UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS No:
WCRO-2023-00488

March 20, 2025

William Abadie
Chief, Regulatory Branch
Department of the Army
U.S. Army Corps of Engineers, Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the NEXT Renewable Fuels, Oregon, LLC Renewable Green Fuels Facility, Port Westward, Columbia County, Oregon (HUC 170800030900) (NWP-2020-383)

Dear Mr. Abadie:

Thank you for your letter of March 28, 2022, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the NEXT Renewable Fuels, Oregon, LLC Renewable Green Fuels Facility, Port Westward, Oregon.

Thank you, also, for your request for essential fish habitat (EFH) consultation. NMFS reviewed the proposed action for potential effects on EFH pursuant to Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESSA consultation process to complete EFH consultation. for this action. We have concluded that the action would adversely affect EFH of Pacific Coast salmon and Pacific Coast groundfish and have included conservation recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH.

In the biological opinion we concluded that the proposed action is not likely to jeopardize the survival or recovery of:

1. Lower Columbia River Chinook salmon
2. Upper Willamette River Chinook salmon
3. Upper Columbia River spring Chinook salmon
4. Snake River spring/summer Chinook salmon
5. Snake River fall Chinook salmon
6. Lower Columbia River coho salmon
7. Columbia River chum salmon
8. Snake River Sockeye salmon
9. Lower Columbia River steelhead
10. Middle Columbia River steelhead
11. Upper Columbia River steelhead
12. Upper Willamette River steelhead

13. Snake River Basin steelhead
14. Green Sturgeon
15. Eulachon
16. Blue whale
17. Fin whale
18. Sei whale
19. Humpback whale-Central America DPS
20. Humpback whale Mexico DPS
21. Sperm whale
22. Leatherback sea turtle
23. Southern Resident killer whales

or result in the destruction or adverse modification of their designated critical habitats.

We also concluded that the proposed action is not likely to adversely affect:

1. Guadalupe fur seals
2. Green turtles
3. Loggerhead turtles
4. Olive Ridley turtles
5. Western Pacific Gray whales
6. North Pacific Right whales

As required by section 7 of the ESA, NMFS is providing an incidental take statement with the biological opinion. Please contact Tom Hausmann, in Portland, Oregon, at 503-231-2315, or tom.hausmann@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kathleen Wells
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: Katherine Mott, USACE
Chris Efird, NEXT Renewables
Laurie Parry, Stewardship Solutions

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the

NEXT Renewable Fuels, Oregon, LLC Renewable Green Fuels Facility
Port Westward, Columbia County, Oregon

NMFS Consultation Number: WCRO-2023-00488

Action Agency: U.S. Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Lower Columbia River Chinook Salmon (*Onchorhynchus tshawytscha*)	Threatened	Yes	No	Yes	No
Upper Willamette River Chinook	Threatened	Yes	No	Yes	No
Upper Columbia River Spring-run Chinook	Endangered	Yes	No	Yes	No
Snake River Spring-run Chinook	Threatened	Yes	No	Yes	No
Snake River Fall-run Chinook	Threatened	Yes	No	Yes	No
Columbia River Chum Salmon (*O. keta*)	Threatened	Yes	No	Yes	No
Lower Columbia River coho (*O. kisutch*)	Threatened	Yes	No	Yes	No
Snake River Sockeye (*O. nerka*)	Endangered	Yes	No	Yes	No
Lower Columbia River steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Upper Willamette River steelhead	Threatened	Yes	No	Yes	No
Middle Columbia River steelhead	Threatened	Yes	No	Yes	No
Upper Columbia River steelhead	Threatened	Yes	No	Yes	No
Snake River Basin steelhead	Threatened	Yes	No	Yes	No
Blue whale (*Balaenoptera musculus*)	Endangered	Yes	No	N/A	N/A
Fin whale (*B. physalus*)	Endangered	Yes	No	N/A	N/A
Sei whale (*Balaenoptera borealis*)	Endangered	Yes	No	N/A	N/A
Mexico DPS Humpback whale (*Megaptera novaeangliae*)	Threatened	Yes	No	Yes	No

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Central America DPS Humpback whale (*Megaptera novaeangliae*)	Endangered	Yes	No	Yes	No
Sperm whale (*Physeter microcephalus*)	Endangered	Yes	No	N/A	N/A
West Pacific DPS Leatherback turtle (*Dermochelys coriacea*)	Endangered	Yes	No	Yes	No
Southern Resident killer whale (*Orcinus orca*)	Endangered	Yes	No	Yes	No
Green Sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No
Eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	Yes	No
Guadalupe fur seals (*Arctocephalus townsendi*)	Threatened	No	No	No	No
Green turtle (*Chelonia mydas*)	Threatened	No	No	No	No
Loggerhead turtle (*Caretta caretta*)	Endangered	No	No	No	No
Olive ridley turtle (*Lepidochelys olivacea*)	Threatened	No	No	No	No
Western Pacific gray whale (*Eschrichtius robustus*)	Endangered	No	No	No	No
North Pacific right whale (*Eubalaena japonica*)	Endangered	No	No	No	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Groundfish	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

Kathleen Wells
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: March 20, 2025

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1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome].

1.2. Consultation History

On April 18, 2023, NMFS received a biological assessment (BA) and a letter from the U.S. Army Corps of Engineers (USACE), requesting formal ESA consultation and EFH consultation on a Clean Water Act (CWA) Section 404 permit to NEXT Renewable Fuels Oregon, LLC (the applicant, or NEXT), to construct and operate a new bio-refinery facility. The proposed NEXT bio-refinery would be built in the Port Westward Industrial Park (Port Westward) and would use the existing Port Westward dock, operated by the Columbia Pacific Bio Refinery (CPBR), to receive feedstocks and export biofuels. The proposed bio-refinery would also use the Port Westward raw water intake, wastewater pumps and wastewater outfall. Existing tenants at Port Westward include Portland General Electric's Beaver Power Plant, the Port Westward 1 and 2 Generation Plants, and CPBR.

On May 5, 2023, NMFS requested additional information on the quantity and rate of water withdrawal from the Columbia River for the NEXT facility and information on the fish screen on the Port Westward raw water intake pump intake. On May 19, 2023 the USACE supplied us with this information and we initiated consultation on May 19, 2023.

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024 (89 Fed. Reg. 24268). We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act. 89 Fed. Reg. at 24268; 84 Fed. Reg. at 45015. We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this biological opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (see 50 CFR 402.02). Under MSA, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken by a federal agency (50 CFR 600.910).

The USACE proposes to permit, under Section 404 of the Clean Water Act, NEXT Renewable Fuels, LLC to construct and operate a biofuel refinery at the Port Westward Industrial Park in Columbia County, Oregon. The NEXT facility will not involve the construction of a dock or other over-water structures. In-water work is not proposed for the NEXT project. Therefore, there are no in-water work windows.

The biofuel production facility would be constructed on upland property. Construction activities include; creating equipment staging areas, stripping vegetation from and grading the site, construction of the main access road and rail spur, construction of pipelines, construction of stormwater treatment facilities, construction of the facility foundations and construction of facility structures.

After the facility site is stripped of vegetation and graded by removing approximately 6 – 18 inches of soil, it would be treated with glyphosate herbicide to prevent reed canary grass and weed regrowth. **Figure** 1 shows the location of the facility in the industrial park and the Columbia River.

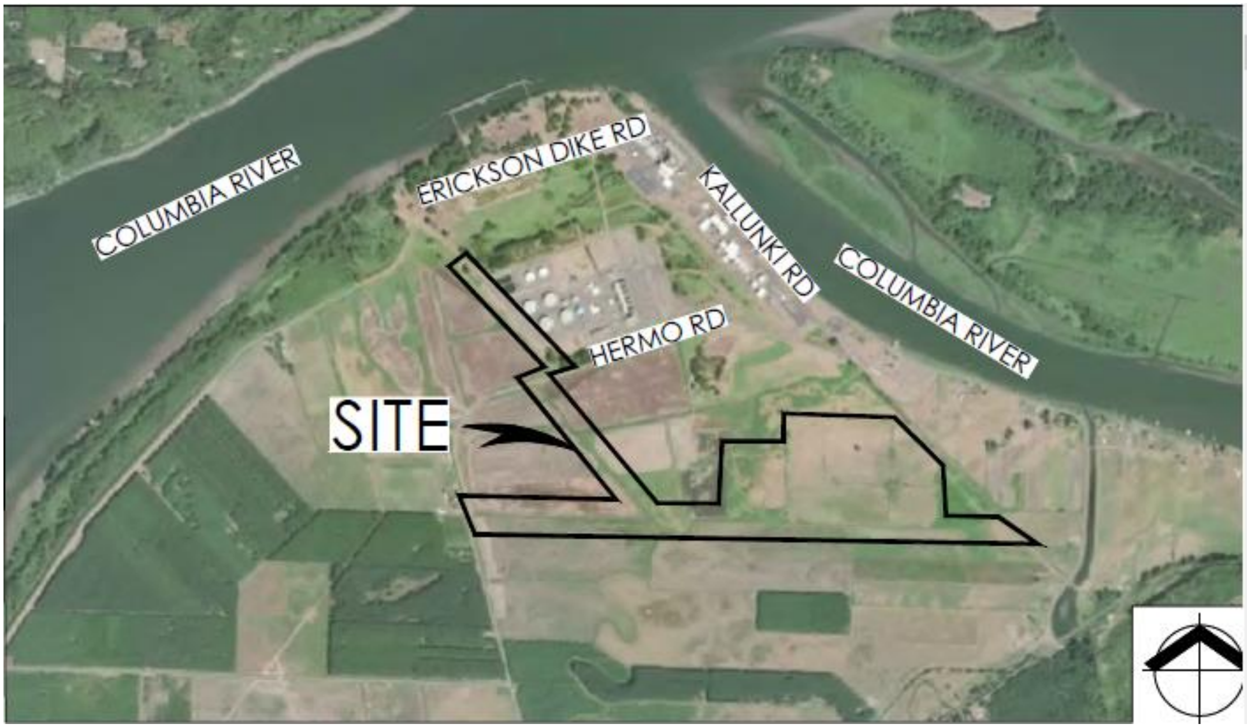

Figure 1. Perimeter of the NEXT facility outlined in black.

NEXT proposes to construct two new loading arms for transferring biofuel and sustainable aviation fuel (SAF) to OGVs at the Berth 1 of the Port Westward dock and a new unloading arm for transferring raw feedstock to pipelines at Berth 2.

The project would include the following BMPs that will be implemented during construction to minimize project impacts:

1. Conditions in local, state, and federal permits will be followed.
2. Construction limits will be clearly defined with stakes prior to the beginning of ground-disturbing activities. The project engineer or construction representative will meet with the contractor to ensure that all workers understand the locations of project construction limits and measures that will be taken to protect them. No disturbance will occur beyond these limits. Erosion and sediment control measures as outlined in the Oregon Department of Environmental Quality Construction 1200-C Stormwater Permit and the Erosion and Sediment Control Plan (ESCP) will be implemented to minimize and control erosion and discharges of pollutants from stormwater.
3. Construction will occur between the hours of 7:00 a.m. and 6:00 p.m.
4. All construction equipment will be maintained and in good working order to minimize the risk of fuel and fluid leaks or spills.
5. A spill containment plan will be developed, and all necessary materials will be onsite prior to, and during, construction.
6. If a leak or spill occurs, work will cease near any waterbody or wetland until the source of the leak is identified and corrected and the contaminants have been removed.

7. All base temporary erosion and sediment control measures (i.e., inlet protection, perimeter sediment control, gravel construction entrances, etc.) must be in place, functional, and approved in an initial inspection prior to beginning construction activities. Temporary erosion and sediment control measures will be inspected regularly and maintained throughout construction.
8. All clearing and excavation will be accomplished in ways that minimizes soil disturbance, compaction, and impacts to vegetation whenever possible.
9. Refueling activities will be conducted within designated refueling areas away from waterbody or wetland areas. For track-mounted equipment, and other equipment whose limited mobility makes it impractical to move for refueling, precautions will be taken to minimize the risk of fuel reaching the project's regulated work area. Spill prevention measures and fuel containment systems designed to completely contain a potential spill will be implemented, as well as other pollution control devices and measures (such as diapering, parking on absorbent material, etc.) that are adequate to provide containment of hazardous materials.
10. Temporary stabilization measures will be employed on slopes, inactive areas, and areas subject to wind erosion.
11. Construction BMPs will be implemented to control dust and limit impacts to air quality and will include the following measures:
    a) Cover loads and ensure adequate freeboard to prevent soil particles from blowing away during transport.
    b) Wet down fill material and dust on site, whenever practicable.
    c) Remove excess dirt, dust, and debris from roadway.
    d) Revegetate disturbed soil as soon as practicable.
12. Measures to minimize noise impacts will be implemented during construction and will include the following measures:
    a) Turn off equipment when not in use for more than 30 minutes.
    b) Use a vibratory hammer to install steel piles.
    c) Use only well-maintained and properly functioning equipment and vehicles.
13. BMPs for stormwater runoff controls will be implemented as follows:
    a) Install temporary sediment control devices such as filter fabric fences or sediment traps.
    b) Sediment barriers shall be installed immediately following establishment of earthwork activities prone to erosion.
    c) Exposed soils and soil stockpiles will be temporarily stabilized at the end of shifts and before holidays and weekends, if needed. Stockpiles shall be placed in a stable location and configuration and covered with plastic sheeting during "wet weather."
    d) Temporary stabilization with a covering of blown straw and a tackifier, loose straw, or an adequate covering of compost mulch will be provided for portions of the site where construction activities will cease for 14 days or more.
    e) Minimize soil disturbance and reseed disturbed areas as soon as practicable.
14. BMPs will be implemented for culvert installation to maintain water quality, and will include the following measures:
    a) Wetland areas and waterways will be designated for protection with silt fencing.
    b) Refueling activities will be conducted within designated refueling areas away from waterbody or wetland areas.

c) All vehicles and equipment operated within 150 ft. of any waterbody will be inspected daily for fluid leaks before leaving the vehicle staging area. Any leaks detected will be repaired before the vehicle resumes operation. When not in use, vehicles will be parked in the designated staging area, which will be located outside all wetlands and waterways and their buffers.

d) Vegetation removal will be minimized to the greatest extent possible, and erosion control blankets will be used to assist rapidly revegetating sites disturbed by culvert replacements and associated temporary impacts.

15. No pollutants, such as green concrete, contaminated water, welding slag, sandblasting abrasive, or grout cured less than 24 hours will contact any waterbody.

