining and ROV Surveys.
- Imaging Flow Cytobot (IFCB) deployment (from dock).
- ROV Nearshore Survey Feasibility Study.
- Gear Testing in Support of Groundfish Surveys in Untrawlable Habitat.
- Forage Fish Influence on Salmon Predation Risk and Food Resources.
- Remote Sensing of 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.

2.2.4 Re-Authorization of NWFSC Research with Potential Incidental Take of ESA-Listed Species, and NWFSC Research Covered Under ESA Section 10 Permits

As described in Section 1.2, NWFSC divisions also propose to continue to conduct directed research that is covered under ESA Section 10 permits for directed taking of ESA-listed species. For example, as shown in Appendix B, the Juvenile Salmon Pacific Northwest (PNW) Coastal Survey and the Salmon Ocean Behavior and Distribution (SOBaD) Study operate under ESA Section 10 permits for directed research on ESA-listed fish. Where appropriate Section 10 permit numbers are shown in Appendix B. Three additional studies not shown in Appendix B also operate under Section 10 permits:

- Ecology of resident Chinook in the San Juan Islands: incorporating a missing component of salmon recovery – PSRA, beach seine, tangle net, permit #20313.
- Contaminant exposure and injury to resident fish in the Lower Willamette River – LCRRA, beach seine, permit #22482-R.
- Evaluating restoration effectiveness for juvenile salmonids and forage fish in Puget Sound – PSRA, beach seine and lampara net, permit# 24367.

A comparison of the No Action and the Preferred Alternatives by gear type is presented in Table 2-1. Appendix B presents the alternatives by survey, with new proposed research or gear shown in grey cells and bold font as indicated.

2.3 Mitigation Measures under the No Action and Preferred Alternatives

The NWFSC considers the suite of mitigation and monitoring measures, as described in the 2018 PEA, to be necessary to avoid adverse interactions with protected species and still allow the NWFSC and its cooperating partners to fulfill their scientific missions. These mitigation measures include but are not limited to marine mammal watches, maximum tow speeds and duration, use of marine mammal excluder devices, and noise aversion measures. The mitigation measures currently used during research are also proposed under the Preferred Alternative, with specific additions as noted in Table 2-2. NWFSC research activities will continue to follow mitigation measures prescribed in Section 10 permits.

Table 2-1. Summary of research by alternative, with proposed future surveys and current surveys with proposed changes in scope or methodology (Alternative 2) shown in italics.

Survey Using Gear Type	Alternative 1 (*No Action Alternative*)	Alternative 2 *(Preferred Alternative)*
Bottom Trawl	• Bycatch Reduction Research. • Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey. • Movement Studies of Puget Sound Species. • Groundfish Bottom Trawl Survey. • Video Beam Trawl Collaborative Research. • Flatfish Broodstock Collection. • Marine Fish Research Broodstock Collection, Sampling, and Tagging. • Beam Trawl Survey to Evaluate Effects of Hypoxia.	**Same as No Action Alternative with the following exceptions:** • *Bottom Trawling For Bycatch Reduction. Research will only be conducted off the coasts of WA and OR (and possibly CA), but not in Puget Sound.* • *The Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey will no longer use bottom trawls.* • *Bottom trawling will no longer be used during the Movement Studies of Puget Sound Species.*
Midwater Trawl	• Bycatch Reduction Research. • California Current Ecosystem: Investigations of Hake Ecology and Survey Methods and the California Current. • Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey. • Northern Juvenile Rockfish Survey. • Salish Sea Studies of Juvenile Salmon and Other Pelagic Species. • Eulachon Arrival Timing. • Pair Trawl Columbia River Juvenile Salmon Survey. • Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring.	**Same as No Action Alternative, plus:** • *Eulachon Arrival Timing to use modified Cobb 9.5 mm codend, as well as active acoustics.* • *Salish Sea Studies of Juvenile Salmon and Other Pelagic Species to include Strait of Juan de Fuca (previously only Puget Sound).* • *Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring to use a Neuston net.*
Surface Trawl	• Juvenile Salmon PNW Coastal Survey. • Salish Sea Studies of Juvenile Salmon and Other Pelagic Species. • Skagit Intensively Monitored Studies of Juvenile Salmon in Skagit Bay. • Pair Trawl Columbia River Juvenile Salmon Survey. • Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring (small surface trawl).	**Same as No Action Alternative, plus:** • *Salish Sea Studies of Juvenile Salmon and Other Pelagic Species to include Strait of Juan de Fuca (previously only Puget Sound).* • *Forage Fish Influence on Salmon Predation Risk and Food Resources.* • *Fish Contaminants Studies using baby otter trawl.*
Longline Surveys	• Movement Studies of Puget Sound Species. • Marine Fish Research Broodstock Collection, Sampling, and Tagging.	**Same as No Action Alternative, plus:** • *Bycatch Reduction Research to use demersal longline, sablefish pots, and nighttime operations.*
Hook and Line or Rod and Reel Surveys	• Flatfish Broodstock Collection. • Movement Studies of Puget Sound Species. • Marine Fish Research Broodstock Collection, Sampling, and Tagging. • Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat. • Southern CA Bight Hook and Line Survey. • Rockfish Projects in Puget Sound. • Eulachon Arrival Timing.	**Same as No Action Alternative, plus:** • *Forage Fish Influence on Salmon Predation Risk and Food Resources.* • *Gear Testing in Support of Groundfish Surveys in Untrawlable Habitat.*

Table 2-1 (continued). Summary of research by alternative, with proposed future surveys and current surveys.

Survey Using Gear Type	Alternative 1 (*No Action Alternative*)	Alternative 2 *(Preferred Alternative)*
Tangle Net[a] or Gill Net	• Migratory Behavior of Adult Salmon.	**Same as No Action Alternative, plus:** • *Fish Contaminants Studies.*
Purse Seine	• Near-coastal Ocean Purse Seining. • Movement Studies of Puget Sound Species. • Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring.	**Same as No Action Alternative, plus:** • *Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring.* • *Lower Columbia River Ecosystem Monitoring.* • *Monitoring (micro purse seine).* • *Salmon Ocean Behavior and Distribution (SOBaD).*
Lampara Seine[b]	n/a	• *Near-coastal Ocean Lampara Seining ROV Surveys.*
Beach Seine	• Salish Sea Studies of Juvenile Salmon and Other Pelagic Species. • Elwha Dam Salmon Recovery. • Puget Sound Marine Diversity Studies. • Fish Contaminants Studies. • Puget Sound Juvenile Salmon Studies. • Columbia River Estuary Tidal Habitats. • Lower Columbia River Ecosystem Monitoring. • Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring. • Southern CA Bight Hook and Line Survey.	**Same as No Action Alternative, plus:** • *Salish Sea Studies of Juvenile Salmon and Other Pelagic Species to include Strait of Juan de Fuca (previously only Puget Sound).* • *Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring.* • *Migratory Behavior of Adult Salmon.* • *Habitat Function of Nearshore Ecosystems with Shellfish Aquaculture and Eelgrass.*
Echosounders and Sonar	• Bycatch Reduction Research. • Groundfish Bottom Trawl Survey. • Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey. • Northern Juvenile Rockfish Survey. • Newport Line Plankton Survey. • Eulachon Arrival Timing.	**Same as No Action Alternative, plus:** • *Surveys of Salmon Predators.* • *Surveys of Larval Fishes.*

[a] A tangle net is similar to a gill net but snares salmon by the teeth and does not harm them.
[b] A lampara seine is a type of fishing net. It is a surrounding net having the shape of a spoon or a dustpan, with a short leadline under a longer floatline. The net has a central bunt to contain the fish, and two lateral wings.

Table 2-1 (continued). Summary of research by alternative, with proposed future surveys and current surveys.

Survey Using Gear Type	Alternative 1 (*No Action Alternative*)	Alternative 2 *(Preferred Alternative)*
Other Gear[c]	• California Current Ecosystem: Investigations of Hake Ecology and Survey Methods. • Groundfish Bottom Trawl Survey. • Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey. • Juvenile Salmon PNW Coastal Survey. • Northern Juvenile Rockfish Survey. • Newport Line Plankton Survey. • Northern California Current Ecosystem Survey. • Technology Development Research. • Skagit Intensively Monitored Studies of Juvenile Salmon in Skagit Bay. • Herring Egg Mortality Survey (egg collection by hand). • *Heterosigma akashiwo* Bloom Dynamics and Toxic Effects. • Puget Sound Marine Diversity Studies. • Puget Sound Juvenile Salmon Studies. • Urban Gradient Surveys. • Long-term Eelgrass Monitoring. • Columbia River Estuary Tidal Habitats. • Effects of Sediment Deposition on Crab Recruitment. • Lower Columbia River Ecosystem Monitoring. • Pile Dike PIT-tag Detection System. • Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring.	**Same as No Action Alternative plus:** • *Washington Coastal Kelp Forest Ecology Research.* • *Deep-sea Coral Habitat Surveys via ROV.* • *Environmental Sample Processor (ESP) Mooring.* • *Salmon Ocean Behavior and Distribution (SOBaD).* • *Green Sturgeon Movements at Willapa Bay, WA.* • *Ocean Acidification Research on Zooplankton and Benthic Crustaceans (e.g., Dungeness crab).* • *Avian Predation Studies.*[d] • *Movement Studies of Puget Sound Species.* • *Habitat Function of Nearshore Ecosystems with Shellfish Aquaculture and Eelgrass.* • *Non-native Species Studies.* • *Temperature Monitoring in Puget Sound Tributaries.* • *Imaging Flow Cytobot (IFCB) Deployment (from dock).* • *ROV Nearshore Survey Feasibility Study.* • *Gear Testing in Support of Groundfish Surveys in Untrawlable Habitat.* • *Remote Sensing Wetland Habitat with UAS.* • *Surveys of Larval Fishes.*

[c] Includes gear such as: CTD rosette; Uncrewed Systems (UxS) such as ROV or AUV; plankton/Bongo nets; passive acoustic recorders; transducer; UCTD profiler; camera sled; fyke trap; electrofishing; moored biological sampling systems; ring nets or Neuston nets.
[d] Hand-held salmon nets for live capture; radio or satellite tags.

Table 2-2. Proposed changes and additions to mitigation measures from 2018 PEA.

Survey Using Gear Type	Alternative 1 (No Action Alternative)	Alternative 2 (Preferred Alternative)
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 (< 5) 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 require the same mitigation measure.	• Requirements also apply to the Lampara seine study that has been added to the Preferred Alternative. • All other measures same as No Action Alternative described in the 2018 PEA.
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.	• Bird entrapment by beach seines will be avoided because they will be visible from the small boats deploying such nets. If birds could be potentially entrapped, the seines will not be deployed. • Other mitigation measure to protect upland birds such as larks include: ◦ NMFS researchers will not travel beyond wet sand beach and up on to dry sand beach. ◦ Pulling the seine only requires that the ends wind up on the edge of the water. ◦ Lunch will be eaten on the boat, not on the beach. • Seines will be kept in the wet to protect the non-target fish that will be released. • All other mitigation measures same as No Action Alternative described in the 2018 PEA.

Table 2-2 (continued). Proposed changes and additions to mitigation measures from 2018 PEA.

Survey Using Gear Type	Alternative 1 (No Action Alternative)	Alternative 2 (Preferred Alternative)
Longline Surveys, and Hook and Line or Rod and Reel Surveys	• Conduct visual monitoring at least 30 minutes prior to 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 minutes. • 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.	• To protect short-tailed albatross and other birds, NWFSC will test the use of night-time only operations of the Bycatch Reduction Research Survey. Night setting is an accepted best practice to prevent seabird bycatch in longline fisheries globally (Løkkeborg 2011). Melvin et al. (2019) also reported dramatic positive effects of night setting for albatrosses and shearwaters, whose bycatch per unit effort (BPUEs) were > 85% lower at night. For surveys that cannot employ nighttime only operations, other mitigation options include line weighting, alternative float and weight configurations, slower setting speed, offal retention. • For all longline surveys paired streamers to deter birds must be used. Melvin et al. (2019) reported a 78% decrease in seabird bycatch after the adoption of streamer lines as mitigation to avoid interactions between commercial fisheries and short-tailed albatross. Streamer lines are used by NWFSC to avoid interactions with seabirds, including short-tailed albatross. • All other mitigation measures same as No Action Alternative described in the 2018 PEA.
Pot and Trap Gear	• No specific requirements.	• 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. • All other mitigation measures same as No Action Alternative described in the 2018 PEA.
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.	• Bird entrapment by small towed nets will be avoided because birds will be visible from the small boats deploying such nets. If birds could be potentially entrapped, the nets will not be deployed. • All other mitigation measures same as No Action Alternative described in the 2018 PEA.

Table 2-2 (continued). Proposed changes and additions to mitigation measures from 2018 PEA.

Survey Using Gear Type	Alternative 1 (No Action Alternative)	Alternative 2 (Preferred Alternative)
Surveys Using Uncrewed Aerial Systems	• No specific requirements.	• UAS surveys will only operate from September 16 through March 14 to reduce potential impacts to nesting western snowy plover, which breed in the region from March 15 through September 15. Nest sites are protected areas with proscribed boundaries, and access by personnel is restricted during the breeding season. Operating during the breeding season will require consultation with USFWS prior to any activity. • UAS will only be in the air for one 30-minute interval per day to minimize noise, disturbance, and/or potential collisions. • UAS will be flown at a minimum vertical height of 91.4 over any nest site boundaries, and during western snowy plover breeding season will avoid flying over nest site boundaries. The minimum horizontal distance of a flight path to a nest set boundary will be established at 300 m and launching and landing will take place < 300 m from nesting sites. • At least one week prior to aerial drone surveys, the NWFSC researcher will contact the USFWS plover biologist (Cheryl Strong, Newport, OR) to ensure there are no nesting western snowy plovers in or around the take-off and landing areas. • If specific nesting sites are not known, activities will take place outside of the nesting season or using the most conservative boundaries at sandy beaches where plovers are known to nest. • If a marbled murrelet, streaked horned lark, and/or western snowy plover is observed in the area, UAS operations will cease until the bird(s) have left the area. • Key seabird nesting and breeding locations will be avoided. During the pre-flight planning stage, inquiries to regulatory agencies to identify the locations of nesting areas is required. The UAS flight will then be programmed to avoid the nesting habitat boundaries. UAS surveys will be conducted at least 0.8 km (lateral horizontal distance) from western snowy plover critical habitat or known nesting areas. • Only trained pilots will operate UAS during the survey and a visual observer will be on site during the work. Any unexpected bird activity observed by pilot or observer would result in remedial action (e.g. aborting the flight plan). • As per regulation (50 C.F.R. § 27.34), UAS cannot take off or land on Refuge lands.

3 AFFECTED ENVIRONMENT

Section 3 of the 2018 PEA (NMFS 2018b) provides a comprehensive summary of physical, biological and socioeconomic resources that characterize the affected environment within the Action Area and that information is incorporated by reference here. As a supplement to the 2018 PEA, this section reviews all resources but only provides detailed updates for resources that have changed in status or condition, or that may be affected by the new or modified proposed research activities.

3.1 Physical Environment

Changes to special resource areas within the CCRA, PSRA and/or LCRRA that have occurred since the 2018 PEA are as follows:

Amendment 28 to the Pacific Coast Groundfish FMP (84 FR 63966; effective Jan 1, 2020) re-opened areas that had been closed to bottom trawling to rebuild previously overfished groundfish stocks, and established new and revised areas closed to bottom trawling to conserve and protect Pacific coast groundfish EFH.[1] Together, these two changes are expected to increase protections for groundfish EFH. Deep-water areas (>3,500 m) off the California coast were also closed to bottom contacting gear to protect deep-water habitats, including deep-sea corals (84 FR 63966). Little to no fishing with bottom gear occurs in this deep-water area at present; however, Amendment 28 prevents future fishing with bottom-contacting gear in sensitive deep-water areas.

Amendment 32 to the Groundfish FMP (86 FR 83830, effective date January 1, 2024) allows increased fishing access, with specific gear types, to Non-Trawl Rockfish Conservation Areas (RCA), for the commercial groundfish limited entry fixed gear sector and vessels that gear switch under the Trawl Individual Fishing Quota program. Amendment 32 modified existing Non-Trawl RCA boundaries, relaxed restrictions on gear regulations inside the Non-Trawl RCA, removed the Cowcod Conservation Areas, developed new closed areas that may restrict some fishing activity, and developed a block area closure tool for preseason or inseason bycatch management.

Section 3.1.2.3 of the 2018 PEA (NMFS 2018b) describes five National Marine Sanctuaries (NMS) located within the CCRA that may be affected by NWFSC fisheries research. These include the following: Olympic Coast NMS; Cordell Bank NMS; Gulf of Farallones NMS; Monterey Bay NMS; and Channel Islands NMS.

In March 2015, NOAA's National Marine Sanctuary Program published a final rule that expanded the Greater Farallones NMS and the Cordell Bank NMS from approximately 3,394 square kilometers (km^2) to approximately 8,544 km^2 (80 FR 13078) (Appendix C, Figure C-1).

[1]Supporting materials for users wanting to visualize or plot associated geospatial information associated with Amendments 28 and 32 to the Pacific Coast Groundfish Fishery Management Plan are available here: https://www.fisheries.noaa.gov/west-coast/sustainable-fisheries/west-coast-groundfish-closed-areas (accessed November 19, 2024).

Additionally, on October 16, 2024, NOAA published the final rule designating the Chumash Heritage NMS, in the waters along and offshore of the coast of central California, to recognize the national significance of the area's ecological, historical, archaeological, and cultural resources and to manage this special place as part of the National Marine Sanctuary System. The sanctuary boundary encompasses 4,543 square miles (mi^2) (3,431 square nautical miles (nmi^2)) of submerged lands and marine waters from approximately two miles southeast of the marina at Diablo Canyon Power Plant, in San Luis Obispo County, to Naples along the Gaviota Coast, in Santa Barbara County (Appendix C, Figure C-2).

Given the expanded boundaries of the NMS system described above, NWFSC research activities are still not expected to have a substantial impact on sanctuary resources. Similarly, this does not change the administrative or regulatory responsibilities of the NWFSC with regard to sampling within a NMS.

3.2 Biological Environment

3.2.1 Fish

The following subsections describe the following categories of fish species that may be encountered in NWFSC research areas: ESA-listed fish, non-listed target species, non-listed highly migratory species, and other non-listed fish. Detailed descriptions of these species can be found in Section 3.2.1.1 of the 2018 PEA and largely remain unchanged. See below for new information.

3.2.1.1 Fish Species Listed Under the Endangered Species Act

3.2.1.1.1 ESA-listed Target Fish

Appendix D provides the most recently available status information for ESA-listed target fish species or populations in the NWFSC research areas. These remain largely unchanged with the single difference described below.

The 5-year review process for the Puget Sound/Georgia Basin DPSs of bocaccio and yelloweye rockfish was completed in February 2024. As shown in Appendix D., the canary rockfish is the only ESA-listed fish species considered in the 2018 PEA that has had a change in status since publication of that document. The Puget Sound/Georgia Basin DPS was listed as threatened under the ESA in 2010 due to a lack of survey data of population levels of the species, as well as a steady drop off in catch records. Critical habitat was designated for several rockfish species in Puget Sound, including this DPS of canary rockfish (79 FR 68042, November 14, 2014). However, on January 23, 2017 (82 FR 7711), the Puget Sound DPS was delisted and critical habitat for this species was removed; NMFS determined that current genetic data provided strong evidence that Puget Sound/Georgia Basin canary rockfish are not discrete from coastal canary rockfish and are not considered to be a DPS. The entire stock was considered rebuilt under the MSA in 2015.

In 2017 after preparation of the NWFSC PEA that published in 2018, NMFS also confirmed that the Puget Sound/George Basin of yelloweye rockfish is discrete from coastal yelloweye rockfish and extended the northern boundary of this threatened DPS to include fish that are

found in Johnstone Strait and Queen Charlotte Canal; at the same time NMFS updated and amended the listing description for the bocaccio DPS to include fish residing within Puget Sound/Georgia Basin, rather than only fish originating in the area (82 FR 7711).

3.2.1.1.2 ESA-listed Anadromous Fish

ESA-listed anadromous fish potentially found in the NWFSC research area include Pacific salmon, Pacific eulachon, and green sturgeon. On October 4, 2019, NMFS initiated the 5-year review process for 17 Pacific salmon Evolutionary Significant Units (ESUs) and 11 Steelhead DPSs (84 FR 53117). Some, but not all of the reviews were available as of December 2024. Appendix D. indicates where reviews have been completed and also shows the most currently available information for the 26 ESA-listed salmonid ESUs. This SPEA evaluates potential impacts to specific ESUs of salmon and steelhead that may be incidentally caught as bycatch during NWFSC surveys. Section 4 of this SPEA describes the analysis that is used to determine the potential impacts of the alternatives on salmon ESUs.

The southern DPS of Pacific eulachon occurs in Puget Sound, Willamette and Lower Columbia rivers, and along the Oregon and Southern Oregon/Northern California Coasts. This DPS was listed as threatened under the ESA in 2010 (75 FR 13012) and critical habitat covering 16 creeks and rivers within Washington, Oregon, and California was designated in 2011 (76 FR 65323). A recovery plan was completed for the DPS in 2017 (NMFS 2017a), and the 5-year review process was initiated in in 2020 (85 FR 12905) and completed in July of 2022 (NMFS 2022a). The review found that the Southern DPS should remain listed as threatened under the ESA.

The Southern DPS of green sturgeon was listed as a threatened species under the ESA in 2006 (71 FR 17757). A 5-year ESA review process was initiated for this species in 2020 (85 FR 12905) and completed in 2021 (NMFS 2021a); the review recommended no change in status.

In Puget Sound and along Pacific Coast, studies have shown that ESA-listed bull trout are anadromous, inhabiting estuarine and nearshore marine waters for up to 5 months each year, possibly returning to these waters every year for up to 10 years (Goetz et al. 2003). As described in the 2018 PEA (NMFS 2018b), scattered populations of bull trout are found in streams of Washington and Oregon. In the Columbia River, bull trout populations occur below the Bonneville Dam in two drainages: the Lewis River and the Willamette River. On September 30, 2010, the USFWS designated critical habitat for bull trout in 754 miles of marine shoreline within Washington State and in the Columbia River estuary downstream of Bonneville Dam (75 FR 2270). Bull trout are managed by the USFWS. A Programmatic BiOp covering SWFSC and NWFSC research activities was issued by USFWS in 2017 and includes analysis of effects on bull trout for 11 core areas in the coastal research areas and marine habitat that supports core areas including: the strait of Juan de Fuca, Puget Sound, Hood River Canal, coastal waters off of Washington, and the Lower Columbia River (USFWS 2017). Appendix D provides the most recently available information regarding bull trout in the NWFSC research areas.

3.2.1.1.3 ESA-Listed Highly Migratory Species

Three species of ESA-listed highly migratory species (HMS) inhabit eastern Pacific Ocean waters including: giant manta rays; oceanic white tip sharks; and scalloped hammerhead sharks. Giant manta rays are rare to extralimital (i.e., these areas would be considered the limit of their normal range) in waters off the U.S. west coast. As stated in the designation for critical habitat, a single giant manta ray was observed off San Clemente Island in 2014 (84 FR 66652), and there have been no documented sightings prior to or since that sighting. Since the occurrence of giant manta rays in waters off the U.S. west coast is extremely uncommon, this species is not considered further in this SPEA.

The final determination of critical habitat for oceanic whitetip sharks (85 FR 12898) notes that observers from commercial West Coast-based U.S. fisheries have not recorded observations of oceanic whitetip sharks. Based on the best available data, the distribution of the species appears to be concentrated in areas farther south in foreign waters or the high seas. Therefore, oceanic white tip sharks are not considered in this analysis.

Scalloped hammerhead sharks were listed as threatened in 2014 (79 FR 38213). The final rule for listing this species states that the northern boundary of the Eastern Pacific scalloped hammerhead shark's range is bounded to the north by 40° N latitude. Though generally considered to be very rare in U.S. waters, 26 scalloped hammerhead sharks have been captured off of Southern California since 1977 (Miller et al. 2014). In 2015, NMFS determined that no marine areas within the jurisdiction of the U.S. meet the definition of critical habitat for Eastern Pacific DPS of scalloped hammerhead shark (80 FR 71774). In September of 2019, NMFS announced its intent to conduct a 5-year review for the four distinction DPS of scalloped hammerhead sharks (84 FR 46938), and in 2020 the review was published (NMFS 2020). The review recommended no change in status. As stated in the final rule for listing scalloped hammerheads, abundance data are lacking for the Eastern Pacific DPS but information from commercial and artisanal fisheries suggests that this DPS has been historically exploited and they are the second most important shark species targeted by Mexican fisheries (79 FR 38213). Appendix D provides the most recently available information on scalloped hammerhead sharks.

3.2.1.2 Non-listed Target Species

Target species are those fish which are managed under an FMP, commercially or recreationally fished, and for which stock assessments are conducted using NWFSC-affiliated fisheries research. As described in the 2018 PEA (NMFS 2018b), the majority of target fish collected by the NWFSC research surveys have been historically captured during the following surveys:

- Groundfish Bottom Trawl Surveys (CCRA).
- Bycatch Reduction Bottom Trawl Surveys (CCRA).
- Hake Acoustic Surveys (Bottom Trawl) (CCRA).
- Juvenile salmon PNW Coastal Surveys (PSRA).
- Northern juvenile rockfish surveys (PSRA).
- PNW Piscine Predator & Forage Fish Surveys (PSRA).
- Near Coastal Purse Seining Surveys (PSRA).

- Puget Sound Marine Pelagic Food Web Surveys (PSRA).
- Columbia River Estuary Purse Seining (LCRRA).

The 2018 PEA (NMFS 2018b) identified 39 target fish species that had an average research catch of over 1 mt per year over the previous five years.[2] These species are included in the Pacific Coast Groundfish FMP or as in the case of Pacific hake and Pacific halibut are managed by international agreement.

Appendix E lists the target species considered in the PEA and their current stock status under the MSA:[3]

- Overfishing – The rate or level of fishing mortality or total catch that jeopardizes the capacity of a stock to produce the maximum sustainable yield on a continuing basis (50 CFR 600.310(e)(2)(i)(B)).
- Overfished – When the biomass of a stock has declined below minimum stock size threshold (the level of biomass below which the capacity of a stock to produce maximum sustainable yield on a continuing basis (50 CFR 600.310(e)(2)(i)(E)).
- Rebuilt – A stock previously determined to be subject to overfishing or overfished stock has increased in abundance to a size that supports the maximum sustainable yield on a continuing basis.

Federal fisheries in the region are managed under four FMPs.[4] As of June 30, 2025, two stocks or stock complexes were listed as overfished: Chinook salmon (Klamath River fall stock); and Pacific sardine (northern subpopulation) which was newly added in 2019 (NMFS 2022k). Additionally, swordfish (Eastern Pacific stock) which is fished under a formal international agreement between U.S. and international fleets is considered as being subject to overfishing.

The stock status has not changed for the majority for target species shown in Appendix E. The following exceptions are noted:

- Overfishing status is now unknown for Aurora rockfish.
- Stock status is now reported for big skate; overfishing is not occurring and the stock is not overfished.
- The bocaccio southern Pacific coast DPS, the Pacific coast stock of Darkblotched rockfish, and Pacific Ocean perch stocks are considered to be rebuilt as of 2017.
- The Pacific coast stock of canary rockfish and petrale sole stocks are considered to be rebuilt as of 2015.

[2] Since the 2018 PEA, quillback rockfish has been designated as overfished under the MSA (89 FR 53961, June 28, 2024). From 1993-2020 the NWFSC West Coast Bottom trawl survey caught 21 (range = 0-15 fish annually) Quillback rockfish off the California Coast (Langseth et al. 2021). Additionally, Quillback rockfish are not known to be in southern California where the NWFSC Hook and Line surveys are conducted, therefore they are not encountered by this survey. No other NWFSC surveys are at risk of encountering this species and there is no reason to believe this will change in the foreseeable future. Therefore, this species is not considered further in this EA.
[3] Source: https://www.fisheries.noaa.gov/national/population-assessments/fishery-stock-status-updates
[4] Coastal pelagic species FMP; Pacific coast salmon FMP; Pacific coast groundfish FMP; and West Coast HMS FMP.

- It is now not known if overfishing is occurring for Greenstriped rockfish but it is considered to be not overfished.
- The overfished status is unknown for Northern anchovy; overfishing is not occurring.
- Results of the 2024 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990s to around 2012. The spawning biomass (SB) is estimated to have increased gradually to 2016 and then decreased to a low of 145 million pounds (~65,700t) at the beginning of 2024 (Stewart and Hicks 2025).
- Recent stock status for redstripe rockfish and rosethorn rockfish are not reported; these species are not as economically significant to the domestic fishing industry and therefore, not included in the index.
- Rougheye rockfish is now considered as part of a Blackspotted and Rougheye rockfish complex.
- Overfishing is not occurring for spiny dogfish.
- Spotted ratfish are now monitored as an ecosystem component and stock status is not reported.

3.2.1.3 Non-listed Highly Migratory Species

The FMP for U.S. West Coast Fisheries for Highly Migratory Species (HMS), as amended, defines EFH for eleven HMS (common thresher shark, shortfin mako shark, blue shark, albacore tuna, bigeye tuna, Pacific bluefin tuna, skipjack tuna, yellowfin tuna, striped marlin, swordfish, and dorado or mahimahi) (PFMC 2018). The combined EFH for these species includes a large fraction of the pelagic marine waters within the U.S. EEZ along the coasts of California, Oregon, and Washington. Habitat boundaries for these species are based on sea surface temperatures, which vary seasonally and from year to year, with some HMS much more abundant in northern California to Washington waters during the summer and in warmer waters years than during winter and cold water years (PFMC 2018). As sea temperatures change, these species may be found more frequently off of the Oregon and Washington coasts. Appendix F. provides the most recently available stock status information for these 11 species. These species were not discussed in detail in the 2018 PEA (NMFS 2018b), so a comparison to that document is not available.

3.2.1.4 Other Non-listed Fish Species

As described in the 2018 PEA, other fish species that are not considered to be target fish or HMS (non-managed commercial species) can be caught during NWFSC research surveys. Non-managed commercial species caught in the West Coast Groundfish Bottom Trawl Survey include the smelts and Pacific herring. Non-commercial species captured include sand dabs, eelpouts, starry flounder, sculpins, croakers, spiny dogfish, and wolf-fish.[5] NWFSC Juvenile Salmon and Ocean Systems surveys occasionally catch ocean sunfish, spiny dogfish, and blue sharks,[6] but not in quantities sufficient to have any impact on these species. For

[5] Unpublished data received from NWFSC May 2022.
[6] Unpublished data received from Cheryl Morgan, Hatfield Marine Science Center, on June 2, 2022.

these species and all other non-commercial, non-listed species, the analyses provided in the 2018 PEA remain valid. As stated in the 2018 PEA, mortality to these fish species would not be measurable because it would represent such a small fraction of the total populations.

3.2.2 Marine Mammals

Appendix G, Tables G-1 and G-2, show the ESA-listed marine mammal species and non-listed marine mammals species, respectively, that may be encountered by NWFSC research activities in the CCRA, PSRA, and LCRRA. The tables provide currently available abundances. There have been no ESA status changes from those presented in the 2018 PEA. ESA listed marine mammals include sperm whale, humpback whale, blue whale, fin whale, sei whale, gray whale, killer whale, Guadalupe fur seal, and sea otter. Detailed descriptions of species life history are provided in Section 3.2.2.2 (ESA-listed species) and Section 3.2.2.3 (non-listed species) of the 2018 PEA (NMFS 2018b).

3.2.2.1 ESA-listed Marine Mammals

Appendix G, Table G-1 compares abundances used in the 2018 MMPA final rule (83 FR 36370) to the most current abundances (where available) in Carretta et al. (2022) or (NMFS 2023f). Estimated abundances for all ESA-listed marine mammals were generally similar (within 25%) between 2018 and 2021 with the exception of humpback whales and Guadalupe fur seals. The stock estimate for Guadalupe fur seals was 20,000 in 2018, increasing to an estimate of 34,187 in 2021. As noted in Appendix G, Table G-1 there are no changes in ESA-status of listed marine mammals from the 2018 PEA. The following subsections describe changes in humpback whale stock structure and abundance, and changes in designated critical habitat for humpback whales and southern resident killer whales. Impacts to the newly designated or revised critical habitat are described in Section 4.3.2.2.4 for the No Action Alternative and 4.4.2.2.1 for the Preferred Alternative. Critical habitat designations for all other ESA-listed marine mammals remain unchanged from the 2018 PEA for the No Action Alternative, and effects on critical habitat due changes in NWFSC research as proposed under the alternatives are not likely to be notably different.

3.2.2.1.1 Changes to Humpback Whale Stock Designations

On September 8, 2016, NMFS issued a final rule which revised the global listing status of the humpback whale by dividing the species into 14 distinct DPSs (81 FR 62260). In 2022, NMFS further refined humpback whale stock structure based on feeding area and migratory routes, and recognized 4 DPSs in the North Pacific: the Western north Pacific DPS (endangered); the Mexico DPS (threatened;) the Central America DPS (endangered); and the Hawaii DPS (not-listed under the ESA) (NMFS 2023f). Individuals from the Central America DPS and Mexico DPS feed within the CCRA (Appendix G, Figure G-1). These DPSs are considered strategic and depleted under the MMPA. On April 21, 2021, NMFS designated critical habitat for 3 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.

In prior stock assessments, NMFS had designated three stocks of humpback whales in the North Pacific: the California/Oregon/Washington (CA/OR/WA) stock; the Central North Pacific stock; and the Western North Pacific stock. These stocks were not necessarily aligned with the ESA DPSs because some were composed of whales from more than one DPS, which led NMFS to reevaluate stock structure under the MMPA (NMFS 2023f). The current structure identifies 5 stocks. ESA-listed humpback whales encountered in NWFSC research areas belong to either the Central America/Southern Mexico-California-Oregon-Washington (CA/OR/WA) stock (part of the Central America DPS) or to the Mainland Mexico-CA/OR/WA stock (part of the Mexico DPS) (NMFS 2023f).

As shown in Appendix G, Figure G-1, the primary wintering areas of the Central America/Southern Mexico-CA/OR/WA stock include the Pacific coasts of Nicaragua, Honduras, El Salvador, Guatemala, Panama, Costa Rica. Primary summering areas for whales from this stock include the California and Oregon coasts, with a few individuals possible off of northern Washington/southern British Columbia. The primary wintering areas of the Mainland Mexico – CA/OR/WA stock include the mainland Mexico states of Nayarit and Jalisco, with some animals seen as far south as Colima and Michoacán. Summer feeding destinations for whales in this stock include waters of off California, Oregon, Washington, Southern British Columbia, Alaska, and the Bering Sea.

Curtis et al. (2022 as cited in (NMFS 2023f) estimated the population size of whales wintering in southern Mexico and Central America based on photographic data collected between 2019 and 2021. Using this data the authors estimated the abundance of the Central America/Southern Mexico – CA/OR/WA stock of humpback whales to be 1,494 (CV=0.167) with a PBR of 7(NMFS 2024k. This stock spends approximately half its time outside the U.S. EEZ so the PBR in U.S. waters is set to half of that or 3.5 whales per year. The best estimate of abundance for the Mainland Mexico – CA-OR-WA stock of humpback whales is considered to be 3,479 animals (CV=0.099). PBR for this stock is 86 whales (NMFS 2024k). However, because this stock spends approximately half its time outside the U.S. EEZ), the PBR in U.S. waters is 43 whales per year.

3.2.2.1.2 Changes to Critical Habitat Designations

Since publication of the 2018 PEA critical habitat has been designated for humpback whales (April 21, 2021 (86 FR 21082), and critical habitat was revised on August 2, 2021 (86 FR 41668).

Humpback Whale Critical Habitat

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 (Appendix G, Figure G-2). Specific areas designated as critical habitat for the Central America DPS of humpback whales contain approximately 48,521 nmi2 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 area.

The final rule (86 FR 21082) describes access to adequate prey as the only essential physical or biological feature of humpback whale critical habitat. NMFS considered and evaluated various biological and physical features of humpback whale habitat in addition to access to prey such as migratory corridors and soundscape but determined that the best available scientific information does not currently support recognizing any additional essential features. Sections 4.3.2.2.4 and 4.4.2.2.1 describe the effects of the No Action and Preferred Alternative, respectively, on humpback whale critical habitat.

Southern Resident Killer Whale Critical Habitat

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 (Appendix G, Figure 3). These areas lie within NWFSC research areas.

The original 2006 final rule designating critical habitat for southern resident killer whales (79 FR 9054) determined that based on the best available scientific information, the following features were essential to the conservation of the species within inland waters of Washington: (1) Water quality to support growth and development; (2) prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) passage conditions to allow for migration, resting, and foraging.

The same three biological and physical features were identified in the revised rule (86 FR 41668). As described in the final revised rule, southern resident killer whales range over a variety of habitats, including inland waters and open ocean coastal areas from the Monterey Bay area in California north to Southeast Alaska. They are highly mobile, and can cover large distances. However, analyses of their movement patterns on the outer coast have revealed preferred depth bands and distances from shore that suggest potential travel corridors, and variations in travel speed or duration of occurrence (86 FR 41668. Impacts of the alternatives on southern resident killer whales are descried in 4.3.2.2.4 and 4.4.2.2.1.

3.2.2.2 Non-listed Marine Mammals

Appendix G, Table G-2 provides the abundances of non-listed marine mammals that could be encountered in the NWFSC research areas. Where available, the table compares the final 2021 abundances (Carretta et al. 2022), or if available the draft 2022 abundances (NMFS 2023f), with those used in the 2018 MMPA final rule (83 FR 36370). Species or stocks with estimated increases of 25% or more include: the Morrow Bay stock of harbor porpoise; the CA/OR/WA stock of common bottle nose dolphins; minke whales; gray whales from the Eastern North Pacific stock; and the Eastern North Pacific stock of northern fur seals. Species or stocks with a 25% or more decrease in abundance estimates include: the Northern CA/Southern OR stock of harbor porpoise; the CA/OR/WA stock of Dall's porpoise; and Baird's beaked whales.

3.2.3 Seabirds

3.2.3.1 Threatened and Endangered Seabird Species

There are five ESA-listed bird species with the potential to occur in the NWFSC research areas: short-tailed albatross, California least tern, marbled murrelet, western snowy plover, and streaked horned lark. The ESA status of these five species have not changed since the 2018 PEA therefore conclusions regarding impacts in the 2018 PEA remain valid. Details regarding the ESA-listed species are shown in Appendix H. Effects of the No Action Alternative and the Preferred Alternative on these species are described in Sections 4.3.2.3 and 4.4.2.3, respectively.

3.2.3.2 Non-listed Seabird Species

There are many seabird species that occur in the three NWFSC fisheries research areas which may potentially interact with research vessels and gear. Section 3.2.3.2 of the 2018 PEA (NMFS 2018b) describes marine bird communities that are found in each of the three research areas.

The 2018 PEA notes that over the period 2002-2013, five different non-ESA-listed seabird species were caught and killed during the Juvenile Salmon PNW Coastal Survey (see Appendix B) that uses the Nordic 264 surface trawl: common murre; rhinoceros auklet; Cassin's auklet; tufted puffin; and sooty shearwater. Detailed descriptions of these species are provided in Section 3.2.3.3 of the 2018 PEA.

3.2.4 Sea Turtles

Five species of sea turtles are all listed as either endangered or threatened under the ESA and are shown in Appendix I. Four of the species (leatherback, olive ridley, green and loggerhead) are found in NWFSC research areas; the fifth species, hawksbill sea turtles, has a low expectation of being encountered in waters where NWFSC research activities occur (NMFS 2016r), and is not discussed further. Detailed descriptions of life history and occurrence of all five species are provided in Section 3.2.4.1 of the 2018 PEA (NMFS 2018b). There have been no changes in ESA status or designated critical habitat for these species since the 2018 PEA; therefore conclusions regarding impacts on critical habitat in the 2018 PEA remain valid. This conclusion has been substantiated by analysis under the 2024 BiOp where after reviewing and analyzing the status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the reasonably foreseeable effects, NMFS concluded that NWFSC research activities were not likely to jeopardize the continued existence of Leatherback sea turtles, North Pacific DPS Loggerhead sea turtles, Olive Ridley sea turtles, or East Pacific DPS green sea turtles (NMFS 2024a). With that being stated, because there is a potential for interactions with NWFSC research surveys with these ESA listed species, , the impacts of the No Action and Preferred Alternatives on four species of sea turtles are analyzed in Sections 4.3.2.4 and 4.4.2.4, respectively.

3.2.5 Invertebrates

3.2.5.1 Threatened and Endangered Species

Two ESA-listed invertebrate species occur in the CCRA: the black abalone and the white abalone. No other ESA-listed invertebrates occur in in the CRRA, PSRA, or LCRRA. Section 3.2.5.1 of the 2018 PEA provides detailed descriptions of these species and Appendix J, Table J-1. provides the most recently available information. As described in the 2018 PEA, neither species has ever been caught in NWFSC affiliated research in the past and they are unlikely to be affected in the future. The potential effects of the No Action or Preferred Alternative on these species are negligible and they will not be discussed further. In 2014, NMFS listed 20 species of corals as threatened, including five in the Caribbean and 15 in the Indo-Pacific (79 FR 53852). These species are known to occur in the western or central portions of the Pacific but not along the West Coast of the U.S. None of these species are known to occur within the NWFSC research areas and would not be expected to be affected by NWFSC research activities. Therefore, coral species are not discussed further in this SPEA.

In March 2023, the sunflower sea star (*Pycnopodia helianthoides*) was proposed as threatened under the ESA. The proposed rule noted that impacts from manmade factors including habitat degradation/destruction, fisheries, and trade were minimal and therefore 4(d) protective regulations were not proposed to prohibit take at that time. Additionally, due to a lack of sufficient information about this species, NMFS concluded that critical habitat was not determinable.

3.2.5.2 Target Species of Invertebrates

According to the 2018 PEA, more than 30 invertebrate species that are federally or state managed occur within the NWFSC research area but, of those, only three have been caught in NWFSC affiliated research. No additional invertebrate species have been identified in NWFSC surveys since publication of the 2018 PEA. These species are shown in Appendix J, Table J-2.

3.2.5.3 Other Invertebrate Species Caught in NWFSC Surveys

According to Section 3.2.5.3 of the 2018 PEA (NMFS 2018b), 74 marine invertebrate species have been historically encountered during NWFSC research surveys. No additional invertebrate species have been identified in NWFSC surveys since publication of the 2018 PEA. These species are named in Table 3.2-9 of the 2018 PEA and include squid, crabs, sea stars, sea cucumbers, jellyfish, shrimp, anemones, sea slugs, mussels, urchins, and snails.

3.3 Economic and Social Environment

3.3.1 NWFSC Operations

The NWFSC fisheries and ecosystem research activities have direct and indirect influence on the economics of U.S. communities and ports in which they operate. As described in the 2018 PEA, research-related spending directly generates jobs and income, and benefits

businesses in the private economy by expenditures on research-related equipment. The NWFSC carries out research in five facilities located in Washington and Oregon. At-sea assessments extend from marine waters off Canada to Mexico, with occasional surveys in Southeast Alaska. Communities that may be affected by proposed NWFSC research are located within the coastal states of Washington, Oregon and California.

Through direct expenditures on fisheries and ecosystem research, NWFSC contributes to the communities and ports in these regions. While the contribution of research-related employment and purchased services is beneficial on an individual basis, the total contribution of research is very small when compared to the value of commercial and recreational fisheries in the communities. Fisheries research is considered beneficial to the economic status of fishing communities through contribution to sustainable fisheries management. The NWFSC also conducts cooperative research with commercial fishing vessels which generates a certain amount of income for vessel owners and contributes to the local economies.

Fisheries research also contributes to local economies through operational support of NOAA vessels and chartered vessels (fuel, supplies, crew wages, shoreside services), operational costs of research support facilities (utilities, supplies, services), and employment of researchers who live in nearby communities. During the period of 2018 to 2021, NWFSC has spent approximately $78–82.6 million annually in support of the fisheries research activities covered in this SPEA, including operating costs for vessels and aircraft time, travel, equipment, logistics, crew wages, taxes and fees, and other incidental expenses (NWFSC Operations Management and Information Staff pers. comm. 2022).

To assess the potential influence of NWFSC research on the communities described above, the 2018 PEA and this SPEA rely on information from the commercial and recreational fisheries to provide a general sense of revenues and economic impact. The NMFS report titled, 'The Fisheries Economics of the United States' includes commercial market conditions, total tonnage of commercial fish landed and revenue by region and state, recreational fishing expenditures and levels of participation by region and state, key species, and community profiles. The 2019 report covers the period 2010-2019 (NMFS 2022k). To assess socioeconomic impacts in this SPEA, information from 2019 (NMFS 2022k) is compared to data for the period 2011 reported in the 2018 PEA.[7] For more detailed information on the entire time-series presented in the annual report, please refer to (NMFS 2022k).

NMFS (2022k) identifies four different measures commonly used to show how commercial fisheries landings/revenue affect the economy in a region (state or nationwide) which include: sales, income, value-added, and employment. Economic impact modeling assumes that every dollar spent in a regional economy (direct impact) is either saved or re-spent on additional goods or services. Dollars that are re-spent on other goods and services in the regional economy generate additional economic activity in the region (NMFS 2022k).

[7] Note the draft and final PEA used fisheries datasets up to 2011, the most recent data available at that time.

For both commercial and recreational fisheries, sales include: direct sales of landed fish or sales by an angler; and secondary sales made between businesses and households resulting from the original sale. Income includes: wages, salaries, and proprietors' income (income from self-employment). Value-added is the contribution of commercial and recreational fisheries to the gross domestic product in a region. Employment is specified on the basis of full-time and part-time jobs supported directly or indirectly by the sales of seafood, purchases by recreational angle, or items purchased to support commercial and recreational fishing (NMFS 2022k).

3.3.2 Commercial Fisheries

In terms of commercial and recreational fisheries management, the Pacific Region includes Washington, Oregon and California. Appendix K, Table K-1 summarizes the total economic effects of commercial fisheries in California, Oregon and Washington, in 2015, including total number of jobs, sales, income and value added.[8] These data represent the most recent year available (NMFS 2022k). In 2019, landings revenue in the Pacific region totaled $715.3 million, a 21% increase from 2010, with 71% of revenue, primarily from shellfish. Crab, other shellfish and Pacific hake accounted for $207.4 million, $152 million and $64.4 million of the total landings revenue, respectively. In 2018 and 2019, the largest increases in landings revenue were from Pacific hake (whiting) (34%), albacore tuna (12 %) and rockfish (9%). Landing revenues declined most notably for squid (58%), salmon (25%) and sablefish (18%) (NMFS 2022k). In total, the Pacific region landed over 1 billion pounds of finfish and shellfish in 2019, representing an 8% decrease from 2010 and a 9% decrease from 2018 (NMFS 2022k). More specific details on landings revenue for key species for the period 2012-2015 are shown in Appendix K, Table K-2. Dungeness crab represents the highest value consistently during this period, followed by Chinook salmon and Pacific hake (whiting).

Landings (in metric tons [mt]) by state for the period 2012-2020 are presented in Appendix K, Figure K-1. California has had the highest volume of landings during this period, followed by Washington. Appendix Figure K-2 presents landings by key species for the period 2012-2020. Clearly, Pacific hake (whiting) represents a significant portion of commercial catch year after year in the Pacific region during this period. Total revenue (in thousands of dollars) by key species for the period 2012-2020 is presented in Appendix K, Figure K-3 for California, Washington and Oregon combined.

Commercial fisheries refer to fishing operations that sell their catch for profit. The term does not include subsistence fishermen or saltwater anglers who fish for sport. It also excludes the for-hire sector, which earns its revenue from selling recreational fishing trips to saltwater anglers and imports from other locations. In 2019, as shown in Appendix K, Figures K-4 through K-6, commercial fisheries generated a total of 135,340 full- and part-time jobs through several sectors in the Pacific region including commercial harvesters, retail, seafood processors, wholesalers and distribution (NMFS 2022k).

[8] Value-added is the contribution made to the gross domestic product in a region NMFS (2022k). Fisheries Economics of the United States 2019: Economics and Sociocultural Status and Trends Series. March 2022, 249 pp.

3.3.3 Recreational Fisheries and Fishing

In 2019, recreational fishing accounted for $1.2 billion in sales in California, $245.5 million in Washington, and $72.2 million in sales in Oregon. This equated to a total of 727.7 million trips, 39.9% of which were on for-hire boats and 36.6% of which were taken with private boats. California generated the greatest income from recreational fisheries ($295.1 million, followed by Washington ($81.2 million) and Oregon ($27.4 million). Across the Pacific coastal states, expenditures on saltwater recreational fishing alone resulted in 8,413 jobs in California, 1,783 jobs in Washington, and 715 jobs in Oregon (NMFS 2022k).

Since 2010, there has been a 14% decrease in the number of recreational fishing trips taken in the Pacific region, with a total in 2019 of 4.3 million. The largest proportion of trips were taken in shore mode (51%) (NMFS 2022k).

3.3.4 Fishing Communities

The leading fishing ports by revenue and volume are reported by state for 2019 and 2020 (Appendix K, Table K-3). Ports are located in eleven communities in California, four in Oregon, and ten in Washington. As described in the 2018 PEA, many of these communities are home ports for fishing vessels that hold permits in both the Pacific and North Pacific Oceans so they spend part of the year fishing in Alaska (84 FR 22051). The top ranked port by revenue was Newport, Oregon, in both years (Appendix K, Table K-3).

4 ENVIRONMENTAL EFFECTS

4.1 Methodology and Impact Criteria

Section 4.1 of the 2018 PEA (NMFS 2018b) describes the methodology used to evaluate potential direct and indirect effects of fisheries and ecosystem research. The same methodology is applied here and consists of the following steps:

- Review and understand the proposed action and alternatives (Section 2).
- Identify and describe:
  - Direct effects that would be caused by the action and occur at the same time and place.
  - Indirect effects that would be caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable.
- Compare the impacts to the baseline conditions described in Section 3 and rate them as major, moderate, or minor.

Criteria shown in Table 4-1 were used in the 2018 PEA are also used to evaluate the SPEA No Action and Preferred Alternatives for resources identified in Section 3. The criteria provide guidance to place the impacts of the alternatives in an appropriate context, determine their level of intensity, and assess the likelihood that they would occur. Some evaluation criteria have also been based on legal or regulatory limits or requirements, and best management practices. The evaluation criteria include both quantitative and qualitative thresholds as appropriate to each resource. As described in the 2018 PEA, overall ratings of impacts (e.g., minor, moderate, adverse or beneficial, or no effect) are determined for a given resource by combining the assessment of the impact components.

Different types of impacts are determined for different resources as applicable. All biological resources are analyzed for impacts due to potential for mortality as well as injury from surveys. Prey removals and physical disturbance are analyzed for marine mammals. Analyses are based on the best available data and as such, may vary in terms of the periods for which data are readily available.

Certain categories of effects are not considered in this SPEA. For example, in the 2018 PEA, potential effects of contamination due to discharges from research vessels, whether accidental or intentional, were evaluated. Accidental discharges may include sewage, ballast water, fuel, oil, miscellaneous chemicals, garbage, and/or plastics. While accidental discharges could still occur during future research, this type of event is expected to be rare. The potential effects of such discharge including physical harm and/or death through both direct and indirect impacts would be the same as described in the 2018 PEA and therefore that analysis is incorporated by reference.

Table 4-1. Criteria for determining effect levels.

Resource Components	Assessment Factor	Effect Level		
		Major	Moderate	Minor
Physical Environment	Magnitude or Intensity	Large, acute, or obvious changes easily quantified.	Small but measurable changes.	No measurable changes.
	Geographic Extent	> 10% of action area (widespread).	5-10% of action area (limited).	0-5% of action area (localized).
	Frequency and Duration	Chronic or constant, lasting up to several months/years (long-term).	Periodic or intermittent, lasting several weeks to months (intermediate).	Occasional or rare, lasting ≤ a few weeks (short-term).
	Likelihood	Certain.	Probable.	Possible.
Biological Environment	Magnitude or Intensity	Measurably affects population trend. Marine mammal mortality or serious injury ≥ 50% of PBR.	Population level effects may be measurable. Marine mammal mortality or serious injury 10-50% of PBR.	No measurable population change. Marine mammal mortality or serious injury ≤ 10% of PBR.
	Geographic Extent	Distributed across range of a population.	Distributed across several areas that support vital life phase(s) of a population.	Localized to one area that supports vital life phase(s) of a population or non-vital areas.
	Frequency and Duration	Chronic or constant, lasting up to several months/years (long-term).	Periodic or intermittent, lasting several weeks to months (intermediate).	Occasional or rare, lasting ≤ a few weeks (short-term).
	Likelihood	Certain.	Probable.	Possible.
Social and Economic Environment	Magnitude or Intensity	Substantial contribution to changes in economic status of region or fishing communities.	Small but measurable contribution to changes in economic status of region or fishing communities.	No measurable contribution to changes in economic status of region or fishing communities.
	Geographic Extent	Affects region (multiple states).	Affects state.	Affects local area.
	Frequency and Duration	Chronic or constant, lasting up to several months/years (long-term).	Periodic or intermittent, lasting several weeks to months (intermediate).	Occasional or rare, lasting ≤ a few weeks (short-term).
	Likelihood	Certain.	Probable.	Possible.

4.2 Rationale for Discounting Disturbance Due to Acoustic Equipment or Vessels

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). These standards are the best available information for determining the impact of noise on marine mammals. For the purpose of our NEPA analysis, exposure resulting in PTS is considered as a major impact and exposure resulting in TTS is considered as a moderate impact.

4.2.1 Exposure Thresholds

The 2018 *Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing* (d), which was summarized in 2022 (NMFS 2022l), uses marine mammal hearing groups defined by Southall et al. (2007) with some modifications. These groups and their generalized hearing ranges are shown in Appendix L, Table L-1. NMFS (2018e) and NMFS (2022l) considered acoustic thresholds by hearing group to acknowledge that not all marine mammals have identical hearing ability or identical susceptibility to sound or sound-induced PTS. NMFS (2018e) also used the hearing groups to establish marine mammal auditory weighting functions. A 2019 publication by Southall et al. (2019) considers studies conducted since 2007 to better understand marine mammal hearing; however, the 2018 revised NMFS Technical guidance continues to be used for defining regulatory thresholds for calculating incidental takes of marine mammals under the MMPA (d, 2022l).

Appendix L, Table L-2 shows the acoustic thresholds resulting in PTS for cetaceans and pinnipeds in water as delineated in the guidance (d, 2022l). In addition, NMFS currently uses a TTS threshold (influencing behavior only) of 120 dB root mean square (rms) for continuous sound sources (i.e., echosounder EK60 used in fisheries surveys) and 160 dB rms for impulsive sound sources. These thresholds are conservative considering that many natural and anthropogenic sound sources such as conditions, geological processes, wind, wave action, rain or hail make important contributions to marine soundscapes (Duarte et al. 2021). Wind blowing over the ocean, waves breaking, rain or hail all generate sound that may exceed thresholds but not necessarily result in adverse behavioral effects to marine mammals.

4.2.2 Sound Levels Generated by Vessels and Acoustic Equipment

Underwater sound from vessels is generated from sources including propeller cavitation, vibration of machinery, flow noise, structural radiation, and auxiliary sources such as pumps, fans, and other mechanical power sources. Vessel sounds associated with research surveys are considered to be continuous noise sources. Marine mammals in the vicinity of surveys may be exposed to these sources. However, due to the transient nature of the exposure to vessel noise, and avoidance and mitigation measures such as the move-on rule described in Section 2.3, exposures would likely be unmeasurable and would not be likely to adversely affect marine mammals that may happen to be in the vicinity (NMFS 2019a). Therefore, the effects of exposure of marine mammals to vessel noise is not considered as a source of disturbance or impact in this SPEA.

As noted in Table 2-1, NWFSC researchers use acoustic equipment with various frequency ranges, 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, also used by NWFSC researchers operates at frequencies ranging from 10-500 kHz. While these frequencies are in the range of cetaceans, phocids and otariids, given the highly directional, e.g., narrow beam widths of acoustic equipment, NMFS does not anticipate animals would be exposed to underwater sound levels resulting in injury, and the potential for exposures resulting in behavioral changes is also reduced. In April 2020, NMFS published interim recommendations (Guan 2020) for sound sources such as multi-beam echosounders and sonar equipment used in geophysical surveys. These sources are similar to those used by NWFSC.

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 an even shorter distance 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, the potential sound levels and effects of this type of equipment on marine mammals are considered *de minimus* and are not assessed further in this SPEA.

4.3 Direct and Indirect Effects of the No Action Alternative

4.3.1 Effects on the Physical Environment

Overall, the effects of NWFSC research activities are expected to result in only minor adverse effects on physical resources and are therefore not significant. The 2018 PEA includes an analysis of the total footprint of NWFSC-affiliated research on benthic habitat, including EFH, the effects of which are considered small in magnitude, short-term in duration, and localized in geographic scope. An analysis is presented on the proportion of research sampling and biomass removals made within five National Marine Sanctuaries in the Pacific. The numbers of samples taken within each of the sanctuaries and the removals of fish and invertebrates for scientific purposes are relatively small and would have temporary and minor adverse effects and are therefore not significant.

4.3.2 Effects on the Biological Environment

ESA-listed fish, target fish, HMS, ESA-listed marine mammals, non-listed marine mammals, and ESA-listed sea turtles are considered in the following subsections. As described in Sections 3.2.4.2 and 3.2.6.2 of this SPEA, the 2018 PEA (NMFS 2018b) determined that effects on ESA non-listed seabirds and target species of invertebrates would be minor adverse and therefore not significant; these conclusions are not changed; therefore non-listed seabirds and invertebrates are not discussed further in this SPEA.

4.3.2.1 Effects on Fish

Section 3.2.1 describes fish species, including those listed under the ESA, that occur in NWFSC research areas. Not all fish species require re-evaluation under the No Action or Preferred Alternative because the potential impacts are expected to be the same as documented in the 2018 PEA (incorporated here by reference). Only ESA-listed fish and species potentially affected by the changed scope of activities or with a significant change in status or abundance are evaluated in the following subsections.

Only the effects of mortality from surveys is analyzed herein for fish species. While fish may exhibit behavioral changes such as diving towards the seafloor or relocating from the area where research vessels are approaching as a result of underwater sound or the presence of vessels, the low number of NWFSC surveys would not likely produce population-level effects. The use of underwater acoustic equipment such as the EK60/80 echosounders is not likely to cause biologically significant behavioral changes in fish given that most fish species have hearing ranges outside of the frequencies produced by these echosounders. In addition, the narrow beam width of the types of sonar equipment used by NWFSC reduces the exposure area such that the potential exposure of fish to these sources would be extremely limited, if at all (Guan 2020) (see Section 4.2). Overall, disturbance and changes in fish behavior due to exposure to underwater sound during NWFSC research activities are expected to be short-term and would not result in biologically significant changes to fish populations.

4.3.2.1.1 Fish Listed Under the Endagered Species Act

While not intended under the No Action Alternative, some ESA-listed fish may be incidentally caught or killed inadvertenly as a result of NWFSC Activities. Appendix M provides information on the numbers of eulachon, Pacific salmon and steelhead trout that NWFSC researchers have incidentally taken on an annual basis.

Bocaccio and Yelloweye Rockfish

While bocaccio are occasionally taken in NWFSC rockfish surveys, and in surveys conducted in the NMS, they are not likely to be from the Puget Sound/Georgia Basin DPS and are not caught in sufficient quantities to cause population-level effects. Therefore impacts under the No Action Alternative would be minor adverse and therefore not significant.

Yelloweye rockfish abundances in the NWFSC research areas remain unknown. However, considering the low number of takes that have occurred during NWFSC research 2018-2021, any detrimental effects of non-directed research on the species are expected to be minor adverse and therefore not significant.

Pacific Eulachon and Green Sturgeon

Adult Pacific eulachon have been incidentally caught during the Groundfish Bottom Trawl Survey; the Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey; Investigations of Hake Ecology, Survey Methods, and the California Current Ecosystem; and the Bycatch Reduction Research Survey. From 2013-2022 NWFSC surveys were estimated to lethally take from 260-6,477 adult eulachon each year (NMFS 2024a). The estimated abundance for

the Southern DPS of eulachon from 2018-2022 ranged from 18,796,090 to 81,736,000 adults. Impacts to the southern DPS eulachon from NWFSC surveys fall within the scope of the 2018 PEA, and are determined to be minor, adverse and therefore not significant. Likewise, as shown in Appendix M, takes of green sturgeon were very low, ranging from 0-3 annually. Therefore, the estimated incidental take as a result of NWFSC research is small, and any effects on this species would also be considered as not significant.

Pacific Salmon and Steelhead Trout

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 would be with gear that are not effective for catching salmon, numbers are expected to be (and have historically been) low as detailed in Appendix M. In general, juvenile and subadults that may be caught incidentally in a trawl would die or be seriously injured. Conversely, most salmonids caught on hook and line would be expected to live. Fish identification sheets are provided for all surveys along with a measuring board and vials for fin clips.

While incidental salmon bycatch in NWFSC surveys (namely trawls) has occurred where salmon may co-occur with survey target species (i.e., Vancouver Island, British Columbia south to approximately Point Conception), these events are considered rare.

At this time, there is no full-scale model that can provide a reliable estimate of the relative proportions of ESUs that may constitute salmon (in particular Chinook and coho) populations, across the year or at any given time. In 2018, the NWFSC developed a "salmon calculator" (Appendix N) to estimate the proportion of incidentally caught salmon to a specific ESU based on the location of the catch proximal to the origin of the ESUs. This approach follows the general concept described in NMFS (2020c), whereby consideration is given as to how incidental captures may be spread out among the various ESA-listed ESUs and DPS throughout the NWFSC research areas. Based on 30 years of data, salmon that are born north of Cape Falcon, Oregon are believed to travel north during their marine life stages. Salmon born south of Cape Falcon generally remain in the coastal waters off southern Oregon and California (Shelton et al. 2018). While some information about the general distributions of salmon in ocean is available, there is not have enough information to pinpoint exactly where and which salmon could be incidentally captured in NWFSC research survey trawls in the future.

Based on the fact that incidental catch of salmon during NWFSC has historically been low (with the exception of a 2021 survey which caught 78 Chinook (see full description below), and fact that most survey gear is not designed to target salmon, it is assumed that incidental catch of salmonids in future research would be low.

In 2021, while conducting Integrated Ecosystem and Pacific Hake Acoustic Trawl Survey (a midwater trawl) in federal waters off of Humboldt Bay, California, the NOAA Ship *Bell M. Shimada* incidentally caught 78 Chinook salmon. Of the 78 salmon caught, the salmon calculator spreadsheet was used to estimate the proportion of each ESUs came from 68 "natural" and 10 "adipose-clip" (i.e., hatchery fish) Chinook. Based on the spreadsheet and using numbers that are not rounded, the salmon are assumed to have been from the following ESUs: Lower Columbia River (both Natural and Adipose Clip), Puget Sound

(Natural), Snake River fall-run (Natural), Snake River spring/summer (Natural), and Upper Willamette River (Natural). Incidentally catching 78 Chinook is considered highly unusual and unprecedented for this survey, given that it targets Pacific hake. According to researchers present during the survey, this unexpected event is not likely to occur again given the spatial distribution of the survey, the gear used, and because hake are the target species, not salmon.

Based on the fact that incidental catch of salmon and specifically ESA-listed salmon are expected to be rare and due to the historically low incidental catch (with the rare exception of 2021) of salmon, the potential effects of NWFSC research on salmon ESUs listed in Appendix D are considered minor adverse and therefore not significant.

As far as directed research on salmon, there is potential for some fish to be from ESA-listed ESUs. For this reason, ESA Section 10 permits are required for certain research where this can occur. For reference, Appendix O summarizes weights of pacific salmon and steelhead trout caught during NWFSC directed salmon research for the Juvenile Salmon and Ecosystem Surveys (a survey for which a Section 10 permit has been authorized under the ESA; Permit #1410-13M). For the 2018 PEA, a threshold of 1,000 kg served as a basis of comparison against the amount of commercial and recreational catch for the purposes of analysis and is therefore, carried forward here. None of the total weights exceed 1,000 kg (i.e., are relatively low).

4.3.2.1.2 ESA-listed Target Fish

Direct mortality of target fish occurs as a result of fisheries research surveys and tagging activities. There have been no significant changes in the status of target species or in their capture by NWFSC surveys. Therefore, the analysis in the 2018 PEA, Section 4.3.3.2 stands and is incorporated by reference. The impacts of mortality due to surveys to these species are considered to be minor adverse (Table 4.2) and therefore not significant . See species caught during Puget Sound juvenile salmon studies (Appendix O), target fish removals over 1000 kg in national marine sanctuaries (Appendix P), target species caught (by count) during rockfish projects in Puget Sound (Appendix Q), and NWFSC research removals of Pacific hake in the California current ecosystem as a percentage of estimated hake biomass (Appendix R) and the discussion that follows.

For the 2018 PEA, a threshold of 1,000 kg served as a basis of comparison against the amount of commercial and recreational catch for the purposes of analysis and is, therefore, carried forward here. For most target species, data indicate the average amount of fish killed in NWFSC research is less than 10 percent of commercial landings and even smaller relative to the Overfishing Limit (OFL) for these fish. OFL is a fisheries management metric used to prevent overfishing. OFLs is defined as "the rate or level of fishing mortality or total catch that jeopardizes the capacity of a stock to produce the maximum sustainable yield on a continuing basis (50 CFR 600.310(e)(2)(i)(B))."

NWFSC conducts sampling in NMS and reports all catch within NMS boundaries. As shown in Appendix P, certain target fish have been removed from NMS during NWFSC surveys over the period 2018-2021 at quantities close to or over 1,000 kg. Where applicable, the data are summarized across catches within the existing NMS for the time period. Only species with at least 1,000 kg taken in any one of the three years are shown on this table. All other target species were taken at amounts lower than 1,000 kg, if at all.

Table 4-2. Summary of potential impacts of the No Action Alternative on non-listed target fish.

Target Fish	Mortality from Surveys	Description[a]
Arrowtooth flounder	Minor adverse, not significant	Consistently taken during surveys in NMS at levels over 1,000 kg.
Aurora rockfish	No effect	
Big skate	No effect	
Bocaccio[b]	Minor adverse, not significant	Removals in 2019 and 2021 were much lower as compared to 2018.
Canary rockfish	Minor adverse, not significant	Removals exceeded 1,000 kg in 2019.
Chilipepper	Minor adverse, not significant	Consistently taken during surveys in NMS at levels over 1,000 kg.
Darkblotched rockfish	No effect	
Dover sole	Minor adverse, not significant	Consistently taken during surveys in NMS at levels over 1,000 kg.
English sole	Minor adverse, not significant	Consistently taken during surveys in NMS at levels over 1,000 kg.
Greenstriped rockfish	No effect	
Halfbanded rockfish	Minor adverse, not significant	Removals jumped to just over 1,000 kg in 2021.
Lingcod	Minor adverse, not significant	With the exception of 2019, removals in NMS were just over 1,000 kg.
Longnose skate	Minor adverse, not significant	Removals in NMS are at levels near or double 1,000 kg.
Longspine thornyhead	Minor adverse, not significant	With the exception of 2019, removals in NMS were over 1,000 kg.
Northern anchovy	No effect	
Pacific cod	No effect	
Pacific grenadier	No effect	
Pacific hake	Minor adverse, not significant	Removals in NMS were over or close to 4,000 kg, but total research take is a very small percentage of total biomass (see Appendix P).
Pacific halibut	No effect	
Pacific herring	No effect	
Pacific ocean perch	Minor adverse, not significant	Removals exceeded 3,000 kg in 2018 but dropped below 1,000 kg in 2019 and 2021.
Pacific sanddab	Minor adverse, not significant	Consistently taken during surveys in NMS at levels over 1,000 kg.
Pacific sardine	No effect	
Pacific spiny dogfish	Minor adverse, not significant	Consistently taken during surveys in NMS at levels over or close to 1,000 kg.
Petrale sole	Minor adverse, not significant	Removals jumped from over 2,000 kg to nearly 11,500 kg in 2021.
Redstripe rockfish	No effect	
Rex sole	Minor adverse, not significant	Consistently taken during surveys in NMS at levels from 1,500-2,000 kg.
Rosethorn rockfish	No effect	
Rougheye rockfish	No effect	
Sablefish	Minor adverse, not significant	Removals were over 5,000 kg in 2019 and 2021.
Sharpchin rockfish	No effect	
Shortbelly rockfish	Minor adverse, not significant	Removals jumped to over 1,500 kg in 2021.
Shortspine thornyhead	Minor adverse, not significant	Removals jumped to nearly 1,200 kg in 2021.
Splitnose rockfish	Minor adverse, not significant	With the exception of 2019, removals were near or well over 3,000 kg.
Spotted ratfish	Minor adverse, not significant	Removals were consistently over or close to 1,000 kg.

[a] Data to support conclusions are shown in Appendices P and Q.
[b] This table considers the Southern Pacific Coast DPS, which is not listed under the ESA.

Table 4-2 (continued). Summary of potential impacts of the No Action Alternative on non-listed target fish.

Target Fish	Mortality from Surveys	Description[a]
Stripetail rockfish	Minor adverse, not significant	With the exception of 2019, removals were close to or over 2,000 kg.
Vermilion rockfish	Minor adverse, not significant	Removals were close to 1,000 kg.
Widow rockfish	No effect	
Yellowtail rockfish	Minor adverse, not significant	With the exception of 2021, removals were well over 1,000 kg.

The data in Appendix P can be used as a proxy to determine effects from all NWFSC research efforts. As shown in Appendix P, species with research catches that were consistently at or above 1,000 kg within the confines of an NMS would be expected to experience only minor adverse or negligible effects; these removals would not be expected to have population level effects. Therefore, for species with less than 1,000 kg removals within the confines of an NMS per year, NWFSC research would have no effect on mortality rates. The 2021 OFL for each species is listed for reference.

As shown in Appendix P, species with the highest consistent removals in NMS over the three years include chilipepper, Dover sole, Pacific hake, Pacific spiny dogfish (high outlier in 2019), sablefish, and yellowtail rockfish (low outlier in 2021). For these species, the magnitude of research mortality is very small and falls within the scope of the 2018 PEA. Thus this research is considered minor adverse and therefore not significant.