Operation

The NEXT facility would refine and export biofuel and SAF from feedstocks such as vegetable oil, used cooking oil, animal tallow and inedible corn oil. The NEXT facility uses the Honeywell UOP Ecofining™ Green Diesel technology. Triglycerides are treated with hydrogen in pressurized reactors where catalysts produce 100% Fatty Acid Methyl Ester (FAME, or biofuel), which is a hydrocarbon product. SAF production incorporates an additional selective cracking step to reduce carbon chain lengths (Figure 2). SAF is a mix of mostly volatile organic hydrocarbons and some light semi-volatile organic hydrocarbons. These substances would have similar effects on the environment as light-weight petroleum hydrocarbons and light-weight PAHs. The biofuel refinery would produce renewable fuels to increase supply and to help meet the renewable fuel requirements of the Federal Renewable Fuel Standard Program and Washington, Oregon, California and British Columbia fuel standard requirements that decrease the carbon intensity of transportation fuels.

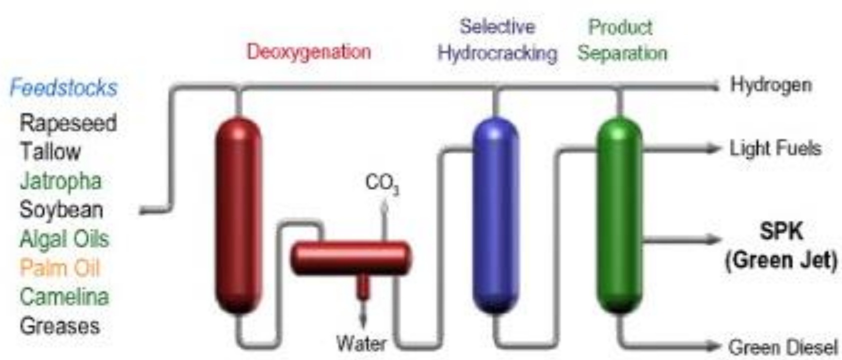

Figure 2. A process schematic of UOP's proprietary process for production of renewable fuels from triglycerides.

Port Westward has Oregon State-permitted water intake and outfall structures in the Columbia River just east of the existing dock. Water for NEXT operations will be supplied from this Port Westward intake structure under the existing water right. NEXT biofuel production wastewater includes oily water, pre-treatment water, stripped sour water,[1] cooling tower blowdown, boiler

[1] Sour water is produced in refinery process units when water is used for steam stripping and quenching. Sour water is contaminated mostly with ammonia (NH3) and hydrogen sulfide (H2S), which must be removed before the water

blowdown, and reverse osmosis reject water. The facility's wastewater treatment system is designed to treat wastewater produced from processing 50,000 barrels per day of vegetable oil and animal fats into renewable fuel and SAF such that it can be combined with Port Westward wastewater and meet the requirements of the Port Westward NPDES permit and 1200Z industrial stormwater permit contaminant concentrations. The wastewater treatment systems are described as meeting 40 CFR 60 Subpart QQQ, Standards of Performance for volatile organic chemical (VOC) Emissions from Petroleum Refinery Wastewater Systems requirements (ELS 2023).

When burned, pure biofuels generally produce fewer emissions of particulates, sulfur dioxide, and air toxics than fossil-fuels. Biodiesel combustion may result in slightly higher amounts of nitrogen oxides relative to petroleum diesel. Nevertheless, biofuels can produce greenhouse gases (GHG), especially when combined or blended with petroleum-based fuels.

Stormwater Treatment

Runoff, water-quality treatment, and flow control (stormwater quantity) would be provided by four vegetated ponds to provide detention, settling, and biofiltration. Absorbent socks or booms would be used to remove floatables, if any, from the water surface in the pond. Pond outlets would be equipped with downturned elbows to trap oil sheen and other floatables in the ponds. Pond construction and components of the stormwater system would be completed contemporaneously with the facility construction.

Ponds 1 and 2 would run parallel along the west rail spur between the access road and the west rail spur. Pond 1 will be 23 feet wide extending east from Hermo Road for approximately 2,684 feet and would collect runoff from the paved access road, gravel laydown area, and rail areas west of the main plant into a series of catch basins with gravity flow to Pond 1 (Figure 3). Runoff from the main plant rail spur would sheet flow to a series of catch basins and would be conveyed via gravity flow to Pond 2 that extends from the main plant westward for approximately 1,064 feet. Stormwater from Ponds 1 and 2 would discharge to McLean Slough.

Runoff from the rail area southeast of the Main Plant (East Rail Spur) would sheet flow to a catch basin and would then be conveyed via gravity flow to Pond 4 located on the south side of the east rail spur adjacent to the existing Waterway F (Figure 3). Runoff from the pipe rack and pipeline maintenance roadway would sheet flow into Pond 3 that would run parallel to the maintenance road and would then be conveyed via gravity flow to Waterway D and McLean Slough. Pond construction would permanently impact approximately 2.45 acres of Wetland 1 by permanently removing 2,280 cubic yards of material in the grading process and placing 5,295 cubic yards of material to create the ponds.

The facility's main wastewater system is designed to process wastewater produced from processing 50,000 barrels per day of vegetable oil and animal fats to produce renewable fuel and SAF. Wastewater would be collected and treated based on various contaminants in the waste stream. Once treated, the wastewater and stormwater from main facility would be comingled and processed through the tertiary filters before being sent through a heat exchanger for cooling prior

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is recycled back into the process. Refineries typically use trays in their sour water strippers to remove the contaminants.

to entering the existing Port Westward wastewater collection system for eventual discharge at the Port's permitted outfall to the Columbia River (NPDES Permit #102650).

The project will create 72.6 acres of new pollution-generating impervious surfaces (PGIS) that will contaminate stormwater in four different drainage areas (Table 1).

Drainage Area 1

This area is approximately 108.5 acres and consists of the Main Plant, and a portion of the rail yard south and southeast of the Main Plant (referred to as the Main Plant Rail Spur), located in the northeast portion of the site. There will be 102 acres of the 108.5 acres in Drainage Area 1 that would be disturbed during construction. The onsite wastewater treatment facility would provide treatment designed to remove a wide range of pollutants from processing water and stormwater from inside the processing areas. Stormwater from the non-process areas would be detained, providing treatment via sedimentation, and then it would be combined with pretreated wastewater and process area stormwater. Treatment would remove, or partially remove, contaminants including, but not limited to, oils and greases, suspended solids, heavy metals, nutrients, and 6PPD-quinone (from vehicle tire wear).

Drainage Area 2

Drainage Area 2 is approximately 12.2 acres and consists of two areas: the paved main access road and gravel laydown area that includes the rail yard located west of the Main Plant (referred to as the West Rail Spur) and the proposed aboveground pipeline and associated gravel Pipeline/Maintenance Road located northwest of Drainage Area 1. Stormwater runoff from the West Rail Spur would be collected in a series of catch basins and conveyed by gravity piping into one of two proposed stormwater ponds (Ponds 1 and 2) located south of the proposed main access road. The ponds would provide detention to meet the County's flow-control requirements, as well as treatment via sedimentation and biofiltration. Pond outlets would be equipped with a downturned elbow to trap floatables, including oil sheen. The pond outlets would be routed to the existing ditch, Waterway D, that is just north of McLean Slough (Figure 3).

Drainage Area 3

Drainage Area 3 is approximately 0.8 acres and consists of a rail spur located southeast of the Main Plant (East Rail Spur). A gravel road in this area provides access to the adjacent property. Stormwater runoff from the East Rail Spur would be collected in a catch basin and conveyed via gravity piping into Pond 4, located along the southwest boundary of this drainage area. This pond would provide detention to meet the County's flow-control requirements, as well as treatment via sedimentation and biofiltration. The Pond 4 outlet would consist of a grated catch basin (CB-DP003) equipped with a downturned elbow to trap floatables in the pond, including oil sheen.

An existing ditch (Waterway F) flows south and then west through the property on the west side of Drainage Area 3 and conveys runoff from the surrounding areas. Runoff from this ditch would be conveyed via a new culvert under the proposed rail tracks to maintain the existing drainage. Industrial stormwater runoff from the proposed Pond 4 would discharge to the existing Waterway F via Discharge Point 003 and would then be conveyed west to McLean Slough.

Treated stormwater discharge from Ponds 1, 2, and 3 will fluctuate with precipitation events and is expected to be little to none during the dry season, typically from May through mid-October.

Drainage Area 4

Drainage Area 4 is approximately one acre and consists of a proposed aboveground pipeline located northwest of Hermo Road (Figure 3). An existing maintenance road runs parallel to the proposed aboveground pipeline; the road would remain in place to provide maintenance access to the pipeline and other Port properties. An existing ditch runs parallel to the proposed aboveground pipeline and discharges through Discharge Point 004 to Waterway D. Impervious surfaces would not increase in Drainage Area 4, and stormwater runoff would continue to be managed through the existing ditches.

Other Stormwater Sources

NEXT is proposing to improve access to the Port Westward location. Improvements would include paving the existing Hermo gravel roadway to provide 12-foot-wide travel lanes and shoulders ranging from about six feet to approximately 11 feet wide. Stormwater runoff from Hermo Road, which is included in the 72.6 acres to be treated, would be detained and treated in stormwater bioswales as described in the post-construction stormwater plan (ELS 2023).

With upgrades of Hermo Road, the proposed design will accommodate over 3,000 vehicles per day. However, NEXT employee vehicles and truck traffic is estimated to add 667 trips per day along Hermo Road (Mackenzie 2021), which would be paved, widened, and drain to constructed bioswales for stormwater detention and treatment. Kallunki Road is the current main access road into the Port industrial area, and it has no existing stormwater detention or treatment facilities. After project construction, Hermo Road is estimated to have a total of approximately 970 vehicle trips per day (current traffic is estimated to be 303 vehicle trips per day plus the addition of 667 trips per day). Groundwater is between 2 feet to 4 feet below the ground surface and stormwater infiltration is not a feasible discharge option for runoff (ELS 2023).

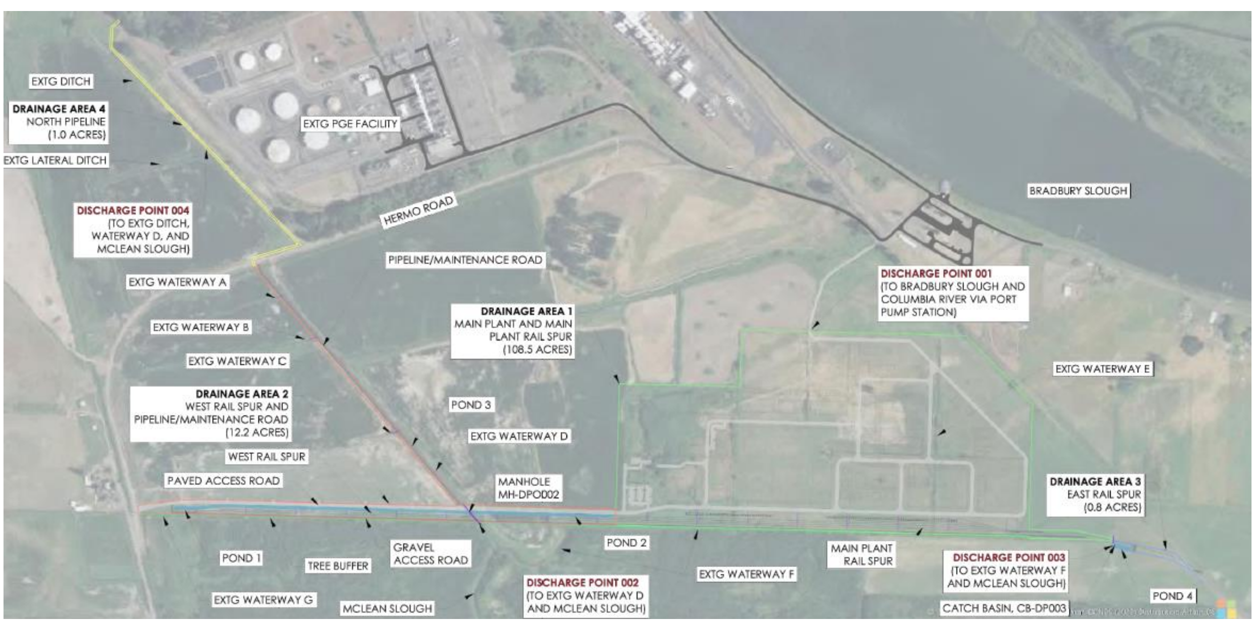

Figure 3. Drainage areas proposed for the NEXT facility.

Table 1. Treatments proposed for stormwater drainage areas (ELS 2023).

Drainage Area	Contaminant sources	Impervious surface area	Treatment
Drainage Area 1 (Main Plant and a portion of the rail spur)	Facility wastewater and stormwater from facility impervious surface including a portion of rail spur	64.2	Stormwater routed to a stormwater basin sized for a 100 year, 24-hour storm and then combined with wastewater and treated to remove contaminants including, but not limited to, oils and greases, suspended solids, heavy metals, nutrients, and 6PPD-quinone. Treated wastewater and stormwater are then filtered and cooled in a heat exchanger against incoming raw water before entering the existing Port Westward wastewater collection system for discharge at the Port's permitted outfall to the Bradbury Slough (Columbia River Side Channel)
Drainage Area 2 (access road, gravel laydown area, West rail yard)	Stormwater from: 1. Paved main access road and West Rail Spur gravel laydown area	8.3	1. Stormwater collected in catch basins and conveyed to one of two stormwater detention ponds (Pond 1 and Pond 2) with outlets routed to a manhole for sampling and an existing ditch discharge to McLean Slough.
	2. Above ground pipeline and gravel road for pipeline maintenance		2. Sheet flow into a detention pond (Pond 3) parallel to road, then combined with treated stormwater from Pond 1 and Pond 2 and discharged to McLean Slough.
Drainage Area 3 (East rail spur)	Stormwater from East Rail Spur and gravel road	0.1	Stormwater collected in a catch basin and conveyed to detention pond (Pond 4) with outlet to a ditch to McLean Slough.
Drainage Area 4 (elevated pipeline)	Stormwater from above ground pipeline	0	Collection in a ditch alongside the pipeline and conveyed by a ditch to McLean Slough.

The NEXT project would withdraw water from the Columbia River under an existing Port water right to process biofuel using the Port's existing water intake. A water intake system would be constructed where raw water from water intake would flow through an ultrafiltration system and into a storage tank. The raw water storage tank supplies water for utility water, potable water, fire water, cooling water and boiler feed water systems. The raw water makeup is estimated to be about 1,850 gpm.

The NEXT project would install rail loading and offloading facilities, increasing impervious surface. The facility would develop 10-spot unloading facilities for bleaching earth, 2 15-spot unloading facilities for feedstock oil, and a 10-spot loading facility for renewable oil. In total, the NEXT project would increase rail traffic to the project site by 1,220 rail cars per month. Additionally, 60 semi-trucks would be loaded with renewable fuel per month.