Relative to OFLs for 2025, the level of catch for all species is infinitely small by comparison and therefore considered minor adverse.

Appendix Q shows counts of important species caught during rockfish projects in Puget Sound, and Appendix R depicts the total research catch of Pacific hake in mt as a percentage of estimated total pacific hake biomass. As illustrated in Appendix R, the research catch is a miniscule percentage of total Pacific hake biomass in the California Current Ecosystem. This SPEA assumes that to be the case for all commercially important target fish since research catch is much lower than commercial catch (see Section 3.3.2). Overall, effects on these species fall within the scope of the 2018 PEA, are minor adverse, and are therefore considered to be not significant.

4.3.2.1.3 ESA-listed Anadromous Fish and ESA-listed Highly Migratory Species

In 2018 one bull trout was taken and released unharmed during a joint NWFSC/SWFSC survey (SWFSC and NWFSC 2019). No bull trout have been taken since (SWFSC and NWFSC 2020, 2021, SWSC and NWFSC 2022). Effects of actions analyzed under the No Action Alternative on bull trout are adverse but minor, if they occur at all, and are therefore not significant.

Scalloped hammerhead sharks are targeted and caught as bycatch in commercial fisheries throughout their range. While their range may overlap with some NWFSC research areas, the type of actions under the No Action Alternative are not likely to interact with this species, therefore no effect to scalloped hammerhead sharks.

4.3.2.1.4 Non-listed Highly Migratory and Other Fish Species

As described in Section 2, NWFSC does not conduct any directed research such as sample collection, or tagging and tracking of HMS. Appendix F lists the HMS with some potential to be encountered during NWFSC research surveys. As oceanographic conditions change over time, these species may be more likely to be encountered in waters north of southern California. As described in Section 3.2.2.1.2, sunfish, dogfish and blue sharks are sometimes caught in the Juvenile Salmon and Ocean Systems surveys. For example in 2018, five spiny dogfish and one ocean sunfish were caught and released.[9] Two blue sharks, four ocean sunfish, and seven spiny dogfish were caught during this survey in 2021. The Juvenile Salmon and Ocean Systems survey employs a Marine Mammal Excluder Device, which also serves to exclude most of the larger fish, further reducing potential impacts. These removals of HMS and other non-listed fish species are unchanged from the 2018 PEA, would have no effect on the species or populations, and are therefore considered as not significant.

4.3.2.2 Effects on Marine Mammals

Section 3.2.3 describes ESA-listed and non-listed marine mammals that may be affected by NWFSC research activities. Section 4.1. discusses the criteria used to assess impacts on marine mammals. Based on the discussion in Section 4.2, acoustic disturbance of marine mammals at either injury (Level A harassment) or behavior (Level B harassment) thresholds is not anticipated; however, incidental takes due to physical disturbance (Level B harassment) have been documented during NWFSC research activities, and there is a slight potential for mortality/serious injury M/SI takes due to encounters with NWFSC sampling equipment. These direct effects along with indirect effects due to removal of prey are assessed herein and fall within the scope of the 2018 PEA. Table 4-3 summarizes the potential effects of the No Action Alternative on ESA-listed and non-listed marine mammals. Sections 4.3.2.2.1, 4.3.2.2.2, and 4.3.2.2.3 describe the rational for the determination of level of effects due to injury or mortality from surveys, physical disturbance, and changes in food availability, respectively.

4.3.2.2.1 Injury or Mortality from Surveys

Marine mammals can suffer injury or mortality due to research vessel strikes and/or encounters with research gear such as long lines or trawls that could result in entanglement leading to injury or death. To date, no collisions with large whales have been reported from any fisheries research activities conducted or funded by the NWFSC. 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 slow speeds along with mitigation measures to watch for marine mammals during gear towing essentially eliminate the risk of ship strikes.

As summarized in Section 4.2.4 and Table 4.2.14 of the 2018 PEA (NMFS 2018b), from 1999-2014 forty incidents of incidental take of marine mammals occurred during NWFSC research trawling efforts. Species impacted included Pacific white sided dolphins, Steller sea lions, California sea lions harbor seals and northern fur seals. In 2014, MMEDs were required on all Nordic 264 trawls and their use continues today. Since 2018 there has only been one marine mammal mortality due to interactions with Nordic 264 trawl research gear (NWFSC 2019, 2020, 2021, 2022, 2023, 2024). This incident involved a Stellar sea lion

[9] Data provided by Cheryl Morgan, NMFS, on June 2, 2022.

Table 4-3. Summary of potential impacts of the No Action Alternative on ESA-listed and non-listed marine mammals.

Species and Stock or DPS	Potential Impact of the No Action Alternative		
	Injury or Mortality for Surveys	**Physical Disturbance**	**Changes in Food Availability**
ESA-listed Species			
Sperm whale *CA/OR/WA stock*	Minor adverse, not significant	No effect	No effect
Humpback whale *Central America DPS, Mexico DPS*	Minor adverse, not significant	No effect	No effect
Blue whale *Eastern North Pacific stock*	Minor adverse, not significant	No effect	No effect
Fin whale *CA/OR/WA stock*	Minor adverse, not significant	No effect	No effect
Sei whale *Eastern North Pacific stock*	Minor adverse, not significant	No effect	No effect
Gray whale *Western North Pacific stock*	Minor adverse, not significant	No effect	No effect
Killer whale *Southern Resident DPS*	Minor adverse, not significant	No effect	No effect
Guadalupe fur seal	Minor adverse, not significant	No effect	No effect
Sea otter *Southern subspecies*	Minor adverse, not significant	No effect	No effect
Non-ESA-listed Species			
Harbor porpoise	Minor adverse, not significant	Minor adverse	No effect
Dall's porpoise	Minor adverse, not significant	No effect	No effect
Pacific white-sided dolphin	Minor adverse, not significant	No effect	No effect
Risso's dolphin	Minor adverse, not significant	No effect	No effect
Common bottlenose dolphin	Minor adverse, not significant	No effect	No effect
Striped dolphin	Minor adverse, not significant	No effect	No effect
Short-beaked common dolphin	Minor adverse, not significant	No effect	No effect
Long-beaked common dolphin	Minor adverse, not significant	No effect	No effect
Northern right whale dolphin	Minor adverse, not significant	No effect	No effect
Killer whale *Eastern North Pacific Northern Resident, West Coast Transient, and Eastern North Pacific Offshore stocks*	Minor adverse, not significant	No effect	No effect
Short-finned pilot whale	Minor adverse, not significant	No effect	No effect
Baird's beaked whale	Minor adverse, not significant	No effect	No effect

Table 4-3 (continued). Summary of potential impacts of the No Action Alternative on ESA-listed and non-listed marine mammals.

Species and Stock or DPS	Potential Impact of the No Action Alternative		
	Injury or Mortality for Surveys	Physical Disturbance	Changes in Food Availability
Mesoplodon spp.	Minor adverse, not significant	No effect	No effect
Pygmy or dwarf sperm whale	Minor adverse, not significant	No effect	No effect
Humpback whale *Hawaii DPS*	Minor adverse, not significant	No effect	No effect
Minke whale	Minor adverse, not significant	No effect	No effect
Gray whale *Eastern North Pacific stock*	Minor adverse, not significant	No effect	No effect
California sea lion	Minor adverse, not significant	Minor adverse, not significant	No effect
Steller sea lion	Minor adverse, not significant	Minor adverse, not significant	No effect
Northern fur seal	Minor adverse, not significant	No effect	No effect
Northern elephant seal	Minor adverse, not significant	No effect	No effect
Harbor seal	Minor adverse, not significant	Minor adverse, not significant	No effect
Sea otter *Northern subspecies*	Minor adverse, not significant	No effect	No effect

and occurred during 2024 while surface trawling using a 264 Nordic rope trawl equipped with a MMED. A total 6 acoustic deterrent devices were also installed and were confirmed to be in working order prior to net deployment.

Up until 2018, NWFSC had no history of marine mammal M/SI in hook-and-line gear (including longlines, rod and reel, and trolling deployments) or purse seine or tangle net gear (NMFS 2018b). However, on Sept 28, 2021, a California sea lion swallowed a hook during a hook and line survey from a contracted ship in the vicinity of Catalina Island (NWFSC 2022). This animal 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 incident was entered into the Protected Species Incidental Take (PSIT) data base as "injured" and considered M/SI. No other M/SI or Level A harassment were recorded for hook and line surveys over the period 2018-2024 (NWFSC 2019, 2020, 2021, 2022, 2023, 2024).

Since 2018, NWFSC sampling activities resulted in a total of four incidents of M/SI on three occasions using midwater or bottom trawl gear. Two separate incidents involved bottom trawl survey gear and resulted in the death of a single sea lion. A third incident resulted from midwater trawl surveys conducted by our Canadian partners and resulted in the death of two Pacific white-sided dolphins. These events were recorded in the PSIT database. Because M/SI of marine mammals has occurred but is very rare and unlikely to produce effects at the population level, our conclusions about the impacts of mortality from surveys on all listed and non-listed marine mammals in the NWFSC research area fall within the scope of the 2018 PEA, and determined to be minor adverse and therefore not significant under the No Action Alternative.

4.3.2.2.2 Physical Disturbance

As described in the 2018 PEA, there are numerous pinniped haul-outs within Puget Sound and the Columbia River estuary. Animals hauled out or in the water may be disturbed by the physical presence and researcher activities in the vicinity. Physical disturbance of cetacean species due to the presence of researchers is not anticipated.

Appendix S shows that actual Level B harassment of pinnipeds and harbor porpoise from 2018-2023 was small. This overall low level of physical disturbance would not be expected to have significant impacts on each species listed.

Physical disturbance of sea otters is not expected and if any sea otters are observed researchers will follow mitigation measures for avoiding them similar to those described in Table 2-2 for work around hauled-out pinnipeds.

4.3.2.2.3 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 prey taken in research surveys is very small relative to their overall biomass in the area, thus resulting in an adverse effect that is not significant (NMFS 2018b). This conclusion falls within the scope of the 2018 PEA.

While some NWFSC research surveys sample zooplankton on which baleen whales such as humpback whales, sei whales and blue whales feed, the biomass of plankton collected is negligible and would have no effect on prey availability for these whales. 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 porpoise, and sperm whales (Fiscus 1979). Table 4-4 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. In addition, NWFSC research incidentally takes marine mammal prey species such as mackerel, sardines, krill and squid. However, total removals of prey biomass during NWFSC research activities are low overall.

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 sample areas. Fish removals by research are therefore highly localized and unlikely to affect the spatial concentrations and availability of prey for any marine mammal species. This is especially true for pinnipeds, which are opportunistic predators that consume a wide assortment of fish and squid. For these reasons, it is determined that removal of prey biomass during NWFSC surveys will not change food availability and will have no effect on overall prey sources for marine mammals.

Table 4-4. Prey biomass removed during 2021 NWFSC research surveys.

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

[a] Source: NWFSC, July 2022.

4.3.2.2.4 Effects on Newly Designated or Revised Marine Mammal Critical Habitat

As described in Section 3.2.3.1.2, critical habitat for humpback whales was designated in 2021. The final rule (86 FR 21082) describes access to adequate prey as the only essential physical or biological feature of humpback whale critical habitat. Humpback whales are generalists who consume a wide variety of prey while foraging, and also switch between target prey species depending on what is most abundant or potentially of highest quality in the system (86 FR 21082). As described in Section 4.3.2.2.3, removals of prey species under the No Action Alternative are minimal and there would be minimal if any effect on humpback whale critical habitat.

Critical habitat for Southern Resident killer whales was amended in 2021 (86 FR 41668) (see Section 3.2.3.1.2). Three original physical or biological features of the critical habitat were upheld in the revision: water quality; availability of prey and unrestricted passage to allow for migration, foraging and breeding. As described in the 2018 PEA, NWFSC research would have no adverse effects on water quality. In addition, because NWFSC research activities in or near Southern Resident killer whale critical habitat would be of short duration, passage or movement of any marine mammals would not be affected by the research activities. Specifically for Southern Resident killer whales, NWFSC research would not sufficiently block their access to migration corridors or resting or foraging areas at levels sufficient to cause more than minor adverse impacts. However, considering the importance of salmon (in particular Chinook salmon) for the Southern Resident DPS killer whale diet, the removal of salmon (incidentally or as directed research take under Section 10 permits) is further evaluated here.

In June 2018, NOAA Fisheries West Coast Region and the Washington Department of Fish and Wildlife published a paper entitled, *Southern Resident Killer Whale Priority Chinook Stocks Report* (NMFS and WDFW 2018). Based on a conceptual model, Chinook stocks were prioritized based on three factors including: whether the stock was observed in Southern Resident killer whale tissue or fecal samples; whether a stock was consumed by a Southern Resident killer whale with a reduced body condition; or the spatial/temporal overlap between the Chinook stock and Southern Resident killer whales. During summer months, Southern Resident killer whales feed primarily on Chinook salmon that are returning to the Fraser River in British Columbia and Puget Sound. Chum, coho, and steelhead as well as small amounts of bottom fish including halibut and lingcod are supplemental prey items for these whales during other months, which may indicate there are not enough Chinook salmon available.[10]

As described in Section 4.3.2.1.1, in 2021, the NWFSC Integrated Ecosystem and Pacific Hake Acoustic-Trawl Survey had an incidental catch of 78 Chinook salmon. According to researchers present during the survey, this unexpected event is considered rare and not likely to occur again given the spatial distribution of the survey, the gear used and because hake are the target species, not salmon. Given the total quantity of prey species available to Southern Resident killer whales throughout their range and the low probability of catching large numbers of Chinook salmon in future NWFSC surveys, the magnitude of research incidental catch of Chinook is considered minor. Overall, the amount of Chinook salmon (or any other marine fish species that may be considered prey) that has been removed under the No Action Alternative is not expected to have an adverse effect on the availability of prey for Southern Resident killer whales and any effects on their critical habitat would likely not be significant.

[10] Source: https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/southern-resident-killer-whale-priority-chinook-salmon (accessed August 29, 2022).

In conclusion, none of the three essential components of Southern Resident killer whale critical habitat or humpback whale critical habitat would be adversely affected under the No Action Alternative given that research is dispersed over large areas, occurs intermittently, has no effect on water quality, would not reduce prey species in notable amounts, and would not prevent passage through migratory corridors.

4.3.2.3 Effects on ESA-listed Seabirds

4.3.2.3.1 Short-tailed Albatross

As described in Appendix H, when not nesting, short-tailed albatross spend most of their life cycle in flight over the Pacific Ocean where they are susceptible to entanglement in fishing gear. Under the No Action Alternative, studies in the CCRA using trawls, seines, and longlines could impact short-tailed albatross. However, to date NWFSC has had zero historical takes of this species (USFWS 2017). This is not expected to change moving forward under the No Action Alternative. In addition, as shown in Table 2-2, mitigation measures to protect seabirds during trawl and longline surveys will be followed. Therefore, impacts of NWFSC research under the No Action Alternative on short-tailed albatross are expected to be minor adverse and therefore insignicant.

4.3.2.3.2 California Least Tern

As described in Appendix H, California least terns are generally found from San Francisco south to Baja (USFWS 2006). As described in Appendix H, they nest on open beaches and forage in nearshore waters and in shallow estuaries and lagoons.

The majority of NWFSC research occurs north of San Francisco, CA. In the fall, the Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat occurs off the California coast from north of Los Angeles to San Diego where these birds are more likely to be encountered (see Table 2.2).

Mitigation measures to protect seabirds during trawling and hook and line research activities are shown in Table 2-2. By following these measures, NWFSC researchers will further reduce the potential for interactions with California least terns. Therefore, interactions with this species are not expected under the No ActionAlternative and any effects of NWFSC research on this species would be considered to be minor adverse and therefore insignicant.

4.3.2.3.3 Marbled Murrelet

The murrelet is a small diving seabird that nests mainly in coniferous forests and forages in nearshore marine habitats (USFWS 2017). Murrelets spend most of their life foraging and breeding in the nearshore marine environment, but use old-growth forests for nesting. Their preferred marine habitat includes sheltered, nearshore waters within 5 km of shore. They are found in all three NWFSC research areas, but densities are expected extremely low within the LCRRA (USFWS 2017).

As described in USFWS (2017), marbled murrelets can become entrapped in purse seines or entangled in longline gear. One study under the No Action Alternative, Movement Studies of Puget Sound Species, uses demersal longlines in Puget Sound and may overlap with marbled murrelet foraging areas. Other longline research projects including pelagic longlining (see Table 2-2) would not be expected to occur in that habitat. Even if marbled murrelets are present in the general vicinity of research activities using demersal or other longlines, aggregations of other, larger birds congregating around longlining activity would likely deter marbled murrelets from approaching the research gear; marbled murrelets are not expected to be close enough to longline fishing gear to risk contact (USFWS 2017).

As shown in Table 2-2, purse seines are used in two NWFSC research projects under the No Action Alternative: Movement Studies of Puget Sound Species (occurring only in the PSRA) and Benefits of Wetland Restoration to Juvenile Salmon: Action Effectiveness Monitoring (occurring only in the LCRRA). While marbled murrelets may be encountered during either of these surveys, there have been no takes historically of these birds during NWFSC research activities (USFWS 2017). Mitigation measures shown for purse seines and longlines in Table 2-2 would further reduce the possibility of impacts to marbled murrelets; therefore, the impacts of the No Action Alternative on marbled murrelets is expected to be minor adverse and therefore insignicant.

4.3.2.3.4 Western Snowy Plover and Streaked Horned Lark

The western snowy plover is a small shorebird that nests on the mainland coast, peninsulas, offshore islands, bays, estuaries, salt ponds, and rivers of the Pacific Coast from southern Washington to southern Baja California, Mexico. Snowy plover use of the marine environment is very limited; they forage on tidal mudflats and may migrate a short distance from the shoreline. Substantial and persistent breeding populations of streaked horned larks can be found near beaches along the southwest Washington coast and on several islands of the lower Columbia River estuary (USFWS 2017).

Under the No Action Alternative, NWFSC research activities that may affect western snowy plover and streaked horned larks include beach and pole seining and associated activities along shorelines within suitable lark and plover habitat. The presence of humans adjacent to or within nesting areas could cause flushing of nesting or foraging birds, which in turn could cause increased energetic costs, reduced foraging time, nest failure, and reduced reproductive success. Researchers who walk within nesting areas could also inadvertently crush nests.

Based on information provided by NWFSC for the 2017 BiOp (USFWS 2017) personnel conducting beach seines do not intentionally enter upland habitat. Mitigation measures shown in Table 2-2 will be implemented for NWFSC research occurring in or near streaked horned lark and western snowy critical habitat. Under the No Action Alternative, given that few, if any, of these birds are likely to occur within the areas proposed for beach or pole seining and personnel will not enter upland habitat, the effects of the alternative on western snowy plover and streaked horned larks would be considered minor and therefore insignicant. Also, since no upland habitat will be entered under the No Action Alternative, critical habitat for the streaked horned lark and snowy plover will not be affected (USFWS 2017).

4.3.2.4 Effects on Non-listed Seabird Species

The Juvenile Salmon PNW Coastal Survey has not changed in scope, location, or gear from that analyzed in the 2018 EA. Therefore, the minor adverse conclusions regarding effects on these non-listed bird species, as described in the 2018 PEA are not changed and are therefore not significant. In addition, mitigation measures to protect seabirds during research using demersal longlines will further reduce the chance for effects (see Table 2-2). Potential effects on non-listed seabirds would be minor adverse, and therefore not significant, as described in the 2018 PEA; these species are not discussed further.

4.3.2.5 Effects on Sea Turtles

The No Action Alternative could affect turtles though entanglement in gear causing mortality or serious injuries, and/or effects on prey. As described in the 2018 PEA, sea turtles may occasionally be found near Puget Sound and at the mouth of the Columbia River but they are mostly found in the CCRA.

Available information on sea turtle hearing suggests that underwater hearing capabilities are limited in functional hearing bandwidth and in absolute hearing sensitivity. Turtles have been shown to respond to low frequency sound. Data suggest that sea turtle hearing is functionally sensitive between about 100 Hz and 1.2 kHz (Ketten and Bartol 2006, Dow Piniak et al. 2012), which is well below the frequencies of acoustic instruments used in fisheries research (18-133 kHz). The higher frequency sounds are unlikely to be audible to sea turtles and therefore unlikely to have any effects. In addition, as described in Section 4.2, the narrow, highly directional band width of acoustic devices used by NWFSC researchers further limits the distance of effects, similar to marine mammals (see Section 4.3.2.2). Impacts from acoustic devises used by NWFSC would not be expected and are not discussed further. Table 4-15 summaries the potential effects of NWFSC research on sea turtles due to engagement in gear and/or collisions with vessels.

Although the NWFSC has no history of interactions with sea turtles (NMFS 2016r, 2018b, NMFS 2024a) there is a potential that a turtle could be caught in research gear. The 2024 BiOp (NMFS 2024a) addresses the vulnerability of sea turtles to trawl gear and notes that NWFSC pelagic trawls used in nearshore coastal waters can also entangle sea turtles. Mitigation measures to reduce the potential for impacts to marine mammals, including the use of MMEDs and monitoring by crews (see Section 2.3) will also reduce impacts for the No Action Alternative on sea turtles. The 2024 BiOp determined that in any year one sea turtle from any of four ESA-listed sea turtle species (leatherback, olive ridley, green or loggerhead) could be captured in the NWFSC survey trawl gear. As described in Section 3.2.5, hawksbill sea turtles are not expected to be encountered and are not considered in Table 4-5. Therefore minor adverse effects due to mortality or injury from encountering NWFSC research gear or vessels would be expected for the four sea turtle species shown in Table 4-5, and these effects are not expected to be significant.

As stated in Table 3-8, west coast critical habitat for leatherback sea turtles was designated in 2012. Designated critical habitat for leatherback sea turtles consists of two sections of marine habitat where leatherbacks are known to feed on jellyfish. As described the 2024

Table 4-5. Summary of potential impacts of the No Action Alternative on ESA-listed sea turtles.

ESA-Listed Species	Mortality from Surveys	Description
Leatherback sea turtle	Minor adverse, not significant	While expected to be rare, encounters with all of these species are possible.
Olive Ridley sea turtle	Minor adverse, not significant	
Green sea turtle	Minor adverse, not significant	
Loggerhead sea turtle	Minor adverse, not significant	

BiOp, removals of turtle prey species such as jellyfish during NWFSC research in the CCRA would be inconsequential considering the total prey available and the fact that surveys move from station to station there by spreading out prey removals in time and space (NMFS 2016r). Therefore, the only potential effect of the No Action Alternative on sea turtles would be due to injury or mortality from encountering research gear, and there would be minimal effect on leatherback designated critical habitat.

4.3.3 Effects on Invertebrates

Sunflower sea stars can occupy soft or hard-bottom substrate in marine areas, therefore, NWFSC surveys using demersal or benthic trawling methods are likely to interact and could adversely affect this species. Although data suggest the density of sunflower sea stars is low, NWFSC surveys have collected this species in the past.

NWFSC Annual capture of sunflower sea stars by the NWFSC bottom trawl survey ranged from 126 to 397 individuals from 2004-2014 but decreased significantly thereafter to between 1 to 4 individuals captured from 2015-2018. Current encounters are similarly low and over the coming years, we anticipate that encounters with sea stars will continue to be less than 10 individuals per year due to their low abundance and density.

On March 16, 2023, a proposed rule for listing the sunflower sea star (as Threatened) Under the Endangered Species Act (ESA) was published in the Federal Register (88 FR 16212). In the foreseeable future, if the population recovers to its pre-2014 abundance, we still do not expect encounters with sampling gear to exceed 500 animals annually.

Due to the potential for NWFSC surveys to adversely impact this species through "relocation, behavioral disruption (e.g., feeding, spawning), increased stress (which is linked with Sea Star Wasting Disease (susceptibility), and physical contact resulting in injury or death," the NWFSC initiated a conference with NOAA's Protected Resources Division (PRD)(NMFS 2024). NMFS concluded that NWFSC research activities were not likely to jeopardize the continued existence of sunflower sea stars (NMFS 2024). For the purpose of this analysis, the effects described above at current and projected impact levels are considered as minor adverse, and therefore not significant.

4.3.4 Effects on the Social and Economic Environment

Major factors that could be influenced by the NWFSC research program under the No Action Alternative include:

- Collection of scientific data used in sustainable fisheries management.
- Economic support for fishing communities.
- Collaborations between the fishing industry and fisheries research.
- Fulfillment of legal obligations specified by laws and treaties.

NWFSC headquarters are located in Seattle, Washington, and there are five research stations in Washington and Oregon. Effects of the No Action Alternative to the communities in these regions are complex and involve multiple factors that result in driving changes both socially and economically. For the purposes of assessing the effects of NWFSC research on socioeconomics in these areas, this SPEA relies on information from the commercial and recreational fisheries to provide a general sense of revenues and economic impact. NMFS's report titled *The Fisheries Economics of the United States* NMFS 2022k, 2024c) provides information on commercial market conditions, total tonnage of commercial fish landed and revenue by region and state, recreational fishing expenditures and levels of participation by region and state, key species, and community profiles which has been summarized in Section 3.3 of this SPEA.

Annual expenditures of the NWFSC for fisheries and ecosystem research ranged from $78-82.6 million for the period 2018-2021, with 2018 having the highest level of funding ($82.6 million) during that period. This funding is used to support field surveys, data collection and analysis, permitting, reporting and other administrative functions. Through direct expenditures on fisheries and ecosystem research, NWFSC contributes to the communities and ports across the Pacific seaboard. While the contribution of research-related employment and purchased services is beneficial on an individual basis, the total contribution of research is very small when compared to the value of commercial and recreational fisheries in the communities. Fisheries research is considered a minor beneficial effect to the economic status of communities within the research areas.

4.3.4.1 Collection of Scientific Data Used in Sustainable Fisheries Management

Stock assessments in the Northwest research regions rely on the data collected from long-term standardized resource surveys conducted by NOAA fishery research vessels. Fishery managers use the extended time-series of data to identify trends and to inform fisheries management decision-making. This information is essential for establishing annual species-specific sustainable harvest limits. Harvest limits that are set too high may lead to overfishing of specific stocks and more restrictive management measures in the future to rebuild those stocks. Harvest limits that are set too low do not allow a maximum sustainable harvest that benefits commercial and recreational fisheries and the communities and services that support them. In addition, the predictability and reliability of long-term data sets and the harvest limits they support is essential for economic stability in the fisheries over time. Therefore, the data collected under the No Action Alternative has economic impacts on the commercial and recreational fishing industries off the west coast.

4.3.4.2 Economic Influence of Research

As described in Section 3.3.1, the NWFSC spent approximately $78-82.6 million in annual operations costs for the period 2018-2021. These funds provide both primary and secondary economic influences on the communities and ports in the region. These funds are distributed among the five NWFSC research stations within the Action Area. The operating budget directly supports employees and operations of facilities at these locations. Funds are spent annually on collecting data at-sea over a geographic area extending from Canada to the southern border of Mexico. Funds are expended for ship and aircraft time, equipment and logistics, contracts, crew wages, and taxes and fees. NOAA-owned ships, charters, and leased research vessels operate from several home ports, and are serviced in many others benefiting those communities. Some commercial fishing operations are compensated for participation in cooperative research projects through grants or shares in fishing quotas that they sell on the market. Therefore, the primary and secondary economic influence from NWFSC operations under the No Action Alternative has economic impacts on communities and ports in the region.

4.3.4.3 Summary of Effects on the Social and Economic Environment

The No Action Alternative would contribute important scientific information for sustainable fisheries management of the valuable commercial and recreational fisheries along the U.S. Pacific Coast. These contributions benefit commercial and recreational fisheries and the communities that support them. The fishing industry generates millions of dollars' worth of sales, thousands of commercial fishing-related jobs, and provides millions of people across the country with highly valued seafood (https://www.fisheries.noaa.gov/data-tools/fisheries-economics-united-states-data-and-visualizations). Recreational fishers also participate and support fishing service industries (see Section 3.3). Direct employment, purchase of fuel, vessel charters, and supplies for NWFSC fisheries research would also result in minor benefits to fishing communities along the coast. For these reasons, the overall effects of NWFSC-affiliated research under the No Action Alternative is considered to have long-term, minor to moderately beneficial effects on social and economic resources.

4.4 Direct and Indirect Effects of the Preferred Alternative

As described in Section 2 and shown in Tables 2-1 and Appendix B, the Preferred Alternative includes the studies described under the No Action Alternative, with the discontinuation of certain projects and gear, addition of several new projects, and modifications to existing projects.

4.4.1 Effects on the Physical Environment

The effects of the Preferred Alternative on the physical environment and on special resource areas would be similar to those of the No Action Alternative (Section 4.3.1). The additional studies proposed under Alternative 2 (see Tables 2-1 and Appendix B) would not change the effects of the research activities on physical properties of the environment and would be minor adverse and therefore not significant.

4.4.2 Effects on the Biological Environment

As described in Section 4.3.2. for the No Action Alternative, only certain ESA-listed fish, target fish, HMS, ESA-listed marine mammals and non-listed marine mammals, ESA-listed seabirds, and sea turtles have been brought forward for analysis in this SPEA.

Overall impacts on biological resources would be potentially reduced due to the discontinuation of bottom trawl use in Bycatch Reduction Research and discontinuation of the Near Coastal Ocean Purse Seining project. However most of the new surveys proposed under the Preferred Alternative use gear such as ROVs, plankton nets, tangle nets (which do not harm salmon, UxS, CTDs, SCUBA, hand nets, crab traps hydrophones, towed cameras, water collection for eDNA analysis and transducers or passive listening devices. These gear types would not be expected to induce additional impacts on biological resources beyond those considered in the 2018 PEA. The exceptions would be the addition of sablefish pots and demersal longlines to Bycatch Reduction Research; purse seines and microtrolling[11] (hook and line) in the new SOBaD study; baby otter trawl, cast nets, and gill nets in the Fish Contaminants Study; fyke nets in the new Habitat Function of Nearshore Ecosystems with Shellfish Aquaculture and Eelgrass study; a Lampara seine in the new Near Coastal Ocean Lampara Seining and ROV Surveys; and a micro-purse seine in the Lower Columbia River Ecosystem Monitoring. The potential effects of these gear types are described in more detail in the following sections.

4.4.2.1 Effects on Fish

NWFSC-affiliated fisheries research conducted under the Preferred Alternative would have the same types of effects on fish species as described for the No Action Alternative (Section 4.3.2.1) through mortality. The use of bottom trawling would be eliminated during the Bycatch Reduction Research, the near Coastal Ocean Purse Seining project would be discontinued, and less harmful tangle nets would be used in some new studies under this alternative. These changes could reduce small scale effects on fish but overall determinations presented in Section 4.3.2.1 would not be changed. Bottom trawls and the use of purse seines would still continue for other projects as shown in Table 2-1. Other types of new gear that are proposed such as fyke nets, Lampara seines and baby otter trawls (see Section 2 and Appendix B), could affect fish species. However, the population level effects for ESA-listed and non-listed target fish brought forward for analysis would not be expected to change. As described in Section 4.3.2.1.3, these effects range from no effect on certain species to moderate adverse for ESA-listed Pacific salmon and steelhead trout. HMS species would not be affected as described in Section 4.3.2.1.4. In addition, NWFSC research actions under the Preferred Alternative would have no effect on bull trout critical habitat.

As described in Section 4.3.2.1.1 and Appendix M, small numbers of Pacific salmon and steelhead trout may be taken but many adult fish are able to be returned to the water alive with no long-term adverse effects (see Table 2-2). The addition of these few new studies

[11] Microtrolling is modified hook and line sampling that is done using downriggers with braided Dacron line and weighted with a 15 lb lead ball. Leaders are 200 cm of 150 lb test monofilament, a flasher, then 50 cm of terminal gear with 10 lb test and a size 0 Dick Nite spoon. Leaders are attached directly to the downrigger line.

and modifications to existing studies would not be expected to change the outcome. Therefore, the overall effects of NWFSC research on ESA-listed fish species under the Preferred Alternative would be similar to the No Action Alternative and would range from minor to moderately adverse, but are not expected to be significant (see Section 4.3.2.1.1).

4.4.2.2 Effects on Marine Mammals

Under the Preferred Alternative, the potential direct and indirect effects on marine mammals through Injury or mortality, physical disturbance or changes in prey availability would be the same those described for the No Action Alternative (Table 4-3) where effects have been identified, they would be considered minor adverse for all species. In addition, the NWFSC considers the current suite of mitigation and monitoring measures to be necessary to avoid adverse interactions with protected species and still allow the NWFSC and its cooperating partners to fulfill their scientific missions. The mitigation measures currently in place under the No Action Alternative to protect marine mammals (see Table 2-2) are also proposed under the Preferred Alternative and would continue to be implemented for the foreseeable future. Mitigation measures to protect marine mammals during the use of tangle nets, purse seines, and Lampara seines are described in Table 2-2 and would be implemented under the Preferred Alternative. Other new mitigation measures for pot and trap gear under this alternative that would protect marine mammals include the use of weighted lines for traps, and fitting beach traps with aluminum bars to prevent marine mammals from entering the holding/collection area. While these measures would provide some additional protection during certain studies, overall effects on ESA-listed and non-listed marine mammals remain the same as the No Action Alternative (Table 4-3).

4.4.2.2.1 Effects on Newly Designated or Revised Marine Mammal Critical Habitat

Effects of the Preferred Alternative on humpback whale critical habitat beyond those identified for the No Action Alternative are not expected. Prey removals would not be very different from those described in Section 4.3.2.2.4. In addition, as described for the No Action Alternative, the amount of Chinook salmon (or any other marine fish species that may be considered prey) that could be removed during future NWFSC research under the Preferred Alternative is not expected to have an adverse effect on the availability of prey for southern resident killer whales and any effects on their critical habitat would be minor.

4.4.2.3 Effects on Seabirds

4.4.2.3.1 Short-Tailed Albatross

The Preferred Alternative would add demersal longlines (50-3,000 hooks per set, up to 5 sets per day) to Bycatch Reduction Research (see Appendix B). To assess impacts of longline gear on short-tailed albatross, the 2017 Biological Assessment prepared jointly by SWFSC and NWFSC (SWFSC and NWFSC 2017) estimated the number of hooks used each year as part of the proposed research activity. As stated in SWFSC and NWFSC (2017), NWFSC proposed to use an estimated 10,000 hooks per year. As described in Section 4.3.2.3.1, zero historical takes of short-tailed albatross have occurred during NWFSC research, and the 2017 BiOp

(USFWS 2017) concluded that research using hooks and lines would result in a relatively small amount of injury or mortality of short-tailed albatross. Under the Preferred Alternative, the number of demersal longline hooks is increased. However, the addition of mitigation measures for demersal longlines such as testing the use of night-time only sets during the Bycatch Reduction Research, and the use of paired streamers to deter birds reduces the potential for interactions with short-tailed albatross. Overall impacts to short-tailed albatross would be similar to the No Action Alternative and would be considered minor adverse.

The Preferred Alternative also adds the use of USS (e.g., Saildrones) to the Winter Integrated Acoustic Trawl Survey of Pacific Hake. Following the mitigation measures described in Table 2-2, the use of USS is not expected to directly affect short-tailed albatross.

4.4.2.3.2 California Least Tern

As described in Section 4.3.2.3.2, California least terns are rare to extralimital in coastal waters north of San Francisco, where much of the NWFSC research occurs. No additional surveys in Southern California waters are planned under the Preferred Alternative. As described for California least tern, the addition of UsX to the Winter Integrated Acoustic Trawl Survey of Pacific Hake would not be expected to directly affect least terns. Effects of the Preferred Alternative on this species would be the same as under the No Action Alternative: minor adverse.

4.4.2.3.3 Marbled Murrelet

Under the Preferred Alternative, three new studies are proposed that take place in marbled murrelet forging habitat and use purse seines or micro purse seines: Benefits of Wetland Restoration to Juvenile Salmon, Action Effectiveness Monitoring; Lower Columbia River Ecosystem Monitoring (micro purse seine); and the SOBaD study. As described in Section 4.3.2.3.3, there have been no takes historically of these birds during NWFSC research activities using purse seines and mitigation measures described in Table 2-2 and Section 2.3.1 will further reduce the potential for interactions with research gear, including UAS. The addition of these studies to the Preferred Alternative will not appreciably change the estimation of minor impact to marbled murrelets.

4.4.2.3.4 Western Snowy Plover and Streaked Horned Lark

As shown in Appendix B, the Preferred Alternative would add beach seining to an existing study in the Columbia River Estuary (Migratory Behavior of Adult Salmon) and would add two new studies in Puget Sound that would use beach seines: Habitat Function of Nearshore Ecosystems with Shellfish Aquaculture and Eelgrass and Non-Native Species Studies. A reasonably foreseeable, but currently unfunded study, Remote Sensing of Wetland Habitat with UAS may occur in the Columbia River wetlands, Willapa Bay and Grays Harbor tidelands. While plovers and larks do not nest in wetlands,[12] they do occur in the geographic areas where this work might be done and can be affected by UAS.

[12] M. Zwartjes, USFWS, personal communication, email dated March 31, 2023.

While western snowy plovers and streaked horned larks are primarily limited to the coastal, sandy beaches, rather than wetlands that would be surveyed, there is a potential to disturb individuals during take-off and landings of UAS from shore. Specific mitigation measures described in Section 2.3.1 will help to avoid or minimize the potential for disturbance. It is anticipated that the proposed activities would result in only insignificant or discountable effects to western snowy plovers based on the provision of a half-mile buffer from critical habitat for take-offs and landings and limitation of the aerial surveys to the latter half of the nesting and breeding season, when plovers are less sensitive to disturbance.

Researchers also note that birds do not generally react to UAS flights. Additional mitigation measures for UAS work shown in Table 2-2 and in Section 2.3.1 would further protect birds. Any potential effects of this study on western snowy plover and streaked horned lark (should they occur) would be minor adverse.

As described in Section 4.3.2.3.4, no upland habitat will be entered by researchers, few of these birds are expected within the new areas proposed for beach seining, and mitigation measures shown in Table 2-2 for beach seining will be implemented. Therefore, as described for the No Action Alternative, any effects of research under the Preferred Alternative on western snowy plover and streaked horned larks would be minor adverse.

4.4.2.4 Effects on Sea Turtles

NWFSC fisheries research activities conducted under the Preferred Alternative involve a relatively small number of research vessels, short deployments of fishing gear, and sample sites dispersed over a wide area. As described in Section 4.3.2.4, the NWFSC has no history of interactions with sea turtles (NMFS 2016r, 2018b, NMFS 2024a) and the use of MMEDs and monitoring by crews (see Section 2.3) will also reduce impacts for the Preferred Alternative on any of four ESA-listed sea turtle species that could be encountered (leatherback, olive ridley, green or loggerhead).

The overall effects of the Preferred Alternative on ESA-listed sea turtles and leatherback critical habitat would be similar to those described in Section 4.3.2.4 for the No Action Alternative and are considered minor in magnitude, dispersed over a large geographic area, and temporary or short-term in duration. Therefore, the potential effects of NWFSC research under the Preferred Alternative would be considered minor adverse on all species of sea turtles except hawksbill sea turtles, which would be no effect.

4.4.3 Effects on the Social and Economic Environment

The NWFSC fisheries research program has the most potential to affect the social and economic environment through its contribution to the fisheries management process under the Preferred Alternative. The information available on fisheries socioeconomics was published in March 2022 (NMFS 2022k) and is for the period 2013-2019. Under the Preferred Alternative, the long-term, standardized resource surveys conducted by the NWFSC and its cooperative research partners would continue to provide a rigorous scientific basis for the development of fisheries stock assessments and federal fishery management actions in the Northwest region.

NWFSC fisheries research also provides information on ecosystem characteristics that is essential to management of commercial fisheries. The scientific information provided by the NWFSC is used not just for current management decisions but also to conserve resources and anticipate future trends, ensure future fishing utilization opportunities, and assess the effectiveness of the agency's management efforts.

The scientific data provided through the long-term and short-term fisheries research conducted and associated with the NWFSC has played an important role in the development of fisheries and conservation policies through informing the fisheries management process.

NWFSC-affiliated fisheries and ecosystem research conducted under the Preferred Alternative would provide a rigorous scientific basis for fisheries managers to set optimum yield fishery harvests while protecting the recovery of overfished resources and ultimately rebuilding these stocks to appropriate levels. It also contributes directly and indirectly to local economies, promotes collaboration and positive relationships between NMFS and other researchers as well as with commercial and recreational fishing interests, and helps fulfill NMFS obligations to communities under U.S. laws and international treaties.

The direct and indirect effects of the Preferred Alternative on the social and economic environment would be certain to occur, minor to moderate in magnitude depending on the community, long-term, and would be widely dispersed throughout the Northwest region. According to the impact criteria established in Table 4-1, the direct and indirect effects of the Preferred Alternative on the social and economic environment would be minor to moderate and beneficial.

5 CUMULATIVE EFFECTS

This section provides an update to the evaluation of potential reasonably foreseeable effects of NWFSC fisheries and ecosystem research that was published in the 2018 PEA. A brief summary of notable events or external activities that may interact with research that have occurred since 2018, as well as reasonably foreseeable future events and activities that may occur are included in this analysis of the No Action and Preferred Alternatives described in Section 2. A publication by Murray et al. (2014) provides a detailed discussion of reasonably foreseeable effects on marine ecosystems from human-caused activities. This section discusses both human-caused and natural stressors that may result in reasonably foreseeable effects on resources within NWFSC research areas.

5.1 Spatial and Temporal Scope

This reasonably foreseeable effects analysis considers actions and events where NWFSC surveys occur as described in Section 1.1. The baseline condition described in the 2018 PEA, as supplemented where necessary by Section 3 of this SPEA, serves as the point of reference for analyzing reasonably foreseeable effects. The temporal scope of this analysis generally covers notable events and actions that have occurred since the 2018 PEA and into the foreseeable future.

References to environmental variations includes sea-level rise, warming ocean temperatures, fluctuations in ocean chemistry changes, and other changes to the U.S. west coast and oceans are occurring and are projected to have significant consequences for the coastal economy, communities, ecosystems, culture, and heritage. These consequences will affect areas within the NWFSC research areas off the U.S. west coast that have the potential to extend into the U.S. economy (Sievanen et al. 2018). The increase in temperature and changes in weather patterns may shift currents carrying waste and debris. In marine ecosystems, changes in temperature, ocean circulation, stratification, nutrient input, oxygen content, ocean acidification and increased atmospheric carbon dioxide may have significant biological effects (Donney et al. 2012).

5.1.1 Physical Environment

Dozens of trans-Pacific undersea cables occupy the seafloor that run through the NWFSC research area off the U.S. and Mexico west coasts . Modern cables are typically about 1 inch in diameter and weigh about 2.5 tons per mile. These cables disturb the benthic habitat, however studies have indicated that cables pose minimal threats to the benthic environment, and in some cases provide habitat for invertebrates to grow (Carter 2009). Military training is unlikely to impact offshore geologic resources, although missile testing, and other exercises may accumulate munitions and other military hardware on the seabed. Natural disasters known to occur in the region (i.e., tsunamis, hurricanes, typhoons) could cause the deposition of various debris and structures on the seabed as well.

5.1.2 Biological Environment

5.1.2.1 Fish

Reasonably foreseeable effects on fish and fish populations are complex and, while there is a body of evidence on the effects of a single stressor on fish populations, identifying the consequences (and the causes) of multiple stressors is more complex (Murray et al. 2014). That said, fisheries research has documented multiple stressors from single fishing types. For example, stressors from benthic trawling include direct mortality to target species, bycatch mortality and injury, sedimentation, and habitat destruction (Hiddink et al. 2006). The spatial scale of the reasonably foreseeable effects of a single activity can vary across local and regional scales, as well as their duration and frequency over time. While direct mortality from fisheries may occur only within a fished area, sedimentation may be widespread and habitat destruction could be long-term (Watling and Norse 1998). The consequences of these reasonably foreseeable effects also depends heavily on the condition (i.e., health) of the resource exposed. For example, an ESA-listed species would be more vulnerable to long-term consequences of reasonably foreseeable effects than a non-listed species. For additional details regarding reasonably foreseeable effects on ESA-listed fish within the NWFSC research area, please refer to the 2016 BiOp (NMFS 2016r) as well as the 2024 BiOp (NMFS 2024a) prepared for this assessment.

Shifts in the distribution of fish population may result from changes in the environment. For example, the historical oscillation between Pacific sardine and northern anchovy populations in the California Current is evidence of this linkage. Other activities in the action area that may affect fish include recreational and commercial fisheries, renewable energy, predation, MPAs, construction and military activities. When considering NWFSC research with other past, present and future actions, reasonably foreseeable effects on fish overall are minor. The overall level of biomass removal compared to commercial and recreational fisheries is very low.

NOAA scientists published a report to assess the vulnerability of 82 fish and invertebrate species in the Northeast region to environmental change (Hare et al. 2016). Overall, vulnerability was high to very high for approximately half the species assessed on the northeast continental shelf; diadromous and benthic invertebrate species exhibit the greatest vulnerability (Hare et al. 2016). Ocean temperatures, shallow-water temperatures, and ocean acidification were the factors with the largest magnitude of expected changes from environmental variations. In addition, the majority of species included in the assessment have a high potential for a change in distribution in response to projected environmental variations. A subsequent change in distribution of fishery landings and potentially the distribution and magnitude of fishing effort were documented by Hare et al. (2016).

Environmental conditions affect salmonid abundance, productivity, spatial structure, and diversity through direct and indirect impacts at all life stages (Lindley et al. 2007, Crozier et al. 2008, Moyle et al. 2013, Wainwright and Weitkamp 2013, Crozier et al. 2019). High temperatures in the lower mainstem of the Columbia River and tributaries in early 2015 caused a failure in the sockeye run (Crozier 2016). Sacramento winter-run Chinook salmon

survival in 2014 and 2015 was the lowest ever observed and has been attributed to the California drought (Poytress 2016, as cited in Crozier 2016). Further evidence of the effects of warming temperatures were reported by PFMC (2016, as cited in Crozier 2016) regarding the low Oregon coho salmon returns from a recent El Nino event and what is referred to as the warm "blob." Ocean acidification, loss of adaptability to environmental extremes, and introduction of non-native species predators have all been associated with changing environmental conditions (Crozier 2016). Generally, impacts to one life stage affect body size or timing in the next life stage. For this reason, the reasonably foreseeable life-cycle effects of environmental variation must be considered to fully appreciate the scope of risk to a given population. Even without interactions among life stages, the sum of impacts in many stages will have reasonably foreseeable effects on population dynamics.

An assessment of the effects of environmental variation on Pacific salmon was completed by (Crozier et al. 2019). This assessment highlighted high-risks for several endangered and threatened ESUs of salmon, some taken by NWFSC fisheries research. Changes in water temperatures, and distinct flow conditions or water pathways are the characteristics that contribute to high vulnerability for these types of species (i.e., anadromous like salmon) (Crozier et al. 2019). These include more extreme high and low flows and hotter oceans and rivers. Certain Chinook, coho, and sockeye salmon population groups are the most vulnerable to expected environmental shifts. For example, both the late-fall and winter-run Chinook ESUs face extinction without continued intensive management/propagation. Similarly, for chum salmon, the summer-run faces relatively greater vulnerability than the more common fall or winter-run life history types in northern regions (Crozier et al. 2019). Steelhead, pink and chum salmon face less risk, either because they are more adaptable to varying conditions (steelhead) or spend less time in freshwater (pink and chum). Generally, populations within distinct ESUs are at most risk along the periphery of the ESU range, especially in interior and southern regions, exactly where the environment is expected to change the most (Crozier et al. 2019).

Globally, a publication by Crowder et al. (2008) presented information on the impacts of fisheries (i.e., commercial recreational and artisanal) on marine ecosystems. Researchers have attributed fishing as one of the oldest and most significant factors modifying marine ecosystems (Jackson et al. 2001 as cited in Crowder et al. 2008). Fishing, combined with other anthropogenic stressors, has resulted in a loss of biodiversity (Worm et al. 2006 as cited in Crowder et al. 2008). Bycatch of sharks and rays in commercial fisheries generally occurs outside of the NWFSC research areas or are from non-listed populations. Free et al. (2019) reviewed historical abundance data for 124 species in 38 regions worldwide compared to ocean temperature; the report stated that eight percent of these populations were adversely impacted by warming while four percent experienced beneficial effects. Significant discrepancies exist among regions with regard to the magnitude of these effects, with East Asia seeing the largest declines (15-35%) in fisheries productivity (Free et al. 2019).

Fully understanding how environmental variation will continue to affect fisheries research and/or commercial fisheries in the future will require additional research such as that conducted by NWFSC. The potential far-reaching impacts of climate change on fish habitat due to warming ocean temperatures, decreased habitat for selected species, changing distributions and abundance, changes in productivity and subsequent production, far exceed the minor impacts of fish removal as a result of NWFSC fisheries research.

For Chinook, coho and pink salmon, EFH is designated and extends from the nearshore and tidal submerged environments within state territorial waters to the seaward boundary of the U.S. EEZ along the coasts of Washington, Oregon, and California north of Point Conception (PFMC 2003). For ESA-listed species of fish including Pacific salmon and steelhead, EFH and critical habitat often overlap considerably. The 2018 PEA (NMFS 2018b) and 2024 BiOp (NMFS 2024a) addressed reasonably foreseeable effects on these ESA-listed species and based on the scope of research in the SPEA Status Quo and Preferred Alternatives, the conclusions presented in those assessment have not changed.

5.1.2.2 Marine Mammals

Numerous natural and anthropogenic threats to marine mammals in the NWFSC research areas may affect their continued existence. These threats include oceanic and climatic regime shifts, habitat degradation, fisheries interactions, vessel strikes, and disease and other disturbances associated with human activities. Fishery interactions with protected species are considered as having the greatest impact on marine mammals worldwide. For example, more than 97% of whale entanglements are caused by derelict fishing gear (Baulch and Perry 2014). These impacts are routinely evaluated by NMFS through the preparation and issuance of environmental impact analyses and biological opinions as well as SARs. Detailed information on bycatch of ESA-listed marine mammals in U.S. commercial fisheries in areas where NWFSC conducts research is monitored on an annual basis. Information from the most recent SARs for NMFS-managed species can be accessed here: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock. USFWS manages the northern and southern species of sea otters. The most recent stock information for sea otters can be found here: https://www.fws.gov/project/marine-mammal-stock-assessment-reports.

Overall, the contribution of NWFSC research to reasonably foreseeable effects on marine mammals is negligible within the context of the past, present, and RFFAs, as discussed in the following subsections.

5.1.2.2.1 Unusual Mortality Events

UMEs could contribute to reasonably foreseeable impacts on marine mammals in the Action Area. Gray whales, California sea lions, and Guadalupe fur seals have recently been affected by these mortality events. A large whale UME that occurred from 2007-2010 in California waters is discussed in the 2018 PEA.

The population size of the North Pacific gray whale stock has increased over several decades despite a UME in 1999 and 2000 (Carretta et al. 2021) and a recent UME in 2019-2020.[13] Since January 1, 2019, gray whale strandings have been documented along the west coast of North America from Mexico through Alaska. As of March 13, 2020 a total of 264 whales have stranded.

Elevated strandings of California sea lion pups have been occurring in Southern California since January 2013.[14] This event was declared a UME and is confined to pup and yearling California sea lions.

[13] https://www.fisheries.noaa.gov/national/marine-life-distress/2019-2020-gray-whale-unusual-mortality-event-along-west-coast (accessed November 18, 2025).
[14] https://www.fisheries.noaa.gov/national/marine-life-distress/2013-2017-california-sea-lion-unusual-mortality-event-california (accessed November 18, 2025).

A UME for Guadalupe and Northern fur seals occurred between 2015 and 2021 along the entire coast of California; strandings have been eight times higher than the historical average. A total of 715 Guadalupe fur seals and 170 northern fur seals stranded during the event. In 2019, strandings in Washington and Oregon became elevated and these states were added to the UME.[15] Strandings are seasonal and generally peak in April through June of each year. Guadalupe fur seals are stranding alive and dead. Those stranding are mostly weaned pups and juveniles (1–2 years old).

5.1.2.2.2 Ship Strikes

Collisions between ships and marine mammals, particularly large whales, are increasing worldwide (Schoeman et al. 2020). Collision-related mortality on species and (sub) populations is not well understood (Thomas et al. 2016; as cited in Schoeman et al. 2020). High mortality rates or a decline in fertile animals could cause population growth rates to decrease which is a significant concern for long-lived marine species (Heppel et al. 1999; as cited in (Schoeman et al. 2020). Over time, it is possible that vessel-related mortality might exceed the recruitment rate, either through contributing to a cumulative mortality rate (i.e., mortality from both natural and human-related causes) or on its own (Kraus et al. 2005, Van der Hoop et al. 2012, Fais et al. 2016).

The probability of a ship strike increases in areas where vessel traffic and marine mammal densities are both high and while more concern has been raised about large vessels, the potential for marine mammal collisions with smaller vessels (<15 m) still exists, especially if vessels are traveling at high speeds (Ritter et al. 2012; as cited in Schoeman et al. 2020).

5.1.2.2.3 Environmental Variation

Environmental variation such as changes in sea temperature, changes in the frequency of major storm events can affect marine mammals through altered prey distribution and suitable habitat. As described in Moore and Huntington (2008), certain marine mammal species may have greater ability than others to adapt to major environmental changes and ecosystem disturbances. The most likely impact of climate change on cetaceans could be changes in the area these species currently occupy due to changes in distribution of prey species with particular thermal requirements (81 FR 62259). According to McLeod (2009), ranges of approximately 88% of cetaceans may be affected by changes in water temperature resulting from global climate change.

Due to increased atmospheric carbon dioxide, the acidity of ocean waters has increased by about 25% since the 1800s.[16] Acidification has been documented in all ocean basins (Fox et al. 2020). Increasingly acidic marine waters can indirectly affect calcifying marine life by decreasing the availability of carbonates they need to build shells and other structures. Increased acidity in marine and estuarine waters slows the growth of these calcium carbonate structures, and acidic waters can dissolve calcified structures faster than they form. While some organisms can compensate for reduced calcification under increased acidity, the compensation requires additional energy to grow critical body parts like carapaces or shells. Scientists have found that mussels, sea urchins, and crabs start to dissolve their protective shells to counter elevated acidity in their body fluids.

[15] https://www.fisheries.noaa.gov/national/marine-life-distress/2015-2020-guadalupe-fur-seal-unusual-mortality-event-california (accessed November 19, 2025).
[16] https://www.epa.gov/ocean-acidification/effects-ocean-and-coastal-acidification-marine-life (accessed November 19, 2025).

5.1.2.3 Seabirds

Disturbances from human activities or natural events can result in a reduction in seabird population health due to mortality, breeding failure or colony abandonment. Disturbance can cause long-term effects to health and survival of affected marine species, and when coupled with changing oceanic conditions and other human-induced stressors, reasonably foreseeable small impacts can impart large-scale harm (NOS 2019). For example, as reported in Webb and Kench (2010), sea-level rise would likely lead to more frequent over-wash of coastal nesting areas by waves.

Prey species can be affected by wind and current patterns which alter their distribution and in turn can affect the behavior and movements of predators including seabirds (Behrenfeld et al. 2006, Polovina et al. 2008). Foraging habitat changes may result in negative consequences on reproductive success for seabirds (Kappes et al. 2010). More energy may be expended by seabirds to find food if their foraging habitat becomes degraded or is redistributed to different areas (Suryan et al. 2008). Overall, the contribution of NWFSC research on seabirds is negligible within the context of the past, present and RFFAs.

5.1.2.4 Sea Turtles

Environmental change and sea level rise may have moderate to major impacts on sea turtles depending upon future trophic changes, including changes in the distribution, amount, and types of seagrasses and macroalgal species (Harley et al. 2006), thus altering green turtle foraging habitat (Hawkes et al. 2009). Sea level rise is likely to reduce the availability and increase the erosion rates of nesting beaches, particularly on low-lying, narrow coastal and island beaches (Fuentes et al. 2009, Hawkes et al. 2009, Anastacio et al. 2014, Pike et al. 2015).

5.2 Conclusion

The 2024 BiOp (NMFS 2024a) concluded that NWFSC research occurs across a vast action area encompassing the coastal waters off of Washington, Oregon, and California, including areas of the Columbia River and Puget Sound and that activities external to NWFSC research that can affect ESA-listed species will likely continue into the foreseeable future. Similarly, the 2018 PEA (NMFS 2018b) concluded that in addition to NWFSC research efforts, there are many current and reasonably foreseeable activities, and that these actions can produce both adverse and beneficial impacts that directly and indirectly affect ocean resources managed by NMFS and the social and economic environment of fishing communities that rely on them. Based on the analysis in this SPEA these conclusions remain valid. Overall, the contribution of NWFSC research to reasonable foreseeable effects on the physical and biological environment, on fish, marine mammals, sea turtles, and on the social and economic environment is negligible and therefore not significant within the context of the past, present, and reasonably foreseeable future actions.

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Appendix A: Acronyms and Abbreviations

ADCP	Acoustic Doppler Current Profiler
AK	Alaska
APPS	Authorizations and Permits for Protected Species
AUV	Autonomous Underwater Vehicle
AZFP	Acoustic Zooplankton Fish Profiler
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
CA	California
CA/OR/WA	California/Oregon/Washington
CBD	Conservation Biology Division
CCRA	California Current Research Area
Centers	Fisheries Science Centers
CFR	Code of Federal Regulations
cm	centimeter
CS	Chief Scientist
CTD	Conductivity, Temperature, and Depth
CZMA	Coastal Zone Management Act
D	Depleted under the MMPA
DAS	days at sea
dB	decibel
dB re 1 µPa at 1 m	decibels referenced at 1 micropascal at 1 meter
DPS	Distinct Population Segment
E	endangered under the ESA
eDNA	environmental DNA
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EFSD	Environmental and Fisheries Sciences Division
ENP	Eastern North Pacific
EO	Executive Order
ESA	Endangered Species Act
ESP	Environmental Sample Processor
ESU	Evolutionarily Significant Unit
FED	Fish Ecology Division
FLIR	Forward Looking Infrared
fm	fathom
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FR	Federal Register
FRAMD	Fishery Resource Analysis and Monitoring Division
FWCA	Fish and Wildlife Coordination Act
ft	foot
GDP	Gross Domestic Product
HAB	Harmful Algal Bloom
HAPC	Habitat Areas of Particular Concern

HMS	Highly Migratory Species
hr	hour
HSUS	Humane Society of the U.S.
Hz	hertz
IFCB	Imaging Flow Cytobot
in	inch
IPHC	International Pacific Halibut Commission
kg	kilogram
kHz	kilohertz
km	kilometer
km^2	square kilometer
kt	knot
LCRRA	Lower Columbia River Research Area
LiDAR	Light Detection and Ranging
LNG	Liquified Natural Gas
LOA	Letter of Authorization
m	meter
µm	micron
µPa	micropascal
MBTA	Migratory Bird Treaty Act
mHz	millihertz
mi	mile
mi^2	square mile
min	minute
mm	millimeter
MMED	Marine Mammal Excluder Device
MMPA	Marine Mammal Protection Act
mo	month
MPA	Marine Protected Area
MSA	Magnuson-Stevens Fishery Conservation and Management Act
M/SI	Mortality/Serious Injury
mt	metric ton
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NL	not listed under the ESA
nmi	nautical mile
NMFS	National Marine Fisheries Service
NMS	National Marine Sanctuary
NMSA	National Marine Sanctuaries Act
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRC	National Research Council
NS	Not Strategic under the MMPA
NWFSC	Northwest Fisheries Science Center
OCS	Outer Continental Shelf

OMAO	Office of Marine Aviation and Operations
ONMS	Office of National Marine Sanctuaries
OOD	Officer on Deck
OPR	Office of Protected Resources
OR	Oregon
PBR	Potential Biological Removal
PEA	Programmatic Environmental Assessment
PFMC	Pacific Fishery Management Council
PIT	Passive Integrated Transponder
PNE	Poly Nor'easter Bottom Trawl
PNW	Pacific Northwest
PSIT	Protected Species Incidental Take
PSRA	Puget Sound Research Area
PTS	Permanent Threshold Shift
PVC	Polyvinyl Chloride
RFFAs	Reasonably Foreseeable Future Actions
rms	root mean square
ROV	Remotely Operated Vehicle
RP	Recovery Plan
R/V	Research Vessel
S	Strategic under the MMPA
SAR	Stock Assessment Report
SHPO	State Historic Preservation Offices
SI	Serious Injury
SOBaD	Salmon Ocean Behavior and Distribution
SPEA	Supplemental Programmatic Environmental Assessment
TTS	Temporary Threshold Shift
WDFW	Washington Department of Fish and Wildlife
UAS	Uncrewed Aerial Systems
UME	Unusual Mortality Event
U.S.	United States
USCG	U.S. Coast Guard
USS	Uncrewed Surface Systems
UUS	Uncrewed Underwater Systems
UxS	Uncrewed System
VHF	Very High Frequency
VTOL	Vertical Take Off and Landing
WA	Washington
WCR	West Coast Region
WDC	Whale and Dolphin Conservation
WNP	Western North Pacific
yr	year

Appendix B: Research Under the Two Alternatives

Table B-1. Detailed description of research under the No Action Alternative and the Preferred Alternative. New research under the Preferred Alternative indicated in gray cells; new gear or other changes to existing projects indicated in gray cells with underlined, bold type. Activities only under the No Action Alternative are underlined italics. Note: This table has been typeset on tabloid-size paper (11 × 17 in).

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.	Southern OR to Canada	April-November, intermittent, 30-90 DAS. Daytime operations primarily, with **potential nighttime operations**.	Chartered commercial fishing vessels	*Bottom trawl (Alt 2 only along coasts not in Puget Sound)*	Net type: Commercial bottom trawls Net size: Varies Tow speed: 1.5-3.5 kt Duration: up to 4 hr Depth: 50-1000 m	40 bottom trawls/yr
					Midwater trawl	Net type: Commercial pelagic trawls Net size: Varies Tow speed: 1.5-3.5 kt Duration: up to 8 hr but avg 2 hr Depth: 50-1000 m	≤ 60 midwater trawls/yr
					Bottom trawl (not in Puget Sound)	Net type: Double rigged shrimp trawl Net size: Varies Tow speed: 1.5-3.5 kt Set duration: 30-80 min Depth: 100-300 m	≤ 60 shrimp trawls/yr
					Multi-frequency active acoustics	38-200 kHz; ≤ 224 dB/1µPa	Continuous during cruise
					Demersal longlines	50-3000 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 CA to Southeast AK, 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 ft Tow speed: 2.8-3.5 kt 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.	150 casts/yr
					Methot trawl	Outer net 2.4 m × 2.4 m × 44 ft long × 2 in mesh, inner net 1.4 m × 1.4 m × 43 ft long × 1/8 in Atlas mesh. PVC collection bucket 2-piece PVC, 6 5/8 in overall diameter × 16 in long; deployed at 20-25 m/min, retrieved at 20 m/min. Ship speed while towing Methot 2-3 kt (never > 3.5 kt).	5-20 trawls/yr
					Uncrewed Surface systems (USS)	USS (e.g., Saildrone) equipped with acoustics (38 and 200 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 kt 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 kt, along acoustic tracklines.	

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
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.	OR, WA, west coast Vancouver Island; occasionally northern CA	Biennially since 2004 in even-numbered years, June-September, 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 kt 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
					USS	USS (e.g., Saildrone) 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 × 2.4 m × 44 ft long × 2 in mesh, inner net 1.4 m × 1.4 m × 43 ft long × 1/8 in Atlas mesh. PVC collection bucket 2-piece PVC, 6 5/8 in overall diameter × 16 in long; deployed at 20-25 m/min, retrieved at 20 m/min. Ship speed while towing Methot 2-3 kt (never > 3.5 kt).	5-50 trawls/yr
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 1,280 m. In addition to spatially indexed data on catch and biology, FRS collects extensive habitat and environmental data via deployed and vessel-mounted sensors.	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 × 15 m Tow speed: 2.2 kt Duration: 15 min Depth: 55-1,280 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 will 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.	34.5°N (Point Conception, CA) to 54.7°N (Dixon Entrance, AK) from the 50 m isobath to the 1,500 m isobath or to 35 nmi 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-September, 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 kt 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 × 2.4 m × 44 ft long × 2 in mesh, inner net 1.4 m × 1.4 m × 43 ft long × 1/8 in Atlas mesh. PVC collection bucket 2-piece PVC, 6 5/8 in overall diameter × 16 in long; deployed at 20-25 m/min, retrieved at 20 m/min. Ship speed while towing Methot 2-3 kt (never > 3.5 kt).	5-20 trawls/yr
					USS	USS (e.g., Saildrone) 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 kt Duration: variable Depth: variable	5-10 trawls/yr; none since 2011
					UCTD profiler	Teledyne Oceanscience Underway Profiling System to measure conductivity and temperature down to 500 m; ship speed ~6 kt along acoustic tracklines.	

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
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. Operates under ESA Section 10 permit #1410-13M for directed research on ESA-listed fish species.	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), 30 m wide × 20 m deep. Tow speed: 3-4 kt 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 kt Duration: 5-6 min Depth: 0-30 m	100 samples/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 Depth: Surface to near bottom or 100 m max.	100 samples/yr
					Water pump	Gear type: Continuous water pump with SBE-45 Micro thermosalinograph Depth: 3 m	Continuous during cruise
					Simrad EK60 multi-frequency echosounder (Alt 1 only)	38, 70, 120, and 200 kHz; 228 dB/1µPa	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. Nighttime operations only.	NOAA Ship *Bell M. Shimada*	Midwater trawl	Net type: Modified Cobb trawl with 9.5 mm codend Net size: 12 × 12 m opening, 26 m headrope Tow speed: 2.7 kt 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 kt Duration: 20-60 min	100 samples/yr
					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.	OR to WA	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 kt Duration: 10 min	20-40 deployments
9) Flatfish Broodstock Collection	Collection of fish for broodstock for aquaculture development by trawls, hook-and-line, various methods.	Puget Sound and WA coast	Intermittent, up to 20 times annually, 20 DAS. Daytime operations only.	Chartered fishing vessels, NOAA small boats (Class I and II)	Bottom trawl	Net type: Commercial bottom trawl Net size: varies Tow speed: < 3.5 kt 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 (or example, sablefish, halibut or hake) for broodstock collection, sampling, tagging.	WA coast	Annual, varied timing, 10 DAS. Daytime operations only.	Chartered fishing vessel	Bottom trawl	Net type: Commercial bottom trawls Net size: varies Tow speed:1.5-3.5 kt Duration: up to 4 hr Depth: 50-1,000 m	10 trawls/yr
					Pelagic longline	Mainline length: 750-1,000 fm Depth: 700-3,000 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 hr fishing/day, 90 hr 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							
11) Newport Line Plankton Survey	Survey along the Newport Hydrographic Line to assess oceanographic conditions and zooplankton species composition and abundance. Includes acoustic estimates of biomass. Operates under a recognition of "no potential take" of ESA-listed fish.	Newport Hydrographic Line, OR	Bi-weekly, 26 DAS Daytime operations only	R/V *Elakha*, owned and operated by Oregon State University	Bongo net	Net type: Bongo plankton net with 335 µm mesh Net size: two 0.6 m diameter nets Tow speed: 2 kt Duration: 5-6 min Depth: 0-30 m	150 samples/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 Depth: Surface to near bottom or 100 m max.	150 samples/yr
					CTD profiler and rosette water sampler	Gear Type: Sea-Bird SBE 19+ CTD Deployment: Vertical drop Depth: Surface to near bottom or 200 m max.	150 samples/yr
					Simrad EK60 multi-frequency echosounder	38, 70, 120, and 200 kHz	Continuous during cruise
12) Northern California Current Ecosystem Survey	Periodic survey of oceanographic conditions in the Northern California Current. This is opportunistic as ship time becomes available.	Off coasts of WA and OR out to 200 nmi	Up to 4 times per year, 12 DAS each. 24-hr operations.	NOAA Ship *Bell M. Shimada*, *Reuben Lasker*, or similar vessel	Vertical plankton net	Vertical drop, variable depth	Varies with ship time
					Bongo net	Net type: Bongo plankton net with 335 µm mesh Net size: two 0.6 m diameter nets Tow speed: 2 kt Duration: 5-6 min Depth: 0-30 m	Varies with ship time
					CTD profiler and rosette water sampler	Gear Type: Sea-Bird SBE 19+ CTD Deployment: Vertical drop Depth: Surface to near bottom or 200 m max.	Varies with ship time
13) Coastwide Groundfish Hook and Line Survey in Untrawlable Habitat	An expansion of the Southern California Bight Hook and Line Survey to sample untrawlable shelf habitats from Pt. Arguello, California, to the U.S.-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.-Mexico to U.S.-Canada border	Annually, May-October, 250 DAS. Daytime operations only.	Charter sportfishing vessels (3-4 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/set Depth: 15-250 m	1,000 sites, 75,000 hooks total
					Camera sled, drop cameras	Tethered video camera	1,000 deployments
					CTD profiler	Deployment: Vertical drop	1,000 casts
14) Technology Development Research	Develop alternative sampling methodologies using AUVs to assess groundfish abundance and distribution using video capturing equipment.	WA to CA and Western Pacific	Summer and fall, up to 30 DAS. Daytime operations only.	Chartered vessels, NOAA vessels (such as NOAA Ship *Bell M. Shimada*)	UUS, USS	AUV, piloted remotely. Several meters long. Dives up to 2,000 ft. Also includes surface USS such as Saildrones.	No sampling other than images. Number of dives varies by scientific objective; up to 25 dives/ cruise.
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.	WA	Annually, late July-early August, 7 DAS. Daytime operations only.	Class I R/V *Minnow* (NWFSC); R/V *Tatoosh* (Olympic Coast NMS	Scuba, transect tape	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 will fly 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 flights total
16) Deep-sea Coral Habitat Surveys via ROV	Surveys and sampling of deep-sea corals and sponges from the West Coast EEZ via ROV with parallel CTD casts.	WA to CA and Western Pacific	Summer and fall, intermittent.	Chartered vessels, UNOL vessels, NOAA vessels (such as NOAA Ship *Bell M. Shimada*)	ROV or other UUS, CTD rosette	ROV deployed, transect surveys on bottom	1-2 dives per day for duration of cruise length, video imagery, coral and sponge collections
17) ESP Mooring	Seasonal deployment of a moored biological sampling system on the Washington shelf to monitor domoic acid, a harmful algal bloom toxin, in near-real time and to collect eDNA samples.	WA	Annually, spring through fall.	University of Washington vessel (R/V *Robertson* or R/V *Thompson*) or chartered vessel	Mooring	Fixed mooring in ~100 m water on WA shelf equipped with an ESP nested inside of a subsurface float at ~20 m depth and a small telemetry buoy at the surface.	2 deployments/yr

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
18) Salmon Ocean Behavior and Distribution (SOBaD)	Examine the distribution and behavior of salmon in the marine environment using telemetry and surveys. Operates under ESA Section 10 permit #22369-2M for directed research on ESA-listed fish species.	WA coast, OR coast, Lower Columbia River	Year-round.	Contract vessels, NOAA Ship *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[a] (hook and line)	Up to 20 hooks deployed for 20 min.	Up to 2,000 deployments
					VR2 receiver	Acoustic receiver that passively listens for tagged animals	Up to 150 stations
					Sound trap	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
19) Green Sturgeon Movements at Willapa Bay, WA	Detect transmitters carried by Green sturgeon and other species using acoustic telemetry.	Willapa Bay, WA	Year-round.	WDFW contract vessel	VR2 receiver	Acoustic receiver that passively listens for tagged animals	Up to 15 Stations
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.	WA and OR	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 traps, divers, and hand nets for crustaceans.	Crab and light traps: < 100 sets/yr Plankton tows: < 75 sets/yr
21) Avian Predation Studies	Examination of seabird diets and foraging movements to determine impacts to salmon and forage species. This study does not collect or tag bird species; it tags fish that are bird prey species. The weight of tags would be in the safe payload range for birds. The tags would be light enough for the fish to still be taken as prey by the bird.	Coastal OR and WA, including the Columbia River Estuary and Plume, Puget Sound, and the Salish Sea	Bi-weekly, May-September, 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/mo, for a total of 200/yr
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 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

[a] Microtrolling is modified hook and line sampling that is done using downriggers with braided Dacron line and weighted with a 15 lb lead ball. Leaders are 200 cm of 150 lb test monofilament, a flasher, then 50 cm of terminal gear with 10 lb test and a size 0 Dick Nite spoon. Leaders are attached directly to the downrigger line.