NEXT proposes to mitigate wetland and waterway impacts with restoration of approximately 466 acres of wetland on a parcel owned by the applicant about 0.25 miles south of the facility parcel. Additionally, riparian plantings are proposed along a 1-mile reach of waterway.

NEXT would maintain unwanted vegetation at the facility and at the mitigation site with herbicides. Reed canary grass and other plants would be sprayed initially and as ongoing maintenance with glyphosate.

A full list of conservation measures is provided in ELS (2023, pages 23 - 26), and is adopted here by reference. These avoidance and minimization measures address Best Management Practices (BMPs) in design features, construction, project operations, and vessel loading and unloading procedures. They are intended to maintain clean water, minimize and treat oil spills, and maintain mitigation wetland features.

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would cause the following activities: The NEXT project will facilitate delivery of feedstock to the facility using ocean going vessels. Feedstock will be delivered by an average of 115 general-purpose tankers or articulated tug barges (ATB) per year and NEXT biofuel and SAF will be shipped to west coast markets in California, Oregon, Washington, and (possibly) British Columbia by approximately 56 OGVs per year (i.e., 171 vessels per year). Each vessel is anticipated to moor at Port Westward for about two days. Vessel traffic would not occur but for the proposed action. It is reasonably certain to occur because the NEXT facility could not operate without product to convert into biofuel, or without selling their refined product.

2. ENDANGERED SPECIES ACT BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency’s actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The USACE determined the proposed action is not likely to adversely affect Gray whales – Western North Pacific DPS, North Pacific right whales, Green sea turtle- East Pacific DPS, Loggerhead sea turtles, Olive Ridley sea turtles, or Guadalupe fur seals or their critical habitat. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.13).

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion also relies on the regulatory definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation(s) of critical habitat for; LCR Chinook salmon, UWR Chinook salmon, UCR spring Chinook salmon, SR spring/summer Chinook salmon, SR fall Chinook salmon, LCR coho salmon, CR chum salmon, SR Sockeye salmon, LCR steelhead, MCR steelhead, UCR steelhead, UWR steelhead, SRB steelhead, sDPS Eulachon, sDPS Green Sturgeon, humpback whale and leatherback sea turtle use(s) the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or

indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. Major ecological realignments are already occurring in response to climate change (IPCC, 2022). Long-term trends in warming have continued at global, national and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 (IPCC 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC 2021). Globally, 2014-2018 were the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA NCEI, 2022). Events such as the 2013-2016 marine heatwave (Jacox *et al*., 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring *et al*., 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC 2022). These two factors are often examined in isolation, but likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refuges (both flow and temperature) and improving growth opportunity in both freshwater and marine environments are strongly advocated in the recent literature (Siegel and Crozier, 2020a).

Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier, 2011; Crozier, 2012; Crozier, 2013; Crozier, 2014; Crozier, 2015; Crozier, 2016; Crozier, 2017; Crozier *et al*., 2019; Crozier and Siegel, 2018; Siegel and Crozier, 2019; Siegel and Crozier, 2020b) have collected hundreds of papers documenting the major themes relevant for salmon. Here we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

Forests

Climate change will impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreak (Halofsky, Peterson and Harvey, 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky *et al*. (2018) projected that the largest changes will occur at low- and high-elevation forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden *et al*. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizadeh *et al*., 2021).

Agne *et al*. (2018) reviewed literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne *et al*. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

Freshwater Environments

The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

Cooper *et al*. (2018) examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter’s precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, interannual variability in winter precipitation was greater. Malek *et al*. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable.

The effect of climate change on ground water availability is likely to be uneven. Sridhar *et al*. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

As cited in Siegel and Crozier (2019), Isaak *et al*. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon *O. nerka* and the availability of suitable habitat for brown trout *Salmo trutta* and rainbow trout *O. mykiss*. Isaak *et al*. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald *et al*., 2020; Myers *et al*., 2018).

Streams with intact riparian corridors and that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby *et al*. (2018), identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in short time-spans by removing riparian cover (Koontz *et al*. 2018), and streams that lose their snowpack with climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan *et al*. 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne *et al*. 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life history traits and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz *et al*. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz *et al*. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay *et al*. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux *et al*. 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (although see Ou *et al*. 2015 and Williams *et al*. 2019), however, impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower streamflows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford 2022, Lindley *et al*. 2009, Williams *et al*. 2016, Ward *et al*. 2015). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier *et al*. 2019).

Climate change effects on salmon and steelhead

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact intergravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier *et al*. 2020). Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (Crozier *et al*. 2020, FitzGerald *et al*. 2021). Rising river temperatures increase the energetic cost of migration and the risk of *en route* or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Keefer *et al*. 2018, Barnett *et al*. 2020).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Burke *et al*., 2013; Holsman *et al*., 2012). It is generally accepted that salmon marine survival is size-dependent, and thus larger and faster growing fish are more likely to survive (Gosselin *et al*., 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco *et al*., 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris *et al*. (2018), explored phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon *O. nerka* from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris *et al*. (2018) recommended that managers maintain and augment such life-history diversity.

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black *et al*. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun *et al*., 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner *et al*. 2018, Kilduff *et al*. 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger *et al*., 2018). Other Pacific salmon species (Stachura el al. 2014) and Atlantic salmon (Olmos *et al*. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Healey 2011; Wainwright and Weitkamp 2013, Gosselin *et al*. 2021). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter and spring adult migrants, such as coho and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie *et al*. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel 2006; Crozier *et al*. 2010, Crozier *et al*. 2019).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson *et al*. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin. In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock *et al*. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson *et al*. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler *et al*., 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson *et al* (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater *et al*., 2019; Munsch *et al*., 2022).

2.2.1 Status of the Species

Table 2, below, provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion. More information can be found in recovery plans and status reviews for these species. Acronyms appearing in the table include DPS (Distinct Population Segment), ESU (Evolutionarily Significant Unit), ICTRT (Interior Columbia Technical Recovery Team), MPG (Major Population Group), NWFSC (Northwest Fisheries Science Center), TRT (Technical Recovery Team), and VSP (Viable Salmonid Population).

Table 2. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each species considered in this opinion.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River Chinook salmon	Threatened 6/28/05	NMFS 2013	NMFS 2022a; Ford 2022	This ESU comprises 32 independent populations. Relative to baseline VSP levels identified in the recovery plan (Dornbusch 2013), 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; Spring-run Chinook salmon populations in this ESU are generally unchanged; most of the populations are at a "high" or "very high" risk due to low abundances and the high proportion of hatchery-origin fish spawning naturally. Many of the populations in this ESU remain at "high risk," with low natural-origin abundance levels. Overall, we conclude that the viability of the Lower Columbia River Chinook salmon ESU has increased somewhat since 2016, although the ESU remains at "moderate" risk of extinction	• Reduced access to spawning and rearing habitat • Hatchery-related effects • Harvest-related effects on fall Chinook salmon • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Contaminant
Upper Columbia River spring-run Chinook salmon	Endangered 6/28/05	Upper Columbia Salmon Recovery Board 2007	NMFS 2022b; Ford 2022	This ESU comprises four independent populations. Current estimates of natural-origin spawner abundance decreased substantially relative to the levels observed in the prior review for all three extant populations. Productivities also continued to be very low, and both abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Salmon Recovery Plan for all three populations. Based on the information available for this review, the Upper Columbia River spring-run Chinook salmon ESU remains at high risk, with viability largely unchanged since 2016.	• Effects related to hydropower system in the mainstem Columbia River • Degraded freshwater habitat • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Persistence of non-native (exotic) fish species • Harvest in Columbia River fisheries

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NMFS 2022c; Ford 2022	This ESU comprises 28 extant and four extirpated populations. There have been improvements in abundance/productivity in several populations relative to the time of listing, but the majority of populations experienced sharp declines in abundance in the recent five-year period Overall, at this time we conclude that the Snake River spring/ summer-run Chinook salmon ESU continues to be at moderate-to-high risk.	• Degraded freshwater habitat • Effects related to the hydropower system in the mainstem Columbia River, • Altered flows and degraded water quality • Harvest-related effects • Predation
Upper Willamette River Chinook salmon	Threatened 6/28/05	NMFS 2011	NMFS 2024; Ford 2022	This ESU comprises seven populations. Abundance levels for all but Clackamas River DIP remain well below their recovery goals. The Clackamas River DIP currently exceeds its abundance recovery goal and its pHOS goal (<10% hatchery-origin fish). While returns to Fall Creek Dam number in the low hundreds, prespawn mortality rates are very high in the basin, and the effects of fires and high summer temperatures resulted in a recruitment failure in 2021. Overall, there has likely been a declining trend in the viability of the Upper Willamette River Chinook salmon ESU since the last review. In order to meet the biological recovery criteria for viability, the UWR Chinook salmon ESU must have four out of seven viable populations. The magnitude of this change is not sufficient to suggest a change in risk category, however, so the Upper Willamette River Chinook salmon ESU remains at "moderate" risk of extinction.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats • Altered food web due to reduced inputs of microdetritus • Predation by native and non-native species, including hatchery fish • Competition related to introduced salmon and steelhead • Altered population traits due to fisheries and bycatch

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017b	NMFS 2022e; Ford 2022	This ESU has one extant population The single extant population in the ESU is currently meeting the criteria for a rating of "viable" developed by the ICTRT, but the ESU as a whole is not meeting the recovery goals described in the recovery plan for the species, which require the single population to be "highly viable with high certainty" and/or will require reintroduction of a viable population above the Hells Canyon Complex (NMFS 2017b). The Snake River fall-run Chinook salmon ESU therefore is considered to be at a moderate-to-low risk of extinction.	• Degraded floodplain connectivity and function • Harvest-related effects • Loss of access to historical habitat above Hells Canyon and other Snake River dams • Impacts from mainstem Columbia River and Snake River hydropower systems • Hatchery-related effects • Degraded estuarine and nearshore habitat.
Columbia River chum salmon	Threatened 6/28/05	NMFS 2013	NMFS 2022a; Ford 2022	This species has 17 populations divided into 3 MPGs. 3 populations exceed the recovery goals established in the recovery plan (Dornbusch 2013). The remaining populations have unknown abundances. Abundances for these populations are assumed to be at or near zero. The viability of this ESU is relatively unchanged since the last review (moderate to high risk), and the improvements in some populations do not warrant a change in risk category, especially given the uncertainty regarding climatic effects in the near future.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Degraded stream flow as a result of hydropower and water supply operations • Reduced water quality • Current or potential predation • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013	NMFS 2022a; Ford 2022	Of the 24 populations that make up this ESU only six of the 23 populations for which we have data appear to be above their recovery goals. Overall abundance trends for the Lower Columbia River coho salmon ESU are generally negative. Natural spawner and total abundances have decreased in almost all DIPs, and Coastal and Gorge MPG populations are all at low levels, with significant numbers of hatchery-origin coho salmon on the spawning grounds. Improvements in spatial structure and diversity have been slight, and overshadowed by declines in abundance and productivity. For individual populations, the risk of extinction spans the full range, from "low" to "very high." Overall, the Lower Columbia River coho salmon ESU remains at "moderate" risk, and viability is largely unchanged since 2016.	• Degraded estuarine and near-shore marine habitat • Fish passage barriers • Degraded freshwater habitat: Hatchery-related effects • Harvest-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants
Snake River sockeye salmon	Endangered 6/28/05	NMFS 2015	NMFS 2022d; Ford 2022	This single population ESU is at remains at "extremely high risk," although there has been substantial progress on the first phase of the proposed recovery approach—developing a hatchery-based program to amplify and conserve the stock to facilitate reintroductions. Current climate change modeling supports the "extremely high risk" rating with the potential for extirpation in the near future (Crozier *et al*. 2020). The viability of the Snake River sockeye salmon ESU therefore has likely declined since the time of the prior review, and the extinction risk category remains "high."	• Effects related to the hydropower system in the mainstem Columbia River • Reduced water quality and elevated temperatures in the Salmon River • Water quantity • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Columbia River steelhead	Threatened 1/5/06	Upper Columbia Salmon Recovery Board 2007	NMFS 2022b; Ford 2022	This DPS comprises four independent populations. The most recent estimates (five year geometric mean) of total and natural-origin spawner abundance have declined since the last report, largely erasing gains observed over the past two decades for all four populations (Figure 12, Table 6). Recent declines are persistent and large enough to result in small, but negative 15-year trends in abundance for all four populations. The overall Upper Columbia River steelhead DPS viability remains largely unchanged from the prior review, and the DPS is at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded floodplain connectivity and function, channel structure and complexity, riparian areas, large woody debris recruitment, stream flow, and water quality • Hatchery-related effects • Predation and competition • Harvest-related effects
Lower Columbia River steelhead	Threatened 1/5/06	NMFS 2013	NMFS 2022a; Ford 2022	This DPS comprises 23 historical populations, 17 winter-run populations and 6 summer-run populations. 10 are nominally at or above the goals set in the recovery plan (Dornbusch 2013); however, it should be noted that many of these abundance estimates do not distinguish between natural- and hatchery- origin spawners. The majority of winter-run steelhead DIPs in this DPS continue to persist at low abundance levels (hundreds of fish), with the exception of the Clackamas and Sandy River DIPs, which have abundances in the low 1,000s. Although the five-year geometric abundance means are near recovery plan goals for many populations, the recent trends are negative. Overall, the Lower Columbia River steelhead DPS is therefore considered to be at "moderate" risk.	• Degraded estuarine and nearshore marine habitat • Degraded freshwater habitat • Reduced access to spawning and rearing habitat • Avian and marine mammal predation • Hatchery-related effects • An altered flow regime and Columbia River plume • Reduced access to off-channel rearing habitat in the lower Columbia River • Reduced productivity resulting from sediment and nutrient-related changes in the estuary • Juvenile fish wake strandings • Contaminants