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
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. Operates under ESA Section 10 permit #17062-6R for directed research on ESA-listed fish species.	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 the circumstances	*Bottom trawl (Alt 1 only)*	Net type: Commercial bottom trawl Net size: Varies Tow speed: < 3.5 kt Duration: 10 min Depth: > 10 m	12/yr
					Purse seines	Net type: Herring seine Net size: 1,500 × 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/yr
					Demersal longline	Mainline: 600 ft Depth: about 200 ft Hooks: 16/0 circle, 30 hooks/set Soak time: 90 min	3 sets, 90 hooks total
					SCUBA divers	Divers capture jellies and stars by hand.	1 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/yr
					Mobile tracking omnidirectional hydrophone	Suspended from a small boat 1-3 m from the surface.	Variable
					Tethered ROV	ROV uses same transects as divers and other gears at corresponding depths. ROV flight times/transect < 5 min.	Variable
			Early spring.		Hand nets	Used to collect steelhead smolts from a trap box near the WDFW-maintained weir at Big Beef Creek.	Up to 140 wild smolts and 160 hatchery raised smolts will be captured, tagged and released
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. Operates under ESA Section 10 permit #1586-5R and Joint USFWS Biological Opinion (BiOp) Ref. No. 01EOFW00-2017-F-0359 (for bull trout).	Greater Puget Sound and **Strait of Juan de Fuca (note that level of effort remains the same but additional sites in the strait have been added)**.	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 kt 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 1 m from bottom	250 trawls/yr
					Beach seine	Net type: Beach seine Net size: 3.6 × 1.8-3.0 m (37 m length) Duration: 15 min Depth: surface to 3 m	200 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
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. Operates under ESA Section 10 permit #1586-5R for directed research on ESA-listed fish species.	Puget Sound	Annually April-October, 30 DAS. Daytime operations only.	Class I and II NOAA vessels	Surface trawl	Net type: Kodiak surface trawl Net size: 3.1 × 6.1 m Tow speed 1.8-2.2 kt 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 kt 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
					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. Operates under ESA Section 10 Permit # 1586-5R and Joint USFWS BiOp Ref. No. 01EOFW00-2017-F-0359 (for bull trout).	Puget Sound	Monthly 2006-present, 30 DAS. Daytime operations only.	Class I NOAA vessel	Beach seine	Net type: Beach seine Net size: 140 × 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 < 10 m 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 × 3 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
28) *Heterosigma akashiwo* Bloom Dynamics and Toxic Effects	Discontinued under the Preferred Alternative.	Puget Sound, Georgia Strait, Strait of Juan de Fuca	Summer, fall, 20 DAS. Daytime operations only.	Various	Plankton nets	20 µm mesh nets deployed by hand over the side of the vessel. Net samples only surface waters (0-2 m).	~70/yr
					CTD profiler and rosette water sampler	Gear Type: Sea-Bird SBE 19 CTD Deployment: Vertical drop by hand Depth: Surface to near bottom or ~35 m max.	~70/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. Operates under ESA Section 10 permit #24367 for directed research on ESA-listed fish.	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 × 2.4 m wide Mesh size: 10 mm	Up to 100 sets/yr
					UUS or tethered ROV	Transect flight duration < 5 min	Up to 50 ROV transects/yr

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
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**. Operates under ESA Section 10 permit #23029-2R for directed research on ESA-listed fish.	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 × 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 × 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: 6-12 ft diameter Mesh size: 10-20 mm	Up to 50 casts/yr
					Gill net	Net type: Surface gill net Net size: 100 ft long × 11 ft wide Mesh size: 0.75 in Set duration: < 20 min	Up to 50 sets/yr
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. Operates under ESA Section 10 permits #16702-4R and #1586-5R and Joint USFWS BiOp Ref. No. 01EOFW00-2017-F-0359 (for bull trout).	Snohomish Estuary	Monthly, twice monthly February-September, 50 DAS. Daytime operations only.	Class A and Class I NOAA vessels	Beach seine	Net type: Beach seine Net size: 140 ft × 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, 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.	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 and trapping ≤ 400 tows and sets/yr; avg. 4 hooks/day for 6 hr/day, 90 hr total
34) Temperature Monitoring in Puget sound Tributaries	Long-term temperature monitoring in Puget Sound watersheds.	Puget Sound watersheds	Throughout year. Sites accessed ~2×/yr.	Access stream locations on foot	Temperature monitors placed in stream	Temperature monitors in protective housing	n/a
35) Near Coastal Ocean Lampara Seining and ROV Surveys	Study of salmon habitat use in nearshore areas of Puget Sound. Operates under ESA Section 10 permit #24367 for directed research on ESA-listed fish.	Nearshore throughout Puget Sound	Monthly, April-September, 36 DAS.	R/V *Minnow*	Lampara seine	Net type: Lampara seine	400 sets
					UUS or Tethered ROV	ROV uses same transects as divers and other gears at corresponding depths. ROV flight times/transect < 5 min.	6 transects/site, surface and benthic/ transect ~100 ROV flights
36) Imaging Flow Cytobot (IFCB) Deployment	In-water deployment of a robotic microscope (a field-deployable IFCB) from a dock to continuously monitor phytoplankton communities.	Puget Sound	Throughout the year.	Access boathouse via marina by foot	IFCB suspended in-water from dock by a line	Instrument in protective housing and cage suspended to a depth of ~3 m using a line from a dock with a telemetry and power cable connected to a dockside modem and power source.	3-4 deployments/yr

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
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 (~0.5 m/s) and 8 hr 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	UUS or tethered ROV	ROV flies 5 surface or benthic transects. ROV flight times/ transect < 5 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 will be vertical deployments throughout water column; rod and reel gear will use up to 5 hooks per deployment; vertical setlines may include up to 15 hooks per deployment; soak times for both will be < 15 min.	Variable; 1-20 sets or deployments/ day
39) Urban Gradient Surveys	Purpose is to identify relationships between land use practices and properties of streams and nearshore marine ecosystems around Puget Sound, and to 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 × 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. Operates under ESA Section 10 permit #17062-6R for directed research o ESA-listed fish species.	Puget Sound, San Juan Islands, 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-hr/day.	~750 hook-hr/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 will be used to quantify fish, invertebrate, and eelgrass densities. Collection of seagrass, sediments, and water samples will be used to quantify epiphyte loads,sediment quality, and water chemistry.	4 transects/site (~5 sites)/quarter 360 transects/yr
					UUS or tethered ROV	ROV uses same transects as divers and other gears at corresponding depths. ROV flight times/transect < 5 min.	4 transects/site, benthic and surface, (~5 sites) each quarter, 160 ROV flights/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. Operates under ESA Section 10 permit #25256 for directed research on ESA-listed fish species.	Columbia River estuary (river km 65-85)	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 × 10 ft opening) Net size: wings 92 m × 92 m, trawl body 9 m wide × 6 m deep × 18 m long Mesh size: wings 3.8 cm, body 1.8 cm Tow speed: 1.5 kt Duration: 8-15 hr Depth: surface to 5 m	800-1,200 hr/yr

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
43) Eulachon Arrival Timing	Determine the arrival timing and distribution of spawning eulachon along the migration corridor in the Columbia River. Samples will be taken for fecundity and other biological data but most fish will be released unharmed.	Columbia River estuary and plume	Weekly, November-April, 30 DAS. Daytime operations only.	NOAA Class II and Class III vessels	Pelagic trawl net	Modified cobb trawl with 9.5 mm cod-end Net size: 12 ×12 m opening Tow speed: 2.7 kt Duration: 15 min Depth: 30-40 m	Depends on adult returns, typically < 75 combined net and jig samples/yr
					Hook-and-line	Hook-and-line type: sabiki/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, and 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) 38-400 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 Dam. Operates under ESA Section 10 permit #22944 for directed research on ESA-listed fish.	Columbia River estuary	Quarterly to monthly, 25 DAS. Daytime operations only.	17 ft whaler	Beach seine	Net type: Beach seine Net size: 46 m × 2 m Mesh size: < 25 mm Set duration: < 10 min	< 100/yr
					Trap nets	Net type: barrier trap Net size: variable Mesh size: < 1/4 in Set duration: up to 6 hr 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 × 40 ft of flexible cable style antennas each) per tidal channel	Continuous operation, ≤ 8 sites/yr
					Fish holding pens	< 1/4 in mesh, 10 ft × 10 ft × 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 × 35 cm × 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)	
					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-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. Operates under ESA Section 10 permit #22944 for directed research on ESA-listed fish species.	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 × 2.4 m wide Mesh size: 10 mm Set duration: < 10 min	≤ 200/yr
					Plankton net	Net type: Neuston Net size: 1 m × 3 m Mesh size: 250 µm Set duration: 100 m/~5 min	50/yr
					Micro-purse seine	Net type: purse seine Net size: 100 ft long × 10 ft wide Mesh size: < 1 in Set duration: < 10 min	50/yr

Survey Name	Description	General Area of Operation	Season, Frequency, Annual Days at Sea (DAS)	Vessels Used	Gear Type	Gear Details	No. Tows/Samples
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. Operates under ESA Section 10 permit #25490 for directed research on ESA-listed fish species (expired Feb. 23,2021).	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	Tangle net size: 600 × 40 ft Mesh size: 4.25 in Duration: 25-45 min Beach seine net size 1,080 × 40 ft Mesh size: 3-3 1/4 in trap with lead of 265 ft, mesh size of 3-3 1/4 in reducing to 2 1/2 in mesh for the holding/collection area	≤ 150 sets/yr
					Catch, tag, and release only		
49) Pile Dike PIT-tag Detection System	Deploy a PIT-tag detector on a pile dike to detect migrating adult and juvenile salmon. Operates under ESA Section 10 permit #24375 for directed research on ESA-listed fish species.	Columbia River estuary (near River km 70)	March to October (potential for year-round). 24 hr operations.	Vessels are only used for servicing	Anchored small guidance net (20 × 20 ft) leading to an 8 × 20 ft (min) opening with subsurface PIT-tag detector	Net type: 18 in square mesh of bright orange twine	Continuous operation
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. Operates under ESA Section 10 permit #22944 for directed research on ESA-listed fish species.	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 × 30 ft Mesh size: 1/3 in (net body), 1/4 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 × 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	
				Two small boats, 17 ft Whaler plus larger tow boat	Small surface trawl	Net type: surface trawl Net size: 10 × 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 × 0.4 m Neuston net, 350 µm mesh Sonteq IQ ADCP 3 millihertz (mHz)	~10 samples/day, ~40 trips/yr, time series of various lengths
51) Remote Sensing Wetland Habitat with Uncrewed Aerial Systems (UAS)	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 sampled in 1 day
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) 38-400 kHz split beam echosounders	Visual, acoustic sampling continuous or at set intervals during daytime hr (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, ≤ 75 DAS.	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 38-400 kHz split beam echosounder (or similar)	Variable; no more than 500/yr

Appendix C: National Marine Sanctuary Changes

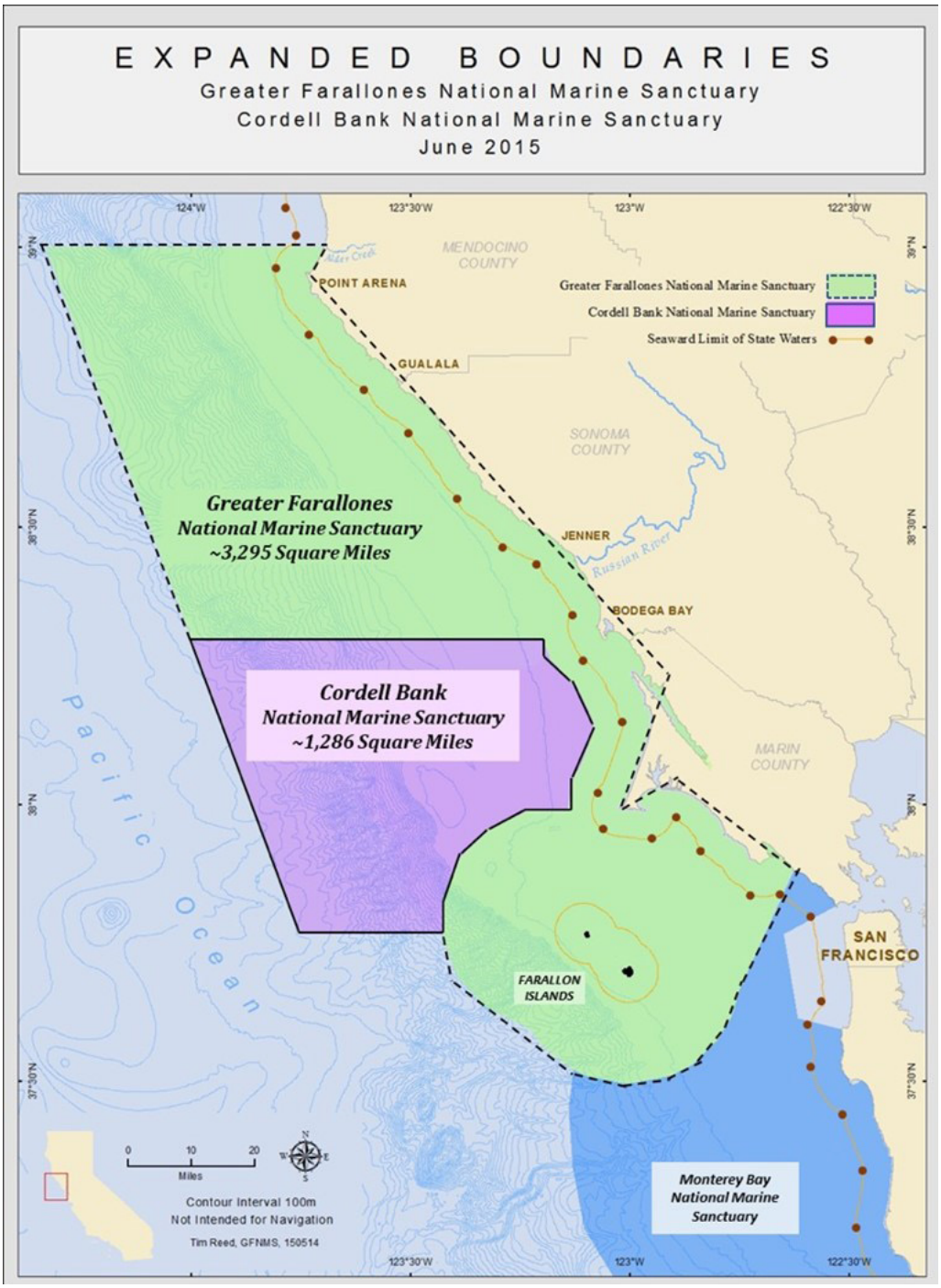


Figure C-1. 2015 sanctuary boundary expansion. Source: https://cordellbank.noaa.gov/news/expansion.html (accessed June 1, 2022).

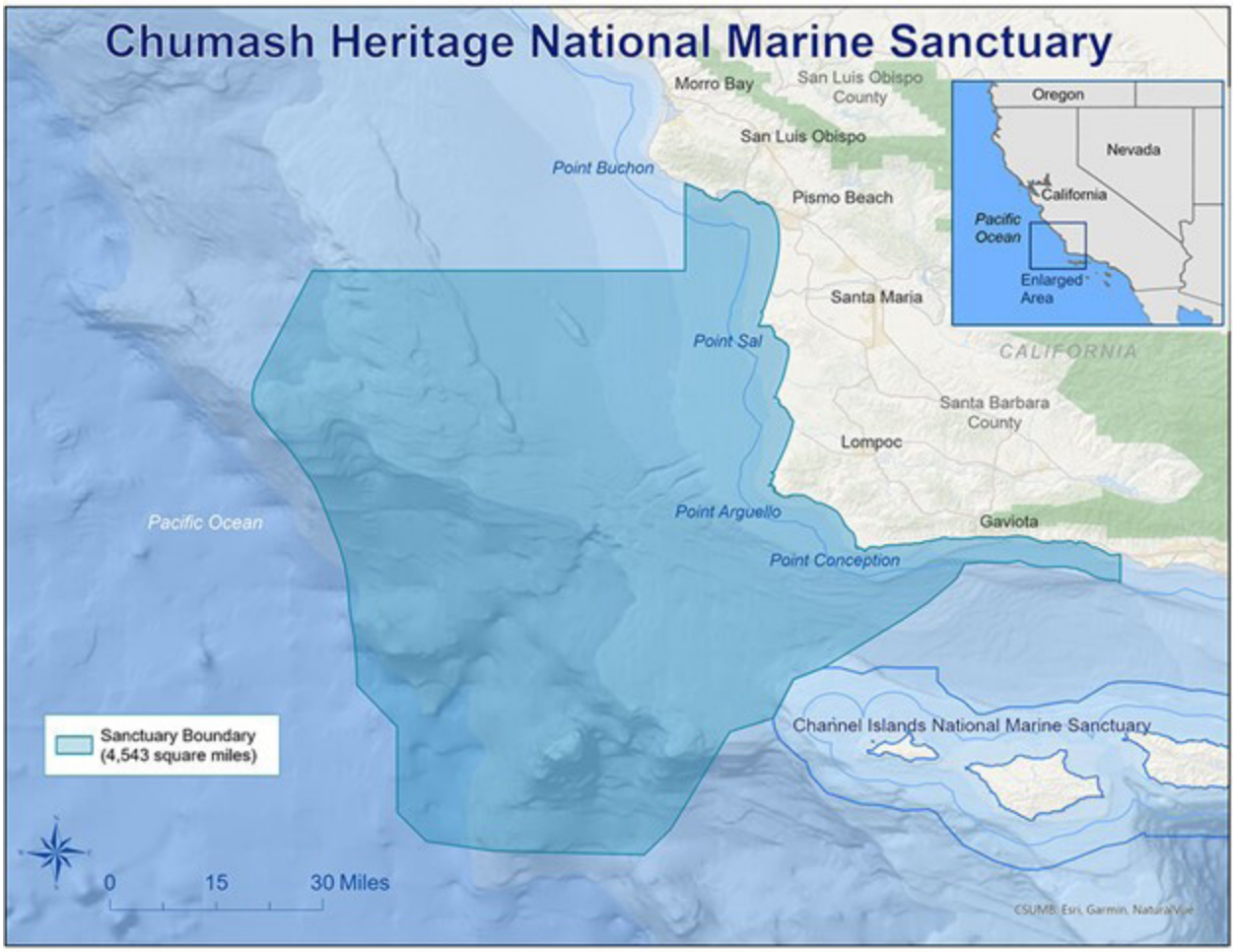


Figure C-2. Chumash Heritage National Marine Sanctuary boundary. Source: https://sanctuaries.noaa.gov/chumash-heritage/ (accessed November 19, 2024).

Appendix D: ESA-listed Fish Species/Populations

Table D-1. ESA-listed fish species that may fall within the action area, their current ESA status, estimated abundance and range, and relevant changes since the 2018 PEA. ESA listing status includes endangered (E), threatened (T), or not listed (NL) (50 CFR 17.11). Note: This table has been typeset on tabloid-size paper (11 × 17 in).

ESA-listed Fish Species	DPS, ESU, or Stock	2018 PEA Section	Current ESA Status	Estimated Abundance and Range	References	Description/Change from 2018 PEA
			Marine Fish			
Bocaccio (*Sebastes paucispinis*)	Puget Sound/Georgia Basin DPS	3.2.1.1	E	The 2016 BiOp reported the total population estimate for Puget Sound/Georgia Basin bocaccio as 4,606 individuals. Also as noted in the 2016 BiOp, relative to other rockfish species, bocaccio have declined in frequency in Puget Sound. According to the 2018 PEA, this species occurs in the CCRA and Puget Sound PSRA.	NMFS (2017d) 82 FR 7711 NMFS (2016r) NMFS (2018b) 85 FR 12905 79 FR 68042 Lowry et al. (2024)	No change in ESA-listed status or critical habitat. Recovery Plan (RP) completed October 13, 2017. In 2017, the DPS definition was expanded to include fish residing within Puget Sound/Georgia Basin, rather than only fish originating in the area (82 FR 7711). Five-year review process initiated in 2020 (85 FR 12905 and completed in February 2024 (Lowry et al. 2024). No changes are recommended to the ESA-listing status and this species remains classified as endangered.
Yelloweye rockfish (*Sebastes ruberrimus*)	Puget Sound/Georgia Basin DPS	3.2.1.1	T	The 2016 BiOp reported the total population estimate for Puget Sound/Georgia Basin yelloweye rockfish as 47,407 individuals. According to the 2018 PEA, this species occurs in the CCRA and PSRA.	NMFS (2017d) 82 FR 7711 NMFS (2016r) NMFS (2018b) Lowry et al (2024)	No change in ESA-listed status or critical habitat. RP completed October 13, 2017. January 23, 2017, the northern boundary of the threatened DPS was extended to Canadian waters (82 FR 7711). Five-year review process initiated in 2020 (85 FR 1290) and completed in February 2024 (Lowry et al. 2024). No changes are recommended to the ESA-listing status and this species remains classified as endangered.
Canary rockfish (*Sebastes pinniger*)	Puget Sound/Georgia Basin DPS	3.2.1.1	NL	The 2016 BiOp reported the total population estimate for Puget Sound/Georgia Basin canary rockfish as 20,548 individuals. According to the 2018 PEA, this species occurs in the PSRA only.	NMFS (2017d) 82 FR 7711 NMFS (2016r) NMFS (2018b) Lowry et al. (2024)	The Puget Sound population was delisted Jan. 23, 2017 (82 FR 7711). Not discrete from coastal populations and no longer meets the criteria to be considered a DPS. Canary rockfish stocks were considered to be rebuilt in 2015. Five-year review process initiated in 2020 (85 FR 12905 and completed in February 2024 (Lowry et al. 2024). No changes are recommended to the ESA status of not listed.
			Anadromous Fish			
Pacific eulachon (*Thaleichthys pacificus*)	Southern DPS	3.2.1.1	T	Historical fishery-independent estimates not available. In 2017 Columbia River spawning stock estimated at 18,307,100 and Fraser River (BC) spawning stock estimated as 763,330 to 1,026,251. The 2016 BiOp reported the total population estimate for Pacific eulachon as 81,736,000. According to the 2018 PEA, this species occurs in the CCRA, PSRA and LCRRA.	NMFS (2017a) NMFS (2018b) NMFS (2016r) NMFS (2022a) NMFS (2016r)16r)	No change in ESA-listed status or critical habitat. RP completed September 2017. Five-year review process initiated in 2020 (85 FR 12905). In 2017, the DPS definition was expanded to include fish residing within Puget Sound/Georgia Basin, rather than only fish originating in the area. The 5-year review process was initiated in 2020 and completed in July 2022 (NMFS 2022a). No changes are recommended to the ESA-listing status and this species remains classified as a threatened species.
Green sturgeon (*Acipenser medirostris*)	Southern DPS	3.2.1.1	T	The 2016 BiOp reported the total population estimate for southern DPS green sturgeon as 1,348. 2,106 adults and 11,055 subadults were reported in 2018. This species occurs in the CCRA, PSRA and LCRRA. The Southern DPS forages in estuaries and bays ranging from San Francisco Bay to Oregon. The marine distribution is considerably larger than freshwater habitat and extends from Mexico into Alaska. They are not usually found in Puget Sound (NMFS 2018b).	NMFS (2018c) Mora et al. (2018) 71 FR 17757 74 FR 52300 NMFS (2018b) NMFS (2016r) NMFS (2021a)	No change in ESA-listed status or critical habitat. RP completed 2018. Five-year review process initiated in 2020 (85 FR 12905) and completed in 2021 (NMFS 2021a). No change in status is warranted.
Bull trout (*Salvelinus confluentus*)	Coterminous U.S. DPS	3.2.1.1	T	The 2007 Upper Columbia Spring Chinook Salmon and Steelhead RP provides bull trout redd counts for three Upper Columbia River core areas (Wenatchee, Entiat and Methow) for 1983-2004. In 2004, total redds for the three areas were 720. Redds in all three areas had increased from the 1990s. According to the 2018 PEA, this species occurs in the CCRA, PSRA, and LCRRA.	USFWS (2015a) USFWS (2017) UCSRB (2007) NMFS (2018b) USFWS 2024a USFWS 2024b 64 FR 58910 95 FR 14240	No change in ESA-listed status or critical habitat. The November 1999 listing (64 FR 58910) combined five DPSs (including the Columbia River DPS and the Puget Sound Coastal DPS) into one listed DPS that covers the coterminous U.S. The five DPSs served as interim recovery units until a Recovery Plan was completed. The recovery plan completed in 2015 identified six recovery units, one of which is the Coastal Recovery Unit. This is the only unit currently supporting anadromous populations of bull trout. A Programmatic BiOp covering SWFSC and NWFSC research activities was prepared in 2017 and includes analysis of effects on bull trout for 11 core areas in coastal and marine habitat that supports core areas including: the strait of Juan de Fuca, Puget Sound, Hood River Canal, coastal waters off of WA, and the Lower Columbia River. A notice for initiation of a 5-year review (95 FR 14240) was published on March 11, 2020. A 5-year Review was published in September 2024 and recommended the species remain listed as threatened (USFWS 2024 a & b).

ESA-listed Fish Species	DPS, ESU, or Stock	2018 PEA Section	Current ESA Status	Estimated Abundance and Range	References	Description/Change from 2018 PEA
Chinook salmon (*Oncorhynchus tshawytscha*)	California Coastal ESU	3.2.1.1	T	The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 5,599 individuals and the natural juvenile abundance at 447,920. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016a) NMFS (2016r) NMFS (2016s) O'Farrell et al. (2015) NMFS (2024d) NMFS (2018b)	No change in ESA status but on October 4, 2019, NMFS initiated the 5-year review process for 17 Pacific salmon ESUs and 11 Steelhead ESUs (84 FR 53117). The purpose of these reviews is to ensure the accuracy of their listing classifications based on the best scientific and commercial data available. The comment period was extended to May 26, 2020 (85 FR 16619). Some of these reviews have been completed and are noted where applicable in this table. For California Coastal ESU, a 5-year review was published on December 11, 2024. No change in ESA status is recommended (NMFS 2024e). For Central Valley Spring Run ESU, as of December 2024, a 5-year Review has not been published, therefore the listing status remains unchanged. The most recent 5-year review (NMFS 2022f) found that the Lower Columbia River ESU of Chinook salmon should remain listed as threatened.
	Central Valley Spring Run ESU	3.2.1.1	T	From 1970 through 2012, Central Valley spring-run Chinook salmon run size estimates fluctuated from highs near 30,000 to lows near 3,000. The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 5,251 individuals and the natural juvenile abundance at 1,092,518. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016n) NMFS (2016r) NMFS (2014b) NMFS (2018b) Cordoleani (2020) NMFS (2024e) Cordoleani (2020)	
	Lower Columbia River ESU	3.2.1.1	T	Annual estimates of natural-origin Tule fall Chinook salmon spawner abundance for the Washington portion of this ESU ranged from a low of 7,065 in 2012 to a high of 18,941 in 2015. The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 29,469 individuals and the natural juvenile abundance at 12,866,892. In 2019 average adult escapement was estimated to be 68,061. As of the 2013 RP, only two of 32 historical populations, the North Fork Lewis and Sandy late-fall populations, are considered viable. As of the 2016 review, there has been an overall improvement in the status of a number of fall-run populations, although most are still far from the recovery plan goals. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2022f)	
	Puget Sound ESU	3.2.1.1	T	Most recent RP in 2007. 2016 review states that across the ESU, most populations have declined in abundance since the last status review in 2011, and the decline has persisted over the past 7 to 10 years. The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 19,258 individuals and the natural juvenile abundance at 2,598,480. As of 2019 the average adult escapement was estimated to be 32,481. According to the 2018 PEA, this ESU occurs in the CCRA and PSRA.	NMFS (2016h) NMFS (2016r) NMFS (2007b) NMFS (2018b) NMFS (2019a) 70 FR 37160 70 FR 52630	For Puget Sound ESU, as of December 2024, a 5-year Review has not been made available yet, therefore the listing status remains unchanged.
	Sacramento River Winter Run ESU	3.2.1.1	E	The population declined from an escapement of near 100,000 in the late 1960s to fewer than 200 in the early 1990s. More recent population estimates of 8,218 (2004), 15,730 (2005), and 17,153 (2006) show a three-year average of 13,700 returning winter-run Chinook salmon. However, the run size decreased to 2,542 in 2007 and 2,850 in 2008. The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 3,708 individuals and the natural juvenile abundance at 771,449. According to the 2018 PEA, this species occurs in the CCRA.	NMFS (2016q) NMFS (2016r) NMFS (2014b) NMFS (2018b) NMFS (2024h)	A 5-year status review was published on February 2, 2024 and no change in ESA status is warranted (NMFS 2024h).
	Snake River Fall Run ESU	3.2.1.1	T	The geometric mean of natural-origin adult abundance for the 10 years of annual spawner escapement estimates from 2005-2014 is 6,418, with a standard error of 0.19. Natural-origin spawner abundance has increased relative to previous status reviews. The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 11,254 individuals and the natural juvenile abundance at 605,921. As of 2019 the average adult escapement was estimated to be 37,812. According to the 2018 PEA, this ESU occurs in the CCRA and PSRA.	NMFS (2016i) NMFS (2016r) NMFS (2017c) NMFS (2018b) NMFS (2019a) NMFS (2022i) 70 FR 37160 58 FR 68543	The most recent status review was completed in 2022 (NMFS 2022i). No change in status was recommended and this ESU remains threatened. However NMFS is concerned about current trends in abundance and productivity and recommend specific actions at the population and ESU levels over the next 5 years, and identified the potential to initiate a status review prior to the standard 5-year period.
	Snake River Spring/ Summer Run ESU	3.2.1.1	T	Adult counts gradually increased during the 1980s but then declined further, reaching a low of 2,200 fish in 1995. The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 11,347 individuals and the natural juvenile abundance at 1,428,881. As of 2019, the average adult escapement was estimated to be 17,043. According to the 2018 PEA, this ESU occurs in the CCRA and PSRA.	NMFS (2016i) NMFS (2016r) NMFS (2017c) NMFS (2019a) NMFS (2022i) 70 FR 37160 58 FR 68543	The most recent status review was completed in 2022 (NMFS 2022i). No change in status was recommended and this ESU remains threatened. However NMFS is concerned about current trends in abundance and productivity and recommend specific actions at the population and ESU levels over the next 5 years, and identified the potential to initiate a status review prior to the standard 5-year period.