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Upper Willamette River steelhead	Threatened 1/5/06	NMFS 2011b	NMFS 2024; Ford 2022	This DPS has four demographically independent populations. Populations in this DPS have experienced long-term declines in spawner abundance. Although the recent magnitude of these declines is relatively moderate, continued declines would be a cause for concern. Overall, the Upper Willamette River steelhead DPS continued to decline in abundance. Although the most recent counts at Willamette Falls and the Bennett Dams in 2019 and 2020 suggest a rebound from the record 2017 lows, it should be noted that current "highs" are equivalent to past lows. In the absence of substantial changes in accessibility to high-quality habitat, the DPS will remain at "moderate-to-high" risk. Overall, the Upper Willamette River steelhead DPS is therefore at "moderate-to-high" risk, with a declining viability trend.	• Degraded freshwater habitat • Degraded water quality • Increased disease incidence • Altered stream flows • Reduced access to spawning and rearing habitats due to impaired passage at dams • Altered food web due to changes in inputs of microdetritus • Predation by native and non-native species, including hatchery fish and pinnipeds • Competition related to introduced salmon and steelhead • Altered population traits due to interbreeding with hatchery origin fish
Middle Columbia River steelhead	Threatened 1/5/06	NMFS 2009b	NMFS 2022f; Ford 2022	This DPS comprises 17 extant populations. Recent (five-year) returns are declining across all populations, the declines are from relatively high returns in the previous five-to-ten year interval, so the longer-term risk metrics that are meant to buffer against short-period changes in abundance and productivity remain unchanged. The Middle Columbia River steelhead DPS does not currently meet the viability criteria described in the Middle Columbia River steelhead recovery plan.	• Degraded freshwater habitat • Mainstem Columbia River hydropower-related impacts • Degraded estuarine and nearshore marine habitat • Hatchery-related effects • Harvest-related effects • Effects of predation, competition, and disease
Snake River basin steelhead	Threatened 1/5/06	NMFS 2017a	NMFS 2022g; Ford 2022	This DPS comprises 24 populations. Based on the updated viability information available for this review, all five MPGs are not meeting the specific objectives in the draft recovery plan, and the viability of many individual populations remains uncertain. Of particular note, the updated, population-level abundance estimates have made very clear the recent (last five years) sharp declines that are extremely worrisome, were they to continue.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage • Degraded freshwater habitat • Increased water temperature • Harvest-related effects, particularly for B-run steelhead • Predation • Genetic diversity effects from out-of-population hatchery releases

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Southern DPS of green sturgeon	Threatened 4/7/06	NMFS 2018	NMFS 2021	The Sacramento River contains the only known green sturgeon spawning population in this DPS. The current estimate of spawning adult abundance is 17,500 individuals. Telemetry data and genetic analyses suggest that Southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey Bay, California and, within this range, most frequently occur in coastal waters of Washington, Oregon, and Vancouver Island and near San Francisco and Monterey bays. Within the nearshore marine environment, tagging and fisheries data indicate that Northern and Southern DPS green sturgeon prefer marine waters of less than a depth of 110 meters.	• Reduction of its spawning area to a single known population • Lack of water quantity • Poor water quality • Poaching
Southern DPS of eulachon	Threatened 3/18/10	NMFS 2017c	NMFS 2022h	The Southern DPS of eulachon includes all naturally-spawned populations that occur in rivers south of the Nass River in British Columbia to the Mad River in California. Sub populations for this species include the Fraser River, Columbia River, British Columbia and the Klamath River. In the early 1990s, there was an abrupt decline in the abundance of eulachon returning to the Columbia River. Despite a brief period of improved returns in 2001-2003, the returns and associated commercial landings eventually declined to the low levels observed in the mid-1990s. Although eulachon abundance in monitored rivers has generally improved, especially in the 2013-2015 return years, recent poor ocean conditions and the likelihood that these conditions will persist into the near future suggest that population declines may be widespread in the upcoming return years.	• Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success. • Climate-induced change to freshwater habitats • Bycatch of eulachon in commercial fisheries • Adverse effects related to dams and water diversions • Water quality, • Shoreline construction • Over harvest • Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Southern resident killer whale	Endangered 11/18/05	NMFS 2008	NMFS 2022i	The Southern Resident killer whale DPS is composed of a single population that ranges as far south as central California and as far north as southeast Alaska. While some of the down-listing and delisting criteria have been met, the biological down-listing and delisting 63 criteria, including sustained growth over 14 and 28 years, respectively, have not been met. The SRKW DPS has not grown; the overall status of the population is not consistent with a healthy, recovered population. Considering the status and continuing threats, the Southern Resident killer whales remain in danger of extinction.	• Quantity and quality of prey • Exposure to toxic chemicals • Disturbance from sound and vessels • Risk from oil spills

Status of Blue Whales. The Endangered Species Conservation Act of 1969 listed blue whales as endangered worldwide and they remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491; June 2, 1970). The entire species remains endangered under the ESA (NMFS 2020a). There is no designated critical habitat for blue whales.

Spatial structure and diversity. The Eastern North Pacific Stock of blue whales includes animals found in the eastern north Pacific from the northern Gulf of Alaska to the eastern tropical Pacific (Carretta *et al*., 2017). Most blue whale sightings are in nearshore and continental shelf waters but blue whales frequently migrate through deep oceanic waters to spend their summers feeding in productive waters near the higher latitudes of the Gulf of Alaska and the Aleutian Islands and their winters in the warmer waters at lower latitudes from Southern California to Costa Rica (Calambokidis and Barlow, 2013; Calambokidis *et al*., 2009b). None of the nine feeding areas for blue whales off the U.S. West Coast areas are within the Action Area (Calambokidis *et al*., 2015). There was one sighting of a blue whale (Oleson and Hildebrand, 2012) during 42 small boat surveys from Grays Harbor out to the 1,000 meter isobath off Quinault between 2004 and 2009. Aerial surveys conducted in waters off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012, encountered a total of 16 blue whales during the fall (Adams *et al*., 2014). Figure 4 shows their general distribution of the Eastern Pacific coast. Acoustic monitoring in waters off the coast of Washington show a yearly seasonal pattern of blue whale presence from summer through winter (Oleson and Hildebrand, 2012).

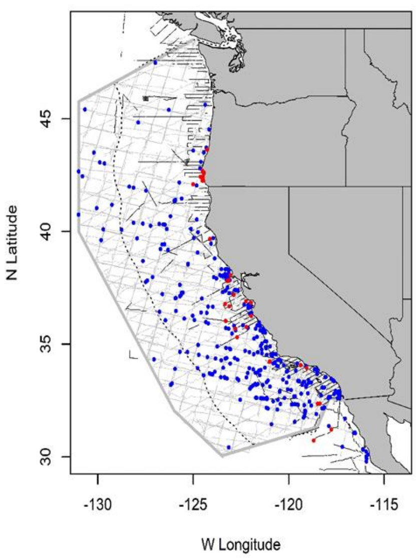

Figure 4. Blue whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991 - 2018 (NMFS 2024b).

Abundance and productivity. Minimum population estimates of the Eastern North Pacific stock of blue whales is 1,551 individuals and show trends that numbers are increasing, although the mark-recapture estimates show there is no evidence of growth in global populations since the early 1990s (NMFS 2020b). The Eastern Pacific blue whale population may have reached a

stable level at 97 percent of carrying capacity in 2013 following the cessation of commercial whaling in 1971 (Monnahan *et al*., 2015).
Limiting factors. Threats to blue whales are vessel strikes, entanglement in fishing gear, habitat degradation, pollution and climate change (Redfern *et al*. 2019; NMFS 2020a; NMFS 2020b). As noted in the Revised Recovery Plan for the blue whale (NMFS 2020b), some blue whale populations are likely more vulnerable than others to ship strikes, largely based on differences in distribution relative to shipping traffic (NMFS 2020). However, some blue whale populations are vulnerable to ship strikes due in large part to coastal populations which seasonally reside in feeding grounds that overlap with shipping routes, such as off southern California (NMFS 2020b). In waters off California between 1991 and 2010 there were 14 ship strikes involving blue whales (Calambokidis, 2012; Calambokidis *et al*., 2009a; Monnahan, Branch and Punt, 2015) and 10 blue whales died from vessel strikes between 2007 and 2011 in waters of the U.S. West Coast (Carretta *et al*., 2017; Carretta *et al*., 2013). There was one blue whale ship strike death reported in 2016 (Carretta *et al*., 2017).

Status of Fin Whales. The Endangered Species Conservation Act of 1969 listed fin whales as endangered worldwide and they remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 Fed. Reg. 8491) (June 2, 1970) (codified at 50 C.F.R. § 17.11(h)) and subsequent 5-year reviews (NMFS 2019b). There is no designated critical habitat for fin whales. The fin whales most likely to be observed within the proposed action area are identified as the CA/OR/WA stock.

Spatial Structure and Diversity. In the North Pacific, populations off the U.S. west coast and in Alaskan waters (Kenai Peninsula to Shumagin Islands) are increasing. Although, information is sparse on other demographic parameters, reasonable annual population growth rates have been reported to range from 4-7.5%, indicating threats acting on these populations are not limiting growth (NMFS 2019b). Fin whales prefer temperate and polar waters making long-range movements along the entire U.S. West Coast (Falcone *et al*., 2011) following prey off the continental shelf (Azzellino *et al*., 2008). There was one sighting of a group of three fin whales during 42 small boat surveys from Grays Harbor out to the 1,000 meters (m) isobath off Quinault conducted over a five-year period in the summer between 2004 and 2009, (Oleson and Hildebrand, 2012). During aerial surveys within the 2,000 m isobath off southern Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012, there were six sightings of 13 fin whales during winter and summer 2012 in offshore waters over the continental slope (Adams *et al*., 2014). Figure 5 shows the distribution of fin whales off the Eastern Pacific Coast. Acoustic monitoring has indicated a yearly seasonal pattern of fin whale calls in the Action Area with the absence of calls from approximately May through July (Oleson and Hildebrand, 2012).

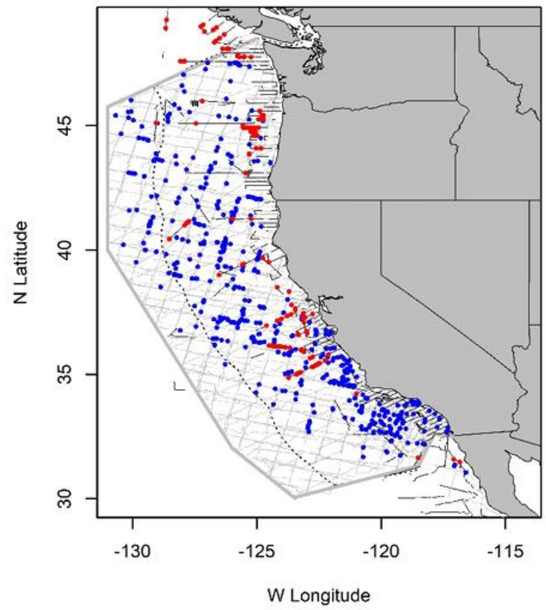

Figure 5. Fin whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991 - 2018 (Barlow 2016, Henry et al. 2020).

Abundance and Productivity. The best estimate of fin whale abundance in California, Oregon, and Washington waters out to 300 nautical miles is 9,029 whales, generated from a trend-model analysis of line-transect data from 1991 through 2014 (Nadeem *et al*., 2016). Removal of the threat of commercial whaling has allowed increased recruitment in global populations and expected to grow.

Limiting factors. Fin whales are susceptible to both ship strikes and entanglement in fishing gear (Carretta *et al*., 2017; NOAA, 2017g). Between 1991 and 201 there were 20 reported ship strikes of fin whales along the U.S. West Coast. From 2010 to 2014 along the U.S West Coast there were nine reported ship strikes to fin whales (Carretta *et al*., 2017). Since 2002, 10 out of the 12 stranded fin whales in Washington have showed evidence attributed to a large ship strike (Carretta *et al*., 2017). Four fin whales were seriously injured by entanglement in fishing gear off the U.S. West Coast between 2007 and 2014 (Carretta *et al*., 2017; Carretta *et al*., 2013).

Status of Sei Whale. The Endangered Species Conservation Act of 1969 listed sei whales was as endangered worldwide and they remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491; June 2, 1970). The North Pacific population is threatened under the ESA (NMFS 2021b). There is no designated critical habitat for sei whales.

Spatial structure and diversity. Sei whales migrate to spend the summer months feeding in the subpolar higher latitudes and return to lower latitudes as far south as Southern California to calve in the winter (Horwood, 2009). They are found feeding along the California Current, preferring deep water habitat along the continental shelf (Perry *et al*., 1999).

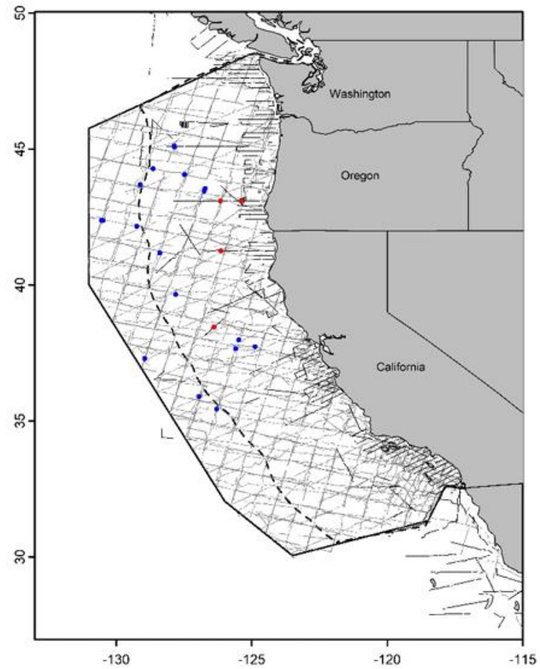

Figure 6. Sei whale sighting locations from shipboard surveys off California, Oregon, and Washington, 1991 – 2018 (NMFS 2024c).

Abundance and productivity. Abundance estimates for the two most recent line transect surveys of California, Oregon, and Washington waters in 2008 and 2014 out to 300 nautical miles are 311 (CV=0.76) and 864 (CV=0.40) sei whales, respectively (Barlow 2016). The best estimate of abundance for California, Oregon, and Washington waters out to 300 nautical miles is the unweighted geometric mean of the 2008 and 2014 estimates, or 519 (CV=0.40) sei whales (Barlow 2016).

Limiting factors. Sei whales, because of their offshore distribution and relative scarcity in U.S. Atlantic and Pacific waters, probably have a lower incidence of fishing gear entanglement than fin whales. One sei whale was killed in a collision with a vessel off the coast of Washington in 2003 (NMFS, 2017e).

Status of Humpback Whales. The Endangered Species Conservation Act listed humpback whales as endangered under in June 1970 (35 FR 18319) and they remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 8491).

In 2016, NOAA Fisheries revised the listing status of the humpback whale under the Endangered Species Act (ESA). The globally listed endangered species was divided into 14 distinct population segments (DPSs), the species-level listing was removed, and NOAA Fisheries listed four DPSs as endangered and one DPS as threatened (81 FR 62260, September 8, 2016). Central America DPS humpback whales are listed as endangered. Mexico DPS humpback whales are listed as threatened. We designated critical habitat on April 21, 2021 (86 FR 21082). The ESA generally requires recovery plans for the conservation and survival of listed endangered and threatened species.

The DPSs are considered new listings under the ESA, so NOAA Fisheries is developing a DPS-specific recovery plan for the Central America, Mexico, and Western North Pacific DPSs. This new plan will replace the species-wide recovery plan that was published in 1991. Until the new recovery plan is complete, this recovery outline will serve as an interim guidance document and, with the existing species-wide recovery plan, direct recovery efforts, including recovery planning, for the Central America, Mexico, and Western North Pacific DPSs of humpback whales (NMFS 2022j).

Spatial structure and diversity. Humpback whales are in all major oceans and most seas. They typically spend the summer on high-latitude nearshore feeding grounds and the winter in the tropics and subtropics around islands, over shallow banks, and along continental coasts, where calving occurs (Barlow *et al*., 2011; Bettridge *et al*., 2015; Calambokidis *et al*., 2017; Calambokidis *et al*., 2009b). Visual surveys and acoustic monitoring studies detect some humpbacks along the Washington coast year-round (Cogan, 2015; Emmons *et al*., 2019; Oleson *et al*., 2009). The Central America DPS is composed of humpback whales that breed along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras and Nicaragua and feed almost exclusively offshore of California and Oregon with only a few individuals identified at the northern Washington – southern British Columbia feeding grounds (81 FR 62259). The Mexico DPS consists of humpback whales that breed along the Pacific coast of mainland Mexico, and the Revillagigedos Islands and transit through the Baja California Peninsula coast. The DPS feeds across a broad geographic range from California to the Aleutian Islands, with concentrations in California-Oregon, northern Washington – southern British Columbia, northern and western Gulf of Alaska and Bering Sea feeding grounds (81 FR 62259).

Three biologically important humpback whale feeding areas are off of the Washington Oregon coast (Calambokidis *et al*., 2015); (1) Point St. George off Crescent City, Oregon from July to November (2) Stonewall and Heceta Bank off Newport, Oregon from May to November, and (3) Northern Washington from May–November. Surveys of the Northern Washington feeding area found that humpback whale sightings were concentrated around the edge of what appears to be the semi-permanent eddy associated with the outflow from the Strait of Juan de Fuca (Dalla Rosa, Ford and Trites, 2012). Figure 7 shows the distribution of humpback whale sightings off the Eastern Pacific Coast. Satellite tag location data from humpback whales indicate a preference for water less than 200 meters deep (Barlow *et al*., 2011; Becker *et al*., 2016; Campbell *et al*., 2015).

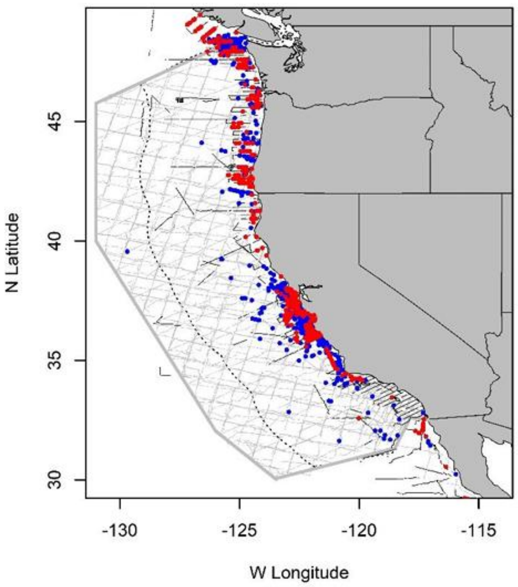

Figure 7. Humpback whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2018 (NMFS 2022l).

Abundance and productivity. Current abundance of the Central America DPS is 411 (81 FR 62259). A population growth rate is currently unavailable for these DPS. The current abundance of the Mexico humpback whale DPS is 3,264 (81 FR 62259). Current estimates of abundance for the CA/OR/WA stock is 1918 individuals with 1729 feeding off California and Oregon and 189 feeding off Washington (NMFS 2019).

Limiting factors. The most common source of injury to humpback whales along the U.S. Pacific coast is entanglement in pot and trap fisheries (Carretta *et al*., 2018). Humpback whales continue to be the predominant species reported as entangled in recent years. There were 54 separate entanglement cases reported for humpback whales along the U.S West Coast in 2016 NOAA, 2017). Fewer humpback whales were entangled in 2023 where 16 whales were entangled, including 3 off Oregon and Washington coasts (NMFS 2023b). For the five-year period between 2011 and 2015 there were 34 cases of entanglement involving pot/trap fisheries and an additional 26 cases of reported interactions with other fisheries (Carretta *et al*., 2017).

Available data from NMFS indicate that along the U.S. Pacific coast between 2011 and 2015, there were nine ship strikes involving humpback whales (Carretta *et al*., 2018). Humpback whales are also potentially affected by loss of habitat, loss of prey (for a variety of reasons including climate variability), underwater noise, jet skis and similar fast waterborne tourist-related traffic disturbance and vessel strike, and pollutants (Muto *et al*., 2017).

***Status of sperm whales*.** Sperm whales are listed as endangered under the ESA, but there is no designated critical habitat for this species. Sperm whales in Alaska are from the North Pacific stock. Sperm Whales in the Action Area are from the California, Oregon, Washington stock (Carretta *et al*., 2017; Carretta *et al*., 2018).

Spatial structure and diversity. Sperm whales are typically found in temperate and tropical waters of the Pacific (Rice, 1989) but they are also found in areas of higher latitudes in the northern Pacific including Alaska (Whitehead, 2009; Whitehead *et al*., 2008). Sperm whales have a preference for deep water areas of high productivity, generally near drop offs and areas with strong currents and steep topography (Gannier and Praca, 2007). The semi-permanent the Strait of Juan de Fuca eddy is one such area (MacFadyen *et al*., 2008). Sperm whales are somewhat migratory. No sperm whales were detected during systematic surveys of waters between the British Columbia border with Alaska and Washington (Williams *et al*., 2007). Sperm whales were observed twice in deep water off the coast from Grays Harbor in aerial surveys of waters off Washington, Oregon, and Northern California in the spring, summer, and fall of 2011 and 2012 (Adams *et al*., 2014). Figure 8 shows the distribution of sperm whales off the Eastern Pacific Coast from 1991 – 2018. There were a total of five sperm whale sightings during the NMFS 2014 summer shipboard survey off the coast of Washington (Barlow, 2016).

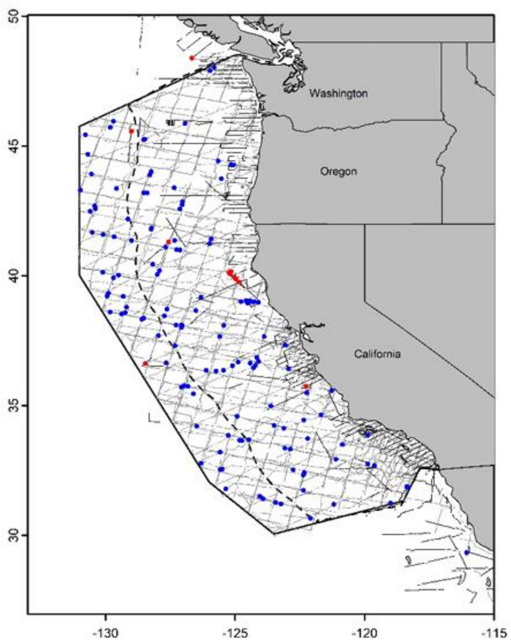

Figure 8. Sperm whale sightings based on shipboard surveys off California, Oregon, and Washington, 1991-2018 (NMFS 2024d).

Abundance and productivity. Estimates of sperm whale total global abundance range from 300,000 and 450,000 individuals (Whitehead, 2009). The California/Oregon/Washington stock abundance is 2,106 individuals (N_{min}=1,332), and the Hawaii stock abundance is 3,354 individuals (N_{min}=2,539) (Carretta *et al*., 2019).

Limiting factors. In waters off the U.S. Pacific West Coast between 2011 and 2015, there was one reported ship strike involving a sperm whale in 2012 (Carretta *et al.,* 2017). From 2010 to 2014, a total of five sperm whales were entangled in fishing gear off the U.S. Pacific West Coast (Carretta *et al*., 2016). Between 1982 – 2017, fourteen sperm whales were reported as entangled to the NMFS West Coast Region. The reports originated from southern California, primarily between September and December in gill or drift net fisheries (Saez et al., 2021).

Status of Leatherback Turtles.

Sea turtles are difficult to study across all life stages due to their extensive distribution, certain cryptic life stages, complex life history, and remote habitats. As a result, status and trends of sea turtle populations are usually based on data collected on nesting beaches (e.g., number of adult females, number of nests, nest success, etc.). The spatial structure of male sea turtles and their fidelity to specific coastal areas is unknown; however, we describe the status of sea turtle populations based on the nesting beaches that females return to when they mature. We make inferences about the growth or decline of leatherback populations based on numbers of nests and trends in numbers of nests.

West Pacific Leatherback Population: Distribution and Population Structure

We define the West Pacific population as leatherback turtles originating from the West Pacific Ocean, with the following boundaries: south of 71° N, north of 47° S latitudes and east of 120° E, and west of 117.124° W longitudes (NMFS and USFWS, 2020) . Indonesia, Papua New Guinea and Solomon Islands have been identified as the core nesting areas for this population Figure 9 (Benson *et al*., 2007a; Benson *et al*., 2011; Benson *et al*., 2007b; Benson *et al*., 2018).

Low levels of nesting are also reported in Vanuatu and the Philippines (NMFS and USFWS, 2020) . Recently, a new leatherback turtle nesting area was identified at Buru Island, Maluku province of Indonesia where approximately 200 nests are laid annually (NMFS and USFWS, 2020; WWF, 2019) . However, long-term monitoring data for this population is geographically limited to the Bird's Head Peninsula in West Papua at Jamursba Medi and Wermon nesting beaches which represent an estimated 50 to 75 percent of all nesting in the West Pacific (NMFS and USFWS, 2020).

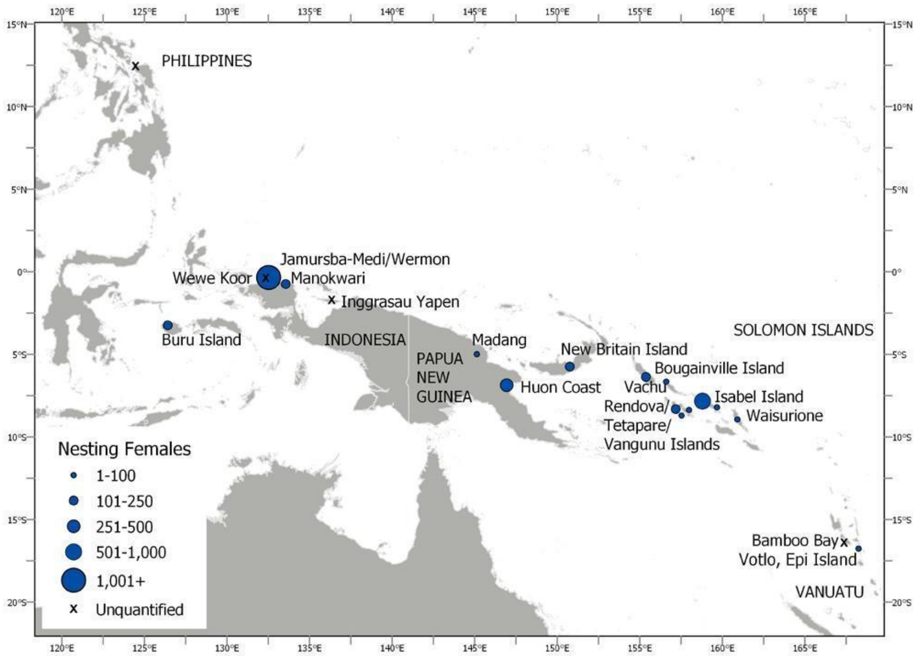

Figure 9. Nesting sites of the West Pacific leatherback population (NMFS and USFWS 2020).

The West Pacific population exhibits metapopulation dynamics and genetic population structure (NMFS and USFWS, 2020). While mtDNA analyses of 106 samples from Indonesia, Papua New Guinea, and Solomon Islands did not detect genetic differentiation among nesting aggregations (Dutton *et al*., 2007), microsatellite DNA analyses indicate fine-scale genetic structure (Dutton *et al*., 2007) (NMFS SWFSC, unpublished data). While we often consider these different nesting aggregations separately, together they comprise the Western Pacific population (NMFS and USFWS, 2020).

Two life history strategies are documented in the West Pacific leatherback population: winter boreal nesters and summer boreal nesters. The most consistent monitoring effort has been at Jamursba-Medi beach, and its nesting females are primarily summer nesters. Wermon beach has a stronger bimodal pattern of nesting, with summer and winter nesters in roughly equal proportions. There is historical evidence to suggest a similar bimodal nesting strategy in other nesting aggregations, but data is lacking to quantify the current extent of summer nesting activity in the Solomon Islands and Papua New Guinea where the majority of nesting activity occurs during winter months (NMFS and USFWS, 2020).

Migration and foraging strategies vary based on these life history strategies, likely due to prevailing offshore currents and, for hatchlings, seasonal monsoon-related effects experienced as hatchlings (Benson *et al*., 2011; Gaspar *et al*., 2012). Summer nesting females forage in Northern Hemisphere foraging habitats in Asia and the North Pacific Ocean, while winter nesting females migrate to tropical waters of the Southern Hemisphere in the South Pacific Ocean (Benson *et al*., 2011; Harrison *et al*., 2018) (Figure 10). The lack of crossover among seasonal nesting populations suggests that leatherback turtles develop fidelity for specific foraging regions likely based on juvenile dispersal patterns (Benson *et al*., 2011; Gaspar *et al*., 2012; Gaspar and Lalire, 2017). Stable isotopes, linked to particular foraging regions, confirm nesting season fidelity to specific foraging regions (Seminoff *et al*., 2012).

West Pacific Leatherback Population: Abundance, Status, and Trends

Our ability to estimate leatherback population abundance is complicated by the life history of the species. Data collected at nesting beaches are often the best available data but do not provide information on life stages away from the nesting beaches (i.e., immature and mature males and immature females). Additionally, standardized nesting surveys are difficult to maintain over many, consecutive years and at all nesting beaches. Here we provide data that have been consistently collected using a standardized monitoring approach over the most recent available remigration interval, providing reasonable certainty that such data are representative of recent nesting at the identified beach. Although some data may have been collected at other nesting beaches, monitoring has not been recent, consistent, or standardized, thus limiting our certainty of these data; therefore data from those nesting beaches cannot be used to calculate abundance.