ESA-listed Fish Species	DPS, ESU, or Stock	2018 PEA Section	Current ESA Status	Estimated Abundance and Range	References	Description/Change from 2018 PEA
Chinook salmon (cont'd).	Upper Columbia River Spring Run ESU	3.2.1.1	E	Most recent RP in 2007, which states that in 2003 a total of 1644 spawners were recorded over three drainages: Wenatchee, Entiat, and Methow. The 2016 BiOp states the population (NMFS 2022f)of natural origin adult Chinook from this ESU at 1,475 individuals and the natural juvenile abundance at 484,538. As of 2019 the average adult escapement was estimated to be 9,057. According to the 2018 PEA this ESU occurs in the CCRA and LCRRA.	NMFS (2016k) NMFS (2016r) NMFS (2018b) UCSRB (2007) NMFS (2019a) NMFS (2022j) 70 FR 37160 70 FR 52630	The most recent status review completed in 2022 for the Upper Columbia River spring run ESU found that no change in status was warranted and the ESU remains endangered (NMFS 2022j)
	Upper Willamette River ESU	3.2.1.1	T	Most recent RP in 2011. From the RP: The UWR Chinook ESU is considered to be extremely depressed, likely numbering less than 10,000 fish compared to a historical abundance estimate of 300,000. Willamette Falls fish counts from 1961-currrent available at https://www.dfw.state.or.us/fish/fish_counts/willamette%20falls.asp. The 2016 BiOp states the population of natural origin adult Chinook from this ESU at 11,443 individuals and the natural juvenile abundance at 5,792,774. As of 2019, average adult escapement was estimated at 45,869. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2016l) ODFW and NMFS (2011) NMFS (2016r) NMFS (2018b) NMFS (2019a) 70 FR 37160 70 FR 52630 NMFS 2024j 70 FR 52630	On July 8, 2024 a 5 year status review was published (NMFS 2024j). No change in the ESA status was recommended.
Chum salmon (*Oncorhynchus keta*)	Columbia River ESU	3.2.1.1	T	As of the 2016 review, the ESU remains at moderate to high risk. The 2016 BiOp states the population of natural origin adult chum from this ESU at 10,644 individuals and the natural juvenile abundance at 3,462,120. As of 2019 the average adult escapement was estimated at 11,070. According to the 2018 PEA, this ESU occurs in the CCRA and(NMFS 2022e) LCRRA.	NMFS (2016d) NMFS (2013) NMFS (2016r) NMFS (2018b) NMFS (2019a) NMFS (2022f) 70 FR 37160 70 FR 52630	On October 4, 2019, NMFS initiated the 5-year review process for 17 Pacific salmon ESUs including the 2 chum ESUs, to ensure accuracy of their listing classifications based on the best scientific and commercial data available. The 5-year review for Columbia River chum salmon was completed in 2022(NMFS 2022f) concluded that this ESU of chum salmon should remain listed as threatened. For Hood Canal Summer Run ESU, as of December 2024, a 5-year Review has not been made available yet, therefore the listing status remains unchanged.
	Hood Canal Summer Run ESU	3.2.1.2	T	Most recent RP in 2005. The 2016 review states that productivity was quite low at the time of the 2011 review, though rates have increased in the last five years, and have been greater than replacement rates in the past two years for both populations. However, productivity of individual spawning aggregates shows only two of eight aggregates have viable performance. The 2016 BiOp states the population of natural origin adult chum from this ESU at 20,855 individuals and the natural juvenile abundance at 3,368,592. As of 2019 average adult escapement was 27,452. According to the 2018 PEA, this ESU occurs in the CCRA and PSRA.	NMFS (2016h) Brewer et al. (2005) NMFS (2016r) NMFS (2018b) NMFS (2019a) 70 FR 37160 70 FR 52630	
Coho salmon (*Oncorhynchus kisutch*)	Central California Coast ESU	3.2.1.2	E	The 2012 RP summarized that the CCC coho salmon abundance had been reduced from up to 500,000 in the 1940s to between 2,000 and 3,000 wild adults in 2011. The 2016 BiOp states the population of natural origin adult coho from this ESU at 1,192 individuals and the natural juvenile abundance at 133,840. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016b) NMFS (2012) NMFS (2016r) NMFS (2018b) NMFS (2023b)	On October 4, 2019, NMFS initiated the 5-year review process for 17 Pacific salmon ESUs including the 4 coho ESUs, to ensure accuracy of their listing classifications based on the best scientific and commercial data available. The 5-year review for Central CA Coast coho salmon was completed in March 2023 (NMFS 2023b) concluded that this ESU of coho salmon should remain listed as endangered. The 2022 5- year review (NMFS 2022f) concluded that this ESU of coho salmon should remain listed as threatened.
	Lower Columbia River ESU	3.2.1.2	T	As of the 2013 RP, 21 of the 24 Lower Columbia River coho salmon populations are considered to have a very low probability of persisting over the next 100 years, and none is considered viable. As of the 2015 review populations in this ESU have generally improved but recent poor ocean conditions suggest that population declines might occur in the upcoming return years, and this ESU is still considered to be at moderate risk. The 2016 BiOp states the population of natural origin adult co(NMFS 2022h)ho from this ESU at 32,986 individuals and the natural juvenile abundance at 729,256. As of 2019 average adult escapement was estimated to be 56,068. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2016d) NMFS (2013) NMFS (2016r) NMFS (2018b) NMFS (2019a) NMFS (2022f) 70 FR 37160 81 FR 9252	

ESA-listed Fish Species	DPS, ESU, or Stock	2018 PEA Section	Current ESA Status	Estimated Abundance and Range	References	Description/Change from 2018 PEA
Coho salmon (cont'd)	Oregon Coast ESU	3.2.1.2	T	From the 2016 RP: All-time low returns in the 1970s and 1990s were around 20,000 spawners. Since the mid-1990s, Oregon Coast coho spawner escapement levels have varied greatly but peak abundance in several years (2011 and 2014) has been higher than at any other period since the 1950s. The 2016 BiOp states the population of natural origin adult coho from this ESU at 234,203 individuals and the natural juvenile abundance at 16,394,210. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016f) NMFS (2016t) NMFS (2016r) NMFS (2018b) NMFS (2022e)	The 2022 5- year review concluded that the Oregon Coast ESU of coho salmon should remain listed as threatened (NMFS 2022e).
	Southern Oregon/ Northern California Coast ESU	3.2.1.2	T	Most recent RP in 2009. The Lake Ozette sockeye salmon ESU is made up of only one population, which currently contains five distinct spawning aggregations. The 2009 RP states that Sockeye run-size estimates from 1996 to 2003 ranged from a low of 1,609 (1997) to a high of 5,075 (2003), averaging approximately 3,600 sockeye per year. The 2016 BiOp states the population of natural origin adult sockeye from this ESU at 2,143 individuals and the natural juvenile abundance at 353,282. As of 2019, average adult escapement was estimated to be 2,321. According to the 2018 PEA, this ESU occurs in the CCRA and PSRA.	NMFS (2016j) NMFS (2016r) NMFS (2018b) NMFS (2014a) NMFS (2024i)	The 5-year review was published on December 11, 2024 (NMFS 2024i) and recommended that ESA status remain as threatened.
Longfin smelt (*Spirinchus thaleichthys*)	San Francisco Bay-Delta		E	Long-term survey efforts in the San Francisco Bay have indicated a recent and significant decline in abundance throughout the estuary and across all life stages (USFWS 2024c).	USFWS 2024c 73 FR 24612 87 FR 60957 89 FR 61029	On May 6, 2008, USFWS received a petition (73 FR 24612) to list as threatened or endangered the San Francisco Bay- Delta population of Longfin Smelt. A 12-month Finding (74 FR 16169) was published on April 9, 2009. The USFWS published a proposed rule (87 FR 60957) on October 7, 2022 to list the longfin smelt San Francisco Bay-Delta DPS as endangered under the ESA, and on July 29, 2024 a final rule (89 FR 61029) was published.
Sockeye salmon (*Oncorhynchus nerka*)	Ozette Lake ESU	3.2.1.2	T	Most recent RP in 2009. The Lake Ozette sockeye salmon ESU is made up of only one population, which currently contains five distinct spawning aggregations. The 2009 RP states that Sockeye run-size estimates from 1996 to 2003 ranged from a low of 1,609 (1997) to a high of 5,075 (2003), averaging approximately 3,600 sockeye per year. The 2016 BiOp states the population of natural origin adult sockeye from this ESU at 2,143 individuals and the natural juvenile abundance at 353,282. As of 2019, average adult escapement was estimated to be 2,321. According to the 2018 PEA, this ESU occurs in the CCRA and PSRA.	NMFS (2016g) NMFS (2009b) NMFS (2016r) NMFS (2018b) NMFS (2019a) NMFS (2022h) 70 FR 37160 70 FR 52630 70 FR 52630	No change in ESA status but on October 4, 2019 NMFS initiated the 5- year review process for 17 Pacific salmon ESUs and 11 Steelhead ESUs (84 FR 53117). The purpose of these reviews is to ensure the accuracy of their listing classifications based on the best scientific and commercial data available. The comment period was extended to May 26, 2020 (85 FR 16619). Reviews for both sockeye ESUs were completed in 2022 as noted below. Based on the results of the 5-year review, NMFS determined the Ozette Lake ESU should remain classified as threatened (NMFS 2022h).
	Snake River ESU	3.2.1.2	E	Adult returns include 646 fish in 2008 (including 140 natural-origin fish), 832 in 2009 (including 86 natural-origin fish), 1,355 in 2010 (including 178 natural-origin fish), 1,117 in 2011 (including 145 natural-origin fish), 257 adults in 2012 (including 52 natural-origin fish, 272 adults in 2013 (including 79 natural-origin fish), and 1,579 adults in 2014 (including 453 natural-origin fish). The 2016 BiOp states the population of natural origin adult sockeye from this ESU at 2,143 individuals and the natural juvenile abundance at 353,282. As of 2019 average adult escapement was 1,373. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2016i) NMFS (2015) NMFS (2016r) NMFS (2018b) NMFS (2019a) NMFS (2022d) 70 FR 37160 58 FR 68543 58 FR 68543	The most recent status review for the Snake River ESU found that no change in either delineation or status as endangered was warranted (NMFS 2022d).
Steelhead trout (*Oncorhynchus mykiss*)	California Central Valley DPS	3.2.1.2	T	Prior to dam construction, water development and watershed changes, Central Valley steelhead were distributed throughout the Sacramento and San Joaquin rivers. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 1,482 individuals and the natural juvenile abundance at 169,033. According to the 2018 PEA, this DPS occurs in the CCRA only.	NMFS (2016m) NMFS (2016r) NMFS (2018b) NMFS (2014b) NMFS (2024d)	October 4, 2019 NMFS initiated the 5- year review process for 17 Pacific salmon ESUs and 11 Steelhead ESUs (84 FR 53117). The purpose of these reviews is to ensure the accuracy of their listing classifications based on the best scientific and commercial data available. The comment period was extended to May 26, 2020 (85 FR 16619). Several steelhead 5-year reviews are available as of February 2023 as noted below. The 5-year review for CA Central Valley DPS was published on December 11, 2024 (NMFS 2024d). No ESA status change is recommended.
	Central California Coast DPS	3.2.1.2	T	Population estimates for some drainages are provided in the Multispecies Recovery Plan. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 2,187 individuals and the natural juvenile abundance at 248,771. From the 2016 review: Even though recent data suggests some CCC steelhead populations are doing better than others, all populations remain at severely depressed levels, suggesting stochastic processes continue to remain a high threat to the species. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016c) NMFS (2016s) NMFS (2016r) NMFS (2018b) NMFS (2024f)	The 5-year review was published in December 2024 (NMFS 2024f) and recommends this DPS to remain listed as threatened.

ESA-listed Fish Species	DPS, ESU, or Stock	2018 PEA Section	Current ESA Status	Estimated Abundance and Range	References	Description/Change from 2018 PEA
Steelhead trout (cont'd)	Lower Columbia River DPS	3.2.1.2	T	As of the 2013 RP, 16 of the 23 Lower Columbia River steelhead populations have a low or very low probability of persisting over the next 100 years, and six populations have a moderate probability of persistence. Modest improvements in the status of several winter-run populations are noted in the 2016 review but none of the populations appear to be at fully viable status. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 23,892. (NMFS 2022g) individuals and the natural juvenile abundance at 393,641. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2016d) NMFS (2013) NMFS (2016r) NMFS (2018b) NMFS (2022f) 71 FR 834 70 FR 52630	The 2022 5-year review concluded that this DPS of steelhead should remain listed as threatened (NMFS 2022f).
	Middle Columbia River DPS	3.2.1.2	T	Most recent RP in 2009. According to the RP, the majority of natural Middle Columbia steelhead populations are rated at moderate risk for abundance and productivity but low to moderate risk for spatial structure and diversity. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 2,187 individuals and the natural juvenile abundance at 248,771. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2016e) NMFS (2009a) NMFS (2016r) NMFS (2018b) NMFS (2022g) 71 FR 834 70 FR 52630	The most recent 5- year status review was completed in 2022 (NMFS 2022g) and concluded no change in listing status for this DPS. It remains threatened. In addition there was no change in delineation of the DPS.
	Northern California DPS	3.2.1.2	T	Population estimates for some drainages are provided in the Multispecies RP. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 5,929 individuals and the natural juvenile abundance at 674,424. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016a) (NMFS 2016s) NMFS (2016r) NMFS (2018b) NMFS (2024g)	The 5-year review for Northern CA DPS was published on July 9, 2024 (NMFS 2024g).
	Puget Sound DPS	3.2.1.2	T	The 2016 review states that recent increases in abundance that have been observed in a few populations have been within the range of variability observed in the past several years. Trends in abundance of natural spawners remain predominantly negative. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 13,422individuals and the natural juvenile abundance at 1,526,753. According to the 2018 PEA, this ESU occurs in the CCRA and PSRA.	NMFS (2016h) 72 FR 26722 81 FR 9252 NMFS (2016r) NMFS (2018b)	The 5-year review for the Puget Sound DPS of Steelhead has not been completed as of December 2024, therefore the status remains unchanged.
	Snake River Basin DPS	3.2.1.2	T	At the time of listing in 1997, the total recent-year average (1990–1994) escapement for Snake River steelhead above Lower Granite Dam had dropped to approximately 71,000 adults, with a natural component of 9,400. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 33,340 individuals and the natural juvenile abundance at 1,142,126. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2016i) NMFS (2017c) NMFS (2016r) NMFS (2018b) 71 FR 834 70 FR 52630	The most recent status review was completed in 2022 (NMFS 2022b). The review recommended no change in status for this DPS; it remains threatened. Also no change in delineation of DPS was warranted.
	South Central California Coast DPS	3.2.1.2	T	From the 2016 review: Native lineages have been nearly extirpated from this far southern region of the native range of O. mykiss, with only a few relict populations persisting in the headwaters of the San Gabriel, Santa Ana, and San Luis Rey rivers. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 695 individuals and the natural juvenile abundance at 79,057. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016o) NMFS (2016r) NMFS (2018b) NMFS (2023c)	The 5-year review for the South - Central CA Coast DPS of Steelhead was completed in March 2023. (NMFS 2023b) NMFS concluded that this ESU of Steelhead should remain listed as threatened.
	Southern California Coast DPS	3.2.1.2	E	From the 2016 review: Native lineages have been nearly extirpated from this far southern region of the native range of O. mykiss, with only a few relict populations persisting in the headwaters of the San Gabriel, Santa Ana, and San Luis Rey rivers. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 695 individuals and the natural juvenile abundance at 79,057. According to the 2018 PEA, this ESU occurs in the CCRA only.	NMFS (2016p) NMFS (2016r) NMFS (2018b) NMFS (2023c)	The 5-year review for the Southern CA Coast DPS of Steelhead was completed in March 2023 (NMFS 2023c). NMFS concluded that this DPS should remain listed as endangered.

ESA-listed Fish Species	DPS, ESU, or Stock	2018 PEA Section	Current ESA Status	Estimated Abundance and Range	References	Description/Change from 2018 PEA
Steelhead trout (cont'd)	Upper Columbia River DPS	3.2.1.2	T	Most recent RP in 2007, which states that in 2003 naturally produced steelhead escapement numbers over the Wenatchee and Entiat drainages totaled 1,791. For Methow and Okanogan drainages the total was 549. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 2,846 individuals and the natural juvenile abundance at 280,338. According to the 2018 PEA, this ESU occurs in the CCRA and LCRRA.	NMFS (2016k) UCSRB (2007) 71 FR 834 70 FR 52630 NMFS (2016r) NMFS (2018b) NMFS (2022j)	The most recent status review completed in 2022 found that no change in status was warranted and the ESU remains threatened (NMFS 2022j).
	Upper Willamette River DPS	3.2.1.2	T	Most recent RP in 2011. From the RP: For UWR steelhead, although the DPS is depressed relative to historical levels, the risk of extinction is modest. The 2016 BiOp states the population of natural origin adult steelhead from this DPS at 5,971 individuals and the natural juvenile abundance at 207,853. According to the 2018 PEA, this ESU occurs in the CCRA and LCCRA.	NMFS (2016l) ODFW and NMFS (2011) NMFS (2016r) NMFS (2018b) 71 FR 834 70 FR 52630 NMFS (2024j)	The 5-year review for the Upper Willamette River DPS of Steelhead was published on July 8, 2024 (NMFS 2024j.
Highly Migratory Species						
Scalloped hammerhead shark (*Sphyrna lewini*)	Eastern Pacific DPS	N/A	E	Abundance data are not available for the Eastern Pacific DPS. The final rule for listing this species states that the northern boundary of the Eastern Pacific scalloped hammerhead shark's range is bounded to the north by 40° N latitude. The 2020 5-year review identified the Gulf of California as an important nursery area; juvenile scalloped hammerheads were predominant. This species is generally considered to be very rare in U.S. waters. While their range may overlap with some NWFSC research areas, the type of research is not likely to interact with this species.	79 FR 38213 80 FR 71774 Miller et al. (2014) NMFS (2020)	Eastern Pacific DPS was listed as endangered on July 3, 2014. Despite this change in status, additional evaluation under the SPEA alternatives is not necessary given the scope of proposed research (i.e., the nature and extent of research is not likely to interact with this species). Critical habitat has not been designated (November 17, 2015).

Appendix E: Stock Status

Table E-1. Target fish species stock status under the MSA summary, including current estimated abundance and changes since the 2018 PEA.

Target Fish (2018 PEA Section 3.2.1.2)	Stock Status as Reported in 2018 PEA[a]	Current Status[b]	Description/Change from 2018 PEA
Arrowtooth flounder (*Atheresthes stomias*	Not overfished	No overfishing Not overfished	No change
Aurora rockfish (*Sebastes aurora*)	Not overfished	Overfishing unknown Not overfished	The species is still not overfished but it is not known if overfishing is occurring.
Big skate (*Raja binoculata*)	Monitored as ecosystem component	No overfishing Not overfished	Stock status is now reported for this species; they are not overfished and overfishing is not occurring.
Bocaccio Southern Pacific Coast DPS (*Sebastes paucispinis*)	Not overfished Rebuilding	No overfishing Not overfished Rebuilt as of 2017	Overfishing is not occurring; stock is not overfished and is considered rebuilt
Canary rockfish Pacific Coast stock (*Sebastes pinniger*)	No overfishing Overfished	No overfishing Not overfished Rebuilt as of 2015	Stock is not overfished and is considered rebuilt
Chilipepper Southern Pacific Coast stock (*Sebastes goodei*)	Not overfished	No overfishing Not overfished	No change
Darkblotched rockfish Pacific Coast stock (*Sebastes crameri*)	No overfishing Rebuilt	No overfishing Not overfished Rebuilt as of 2017	Stock is not overfished and is considered rebuilt
Dover sole (*Microstomus pacificus*)	Not overfished	No overfishing Not overfished	No change
English sole (*Parophrys vetulus*)	Not overfished	No overfishing Not overfished	No change
Greenstriped rockfish (*Sebastes elongatus*)	No overfishing Overfished status unknown	Overfishing unknown Not overfished	It is not known if overfishing is occurring for this species but it is considered to be not overfished
Halfbanded rockfish (*Sebastes semicinctus*)	Unknown	Not reported	No change; stock status for halfbanded rockfish is still unknown
Lingcod (*Ophiodon elongatus*)	Not overfished Rebuilt	No overfishing Not overfished	No change
Longnose skate (*Raja rhina*)	Not overfished	No overfishing Not overfished	No change
Longspine thornyhead (*Sebastolobus altivelis*)	Not overfished	No overfishing Not overfished	No change

[a] As of third quarter 2014; see Table 3.2-2 of the 2018 PEA (NMFS 2018b).
[b] As of December 31, 2022 (NMFS 2023e).

Target Fish (2018 PEA Section 3.2.1.2)	Stock Status as Reported in 2018 PEA[a]	Current Status[b]	Description/Change from 2018 PEA
Northern anchovy Southern Pacific Coast stock (*Engraulis mordax*)	Unknown	No overfishing Overfished status unknown	It is not known whether this stock is overfished or approaching overfished but overfishing is not occurring.
Pacific cod Pacific Coast stock (*Gadus macrocephalus*)	No overfishing Overfished status unknown	No overfishing Overfished status unknown	No change
Pacific grenadier (*Coryphaenoides acrolepis*)	Unknown	Not reported	No change; stock status for Pacific grenadier is still unknown
Pacific hake (*Merluccius productus*)	Not overfished	No overfishing Not overfished	No change
Pacific halibut (*Hippoglossus stenolepis*)	Overfishing unknown Not overfished	Not overfished Catch levels set by the International Pacific Halibut Commission (IPHC)	Results of the 2024 stock assessment indicate that the Pacific halibut stock declined continuously from the late 1990's to around 2012. The spawning biomass (SB) is estimated to have increased gradually to 2016 and then decreased to a low of 145 million pounds (~65,700t) at the beginning of 2024 (Stewart and Hicks 2025).
Pacific herring (*Clupea pallasii*)	Monitored as ecosystem component	Monitored as ecosystem component	No change
Pacific ocean perch (*Sebastes alutus*)	No overfishing Overfished	No overfishing Not overfished Rebuilt as of 2017	Stock is no longer overfished and is considered rebuilt
Pacific sanddab (*Citharichthys sordidus*)	Overfishing unknown Not overfished	Overfishing unknown Not overfished	No change
Pacific sardine Northern subpopulation (*Sardinops sagax caerulea*)	Not overfished	No overfishing Overfished	No change
Petrale sole (*Eopsetta jordani*)	Not overfished Rebuilt	No overfishing Not overfished Rebuilt as of 2015	Overfishing is no longer occurring and stock is considered to be rebuilt.
Redstripe rockfish (*Sebastes proriger*)	No overfishing Overfished status unknown	Not reported	Recent stock status is not reported; stock status for redstripe rockfish is unknown
Rex sole (*Glyptocephalus zachirus*)	Overfishing unknown Not overfished	Overfishing unknown Not overfished	No change
Rosethorn rockfish (*Sebastes helvomaculatus*)	No overfishing Overfished status unknown	Not reported	Recent stock status is not reported; stock status for rosethorn rockfish is unknown

Target Fish (2018 PEA Section 3.2.1.2)	Stock Status as Reported in 2018 PEA[a]	Current Status[b]	Description/Change from 2018 PEA
Rougheye rockfish (*Sebastes aleutianus*)	Overfishing unknown Not overfished	No overfishing Not overfished	This species is now considered as part of the blackspotted and rougheye rockfish complex.
Sablefish (*Anoplopoma fimbria*)	Not overfished	No overfishing Not overfished	No change
Sharpchin rockfish (*Sebastes zacentrus*)	Overfishing unknown Not overfished	Overfishing unknown Not overfished	No change
Shortbelly rockfish (*Sebastes jordani*)	Not overfished	No overfishing Not overfished	No change
Shortspine thornyhead (*Sebastolobus alascanus*)	Not overfished	No overfishing Not overfished	No change
Spiny dogfish (*Squalus acanthias*)	Overfishing unknown Not overfished	No overfishing Not overfished	Overfishing is not occurring
Splitnose rockfish (*Sebastes diploproa*)	Not overfished	No overfishing Not overfished	No change
Spotted ratfish (*Hydrolagus colliei*)	No overfishing Overfished status unknown	Not reported Monitored as ecosystem component	Stock status is not currently reported but the species is monitored as an ecosystem component
Stripetail rockfish (*Sebastes saxicola*)	Overfishing unknown Not overfished	No overfishing Not overfished	As of December 31, 2022 overfishing is not occurring (NMFS 2023e)
Vermilion rockfish (*Sebastes miniatus*)	Unknown	Unknown	No change
Widow rockfish (*Sebastes entomelas*)	Not overfished	No overfishing Not overfished	No change
Yellowtail rockfish (*Sebastes flavidus*)	Not overfished	No overfishing Not overfished	No change

Appendix F: Highly Migratory Species Status

Table F-1. Summary of the current status of highly migratory species.

Highly Migratory Species[a]	Current Status	References
Common thresher shark (*Alopias vulpinus*)	Found in the Eastern Pacific Ocean from Goose Bay, British Columbia, south to Baja California. Spawning depletion reached a minimum of 0.53 in 2006. However since 2006, the population has been slowly recovering. These sharks currently are not overfished and are not subject to overfishing.	Teo et al. (2018) NMFS (2023b)
Pacific shortfin mako shark (*Isurus oxyrinchus*)	Inhabit the Eastern Pacific ocean from the Columbia River to Chile. Currently the stock is not overfished and is not subject to overfishing.	ISC (2018) NMFS (2023b)
Blue shark (*Prionace glauca*)	Blue sharks range throughout NWFSC research areas and are found at higher latitudes in the summer months. Blue sharks in the North Pacific Ocean are not currently overfished or approaching overfished. Overfishing is not occurring.	Li et al. (2020) Flores et al. (2019) NMFS (2023b)
North Pacific albacore tuna (*Thunnus alalonga*)	Stock area consists of all waters in the Pacific Ocean north of the equator to 55°N. The stock is not overfished and is not subject to overfishing.	ISC (2020b) NMFS (2023b)
Pacific bigeye tuna Eastern Pacific stock (*Thunnus obesus*)	Range from Peru to Iron Springs, Washington. More likely to be encountered in the waters off of southern California. Since hitting a low in 2004, the Eastern Pacific population has been increasing in abundance and is now above its target population level. The Eastern Pacific stock is not overfished and is not subject to overfishing.	Xu et al. (2020) NMFS (2023b)
Pacific bluefin tuna (*Thunnus orientalis*)	Found within 100 nmi of the California coast. NOAA Fisheries first determined the Pacific bluefin tuna stock to be overfished in 2013, and the 2020 stock assessment determined that the stock was still overfished and subject to overfishing. However in a 2022 Q4 update, the stock was determined to be no longer subject to overfishing but remained overfished.	ISC (2020a) NMFS (2023b)
Pacific skipjack tuna Eastern Pacific stock (*Katsuwonus pelamis*)	Range from Peru to Vancouver Island. More likely to be encountered in the waters off of southern California. The eastern Pacific stock is not overfished and not subject to overfishing.	Maunder (2018) NMFS (2023b)
Pacific yellowfin tuna Eastern Pacific stock (*Thunnus albacares*)	Range from Chile to Port Buchon, CA. May be encountered in the waters off of southern California. They enter California waters when temperatures are warm. Not overfished and not subject to overfishing.	Minte-Vera et al. (2020) NMFS (2023b)
Striped marlin Eastern Pacific stock (*Kajikia audax*)	Found from Peru to California. May be encountered in the waters off of southern California as they are not usually found north of 45°N. Off the coast of southern California, they often feed at the surface on small coastal fish and squid. Not overfished and not subject to overfishing.	Hinton (2009) NMFS (2023b)
Swordfish Eastern Pacific stock (*Xiphias gladius*)	Off the U.S. West Coast, swordfish are found in tropical, temperate, and occasionally cold waters. The stock is not overfished but is subject to overfishing.	ISC (2014)
Dorado or mahimahi (*Coryphaena hippurus*)	Mahimahi are caught off of California. The overfishing status of mahimahi is unknown because the population is not formally assessed. Populations are assumed to be stable because the species is very productive and ranges throughout the tropical and subtropical Pacific.	https://www.fisheries.noaa.gov//species/pacific-mahimahi#overview (accessed February 20, 2023)

[a] As identified in the FMP for U.S. West Coast Fisheries for Highly Migratory Species, as amended (PFMC 2018).

Appendix G: Marine Mammals

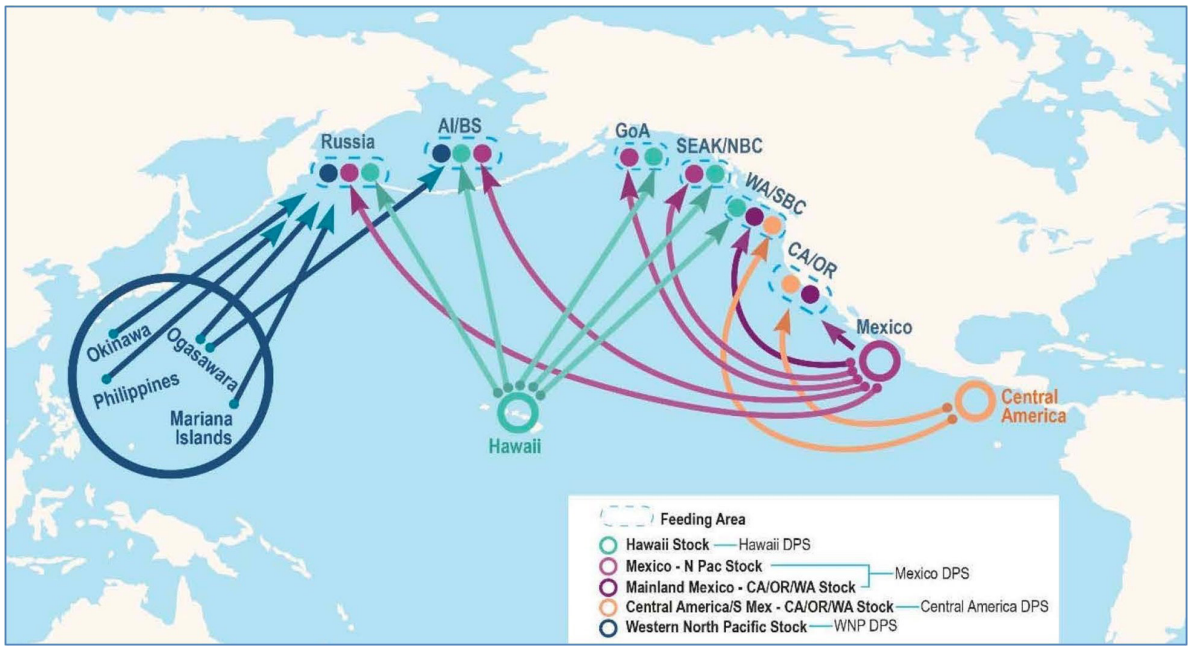


Figure G-1. North Pacific humpback whale stocks. Source: NMFS (2023c).

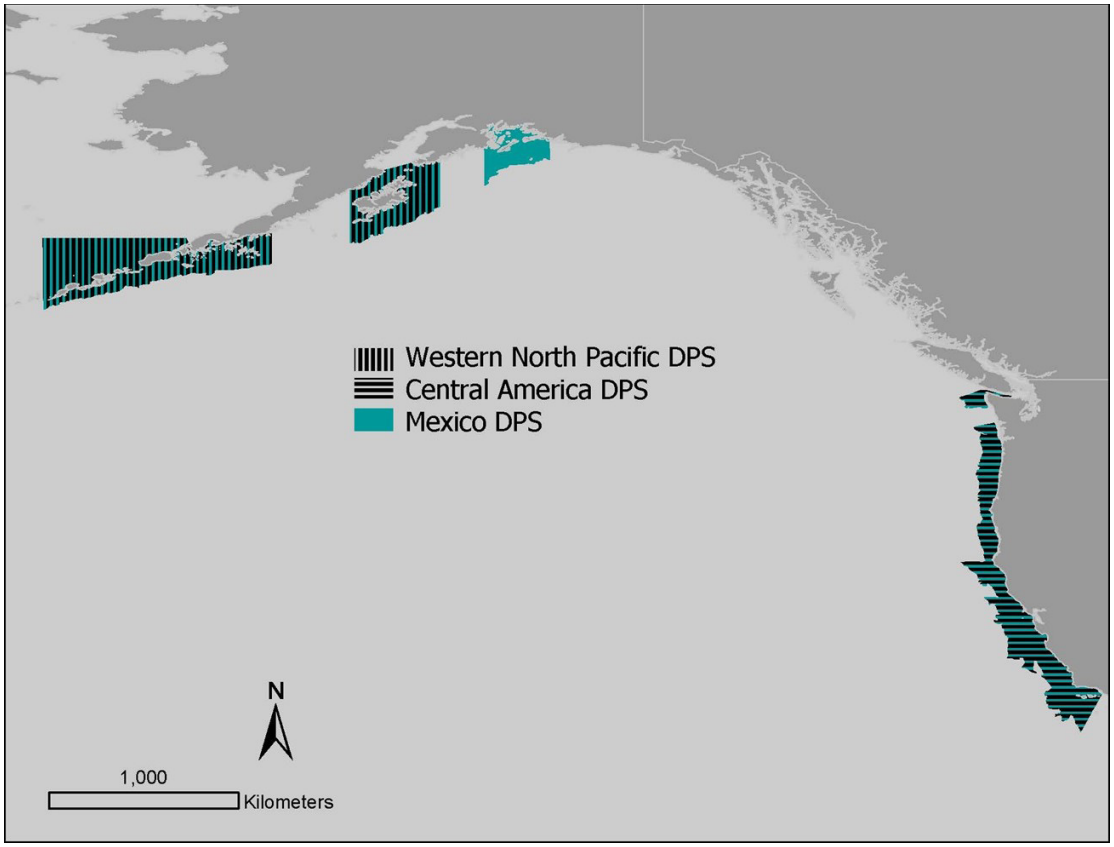


Figure G-2. Humpback whale critical habitat. Source: https://www.fisheries.noaa.gov/resource/map/humpback-whale-critical-habitat-maps-and-gis-data (accessed June 1, 2022).

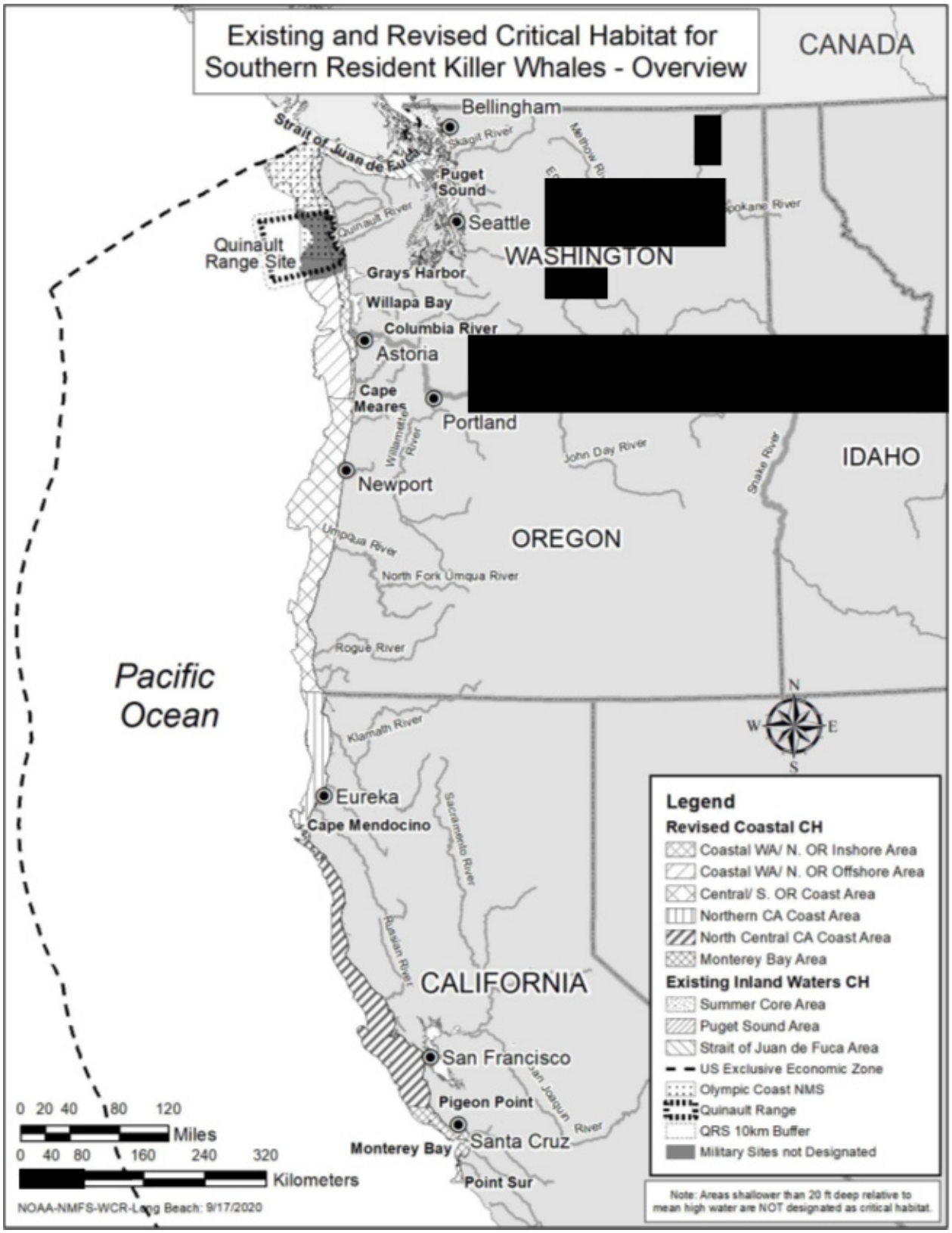


Figure G-3. Revised critical habitat for Southern Resident killer whales. Source: https://media.fisheries.noaa.gov/2021-07/map-srkw-ch-overview-fedreg-final7.pdf?null= (accessed June 1, 2021).