Using the best available data for the West Pacific leatherback population (Fitry Pakiding, University of Papua, pers. comm. 2020) and a Bayesian steady-state model (Martin *et al*., 2020) provided a median estimate of the total number of nesting females (i.e., over one, 3-year, remigration interval) at Jamursba Medi and Wermon beaches of 790 females, with a 95 percent credible interval of 666 to 942 females, as a snapshot of current abundance in 2017. We consider this the best available estimate of total adult female abundance at these two nesting beaches in 2017 (based on data from 2014 through 2017). To estimate the total number of nesting females from all nesting beaches in the West Pacific, we need to consider nesting at unmonitored or irregularly monitored beaches. As noted above, an estimated 50 to 75 percent of West Pacific leatherback nesting occurs at Jamursba-Medi and Wermon beaches (Dutton *et al*., 2007; NMFS and USFWS, 2020). Applying the conservative estimate of 75 percent to the Martin *et al*. (2020) estimate of 790 nesting females at Jamursba Medi and Wermon beaches, the total number of nesting females in the West Pacific population would be 1,054 females with an overall 95 percent credible interval of 888 to 1,256 females. It should be noted that this estimate (*i.e*., 1,054) of nesting females for the West Pacific population based on more recent available information is an update of the NMFS and USFWS (2020) estimate (*i.e.*, 1,277), which was based on a simple calculation that did not provide confidence or credible intervals.

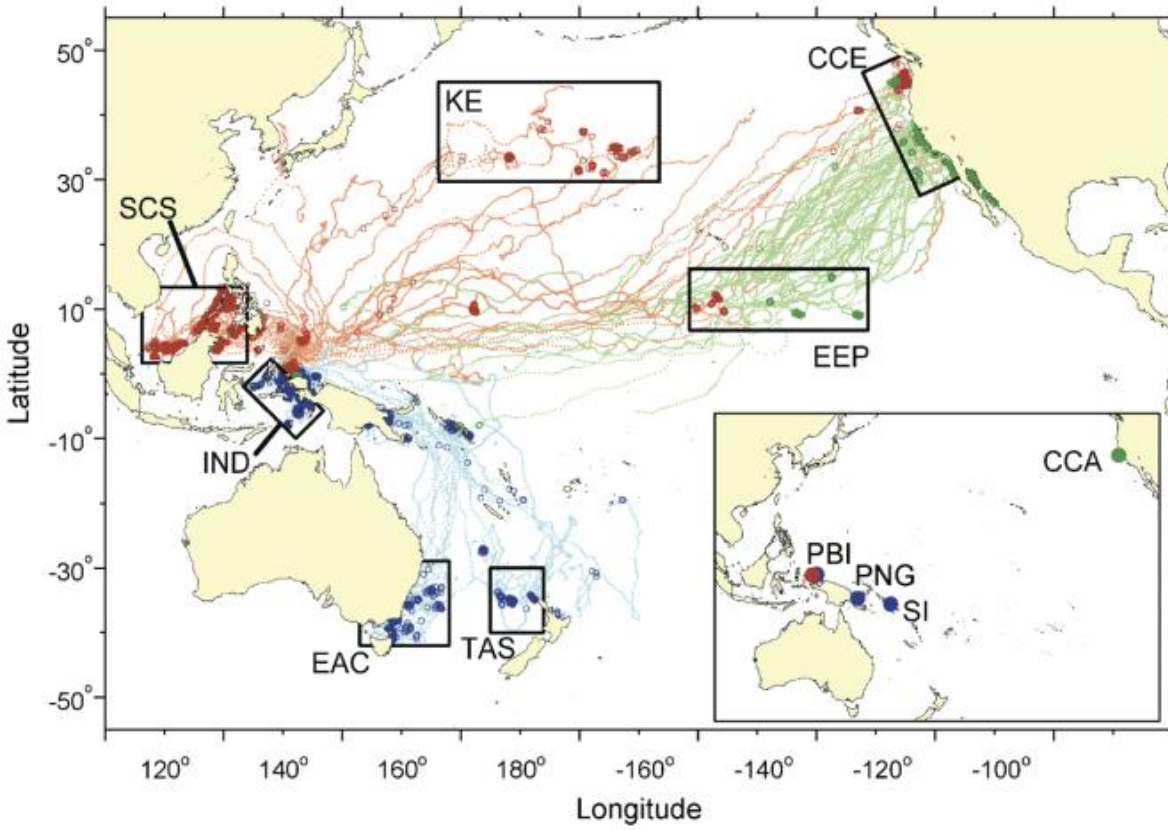

Figure 10. Satellite tracks from 126 West Pacific leatherbacks. Color of track indicates deployment season: red = summer nesters, blue = winter nesters, green = deployments at central California foraging grounds. Inset shows deployment locations; PBI = Papua Barat, Indonesia, PNG = Papua New Guinea, SI = Solomon Islands, CCA = central California. Black boxes represent ecoregions for which habitat associations were quantitatively examined: SCS = South China, Sulu and Sulawesi Seas, IND = Indonesian Seas, EAC = East Australia Current Extension, TAS = Tasman Front, KE = Kuroshio Extension, EEP = equatorial eastern Pacific, and CCE = California Current Ecosystem (Benson *et al*. 2011).

Based on the estimates presented in Jones *et al*. (2012) for all Pacific populations, NMFS inferred an estimated West Pacific leatherback total population size (i.e., juveniles and adults) of 250,000 (95 percent confidence interval 97,000 to 535,000) in 2004. Based on the relative change in the estimates derived from Jones *et al*. (2012) and the more recent Martin *et al*., (2020), NMFS estimates the current juvenile and adult population size of the West Pacific leatherback population is around 100,000 sea turtles (95 percent confidence interval 47,000 to 195,000 individuals).

The Western Pacific population exhibits low hatching success and decreasing nesting population trends due to past and current threats, which are likely to further lower abundance and increase the risk of extinction (NMFS and USFWS 2020). The low estimated nesting female abundance of the West Pacific population places it at elevated risk for environmental variation, genetic complications, demographic stochasticity, negative ecological feedback, and catastrophes (NMFS and USFWS 2020). These processes, working alone or in concert, place small populations at a greater extinction risk than large populations, which are better able to absorb impacts to habitat or losses in individuals (NMFS and USFWS 2020). Low site fidelity, which is characteristic of the species, results in the dispersal of nests among various beaches (NMFS and USFWS 2020). This may help to reduce population level impacts from threats which may disproportionately affect one area over another, but may also place nests in locations that are likely unmonitored and not protected from human poaching or predation, thereby increasing threats to the population. Due to its small size, this population has restricted capacity to buffer such losses (NMFS and USFWS 2020).

The median trend in annual nest counts estimated for Jamursba Medi nesting beaches from data collected from 2001-2017 was -5.7 percent annually (NMFS and USFWS 2020). The median trend in annual nest counts estimated for Wermon nesting beaches from data collected from 2006 to 2017 (excluding 2013–2015 due to low or insufficient effort) was -2.3 percent annually (NMFS and USFWS 2020). In the absence of population trend data on other leatherback life history stages, we consider these trends in annual nest counts an index of the population's growth rate.

Martin *et al*. (2020) estimated the mean and median time until the West Pacific population declines to 50 percent, 25 percent, and 12.5 percent of its current estimated abundance. Results of this modeling effort indicate that the adult female portion of West Pacific leatherbacks nesting at Jamursba-Medi and Wermon beaches are predicted to decline to 50 percent of their current abundance in a mean of about 13 years (95 percent CI from 5 to 26 years) and to 25 percent of their current abundance in a mean of about 24 years (95 percent CI from 13 to 42 years).

Pacific Population Abundance Relative to the Global Leatherback Population

The greatest genetic divergence within leatherback sea turtles is evident between Atlantic and Indo-Pacific populations (NMFS and USFWS 2020). At least two populations occur within the Pacific Ocean, the West Pacific and the East Pacific, and it has long been considered likely that individuals from the Northeast Indian Ocean population may also occur in the Pacific Ocean. The West Pacific, East Pacific, and Northeast Indian Ocean leatherback populations have all experienced severe and continuing declines. While the West Pacific population is arguably the most robust of the three Pacific populations, our best estimate for the total index of nesting female abundance is only 1,054 females, and at its current rate of decline is predicted to reach half of its current abundance in only 13 years (Martin *et al*., 2020). The Northeast Indian Ocean has exhibited a drastic population decline with the extirpation of its largest nesting aggregation in Terengganu, Malaysia (Tiwari and Wallace, 2013). NMFS and FWS (2020) calculated an index of nesting female abundance, defined as the estimated number of nesting females over one (3-year) remigration interval, for each of the Pacific populations. Based on this index, the Northeast Indian Ocean is the smallest of the three populations, with an estimated total index of nesting female abundance of 109 females. The minimum estimated total index of nesting female abundance for the East Pacific population is 755 females. Pacific leatherback recovery is defined, in part, when each population (stock) averages 5,000 females nesting annually over 6 years, and all nesting populations are either stable or increasing over a 25-year monitoring period

(NMFS and USFWS, 1998). The Pacific populations are not on a trajectory to meet these, or other relevant recovery criteria.

The conservation biology principles of resiliency, redundancy, and representation (collectively known as the "3Rs") can be used as a lens for evaluating the current and future status of a species based on an assessment of its reproductive potential, numbers, and distribution. Resiliency describes the ability of the species to withstand stochastic disturbance events, which is associated with population size, growth rate, and habitat quality. Redundancy describes the ability of a species to withstand catastrophic events, which is related to the number, distribution, and resilience of populations. Representation describes the ability of a species to adapt to changing environmental conditions, which is related to distribution within the species' ecological settings. The spatial distribution of a species' populations determines, among other things, whether the same natural and anthropogenic stressors affect all of a species' populations, or whether some populations occur in protected areas or are at least protected from stressors that affect other populations. Changes in the spatial distribution of the populations (or subpopulations) that comprise a globally-listed entity are also important indicators of the species' status and health, as they provide insight into how the species is responding to long-term changes in its environment (for example, to climate change).

Based on the best available information presented above, the Pacific leatherback population is characterized by low resiliency and redundancy. With low abundance estimates in all countries where the species nests in both the Western Pacific and Eastern Pacific, leatherback sea turtles are at an extremely high risk of being extirpated from the Pacific Ocean. While leatherback abundance estimates are higher for other portions of its global range (e.g., Northwest Atlantic), all seven leatherback populations are currently at a high risk of extinction (NMFS and USFWS 2020).

2.2.2 Status of the Critical Habitat

This section describes the status of designated critical habitat affected by the proposed action by examining the condition and trends of the essential physical and biological features of that habitat throughout the designated areas. These features are essential to the conservation of the ESA-listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

For most salmon and steelhead, NMFS's critical habitat analytical review teams (CHARTs) ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each ESA-listed species that they support (NMFS 2005). The conservation rankings were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. Even if a location had poor habitat quality, it could be ranked with a high conservation value if it were essential due to factors such as limited availability, a unique contribution of the population it served, or is serving another important role.

For southern DPS green sturgeon, a team similar to the CHARTs — a critical habitat review team (CHRT) — identified and analyzed the conservation value of particular areas occupied by southern green sturgeon, and unoccupied areas necessary to ensure the conservation of the species. The CHRT did not identify those particular areas using HUC nomenclature, but did provide geographic place names for those areas, including the names of freshwater rivers, the bypasses, the Sacramento-San Joaquin Delta, coastal bays and estuaries, and coastal marine areas (within 110 m depth) extending from the California/Mexico border north to Monterey Bay, California, and from the Alaska/Canada border northwest to the Bering Strait; and certain coastal bays and estuaries in California, Oregon, and Washington.

For southern DPS eulachon, critical habitat includes portions of 16 rivers and streams in California, Oregon, and Washington (USDC 2011). We designated all of these areas as migration and spawning habitat for this species.

A summary of the status of critical habitats, considered in this opinion, is provided in Table 3, below.

Table 3. Critical habitat, designation date, federal register citation, and status summary for critical habitat considered in this opinion.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Lower Columbia River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 47 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30 watersheds, medium for 13 watersheds, and low for four watersheds.
Upper Columbia River spring-run Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses four subbasins in Washington containing 15 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. We rated conservation value of HUC5 watersheds as high for 10 watersheds, and medium for five watersheds. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Snake River spring/summer-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers (except the Clearwater River) presently or historically accessible to this ESU (except reaches above impassable natural falls and Hells Canyon Dam). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar *et al*. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Willamette River Chinook salmon	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon containing 56 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some, or high, potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 22 watersheds, medium for 16 watersheds, and low for 18 watersheds.
Snake River fall-run Chinook salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers, and all tributaries of the Snake and Salmon rivers presently or historically accessible to this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar *et al*. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Columbia River chum salmon	9/02/05 70 FR 52630	Critical habitat encompasses six subbasins in Oregon and Washington containing 19 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 16 watersheds, and medium for three watersheds.
Lower Columbia River coho salmon	2/24/16 81 FR 9252	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the lower Columbia River and estuary rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 34 watersheds, medium for 18 watersheds, and low for three watersheds.
Snake River sockeye salmon	10/25/99 64 FR 57399	Critical habitat consists of river reaches of the Columbia, Snake, and Salmon rivers; Alturas Lake Creek; Valley Creek; and Stanley, Redfish, Yellow Belly, Pettit and Alturas lakes (including their inlet and outlet creeks). Water quality in all five lakes generally is adequate for juvenile sockeye salmon, although zooplankton numbers vary considerably. Some reaches of the Salmon River and tributaries exhibit temporary elevated water temperatures and sediment loads that could restrict sockeye salmon production and survival (NMFS 2015b). Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Upper Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 10 subbasins in Washington containing 31 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 20 watersheds, medium for eight watersheds, and low for three watersheds.
Lower Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses nine subbasins in Oregon and Washington containing 41 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of HUC5 watersheds as high for 28 watersheds, medium for 11 watersheds, and low for two watersheds.
Upper Willamette River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses seven subbasins in Oregon containing 34 occupied watersheds, as well as the lower Willamette/Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. Watersheds are in good to excellent condition with no potential for improvement only in the upper McKenzie River and its tributaries (NMFS 2005). We rated conservation value of HUC5 watersheds as high for 25 watersheds, medium for 6 watersheds, and low for 3 watersheds.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Middle Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 15 subbasins in Oregon and Washington containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most HUC5 watersheds with PCEs for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. We rated conservation value of occupied HUC5 watersheds as high for 80 watersheds, medium for 24 watersheds, and low for 9 watersheds.
Snake River basin steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 25 subbasins in Oregon, Washington, and Idaho. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar *et al*. 1994). Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems. Migratory habitat quality in this area has been severely affected by the development and operation of the dams and reservoirs of the Federal Columbia River Power System.
Southern DPS of green sturgeon	10/09/09 74 FR 52300	Critical habitat has been designated in coastal U.S. marine waters within 60 fathoms depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its United States boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; tidally influenced areas of the Columbia River estuary from the mouth upstream to river mile 46; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor), including, but not limited to, areas upstream to the head of tide in various streams that drain into the bays. Several activities threaten the PBFs in coastal bays and estuaries and need special management considerations or protection. The application of pesticides, activities that disturb bottom substrates/ adversely affect prey resources/ degrade water quality through re-suspension of contaminated sediments, commercial shipping and activities that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom/prey resources for green sturgeon.
Southern DPS of eulachon	10/20/11 76 FR 65324	Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington. All of these areas are designated as migration and spawning habitat for this species. In Oregon, we designated 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek. We also designated the mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles. Dams and water diversions are moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath river basins, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods. Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown. Dredging is a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Southern resident killer whale	08/02/21 86 FR 41668	Critical habitat includes approximately 2,560 square miles of marine inland waters of Washington: 1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; 2) Puget Sound; and 3) the Strait of Juan de Fuca. Six additional areas include 15,910 square miles of marine waters between the 20-feet (ft) (6.1-meter (m)) depth contour and the 656.2-ft (200-m) depth contour from the U.S. international border with Canada south to Point Sur, California. We have excluded the Quinault Range Site. Based on the natural history of the Southern Residents and their habitat needs, NMFS identified three PCEs, or physical or biological features, essential for the conservation of Southern Residents: 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 Water quality in Puget Sound, in general, is degraded. Some pollutants in Puget Sound persist and build up in marine organisms including Southern Residents and their prey resources, despite bans in the 1970s of some harmful substances and cleanup efforts. The primary concern for direct effects on whales from water quality is oil spills, although oil spills can also have long-lasting impacts on other habitat features In regards to passage, human activities can interfere with movements of the whales and impact their passage. In particular, vessels may present obstacles to whales' passage, causing the whales to swim further and change direction more often, which can increase energy expenditure for whales and impacts foraging behavior. Reduced prey abundance, particularly Chinook salmon, is also a concern for critical habitat.
Central America DPS Humpback Whales	4/21/2021 86 FR21082	Specific areas designated as occupied critical habitat for the Central America DPS of humpback whales contain approximately 48,521 nmi^2 of marine habitat in the North Pacific Ocean within the portions of the California Current Ecosystem off the coasts of Washington, Oregon, and California. The nearshore boundary is defined by the 50-m isobath, and the offshore boundary is defined by the 1,200-m isobath relative to MLLW. The Columbia River Area was rated with medium/low conservation value. The PBF for this species is prey species of sufficient quality, abundance, and accessibility to support feeding and population growth.
Mexico DPS Humpback Whales	4/21/2021 86 FR21082	Specific areas designated as critical habitat for the Mexico DPS of humpback whales contain approximately 116,098 nmi^2 of marine habitat in the North Pacific Ocean, including areas within portions of the eastern Bering Sea, Gulf of Alaska, and California Current Ecosystem. The PBF for this species is The PBF for this species is prey species of sufficient quality, abundance, and accessibility to support feeding and population growth.

Status of Designated Critical Habitat for Leatherback Sea Turtles

On January 26, 2012, NMFS issued a final rule to revise the critical habitat for the leatherback sea turtle by designating areas within the Pacific Ocean (77 FR 4169; effective February 27, 2012). Previous critical habitat for this species was limited to the island of St. Croix, U.S. Virgin Island for the Northwest Atlantic leatherback population. The critical habitat designation for Pacific leatherbacks includes approximately 16,910 mi^2 (43,798 km^2) stretching along the California coast from Point Arena to Point Arguello east of the 3,000 meters depth contour; and 25,004 mi^2 (64,760 km^2) stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meters depth contour (Figure 11).

The leatherback sea turtle Critical Habitat Review Team identified one essential physical and biological feature (PBF) that is essential for the conservation of leatherbacks in marine waters of the U.S. West Coast: The occurrence of prey species, primarily *scyphomedusae* of the order *Semaeostomeae* (e.g., *Chrysaora, Aurelia*, *Phacellophora*, *and Cyanea*), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

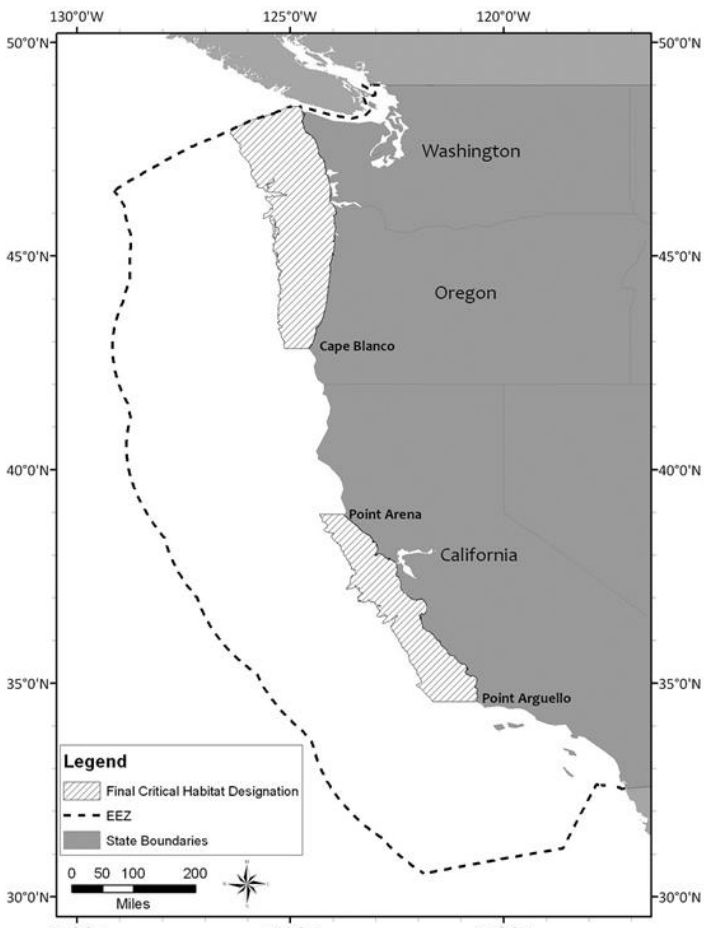

Figure 11. Leatherback sea turtle designated critical habitat along the Pacific Coast.

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

For this consultation, the action area encompasses the facility, including the activities associated with construction and operation of the proposed facility and management of the associated stormwater, and the restoration site of approximately 466 acres located 0.25 miles south of the facility parcel.

The action area also includes the Columbia River starting at the Port Westward Industrial Park outfall in the Bradbury Slough side channel and the Clatskanine River starting at the McLean Slough confluence. It extends downstream, through the mouth of the Columbia River and into the Pacific Ocean, where it expands into a fan shape as defined by OGV travel routes, until it reaches the continental shelf approximately 40 nautical miles offshore. The northern border of this fan is N 46° 57´, W 125° 18´ and the southern border is N 45° 01´, W 125° 18´ (approximately 117 nautical miles) (Figure 12). Within this fan area, encounters, including vessel collisions and impact from ship noise, are reasonably certain to occur between OGVs and marine mammals and leatherback sea turtles. Although the OGVs that travel through this area are likely to continue along the West Coast of the United States and Canada, their exact destinations and routes are not known at this time and the density of marine mammals and leatherback sea turtles is substantially lower beyond the continental shelf. Beyond this area in the Pacific Ocean, the risk of a ship strike with a marine mammal or sea turtle becomes unlikely. Therefore, this action area delimits the geographic location where the proposed action is likely to result in effects on listed species and critical habitat.

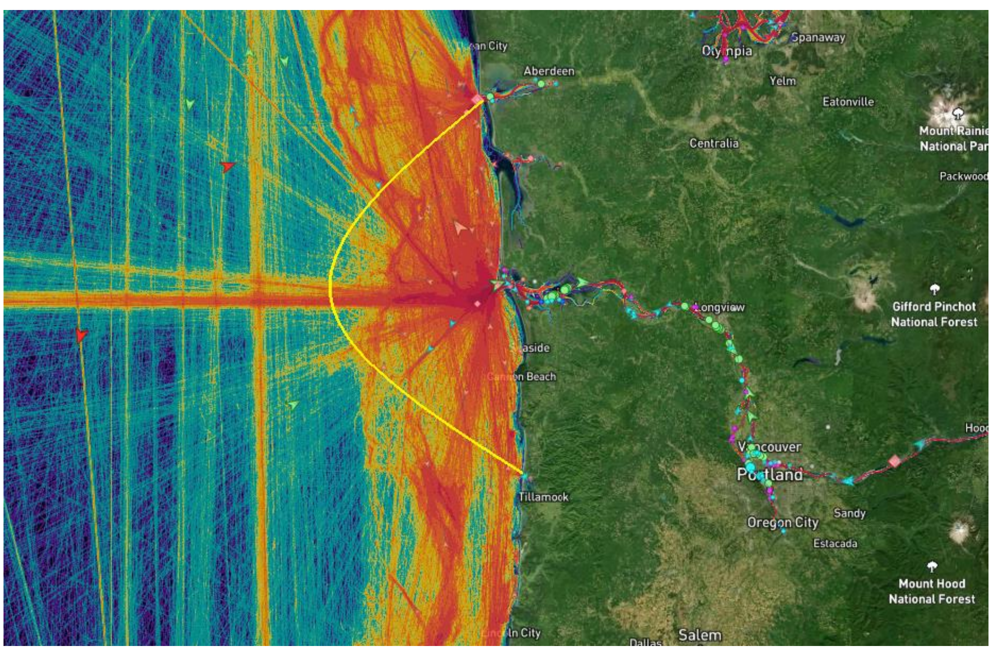

Figure 12. Approximate Pacific Ocean portion of the action area for OGV traffic from NEXT (Data/Image from www.marinetraffic.com, Feb. 27, 2025).

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or their designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The Columbia River is the largest river system in the Pacific Northwest, originating in the Canadian Rockies at Columbia Lake and flowing 1,253 miles downstream to its confluence with the Pacific Ocean. In all, the Columbia River drains an area of 258,000 square miles. Discharges range between 80,000 cubic feet per second (cfs) and 400,000 cfs seasonally, with higher flow pulses occurring in the spring and lower flow periods between July and October (USGS 2024). The flow regime of the mainstem Columbia River has been significantly altered by dams and flow control structures that divert water for hydropower, flood control, irrigation, and transportation. 40 percent of all U.S. hydropower is derived from the Columbia and Snake Rivers, and the Columbia River is used to irrigate more than 6 million acres of agricultural land (LCREP 2023).

On the mainstem of the Columbia River, hydropower projects including the Federal Columbia River Hydropower System (FCRPS) have significantly degraded salmon and steelhead habitats (Bottom *et al*. 2005; Fresh *et al*. 2005; NMFS 2011; NMFS 2013; NMFS 2020c). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts. Hydroelectric development modified natural flow regimes, resulting in higher water temperatures, changes in fish community structure leading to increased rates of piscivorous and avian predation on juvenile salmon and steelhead, and delayed migration for both adult and juvenile salmonids. Physical features of dams such as turbines also kill migrating fish. In-river survival is inversely related to the number of hydropower projects encountered by emigrating juvenile fish.

The Columbia River Estuary extends from the mouth of the river to its furthest extent of tidal influence at the Bonneville Dam (RM 146). The estuary includes three physiographic subsystems based on salinity: the euryhaline region, which is subject to large fluctuations in salinity, extending from the mouth of the river to RM 18, the brackish mixing zone between RM 18 and RM 34, and the tidal freshwater zone between RM 34 and RM 146 (Weitkamp *et al*. 2014; Bottom *et al*. 2005). The flow regimes, physical composition, and sediment input of each of these zones have been significantly altered by upriver activities over the last 150 years, resulting in degraded conditions for fish (Bottom *et al*. 2005). These impacts have been particularly harmful for juvenile emigrating salmon. While historical Columbia River salmon returns averaged between 11 and 16 million annually (with a much larger number of juveniles emigrating), these rates have declined to less than 12% of predevelopment levels (Bottom *et al*. 2005).

The Federal Navigation Channel and adjacent Port berths have been subject to over a century of channel deepening activities to facilitate vessel traffic. In this time, the depth of the river has doubled, altering the hydrologic regime within the reach and reducing the complexity of the river system (Helaire *et al*. 2019). Industrial harbor and port development are also significant influences on the Lower Willamette and Lower Columbia rivers (Bottom *et al*. 2005; Fresh *et al*. 2005; NMFS 2011; NMFS 2013).

The most extensive urban development in the LCR subbasin has occurred in the Portland/Vancouver area. Along the western bank of the Columbia River, the City of Portland has constructed 45 miles of levees, cutting off the river from its floodplain and channelizing flow. These activities, along with the upstream dam operations, have reduced productivity and foraging habitat for salmonids as well as the distribution of sediment and nutrients from floodplain habitat. Habitat complexity is a key factor related to the success of species after floods (Pearsons *et al*. 1992). The extensive levee system in the LCR inhibits habitat forming processes, thereby reducing the availability of rearing habitat and forage opportunities for salmonids.

Virtually the entire LCR channel and riparian zone has been degraded by the effects of forest management, agriculture, mining, transportation, and urbanization, as well as the use of LCR water for hydropower, consumption, irrigation, heat transfer, transportation and recreation. These economic activities contribute to; degraded water quality, changes in channel morphology, reduced instream roughness and cover, degraded riparian functions, and lost estuarine rearing habitats such as wetlands, and floodplains. Climate change is likely to play an increasingly important role in determining the fate of ESA-listed species and the conservation value of their designated critical habitats in the LCR as described in Section 2.2.

Birds, other fish and marine mammals prey on juvenile or adult salmon in the Columbia River. Caspian terns, double-crested cormorants, glaucous-winged/western gull hybrids, California gulls, and ring-billed gulls are the main avian predators. Avian predators congregate near hydroelectric dams and nest in the LCR on islands made from dredged sediment and other man-made structures. They benefit from dams and reservoirs because low flow velocity increases smolt migration time and suspended sediment deposition in reservoirs reduces turbidity below the dam. Smolt bypass systems in dams concentrate fish at the bypass entry points making them easier for avian predators to catch. The Columbia River Basin also has native and introduced fish species that prey on salmon and steelhead. The primary piscine predators of salmonids are northern pikeminnow (native), smallmouth bass (introduced), and walleye (introduced). Other predatory resident fish are channel catfish (introduced), yellow perch (introduced), largemouth bass (introduced), and bull trout (native). Seals and sea lions have learned to hunt returning adult salmon and steelhead in the LCR, especially in the constricted passages past Bonneville Dam and Willamette Falls.