Table G-1. ESA-listed marine mammals within the action area. Key: *E* = endangered, *T* = threatened, *D* = depleted under the MMPA, *NR* = not reported. Note: This table has been typeset on tabloid-size paper (11 × 17 in).

ESA-listed Species	DPS, ESU, or Stock	2018 Final Rule Abundance[a]	Current Abundance[b]	Current ESA and MMPA Status	Current Estimated Abundance	References	Description/Change from 2018 PEA (Section 3.2.2.2 of the 2018 PEA)
Sperm whale (*Physeter macrocephalus*)	CA/WA/OR Stock	1,997	2,606	E, D	According to Moore and Barlow (2014), sperm whale abundance estimates based on the trend-model range between 2,000 and 3,000 animals for the 1991 to 2014 time series. Nest is 2606. Potential Biological Removal (PBR) is 4. Abundance has not been revised since 2018.	Carretta et al. (2021) Carretta et al. (2022) Moore and Barlow (2014)	No change in ESA status. Critical Habitat not designated. According to the 2018 PEA, this DPS occurs in the CCRA only. Moore and Barlow (2014) reported that sperm whale abundance appeared stable from 1991 to 2008 and additional data from a 2014 survey do not change that conclusion. The observed annual rate of documented mortality and serious injury (≥ 0.64 per year) is less than the calculated PBR (2.5) for this stock but anthropogenic mortality and serious injury is likely underestimated due to incomplete detection of carcasses and injured whales. Total human-caused mortality is greater than 10% of the calculated PBR and, therefore, is not insignificant and approaching zero mortality and serious injury rate. Increasing levels of anthropogenic sound in the world's oceans has been suggested to be a habitat concern for whales, particularly for deep-diving whales like sperm whales that feed in the ocean's sound channel.
Humpback whale (*Megaptera novaeangliae*)	Central America DPS (Central America/S. Mexico-CA/OR/WA) stock	1,918 Note: this abundance is for the former CA/OR/WA stock	1,496 (NMFS 2023f)	E, D	Based on the new stock definitions, abundance of the Central America DPS is 1,496 (CV=0.171); PBR in U.S. waters is 3.5.	Carretta et al. (2022) NMFS (2023c)	No change in ESA listing but changes to MMPA stock definitions were made by NMFS in 2023 (NMFS 2023f). Now, ESA-listed humpback whales encountered in NWFSC research areas belong to either the Central America/Southern Mexico-California-Oregon-Washington (CA/OR/WA) stock (part of the endangered Central America DPS) or to the Mainland Mexico-CA/OR/WA stock (part of the threatened Mexico DPS).
	Mexico DPS (Mainland Mexico-CA/OR/WA stock)	Stock definitions were revised in 2023 as discussed in the far right column	3,477 (NMFS 2023f)	T, D	Based on the new stock definitions, abundance of the Mexico DPS is 3,477 (CV=0.101). PBR in U.S. waters is 43.		Critical Habitat designated April 21, 2021 (86 FR 21082). CH may overlap with NWFSC research activities. According to the 2018 PEA (NMFS 2018b), this species occurs in the CCRA and is rarely observed in the PSRA.
Blue whale (*Balaenoptera musculus musculus*)	Eastern North Pacific stock	1,647	1,898	E, D	The most-recent abundance estimate for 2018 is 1,898 (CV=0.085) whales. PBR is 7 whales but since most blue whales are outside U.S. West Coast waters from November to March (5 months), so the PBR for U.S. waters is 7/12 of the total PBR, or 4.1 whales per year.	Carretta et al. (2022) Barlow (2016)	No change in ESA status. Critical Habitat not designated. According to the 2018 PEA (NMFS 2018b), this stock occurs in the CCRA only. Satellite telemetry deployments (Hazen et al. 2017) indicate that Behavioral changes associated with exposure to simulated mid-frequency sonar, including no change in behavior, cessation of feeding, increased swimming speeds, and movement away from simulated sound sources has been documented in tagged blue whales (Goldbogen et al. 2013).
Fin whale (*Balaenoptera physalus velifera*)	CA/OR/WA stock	9,029	11,065	E, D	The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nmi is 11,065 (CV=0.405) whales. PBR is 80.	Carretta et al. (2021)	No change in ESA status. Critical Habitat not designated. A 5-year review was initiated in January of 2018 (83 FR 4032) and completed in February of 2019 (NMFS 2019b). The review 5-year review concluded that the fin whale should be down-listed from endangered to threatened and recommend that NMFS commence rulemaking in the future to reclassify.
Sei whale (*Balaenoptera borealis borealis*)	Eastern North Pacific stock	519	864	E, D	The best estimate of abundance for California, Oregon, and Washington waters is 625 (CV=0.40) sei whales. PBR is 1,25.	Carretta et al. (2021) Carretta et al. (2022) Barlow (2016) NMFS (2024k)	No change in ESA status. Critical Habitat not designated. According to the 2018 PEA (NMFS 2018b), this stock occurs in the CCRA only. A 5-year review was initiated in January of 2018 (83 FR 4032) and completed in August of 2023 (NMFS 2024k). The review recommended no change in ESA-listing. No data on trends in sei whale abundance exist for the eastern North Pacific. Barlow (2016) noted that an increase in sei whale abundance observed in 2014 in the California Current is partly due to recovery of the population from commercial whaling but may also involve distributional shifts in the population.

[a] 2018 Abundance taken from 83 FR 36370.
[b] From U.S. Pacific marine mammal stock assessments (NMFS 2024k) unless otherwise noted.

ESA-listed Species	DPS, ESU, or Stock	2018 Final Rule Abundance[a]	Current Abundance[b]	Current ESA and MMPA Status	Current Estimated Abundance	References	Description/Change from 2018 PEA (Section 3.2.2.2 of the 2018 PEA)
Gray whale (*Eschrichtius robustus*)	Western North Pacific stock	NR	290	E, D	Estimated population size from photo-ID data for Sakhalin and Kamchatka in 2016 was estimated at 290 whales (90% percentile intervals = 271 – 311). PBR for the proportion of the stock that uses U.S. EEZ waters the proportion of the year that those animals are in U.S. waters (3 months, or 0.25 years) is 0.12 WNP gray whales.	Carretta et al. (2021) Carretta et al. (2022) NMFS (2024k)	No change in ESA status. Critical Habitat not determined. A 5-year review was initiated in January of 2018 (83 FR 4032) and completed in 2023 (NMFS 2024k). According to the 2018 PEA (NMFS 2018b) the endangered Western North Pacific (WNP) stock occurs in the CCRA only. The delisted Eastern North Pacific (ENP) stock occurs in both the CCRA and PSRA. Information from tagging, photo-identification and genetic studies show that some whales identified in the WNP off Russia have been observed in the ENP, including coastal waters of Canada, the U.S. and Mexico (Weller et al. 2012, Lang et al. 2014, Mate et al. 2015, Urbán et al. 2019). Cooke et al. (2019) note that the fraction of the WNP population that migrates to the ENP is estimated at 45-80%. The combined Sakhalin Island and Kamchatka populations were estimated to be increasing from 2005 through 2016 at an average rate between 2-5% annually (Cooke et al. 2017).
Killer whale (*Orcinus orca*)	Eastern North Pacific Southern Resident DPS	83	75	E, D	The Eastern North Pacific southern resident stock is a trans-boundary stock including killer whales in inland Washington and southern British Columbia waters. The population most recently numbered 75 whales. PBR is 0.13.	NMFS (2023c) NMFS (2024k)	No change in ESA status. Critical Habitat for southern resident killer whales revised August 2, 2021 (86 FR 41668). CH may overlap with NWFSC research activities. According to the 2018 PEA (NMFS 2018b), this DPS occurs in the CCRA and PSRA.
Guadalupe fur seal (*Arctocephalus townsendi*)	n/a	20,000	57,199	T, D	The minimum population size is taken as the lower bound of the estimate provided by Juárez-Ruiz et al. (2022), or 57,199 animals. PBR is 1,959. However, the vast majority of this PBR would apply towards incidental mortality in Mexico as most of the population occurs outside of U.S. waters. The fraction of this stock that occurs in U.S. waters and the amount of time spent in U.S. waters is unknown, and a PBR in U.S. waters is not available.	Carretta et al. (2021) Carretta et al. (2022) García-Aguilar et al. (2018) NMFS (2024k) Juárez-Ruiz et al. (2022)	No change in ESA status. Critical Habitat not designated. According to the 2018 PEA (NMFS 2018b), this species occurs in the CCRA only. Along the U.S. West Coast, strandings occur almost annually in California waters and animals are increasingly observed in Oregon and Washington waters. Guadalupe fur seals that stranded in central California and treated at rehabilitation centers were fitted with satellite tags and documented to travel as far north as Graham Island and Vancouver Island, British Columbia, Canada. The population is considered to be a single stock because all are recent descendants from one breeding colony at Isla Guadalupe, Mexico.
Sea otter[c] (*Enhydra lutris nereis*)	Southern subspecies	2,941	2,962	T	In their summary table, (Carretta et al. 2022) noted an abundance of 3,272, and a PBR of 10 from a 2016 survey. Hatfield et al. (2018) recorded a range-wide index of abundance of 3,128 from a spring 2018 count. The USFWS 2021 SAR estimated the population to be 2,962 animals with a PBR of 12.	Carretta et al. (2022) USFWS (2015b) USFWS (2019) Hatfield et al. (2018) Hatfield et al. (2019) USFWS (2021)	No change in ESA status. Historically, southern sea otters ranged from present-day Punta Abreojos, Baja California, Mexico, to at least as far north as Newport, Oregon. However, their current range from a 2018 USFWS census is south of San Francisco.

[c]Sea otter abundance from USFWS (2021).

Table G-2. Abundance of non-listed marine mammals in the action area (*X* = species/stock is present in the action area, *NR* = not reported).

Species and Stock or DPS		CCRA	PSRA	LCRRA	Abundance as documented in 2018 Final Rule[a]	Estimated Abundance[b]
Harbor porpoise (*Phocoena phocoena*)	Morrow Bay stock	X			2,917	4,191
	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
	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*)	CA/WA/OR stock	X	X		25,750	16,498
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)		X	X		26,814	34,999
Risso's dolphin (*Grampus griseus*)		X			6,336	6,336
Common bottlenose dolphin (*Tursiops truncatus truncatus*)	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
Short-beaked common dolphin (*Delphinus delphis*)		X			969,861	1,056,308
Long-beaked common dolphin (*Delphinus capensis*)		X			101,305	83,379
Northern right whale dolphin (*Lissodelphis borealis*)		X			26,556	29,285
Killer whale (*Orsinus orca*)	Eastern North Pacific Northern Resident	X	X	X	261	302
	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
Baird's beaked whale (*Berardius bairdii*)		X			2,697	1,363
Curvier's beaked whale[c] (*Ziphius cavirostris*)		X			3,274	5,454

[a] Distribution and abundance as documented when the 2018 Final Rule (83 FR 36370) was published.
[b] Source: Carretta et al. (2022) unless otherwise noted.
[c] Source: NMFS (2023c).

Species and Stock or DPS		CCRA	PSRA	LCRRA	Abundance as documented in 2018 Final Rule[a]	Estimated Abundance[b]
Hubbs' beaked whale[d] (*Mesoplodon carlhubbsi*)		X			3,044	3,044
Blainville's beaked whale[d] (*Mesoplodon densirostris*)						
Ginko-toothed beaked whale[d] (*Mesoplodon ginkodens*)						
Perrin's beaked whale[d] (*Mesoplodon perrini*)						
Lesser (pygmy) beaked whale[d] (*Mesoplodon peruvianus*)						
Stejneger's beaked whale[d] (*Mesoplodon stejnegri*)						
Pygmy or dwarf sperm whale[e] (*Kogia breviceps or K. sima*)		X			4,111	4,111
Humpback whale (*Megaptera novaeangliae*)	Hawaii stock	X	X		NR	NR
Minke whale (*Balaenoptera acutorostrata*)		X	X		636	915
Gray whale (*Eschrichtius robustus*)	Eastern North Pacific stock	X	X		20,990	26,960
California sea lion (*Zalophus californianus*)		X	X	X	296,750	257,606
Steller sea lion (*Eumetopias jubatus monteriensis*)	Eastern DPS	X	X	X	41,638	43,201
Northern fur seal (*Callorhinus ursinus*)	Eastern Pacific stock	X			237,561	626,618
	California stock	X			14,050	14,050
Northern elephant seal (*Mirounga angustirostris*)	California breeding stock	X	X		179,000	187,386
Harbor seal (*Phoca vitulina richardsii*)	California stock	X			30,968	30,968
	OR/WA Coast stock	X		X	24,732	Unknown
	WA Inland Waters stock		X		11,036	Unknown
	Southern Puget Sound		X		1,568	Unknown
	Hood Canal		X		1,088	Unknown
Sea otter (*Enhydra lutris nereis*)	Northern subspecies[f]	X	X		NR	1,811

[d] *Mesoplodon* spp. species are managed as a single stock due to difficulty in distinguishing among them.
[e] Abundance reported is for pygmy sperm whales; abundance for dwarf sperm whales is unknown (83 FR 36370).
[f] Population in Washington state waters (Clark et al. 2021).

Appendix H: ESA-listed Seabirds

Table H-1. ESA-listed seabirds within the action area, including current estimated abundance and changes since the 2018 PEA. Note: This table has been typeset on legal-size paper (8.5 × 14 in).

ESA-listed Species	CCRA	PSRA	LCRRA	Current ESA Status	Current Estimated Abundance	References	Description/Change from 2018 PEA
Short-tailed albatross (*Phoebastria albatrus*)	X			E	Although the highest concentrations of short-tailed albatross are found in the Aleutian Islands and Bering Sea (primarily outer shelf) regions of Alaska, subadults appear to be distributed along the west coast of the U.S. more than has been previously reported (Guy et al. 2013). As of 2014, 60 percent (450 eggs at Tsubamezaki / 762 estimate total number of eggs total among all colonies) of the known breeding population of short-tailed albatross continues to use a single colony, Tsubamezaki, on Torishima, Japan. In 2013, there were 159 breeding pairs using a new Hatsunezaki site (H. Hasegawa, pers. comm. 2014 as cited in USFWS 2014).	USFWS (2008) USFWS (2014) O'Connor (2013) USFWS (2020) 85 FR 21305	No change in ESA status. Critical Habitat not designated. A draft recovery plan was done in 2005 and finalized in 2008. The most recent status review was completed in 2014. And a 5-year review was completed in 2020. This species spends most of its life in flight over the Pacific Ocean when not nesting, ranging from the coasts of Russia and Asia, Hawaii, and the Pacific Coast of North America. It is a migratory species and is covered under the MBTA. Juvenile and younger sub-adult birds (up to 2 years old) range much more widely than the adult birds, inhabiting the Sea of Okhotsk, a broader region of the Bering Sea, and the west coast of North America. The most recent 5-year review notes that the short-tailed albatross is making good progress toward meeting delisting criteria and that the challenge to recovery will be in growing new colonies. The review recommended no change to the ESA-listing for this species.
California least tern (*Sterna antillarum browni*)	X			E	The population increased to about 7,100 pairs over the period 1995-2005 (USFWS 2006). A 2014 survey noted An estimated 4,232-5,786 California least tern breeding pairs established 6,038 nests and produced 2,136-2,859 fledglings at 48 documented locations across California (Frost 2014). California least terns nest in colonies on relatively open beaches and forage in nearshore ocean waters and in shallow estuaries and lagoons.	USFWS (2006) Frost (2014) NMFS (2018b) 85 FR 21305	No change in ESA status. Critical Habitat not designated. According to the 2018 PEA this species occurs regularly in the CCRA; it has been recorded rarely as a vagrant along the coast of WA and OR. The most recent status review in 2006 states that this species occurs from San Francisco south to Baja, and that although San Francisco may be the northern limit of their range, in the 1970s terns were observed at Humbolt Bay, Fort Stevens, OR, and Ocean shores WA (USFWS 2006). It is a migratory species and is covered under the MBTA.
Marbled murrelet (*Brachyramphus marmoratus*)	X	X	X	T	The Oregon population was estimated at 10,975 birds in 2015 and was likely somewhere between a range of 8,188 and 13,762 birds (ODFW 2018). During June–August 2020 and 2021, the U.S. Geological Survey Western Ecological Research Center continued previously established, long-term (1999–present), at-sea surveys to estimate abundance and productivity of marbled murrelets in USFWS Conservation Zone 6 (San Francisco Bay to Point Sur in central California). The abundance estimated for the entire study area was 470 birds (95% confidence interval, 313–707 birds) in 2020 and 402 birds (95% confidence interval, 219–737 birds) in 2021.	USFWS (1997) Desimone (2016) ODFW (2018) Felis et al. (2022) 76 FR 61599 85 FR 21305	No change in ESA status. Critical habitat was designated in 1996 and revised in 2011 in forested breeding habitat in Washington, Oregon, and California (76 FR 61599). Because CH is in upland areas it does not overlap with NWFSC research activities. The most recent RP was done in 1997. The marbled murrelet's breeding range extends from Alaska, south to British Columbia, Washington, and Oregon; to northern Monterey Bay in central California. This is a migratory species and is covered under the MBTA.

ESA-listed Species	CCRA	PSRA	LCRRA	Current ESA Status	Current Estimated Abundance	References	Description/Change from 2018 PEA
Western snowy plover (*Charadrius alexandrinus nivosus*)	X		X	T	In Washington in 2006, the maximum estimated nesting population of western snowy plovers statewide was 70 birds. The population in Washington was declining by about 12 percent between 2006 and 2009, and in 2009 the adult breeding population was 35 snowy plovers. Snowy Plovers currently nest at 3 sites in Washington, and the 2015 population was estimated at 77 adults. In 2015, an estimated 69-77 chicks fledged, the highest number since formal surveys began in 2007.	WDFG (2011) USFWS (2007) Stinson (2016) 77 FR 36728 85 FR 21305	No change in ESA status. Critical habitat was designated at 32 coastal upland areas along the coasts of California, Oregon, and Washington in 2005, and expanded in June 2012. The most recent Recovery Plan was published in 2007. This is a migratory species and is covered under the MBTA.
Streaked horned lark (*Eremophila alpestris strigata*)		X	X	T	These are small, ground-dwelling birds. Their habitat is flat upland areas with substantial patches of bare ground and sparse low-stature vegetation such as grasses and forbs. They nest from early April to late August on bare ground adjacent to clumps of bunchgrass. They have strong natal fidelity to nesting sites, returning each year to the place they were born.	78 FR 61452 78 FR 61506 87 FR 21783 USFWS (2017) 85 FR 21305	No change in ESA status. Species was listed as threatened in 2013 and that status was affirmed in 2022 (87 FR 21783, April 13, 2022). Critical habitat was also designated in 2013. They are found in Puget Sound the Lower Columbia River estuary and adjacent Oregon and Washington coasts where critical habitat has been designated. This is a migratory species and is covered under the MBTA.

Appendix I: ESA-listed Sea Turtles

Table I-1. ESA-listed sea turtles within the action area, including current estimated abundance and changes since the 2018 PEA. Note: This table has been typeset on tabloid-size paper (11 × 17 in).

ESA-listed Species	DPS, ESU, or Stock	CCRA[a]	PSRA[a]	LCRRA[a]	Current ESA Status	Current Estimated Abundance	References	Description/Change from 2018 PEA
Leatherback sea turtle (*Dermochelys coriacea*)	West Pacific DPS	X			E	NMFS and USFWS (2020a) estimated the total index of nesting female abundance of the West Pacific DPS to be 1,277 females. Critical habitat for leatherback sea turtles is found in the CCRA (77 FR 4170). They are unlikely to be found in the PSRA or LCRRA but a major feeding area for the species is found near the mouth of the Columbia River (NMFS 2018b).	NMFS and USFWS (2020a) Bailey et al. (2012) Martin et al. (2020)	No change in ESA status. West coast critical habitat designated in 2012 (77 FR 4169). Designated critical habitat is made up of two sections of marine habitat where leatherbacks are known to feed on jellyfish. The southern portion stretches along the California coast from Point Arena to Point Arguello east of the 3,000-meter depth contour, while the northern portion stretches from Cape Flattery, Washington to Cape Blanco, Oregon, east of the 2,000-meter depth contour, and includes important habitat associated with the Columbia River plume. According to the 2018 PEA (NMFS 2018b) this species occurs in the CCRA, is unlikely in the PSRA, and a major feeding area is near the mouth of the Columbia River. The new status review completed in 2020 identified 7 DPSs including the West Pacific and East Pacific DPSs. Based on tracking data from Bailey et al. (2012), leatherback turtles tagged along the CA/OR/WA coast are from the West Pacific DPS.
Olive Ridley sea turtle (*Lepidochelys olivacea*)	Mexico's Pacific coast breeding populations	X			E	From the 2014 status review: "At-sea estimates of density and abundance were determined from shipboard line-transect surveys conducted along the Mexico and Central American coasts during summer and autumn of 1992, 1998, 1999, 2000, 2003, and 2006 (Eguchi et al. 2007). A weighted average of the yearly estimates of olive Ridley abundance was 1.39 million, which is consistent with the increases seen on the eastern Pacific nesting beaches as a result of protection programs that began in the 1990s."	NMFS and USFWS (1998b) NMFS and USFWS (2014) Eguchi et al. (2007)	No change in ESA status. Critical habitat not designated. The most recent 5-year review was done in 2014. Olive Ridley turtles do not nest in the United States. In the eastern Pacific, olive Ridleys typically occur in tropical and subtropical waters, as far south as Peru and as far north as California but occasionally have been documented as far north as Alaska (Hodge and Wing 2000). Populations that breed on Mexico's Pacific coast are endangered. At-sea abundance estimates appear to support an overall increase in the Endangered breeding colony populations on the Pacific coast of Mexico (Eguchi et al. 2007). According to the 2018 PEA (NMFS 2018b) this species occurs only in the CCRA.
Green sea turtle (*Chelonia mydas*)	East Pacific DPS	X			T	The DPS exhibits an estimated total nester abundance of 20,112 females at 39 nesting sites. Nesting data indicate increasing trends in recent decades (81 FR 20058). They are unlikely to be found in the PSRA.	Seminoff et al. (2015)	No change in ESA status. Critical habitat not designated. The East Pacific DPS includes the Mexican Pacific coast breeding population, which was originally listed as endangered (43 FR 32800, July 28, 1978).The East Pacific DPS was listed as a threatened species under the ESA on April 6, 2016 (81 FR 20058). The East Pacific DPS extends from the California/Oregon border, USA (42°N) southward along the Pacific coast of the Americas to central Chile (40°S) (Seminoff et al. 2015). According to the 2018 PEA (NMFS 2018b) this species occurs in the CCRA and is unlikely in the PSRA. Most recent RP was completed in in 1998, and the most recent status review was done in 2015.
Loggerhead sea turtle (*Caretta caretta*)	North Pacific Ocean DPS	X			E	Based on estimates derived from a trend analysis, an abundance "snapshot" of 4,541 nesting females (95 percent credible limit of 4,074 to 5,063) using three beaches in 2015 was calculated. The beaches used in the calculation comprise approximately 52 percent of the total nesting population, therefore, the extrapolated 2015 total nesting abundance for the entire DPS is approximately 8,733 nesting females (95 percent credible limit of 7,834 to 9,736 nesting females). However, this species is unlikely to be found in the PSRA.	NMFS and USFWS (2020b) Martin et al. (2020)	No change in ESA status. No designated critical habitat in NWFSC research areas. According to the 2018 PEA (NMFS 2018b) this species occurs in the CCRA, and is unlikely in the PSRA. The most recent status review completed in 2020 concluded that abundance continues to be small for the North Pacific Ocean DPS but that North Pacific loggerhead nesting has increased between 1999 and 2012, at a minimum. The review concluded that the current endangered status of the DPS is warranted.
Hawksbill sea turtle (*Eretmochelys imbricate*)					E	There are no confirmed hawksbill sightings in recent history from the U.S. West Coast either at sea or nesting (NMFS and USFWS 1998a). As recently as 2007 the species had been considered largely extirpated in the region (Gaos et al. 2010). They are possible but unlikely to be found in the CRRA and are not found in the PSRA or LCRRA.	NMFS and USFWS (1998a) NMFS and USFWS (2013)	No change in ESA status. No designated critical habitat in NWFSC research areas. Most recent RP was in 1998. Most recent status review completed in 2013. According to the 2018 PEA (NMFS 2018b) this species is possible but rare in the CCRA and is not found in the PSRA or LCRRA.

Appendix J: Invertebrates

Table J-1. ESA-listed invertebrates within the action area, including current estimated abundance and changes since the 2018 PEA. Note: This table has been typeset on legal-size paper (8.5 × 14 in).

ESA-listed Species	Current ESA Status	Current Estimated Abundance	References	Description/Change from 2018 PEA
Black abalone (*Haliotis cracherodii*)	E	Black abalone are believed to be naturally rare at the northern and southern extremes of their range, with the highest abundances historically south of Monterey, particularly at the Channel Islands off southern California. Beginning in the mid-1980s, black abalone populations began to decline dramatically due to the spread of withering syndrome. Overall, the disease caused declines of more than 80% in populations throughout southern California.	NMFS (2018a)	No change in ESA status. Critical habitat designated in 2011 along approximately 360 square kilometers of rocky intertidal and subtidal habitat within five segments of the California coast (76 FR 66806). Most recent status review was published in July of 2018. According to the 2018 PEA (NMFS 2018b) this species occurs only in the CCRA. The current range is estimated to extend from Point Arena, California, south to Bahia Tortugas, Mexico, including offshore islands (NMFS 2018a). This species is rarely found north of San Francisco.
White abalone (*Haliotis sorenseni*)	E	The most recent depth-weighted density estimates for an offshore bank (2 abalone per hectare for 2014) and one Channel Island (0.62 abalone/ha for 2012) also indicate that densities in the wild are far below those required for downlisting (2,000 abalone/ha) and delisting (3,000 abalone/ha).	NMFS (2018e)	No change in ESA status. Critical habitat has not been designated. The most recent status review was in 2018. According to the 2018 PEA (NMFS 2018b) this species occurs only in the CCRA. The white abalone is a marine snail that occurs sub-tidally at depths of 5 to 60 meters (m) in waters off southern California and Baja California.

Table J-2. Target invertebrate species caught during NWFSC research. Note: This table has been typeset on legal-size paper (8.5 × 14 in).

Species	Fishery Management Plan	2018 Stock Status[a]	Current Stock Status
Dungeness crab *(Cancer magister)*	Washington Coastal Dungeness Crab Summer FMP Pacific States Marine Fisheries Commission, Dungeness Crab Tri-State process	No stock assessment but believed to be stable and not overfished.	West coast Dungeness crab population has either remained stable or continued to increase.[b]
Market squid (*Loligo opalescens)*	California Market Squid Fishery Management Plan NMFS Coastal Pelagic Species Fishery Management Plan NOAA Fisheries Pacific Fishery Management Council	No stock assessment but believed to be stable and not overfished.	Population has increased from San Francisco north in conjunction with warming ocean temperatures. Greatest increases observed off of Washington and Oregon (Chasco et al. 2022).
Ocean pink shrimp *(Pandalus jordani)*	No specific management plan. State management techniques have primarily been related to bycatch reduction and understanding of life history.	No stock assessment but believed to be stable and not overfished.	Environmental factors explain most of the variation in the pink shrimp population. A consistent impact of the pink shrimp fishery on stock abundance has not been shown. However, overfishing may be possible if intensive fishing occurs on a failed year class.[c]

[a] Source: NMFS (2018b).
[b] Source: https://www.fisheries.noaa.gov/feature-story/west-coast-dungeness-crab-stable-or-increasing-even-intensive-harvest-research-shows (accessed June 2, 2022).
[c] Source: https://opc.ca.gov/webmaster/ftp/project_pages/Rapid%20Assessments/Pink%20(Ocean)%20Shrimp.pdf (accessed June 2, 2022).

Appendix K: Socioeconomic Data

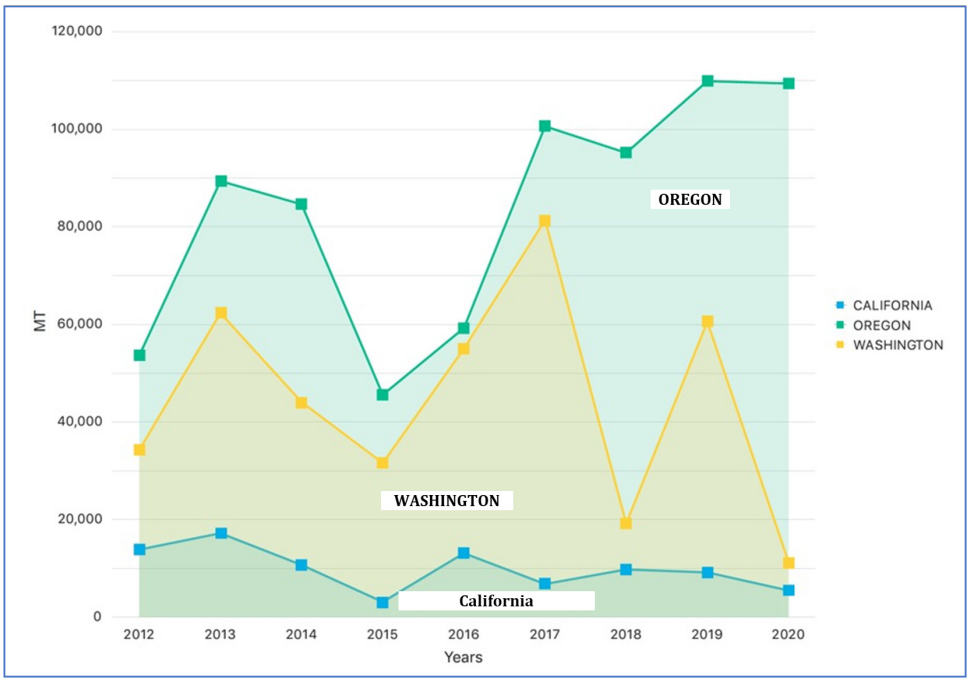


Figure K-1. Total landings in metric tons by state, 2012-2020. Source: https://www.fisheries.noaa.gov/foss/f?p=215:8:1273488727771::NO::: (accessed May 4, 2022).

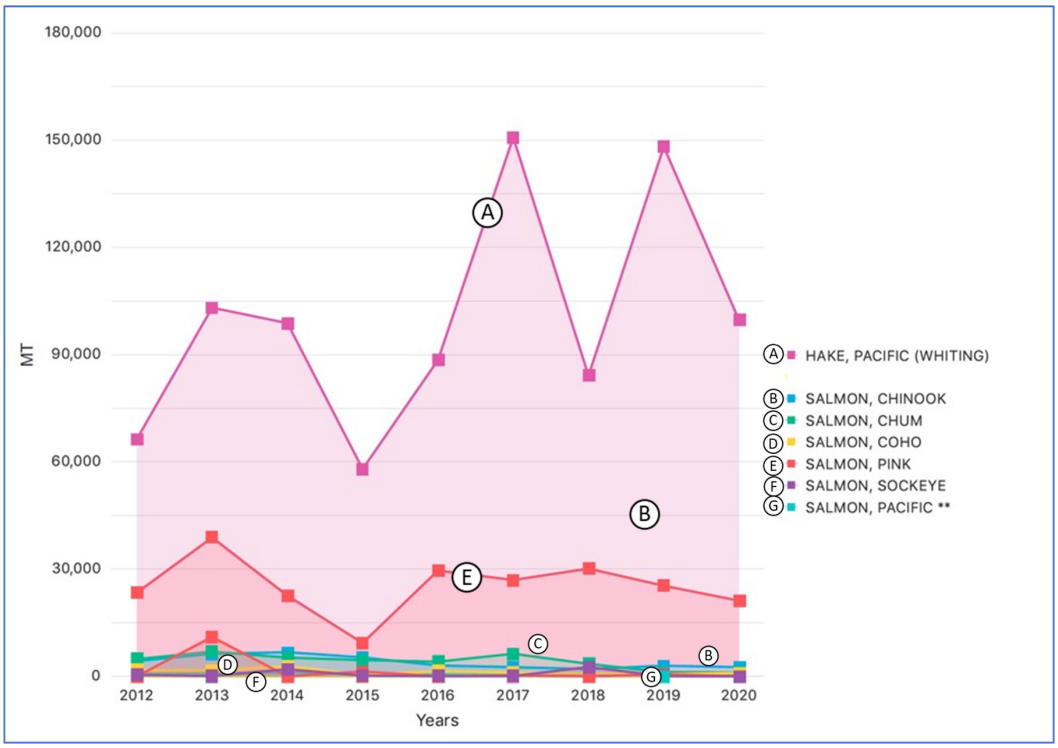


Figure K-2. Key species landings in metric tons for California, Oregon, and Washington combined, 2012-2020. Source: https://www.fisheries.noaa.gov/foss/f?p=215:8:1273488727771::NO::: (accessed May 4, 2022).

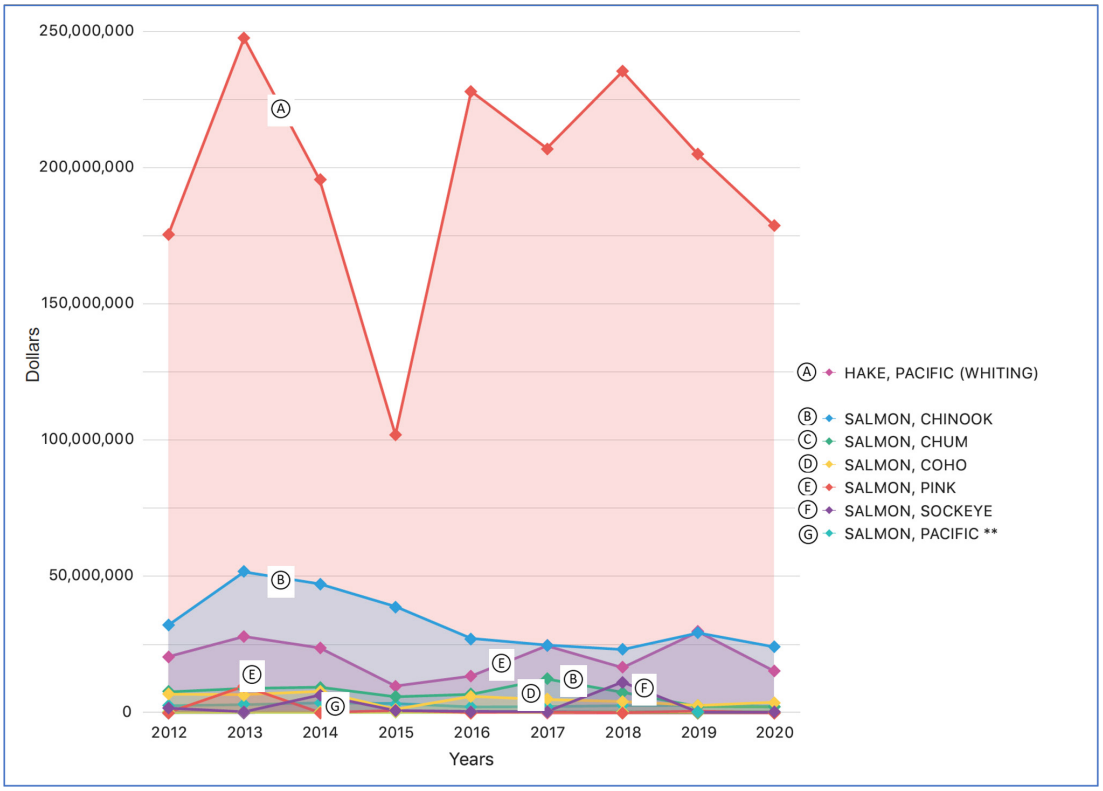


Figure K-3. Total revenue by key species for California, Oregon, and Washington combined, 2012-2020. Source: https://www.fisheries.noaa.gov/foss/f?p=215:8:1273488727771::NO::: (accessed May 4, 2022).

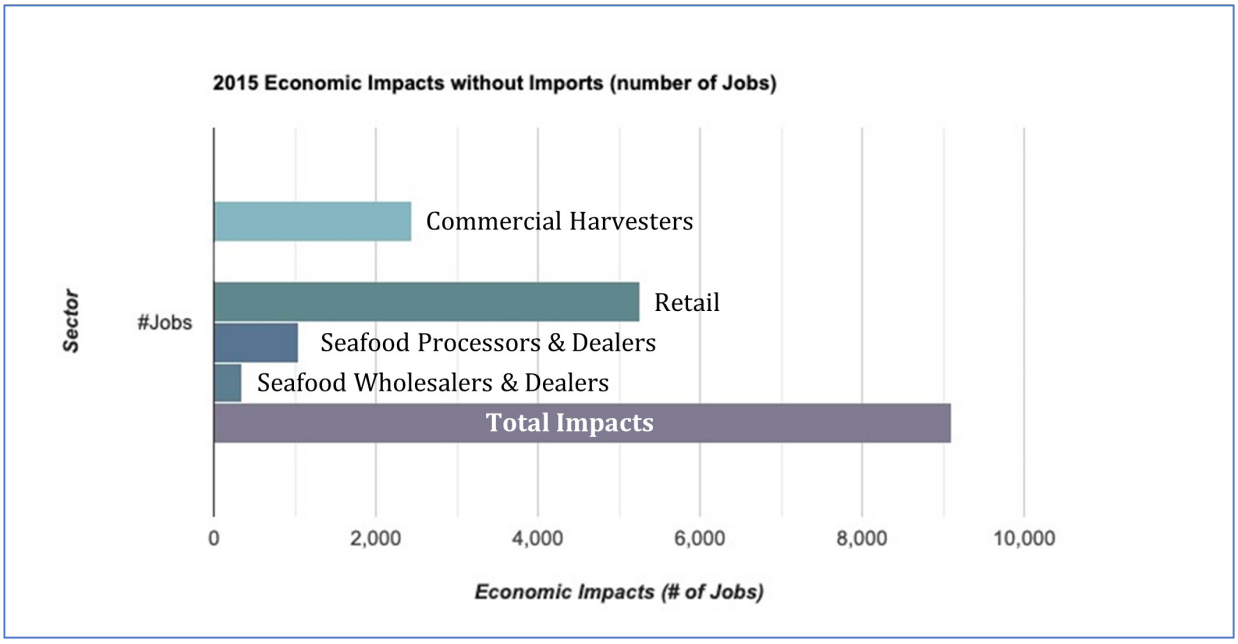


Figure K-4. Number of commercial fisheries in California jobs by sector in 2015. 2015 is the most recent year of data available from https://www.st.nmfs.noaa.gov/data-and-tools/FEUS/explore-the-data (accessed May 2, 2022).

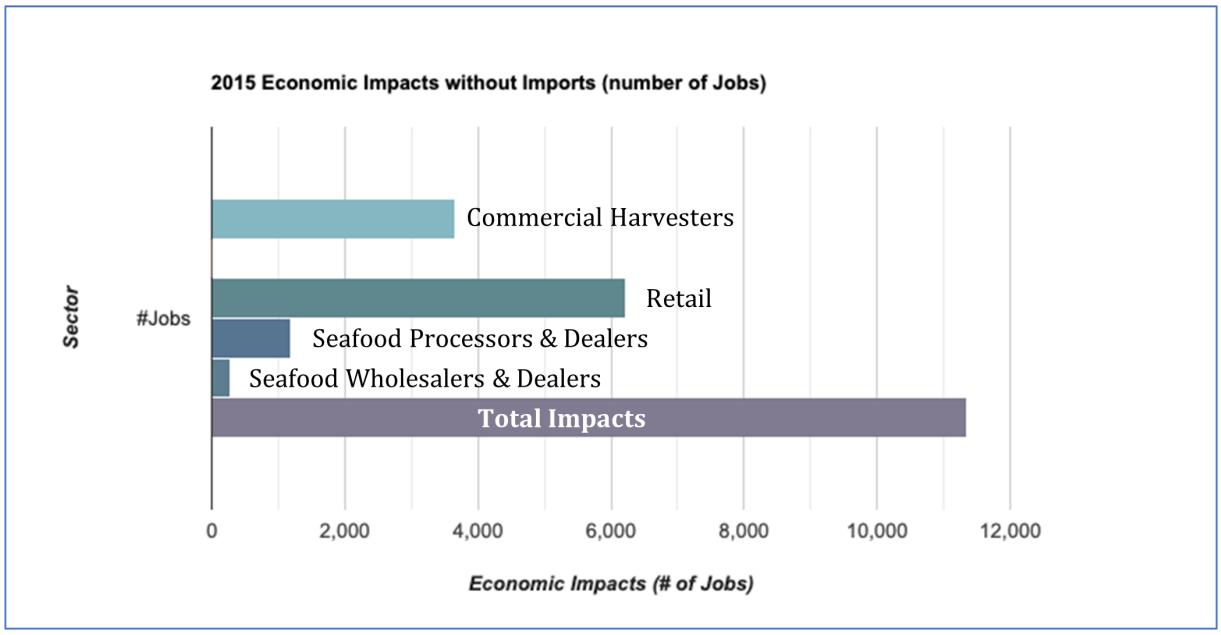


Figure K-5. Number of commercial fisheries in Oregon jobs by sector in 2015. 2015 is the most recent year of data available from https://www.st.nmfs.noaa.gov/data-and-tools/FEUS/explore-the-data (accessed May 2, 2022).

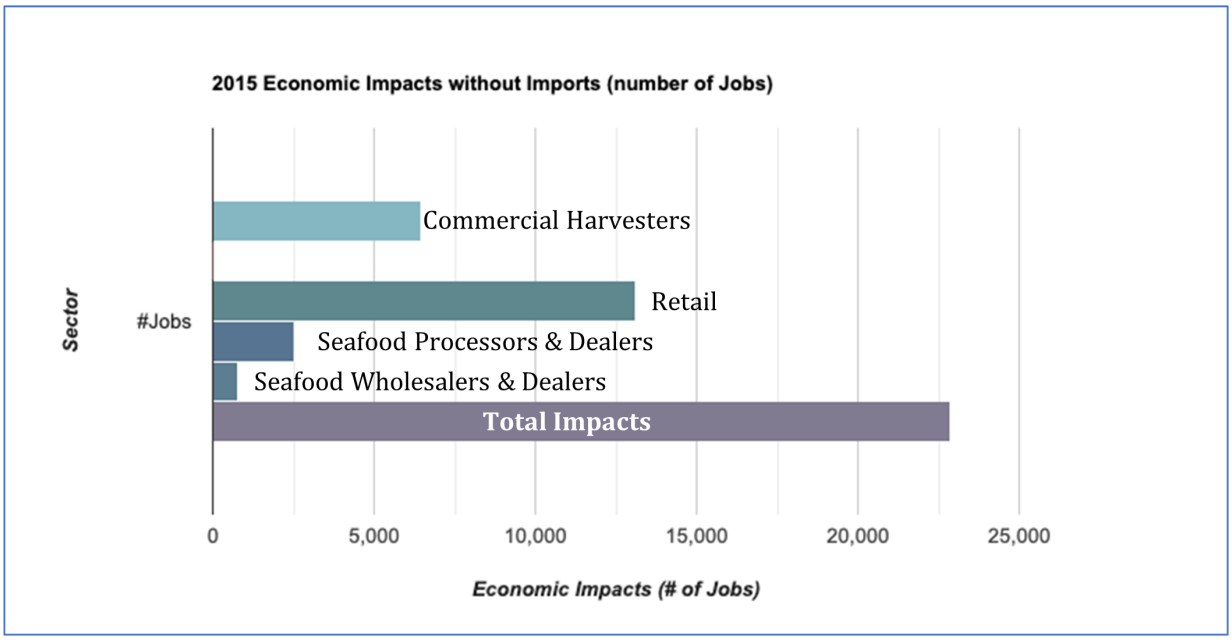


Figure K-6. Number of commercial fisheries in Washington jobs by sector in 2015. 2015 is the most recent year of data available from https://www.st.nmfs.noaa.gov/data-and-tools/FEUS/explore-the-data (accessed May 2, 2022).

Table K-1. Economic effects from the Pacific region commercial fishing industry. Source: https://www.st.nmfs.noaa.gov/data-and-tools/FEUS/explore-the-data (accessed May 2, 2022).

Sector	Jobs	Sales	Income	Value Added
Commercial Harvesters	6,469	597,359	254,216	358,232
Seafood Processors and Dealers	2,548	271,576	102,000	134,981
Seafood Wholesalers and Distributors	774	111,573	37,381	51,001
Retail	13,095	667,848	287,565	377,721
Total	**22,887**	**1,648,356**	**681,162**	**921,935**

Table K-2. Commercial revenue for key species across Pacific coastal states, 2012-2015. Source: NMFS (2022k).

Key Species	Revenue (Thousands of $)			
	2012	2013	2014	2015
Albacore tuna	45,827	41,930	32,792	29,387
Crab	176,880	249,579	199,222	105,053
Flatfish	13,490	17,408	15,655	16,736
Hake	47,054	61,321	58,630	24,109
Other shellfish	141,221	166,551	177,487	137,035
Rockfish	9,329	9,739	9,728	10,439
Sablefish	28,096	19,530	24,118	28,697
Salmon	48,197	77,754	71,416	48,157
Shrimp	40,326	42,614	61,100	87,556
Squid	63,886	73,703	72,915	24,472

Table K-3. 2019 and 2020 commercial fishery landings and revenues by port. Source: https://www.fisheries.noaa.gov/foss/f?p=215:11:17517155877172::NO::: (accessed May 4, 2022).

Port by State	2019		2020	
	Millions of Pounds	Millions of Dollars	Millions of Pounds	Millions of Dollars
California				
Los Angeles	23.8	15.4	15.1	12.8
Moss Landing	18.2	5.4	21.5	9.6
Eureka	10.9	14.3	8.0	8.3
Crescent City	8.4	22.3	3.6	10.6
Monterey	8.3	2.6	18.0	10.5
Fort Bragg	4.1	6.4	4.4	6.1
San Francisco area	3.8	12.4	2.8	8.0
San Diego	3.2	10.1	3.1	9.9
Bodega Bay	2.8	9.4	3.1	10.2
Santa Barbara	2.6	10.8	2.4	11.4
Morro Bay	1.1	3.9	—	—
Oregon				
Newport	121.5	58.1	117.2	59.8
Astoria	171.1	44.5	182.1	42.9
Coos Bay-Charleston	18.5	28.5	16.7	20.0
Brookings	8.2	11.2	11.1	9.0

Port by State	2019		2020	
	Millions of Pounds	Millions of Dollars	Millions of Pounds	Millions of Dollars
Washington				
Westport	120.9	52.9	113.1	50.6
Bellingham	8.1	17.8	4.8	13.8
Ilwaco-Chinook	9.7	17.5	6.1	15.5
Anacortes-La Conner	4.1	20.5	2.8	14.8
Shelton	3.4	32.1	1.9	13.5
Seattle	1.5	6.3	—	—
Olympia	1.3	14.7	—	—
Willapa Bay	4.3	15.3	1.8	6.1
Neah Bay	2.4	5.5	1.2	2.5
Blaine	1.3	5.5	1.1	5.9

Appendix L: Marine Mammal Hearing and Acoustic Thresholds

Table L-1. Generalized hearing ranges for marine mammal hearing groups in water. Source: NMFS (2018e).

Hearing Group	Hearing Range
Low-frequency cetaceans (e.g., baleen whales)	7 Hz to 35 kHz
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

Table L-2. Acoustic thresholds resulting in permanent threshold shift. Notes: Peak sound pressure is "flat" or unweighted. Cumulative sound exposure level has a reference value of 1 $\mu Pa^2 \times s$. Cumulative levels should be appropriately weighted for the hearing group for assessment to the threshold. Source: NMFS (2018e).

	PTS Onset Acoustic Thresholds (Received Level)		
	Impulsive Sources		Non-impulsive Sources
Hearing Group	Peak, L_{pk}, flat (dB re 1 µPa)	Cumulative weighted SEL_{24h} (dB re 1 $\mu Pa^2 \times s$)	Cumulative weighted SEL_{24h} (dB re 1 $\mu Pa^2 \times s$)
Low-frequency cetaceans	219	183	199
Mid-frequency cetaceans	230	185	198
High-frequency cetaceans	202	155	173
Phocid pinnipeds in water	218	185	201
Otariid pinnipeds in water	232	203	219

Appendix M: Incidental Takes

Table M-1. Actual incidental takes in the Groundfish Bottom Trawl Survey (*Groundfish*), the Integrated Ecosystem and Pacific Hake Acoustic-Trawl Survey (*Hake*), the California Current Ecosystem Investigations (*CA*), and the Bycatch Reduction Research (*Bycatch*), 2018-2021. Note: No surveys were conducted in 2020. Dashes = none reported.

		Groundfish			Hake		CA	Bycatch[a]		
ESA-listed Species	**DPS or ESU**	**Actual Takes 2018**	**Actual Takes 2019**	**Actual Takes 2021**	**Actual Takes 2019**	**Actual Takes 2021**	**Actual Takes 2018**	**Actual Takes 2018**	**Actual Takes 2019**	**Actual Takes 2021**
Green sturgeon[b]	Southern DPS	0	0	3	—	—	0	0	0	0
Pacific eulachon	Southern DPS	828	1,962	3,451	333	349	0	0	0	0
Chinook salmon[c]	California Coastal ESU	0	0	0	0	0	0	0	0	0
	Central Valley Spring ESU	0	0	0	0	0	0	0	0	0
	Lower Columbia River ESU	3	0	0	0	12	3	0	0	0
	Puget Sound ESU	0	0	0	0	6	0	0	0	0
	Sacramento River Winter ESU	0	0	0	0	0	0	0	0	0
	Snake River Spring/Summer ESU	0	0	0	0	3	0	0	0	0
	Snake River Fall ESU	0	0	0	0	9	3	0	0	0
	Upper Columbia Spring Run ESU	0	0	0	0	0	0	0	0	0
	Upper Willamette River ESU	3	0	0	0	9	3	0	0	0
Chum salmon	Columbia River ESU	0	0	0	0	0	0	0	0	0
	Hood Canal Summer ESU	0	0	0	0	0	0	0	0	0
Coho salmon[d]	Central California Coast ESU	0	0	0	0	0	0	0	0	0
	Lower Columbia River ESU	0	0	0	0	0	0	0	0	0
	Oregon Coast ESU	0	0	0	3	0	0	0	0	0
	S. Oregon/N. California Coast ESU	0	0	0	0	0	0	0	0	0
Sockeye salmon	Ozette Lake ESU	0	0	0	0	0	0	0	0	0
	Snake River ESU	0	0	0	0	0	0	0	0	0

[a] Source: APPS database supplied by Diana Dishman.
[b] All authorized and reported green sturgeon takes are non-lethal.
[c] Only hatchery Chinook salmon were taken in the Groundfish Bottom Trawl Survey and the California Current Ecosystem Investigations as identified by adipose clip; those taken in the Integrated Ecosystem Survey were natural and hatchery.
[d] All coho salmon takes were of natural fish.

		Groundfish			Hake		CA	Bycatch[a]		
ESA-listed Species	DPS or ESU	Actual Takes 2018	Actual Takes 2019	Actual Takes 2021	Actual Takes 2019	Actual Takes 2021	Actual Takes 2018	Actual Takes 2018	Actual Takes 2019	Actual Takes 2021
Steelhead trout	California Central Valley DPS	0	0	0	—	—	—	0	0	0
	Central California Coast DPS	0	0	0	—	—	—	0	0	0
	Lower Columbia River DPS	0	0	0	—	—	—	0	0	0
	Middle Columbia River DPS	0	0	0	—	—	—	0	0	0
	Northern California DPS	0	0	0	—	—	—	0	0	0
	Puget Sound DPS	0	0	0	—	—	—	0	0	0
	South Central California Coast DPS	0	0	0	—	—	—	0	0	0
	Snake River Basin DPS	0	0	0	—	—	—	0	0	0
	Upper Columbia River DPS	0	0	0	—	—	—	0	0	0
	Upper Willamette River DPS	0	0	0	—	—	—	0	0	0

Appendix N: Salmon Calculator

	A	B	C	D	E	F	G
1	**ESU/production**	**Geo Mean**	**production**	**% of production**	**Captures per ESU**	Natural rounded	Hatchery rounded
2	Central Valley Fall Chinook ESU Natural	173,839	Natural	16.11%	10.95	11	
3	Central Valley Fall Chinook ESU Hatch	88,578	Hatchery	33.32%	3.33		3
4	Sacramento River Chinook Late Fall-run	4,159	Natural	0.39%	0.26	0	
5	Sacramento River Chinook Late Fall-run	4,426	Hatchery	1.66%	0.17		0
6	Sacramento River Chinook Winter-run Natural	2,684	Natural	0.25%	0.17	0	
7	Central Valley Chinook Spring-run natural	7,090	Natural	0.66%	0.45	0	
8	Central Valley Chinook Spring-run hatchery	3,297	Hatchery	1.24%	0.12		0
9	Upper Klamath-Trinity River Chinook Natural	136,325	Natural	12.63%	8.59	9	
10	Upper Klamath-Trinity River Chinook Hatchery	29,616	Hatchery	11.14%	1.11		1
11	California Coastal Chinook	5,599	Natural	0.52%	0.35	0	
12	Oregon Coast Chinook (estimate)	175,000	Natural	16.22%	11.03	11	
13	Upper Columbia River fall	318,681	Natural	29.53%	20.08	**20**	
14	Upper Columbia River spring Natural	1,475	Natural	0.14%	0.09	0	
15	Upper Columbia River spring Hatchery	2,967	Hatchery	1.12%	0.11		0
16	Middle Columbia River spring Natural	34,281	Natural	3.18%	2.16	2	
17	Middle Columbia River spring Hatchery	819	Hatchery	0.31%	0.03		0
18	Washington coast Natural	33,326	Natural	3.09%	2.10	2	
19	Washington coast Hatchery	8,718	Hatchery	3.28%	0.33		0
20	Snake River fall chinook Natural	11,254	Natural	1.04%	0.71	1	
21	Snake River fall chinook hatchery	26,558	Hatchery	9.99%	1.00		**2**
22	Snake River spr/sum chinook natural	11,347	Natural	1.05%	0.72	1	
23	Snake River spr/sum chinook hatchery	5,696	Hatchery	2.14%	0.21		0
24	LCR chinook natural	29,469	Natural	2.73%	1.86	2	
25	LCR chinook hatchery	38,594	Hatchery	14.52%	1.45		1
26	UWR spring Chinook natural	11,443	Natural	1.06%	0.72	1	
27	UWR spring Chinook hatchery	34,454	Hatchery	12.96%	1.30		1
28	PS chinook natural	19,258	Natural	1.78%	1.21	1	
29	PS chinook hatchery	13,223	Hatchery	4.97%	0.50		0
30	SONCC chinook natural	6,809	Natural	0.63%	0.43	0	
31	SONCC chinook hatchery	8,916	Hatchery	3.35%	0.34		0
32	Deschutes chinook natural	97,078	Natural	9.00%	6.12	6	
33							
34							
35	Total Chinook Captured - Natural Origin	68					
36	Total Chinook Captured - Ad-clip	10					

Figure N-1. Screenshot of the salmon calculator tool used by NWFSC to estimate the proportion of incidentally caught salmon from each ESU.

Appendix O: Juvenile Salmon Studies

Table O-1. Species caught during the Puget Sound Juvenile Salmon Studies, 2018-2021. Note: Based on the proportion of each ESU expected to occur in the research area, some fish may be from ESA-listed ESUs, though available data cannot confirm this. Source: NWFSC.

		Weight			
Common Name	**Scientific Name**	**2018**	**2019**	**2020**	**2021**
Chum salmon	*Oncorhynchus keta*	20.0	8.0	0.2	2.0
Coho salmon	*Oncorhynchus kisutch*	105.0	28.0	20.0	37.0
Sockeye salmon	*Oncorhynchus nerka*	10.0	0.3	0.3	3.0
Chinook salmon	*Oncorhynchus tshawytscha*	151.0	44.0	18.0	61.0
Steelhead trout	*Oncorhynchus mykiss*	1.0	2.0	3.0	1.0

Appendix P: Fish Removals

Table P-1. Target fish removals over 1,000 kg in National Marine Sanctuaries, 2018-2021, compared to the 2021 overfishing limit (OFL). NWFSC did not conduct surveys in 2020. Source: NWFSC unpublished data received May 2022.

	NWFSC Surveys in National Marine Sanctuaries (kg)			OFL[a]
Target Fish	**2018**	**2019**	**2021**	**2021**
Arrowtooth flounder	1,200	1,640	1,904	16,460,000
Bocaccio Southern Pacific Coast DPS	2,052	606	753	1,849,000
Canary rockfish Pacific Coast stock	202	1,319	240	647,000
Chilipepper Southern Pacific Coast stock	10,275	6,202	4,733	3,128,000
Dover sole	8,883	3,923	7,859	52,214,000
English sole	2,541	1,488	1,384	11,175,000
Lingcod	1,327	277	1,017	4,237,000 (N of 40°N) 897,000 (S of 40°N)
Longnose skate	2,306	900	2,156	1,922,000
Longspine thornyhead	2,463	713	1,834	4,284,000
Pacific hake[b]	4,674	3,867	4,055	560,742,000
Pacific ocean perch	3,516	813	528	4,029,000
Pacific sanddab[c]	3,151	1,502	2,474	n/a
Pacific spiny dogfish	2,523	35,750	909	1,857,000
Petrale sole	2,600	2,361	11,480	2,518,000
Rex sole[c]	2,150	1,529	1,993	n/a
Sablefish	5,717	1,384	5,562	39,085,000
Shortspine thornyhead	820	331	1,187	940,000
Splitnose rockfish	3,940	194	2,828	1,724,000 (S of 40°10′N)
Spotted ratfish[d]	1,353	934	1,252	n/a
Stripetail rockfish[e]	2,204	866	1714	1,668,000 (N of 40°10′N) 1,827,000 (S of 40°10′N)
Vermilion rockfish[e]	852	828	919	1,668,000 (N of 40°10′N) 1,827,000 (S of 40°10′N)
Yellowtail rockfish[e]	2,586	4,614	635	6,866,000 (N of 40°10′N)

[a] Source: https://www.ecfr.gov/current/title-50/chapter-VI/part-660#Table-1a-to-Part-660,-Subpart-C (accessed July 30, 2025).
[b] Pacific hake removals are combined for three studies: 1) the Integrated Ecosystem and Pacific Hake Acoustic-Trawl Survey in the Monterey Bay, Cordell Banks, Greater Farallones, and Olympic Coast NMSs in 2019 and 2021 (2018 data not available); 2) California Current Ecosystem: Investigations of Hake Ecology, Survey Methods, and the California Current in 2018; and 3) the Groundfish Bottom Trawl Survey in all five NMSs in 2018, 2019, and 2021.
[c] Part of the "other flatfish" complex comprised of flatfish species that are not managed with stock-specific OFLs/ABCs/ACLs. Most of the species in the complex are unassessed.
[d] These species are not actively managed with ACLs, but they are monitored to ensure that harvest is not appreciably increasing. Source: https://www.pcouncil.org/fact-sheet-groundfish/ (accessed August 20, 2022).
[e] Managed as part of the "shelf rockfish" complex.

Appendix Q: Rockfish Projects

Table Q-1. Target species caught, by count, during rockfish projects in Puget Sound. Source: Kelly Andrews (NMFS/NWFSC); not all species caught are shown in this table.

Species	Count						Grand Total
	2014	2015	2016	2017	2018	2019	
Black rockfish	13	5	—	5	9	3	**35**
Bocaccio[a]	1	3	—	—	—	—	**4**
Brown rockfish	14	13	—	7	6	3	**43**
Butter sole	2	—	—	—	—	—	**2**
Cabezon	1	—	—	2	2	2	**7**
Black rockfish	13	5	—	5	9	3	**35**
Canary rockfish	32	18	4	1	—	—	**55**
Chinook salmon[a]	—	2	—	—	1	—	**3**
Copper rockfish	132	148	45	46	106	101	**578**
English sole	9	3	—	—	—	—	**12**
Greenstriped rockfish	3	4	2	—	—	—	**9**
Lingcod	110	115	1	114	68	42	**450**
Pacific cod	2	—	—	—	—	—	**2**
Pacific hake	1	—	—	—	—	—	**1**
Pacific halibut	3	4	—	—	—	—	**7**
Pacific herring	1	—	—	—	—	—	**1**
Pacific sanddab	83	26	1	—	2	—	**112**
Quillback rockfish	244	133	29	83	69	59	**617**
Redstripe rockfish	21	1	2	3	1	—	**28**
Rex sole	1	1	—	—	—	—	**2**
Rock sole	7	6	—	7	1	2	**23**
Spiny dogfish	103	116	8	5	29	7	**268**
Starry flounder	2	—	—	—	—	—	**2**
Striped surfperch	—	—	—	—	1	—	**1**
Tiger rockfish	—	—	—	1	1	—	**2**
Yelloweye rockfish[a]	59	10	28	4	6	1	**108**
Yellowtail rockfish	33	—	3	4	5	11	**56**

[a] ESA-listed.

Appendix R: Research Removals of Pacific Hake

Table R-1. NWFSC research removals of Pacific hake in the California Current Ecosystem as a percentage of estimated hake biomass. Source: Julia Clemons (NMFS/NWFSC).

Year	Hake Biomass Estimate for CCE (mt)	Research Catch (mt)	Research Catch as Percent of Biomass
2019	1,718,030	16.4284969	0.0009562%
2021	1,524,640	20.6319618	0.0013532%

Appendix S: Pinniped Physical Disturbance

Table S-1. Total annual incidents of pinniped physical disturbance, 2018-2023. Numbers are totals for Puget Sound and Columbia River. Note: Takes may be over-reported as the same animal may have been reported twice during the 6 hr observation period. The 2020 field season was severely limited due to COVID and no disturbances were reported.

	Recorded Physical Disturbance					
Species	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Harbor seal	3	25	—	0	5	0
California sea lion	93	16	—	145	43	0
Steller sea lion	6	2	—	4	2	0
Harbor porpoise	0	6	—	0	0	0

Appendix T: Finding of No Significant Impact

The National Environmental Policy Act (NEPA) (42 U.S.C. § 4321 et seq.) requires the preparation of an Environmental Impact Statement (EIS) for any proposal for a major Federal action significantly affecting the quality of the human environment. 42 U.S.C. § 4332(C). Agencies may issue a Finding of No Significant Impact (FONSI) if they determine that a proposed agency action will not have a significant effect on the human environment and therefore does not require the issuance of an EIS. Id. § 4336e(7). Based on the Final Supplemental Programmatic Environmental Assessment for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center, the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) has determined in this FONSI that preparation of an EIS is not required for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center because the proposed action will not have significant effects.

This FONSI incorporates by reference the Final Supplemental Programmatic Environmental Assessment for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center, which contains the evidence and analysis supporting this FONSI. As further detailed in the SPEA, research conducted by the NWFSC contributes scientific data necessary 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. In addition, NWFSC uses the information obtained through its research to support: the restoration of Pacific coastal rivers and estuaries; the recovery of protected species; the establishment of Marine Protected Areas (MPAs); marine spatial planning; and understanding marine ecosystems. NWFSC scientists conduct fishery-independent research using NOAA-owned and operated vessels or chartered vessels.

As analyzed in the SPEA, NWFSC research activities are expected to result in only minor adverse effects on physical and biological resources and are therefore not expected to be significant. This conclusion is based in part on the localized and intermittent nature of NWFSC operations, and on the rigorous mitigation measures employed by NWFSC researchers. Furthermore, acoustic disturbances to marine mammals are considered de minimus, while physical effects on benthic habitats and essential fish habitats are small in magnitude and short-term duration.

NWFSC research is not expected to have a significant effect on prey availability or the critical habitats of protected species, such as the Southern Resident killer whale and humpback whale, as research activities are dispersed over vast geographic areas. Incidental and directed takes of ESA-listed fish, such as salmonids, rockfish, and green sturgeon, are expected to be very low relative to their overall population sizes. Thus, no population-level effects are expected for these species. A similar conclusion is made for seabirds, sea turtles, and invertebrates, where based on historical data and the use of specialized gear types harmful interactions are also expected to be minimal.

The NWFSC research program is identified as having a minor beneficial effect on local economic communities. Additionally, the center has ensured full compliance with federal, state, and local environmental laws through extensive consultation with relevant agencies. Research activities are deemed safe for public health and do not pose a threat to human safety or to the long-term viability of the marine ecosystems involved.

Table T-1. Mitigation measures for the Preferred Alternative.

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 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.

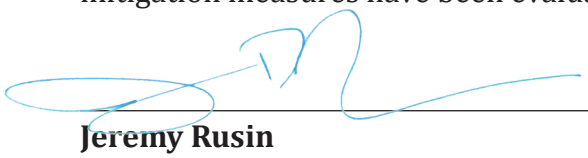
Type of Survey	Mitigation and Monitoring Measure
Surveys Using Trawl Gear (cont'd)	• For pair trawl gear used only in the Columbia River Estuary, use deterrents such as poppers or screamers to drive pinnipeds from the open net. An occasional animal nearby is tolerated but pinnipeds intent on approaching 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 minutes 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. • 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 minutes excluding deployment and retrieval at target depths for less than 3 nautical miles (nm). • Clean gear prior to deployment. Empty gear as quickly as possible to ensure no protected species or birds are entangled.
Puget Sound Surface (Kodiak) Trawls and Tow Nets	• 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 and Lampara 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.

Type of Survey	Mitigation and Monitoring Measure
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. • Bird entrapment by beach seines will be avoided as they will be visible from the small boats deploying such nets. If birds could be potentially entrapped, the seines will not be deployed. • Other mitigation measure to protect upland birds such as larks include: ◦ NMFS researchers will not travel beyond wet sand beach and up onto dry sand beach. ◦ Pulling the seine only requires that the ends wind up on the edge of the water. ◦ Lunch will be eaten on the boat, not on the beach. • Seines will be kept in the wet to protect the non-target fish that will be released.
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. • To protect short-tailed albatross and other birds, NWFSC will test the use of night-time only operations of the Bycatch Reduction Research Survey. Night setting is an accepted best practice to prevent seabird bycatch in longline fisheries globally (Løkkeborg 2011). Melvin et al. (2019) also reported dramatic positive effects of night setting for albatrosses and shearwaters, whose bycatch per unit effort (BPUEs) were >85% lower at night. For surveys that cannot employ night time only operations, other mitigation options include line weighting, alternative float and weight configurations, slower setting speed, offal retention. • For all longline surveys paired streamers to deter birds must be used. Melvin et al. (2019) reported a 78% decrease in seabird bycatch after the adoption of streamer lines as mitigation to avoid interactions between commercial fisheries and short-tailed albatross. Streamer lines are used by NWFSC to avoid interactions with seabirds, including short-tailed albatross.
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. • Bird entrapment by small towed nets will be avoided because birds will be visible from the small boats deploying such nets. If birds could be potentially entrapped, the nets will not be deployed.
Uncrewed Systems (UxS): Uncrewed Aerial Systems (UAS), Uncrewed Surface Systems (USS), Uncrewed Underwater Systems (UUS)	• 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. UAS 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).

Type of Survey	Mitigation and Monitoring Measure
Uncrewed Systems (cont'd)	• Use of surface and underwater UxS such as Saildrones or ROVs pose minimal risk to protected species but researchers must follow standard avoidance measures before deployment. • For work in intertidal areas particularly in Willapa Bay and the lower Columbia River estuary, UAS will not be launched near bird besting areas and work using UAS directly over western snowy plover nesting areas will not be conducted during nesting season, March 15 through September 15. See Section 2.3.1 of the SPEA for additional specific mitigation measures for protecting murrelets, plovers and larks during UAS surveys.
Sea Turtle Measures	• NWFSC will take appropriate measures to handle and release sea turtles without injury, consistent with procedures in 50 CFR 223.206(d)(1). • If applicable, crew will measure, photograph, and apply flipper and passive integrated transponder (PIT) tags to any live sea turtle, and salvage any carcass or parts or collect any other scientifically relevant data from dead sea turtles, per authorization in 50 CFR 222.310 (endangered) and 223.206 (threatened) regarding the handling of ESA-listed sea turtles by designated NMFS agents (see Appendix C for Protected Species Handling Procedures).
Eulachon Measures	• Live eulachon will be processed quickly and returned to the water as soon as practicable. • NWFSC may collect, freeze and transport dead eulachon incidentally captured for further study. • With the exception of directed research on eulachon that is permitted under Section 10 of the ESA, NWFSC commits to retaining no more than 1 kg of eulachon (~ 25 individuals) during any research survey.
Salmonid Measures	• With the exception of directed research that is permitted under Section 10 of the ESA to take salmonids, NWFSC may elect to retain any whole or part (e.g., fin clip) of dead sub-adult salmon that are incidentally captured. • Live adult salmon will be handled as priority and will be processed quickly (weighed and measured) and returned to the water as soon as practicable.
Handling Procedures for Incidentally Captured Individuals	• Handling Procedures (see Appendix C of the SPEA): 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 CS 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.

Determination

Based on the Final Supplemental Programmatic Environmental Assessment for Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center, the NOAA NMFS has determined in this FONSI that preparation of an EIS for the Fisheries Research Conducted and Funded by the Northwest Fisheries Science Center is not required because the proposed action will not have significant effects. All adverse impacts of the proposed action as well as mitigation measures have been evaluated to reach this conclusion of no significant impacts.



14 January 2026

Jeremy Rusin **Date**
Science Director (Performing Duties of)
NOAA Fisheries, Northwest Fisheries Science Center

U.S. Secretary of Commerce
Howard Lutnick

Under Secretary of Commerce
for Oceans and Atmosphere
Dr. Neil Jacobs

Assistant Administrator for Fisheries
Eugenio Piñeiro Soler

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National Marine
Fisheries Service
Northwest Fisheries Science Center
2725 Montlake Boulevard East
Seattle, Washington 98112