The environmental baseline includes the anticipated impacts of all Federal actions in the action area that have already undergone formal consultation. The USACE, Bonneville Power Administration (BPA), and Bureau of Reclamation have consulted on large water management actions, such as operation of the Federal Columbia River Power System, the Umatilla Basin Project, and the Deschutes Project. The U.S. Bureau of Indian Affairs (BIA), U.S. Bureau of Land Management, and the U.S. Forest Service (USFS) have consulted on Federal land management throughout Oregon and Washington, including restoration actions, forest management, livestock grazing, and special use permits. The BPA, NOAA Restoration Center, and USFWS have also consulted on large restoration programs that consist of actions designed to address species limiting factors or make contributions that would aid in species recovery.

The project area is on Columbia River floodplain that has been converted to uplands by system of levees (Figure 13). About 10,000 linear feet of waterways operated and maintained by the Beaver Drainage Improvement Company drain floodwater and supply irrigation water to farms. These waterways drain south through McLean Slough and Beaver Slough for approximately six miles to a pump station near the Clatskanie River that discharges water back over the levee. Pump-station floats have a summertime setting of 8.5 feet below sea level, and wintertime setting of 6.5 feet below sea level. Any water surface above these elevations triggers the three pumps to turn on at the pump station.

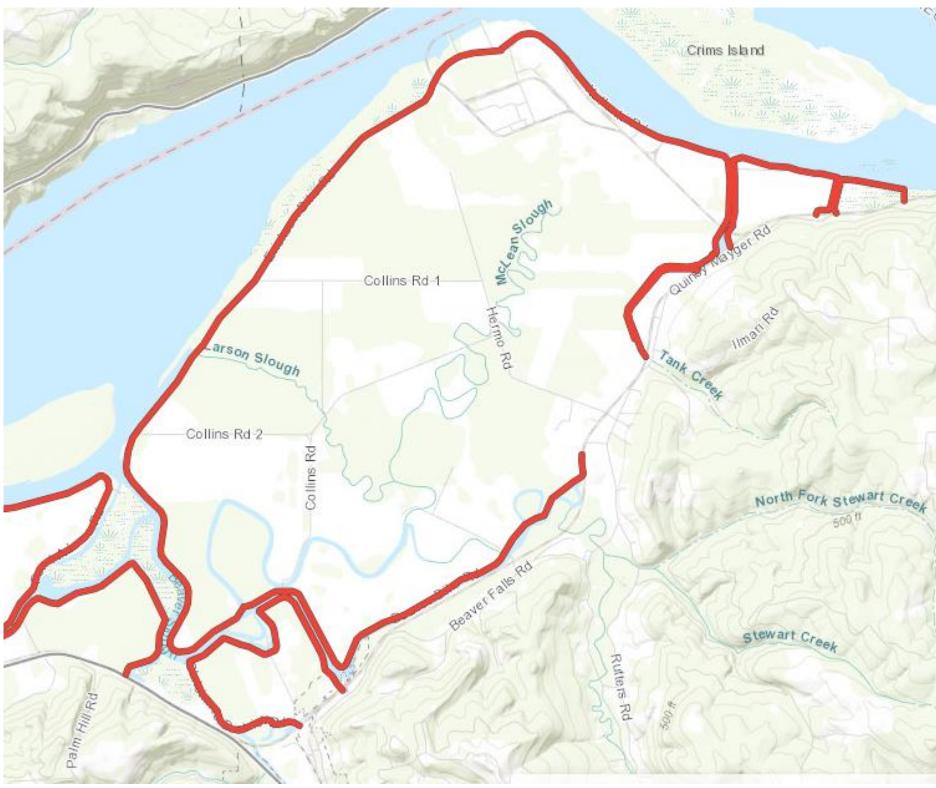

Figure 13. Levees around the Port Westward Industrial Park.

Baseline effects in the action area

Water withdrawal

Port Westward has an Oregon Water Resources Department (OWRD) water right for 30 cubic feet per second (13,465 gpm) at their Columbia River intake. The intake is a Cook Legacy Intake System that has a 21-Inch tee screen with an AirBurst system. The system works together to allow withdrawal of up to 4,000 gpm per screen at a mean approach velocity of 0.27 feet per second. In 2012, NMFS issued a biological opinion concluding the construction of this water withdrawal and its future operation were not likely to jeopardize the continued existence of any listed species nor adversely modify their critical habitat. The NEXT proposal will not withdraw additional water than that analyzed in the 2012 opinion. As such, the impacts from the withdrawal are part of the environmental baseline for this consultation (NMFS Reference Number NWR 2012-00566).

Contaminants and Temperature

Port Westward has an NPDES permitted (permit number 111746) outfall in the Columbia River that sets discharge limits on pH, excess heat and the concentrations of residual chlorine, free available chlorine, total chromium, total zinc, total suspended solids and oil and grease. The length of the permitted mixing zone is 30 meters. The permit requires that effluent discharged at 27 °C (80.6°F) be cooled to 20 °C (68°F) at the edge of the mixing zone. We've followed the analysis for buoyant jets in Fischer (1979) using temperature as a tracer to estimate that the outfall mixing zone dilution factor is greater than 30 (see Appendix 1).

There are no existing stormwater treatment facilities along Port Westward Industrial Park roadways or railroads but the waterways throughout Port property are slow-flowing and provide some infiltration and runoff treatment from contaminants partitioning to bottom sediments and bank soils. Background stormwater and wastewater contaminant concentrations at Port Westward are in Morace (2006). Columbia River water quality conditions (turbidity, pH, and dissolved oxygen) at the Port Westward are generally within the range needed to support aquatic life but two areas on the Columbia River, upstream from the project site (one at RM 71.9 and one at RM 74) are listed for temperature exceedances. Data published by the U.S. Geological Survey in 2012 indicate that summer water temperatures downstream of Bonneville Dam routinely exceed 70°F.

OGV wake waves and other effects

The action area captures all OGV traffic heading for or leaving the Port Westward facility. From 2013 through 2022 there was an average of 1,376 vessel calls per year at all Columbia River ports. Between 2015 and 2021, Port Westward received a total of 94 ocean going tankers and 17 articulated tug barges, an average of 15.6 ships per year. The main destination of export vessels are California and Washington. The largest percentage of the vessel types that travel in the Columbia River are bulk carriers carrying grain, automobiles, petroleum and soda ash. Barges are the second most common vessel using the Columbia River. Smaller vessels that supply feedstocks are 250 to 450 feet long, 75 to 85 feet wide, and have a draft of 28 to 40 feet when fully loaded and a draft of 15 to 20 feet when empty. The average speed of smaller vessels is 14.4 knots in the ocean and 10.7 knots on the Columbia River. The States of Washington and Oregon require ballast water to be exchanged at sea or treated to eliminate living organisms prior to discharge. In addition, NMFS developed a biological opinion addressing the USCG's national ballast water management program and initial numerical standard. NMFS found that the discharge of ballast water using the initial numerical standard in not likely to jeopardize the continued existence of endangered or threatened species in the Columbia River (NMFS 2012).

Long period wake waves from OGVs strand juvenile salmon on low slope beaches of the Columbia River (Bauersfeld 1977, Hinton and Emmett 1994, Ackerman 2002, Pearson *et al.*, 2006). Wake wave stranding occurs every year, mostly during spring months when juvenile salmonids are at their highest density in the LCR. The Wapato Conservation Bank monitored wake wave stranding at the mouth of the Lewis River (Columbia River mile 87) and documented wake stranding of ESA-listed salmonids from both OGVs and smaller watercraft. Pearson *et al*. (2006) found that wake wave stranding is a function of: beach slope, shielding, and distance from the shipping lane; tide stage and amplitude; river flow and velocity; vessel type, size, direction, speed, and load; and fish density. They observed that ships moving slower than 8 nautical miles per hour did not cause wake stranding. Juveniles of every population of every ESA-listed Snake River, Willamette River and Columbia River salmon and steelhead ESU/DPS will be exposed to wake/wave stranding from OGVs in the Lower Columbia River moving to and from Port Westward. Ocean-type life history Chinook, and chum salmon, subyearlings that migrate in shallow water along the shoreline, are most vulnerable to being stranded by OGV wake waves. Pearson *et al*. (2006) also monitored fish wake stranding from 126 deep-draft OGVs at three Lower Columbia River 'sentinel' beaches, Sauvie Island, Barlow Point and County Line Park, in the summer of 2004 and the winter and spring of 2005. Wake wave stranding occurred at all three sites over all three seasons, ranging from a low of 15 percent of OGVs at Sauvie Island to a high of 53 percent of OGVs at Barlow Point. Fifteen percent of OGVs passing County Line Park in the winter, spring or summer stranded an average of 7.3 fish per pass. Pearson and Skalski (2011) conducted a GIS search for beaches that might be susceptible to wake wave stranding based on channel confinement, beach distance from the navigation channel, beach shielding features, beach slope, submerged berms in the navigational channel, and fine scale beach features. They determined that stranding is likely or highly likely at about 33 miles of the 208 miles (104 Washington miles and 104 Oregon miles) of shoreline they analyzed.

Marine mammal and turtle collisions

The action area overlaps humpback whale and leatherback sea turtle designated critical habitat. Blue whales, sei whales, fin whales, and sperm whales also migrate through and forage in the action area every year. Collisions with commercial ships are a threat to marine mammals and turtles where shipping lanes cross breeding and feeding habitats and migratory routes. Between 2013 and 2022, an average of 1376 ocean going vessels (OGVs (cargo and passenger vessels 300 gross tons or larger, tankers, tank barges and articulated tug barges)) entered the Columbia River with a standard deviation of 70 OGVs (Table 4).

Table 4. OGVs entering the Columbia River from 2013 to 2022 (WDOE, 2022).

Year	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013
Cargo & Passenger Washington	721	787	764	751	795	734	805	744	762	673
C&P Oregon	525	521	473	436	524	505	496	447	612	620
Tanker Washington	4	11	5	15	30	30	40	42	38	32
Tanker Oregon	73	54	57	62	60	21	32	35	33	31
Tanker Barge or Articulated Tug Barge	31	31	27	37	32	31	37	55	81	1
Total	1354	1404	1326	1301	1441	1321	1410	1323	1526	1357
Average	1376									
Standard Deviation	69.5									

The number of confirmed vessel collisions with ESA-listed species in Oregon and Washington from 2000-2018 are: three sperm whale, three humpback whales, and ten fin whales (Marine Mammal Health and Stranding Response Program database[2]). Additional strikes likely occur and go unnoticed and unreported.

Acoustic Disturbance.

Increasing levels of anthropogenic sound in the world's oceans (Andrew *et al*. 2002), such as those produced by shipping traffic, Acoustic Thermometry of Ocean Climate or Low Frequency Active sonar, have been suggested to be a habitat concern for whales, particularly for baleen whales (fin, sei, humpback, and blue) that may communicate using low frequency sound. Based on vocalizations (Richardson *et al*. 1995; Au *et al*. 2006), reactions to sound sources (Lien *et al*. 1993, 1992; Maybaum 1993), humpback whales also appear to be sensitive to mid-frequency sounds, including those used in active sonar military exercises (Reynolds 2007). We do not have specific information about what types of acoustic disturbance is in the action area; however, we expect noise from vessel activities, including shipping, boating associated with commercial and recreational fishing, and Coast Guard operations.

Use of the action area by listed species

ESA-listed salmonids

Despite degraded habitat conditions, ESA-listed species migrate through and rear in the action area. Numerous early life history strategies of Columbia River salmonids have been lost as a result of past management actions such as channel deepening and loss of floodplain habitat connectivity (Bottom *et al*. 2005). In addition to variations in outmigration timing, juvenile ESA-listed species also have a wide horizontal and vertical distribution in the Columbia River related to size and life history stage. Generally speaking, juvenile salmonids would occupy the action

[2] https://www.fisheries.noaa.gov/national/marine-life-distress/marine-mammal-health-and-stranding-response-program

area across the width of the river, and to average depths of up to 35 feet (Carter *et al*., 2009). Smaller-sized fish use the shallow inshore habitats and larger fish would use the channel margins and main channel. The pattern of use generally shifts between day and night. Juvenile salmon occupy different locations within the Columbia River, and are typically in shallower water during the day, avoiding predation by larger fish that are more likely to be in deeper water. These juveniles venture into the deeper areas of the river away from the shoreline, towards the navigation channel and along the bathymetric break (channel margin) and would be closer to the bottom of the channel (Carter *et al*., 2009). The smaller sub-yearling salmonids typically congregate along the nearshore areas in shallow water and extend into the channel margins (Bottom *et al*., 2011). Yet, as Carlson *et al*. (2001) indicated, there is higher use of the channel margins than previously thought. Considering the parameters above, juvenile and subyearling salmonids are likely to be found in shallower waters such as the flushing channel while adult salmonids are more likely to occupy the deep-water berths and Federal Navigation Channel.

The level of exposure of juvenile salmonids would vary depending on the species, life history, location, migration timing, and water depth occupied. Juvenile salmonids migrate in the vicinity of and may rear in the action area during different times of the year. In general, juvenile salmonids are present in the action area year-round, being most abundant from the late winter through the summer, becoming less abundant in the fall (NMFS, 2017b). Juvenile Chinook salmon are present year-round with timing ranging from spring to early fall, although sub-yearlings are present later into the fall (Dawley *et al*., 1986; NMFS, 2017b). Juvenile chum salmon are present from winter to spring. Juvenile coho salmon and steelhead are present year-round with their primary migration timing ranging from spring to mid-summer. Juvenile sockeye salmon are present during mid-spring to late summer.

Eulachon.

Pacific eulachon are anadromous smelt that spawn within the mainstem LCR and its tributaries. Previous studies have documented the highest densities of out-migrating larvae in the Columbia River upstream of the Port at the confluence of the Cowlitz River and Columbia River, however eulachon do spawn upriver in the mainstem channel and in Sandy River (WDFW 2020). Adult eulachon ascend large tributaries of the Columbia River (i.e., Cowlitz, Elochoman, Grays, Kalama, Lewis, Sandy, etc.) during late winter and spring (Gustafson *et al*., 2016). They produce hundreds of millions of eggs with a sticky exterior covering that adheres to the substrate until larvae hatch and are rapidly transported downstream as free-floating drift throughout early spring (Parente & Snyder, 1970; Smith & Saalfeld, 1955). Eulachon larvae rapidly disperse throughout the water column and are widely distributed as they passively drift downstream (Howell & Uusitalo, 2000).

In the Columbia River, eulachon abundance decreased markedly since the 2016 status review NMFS 2022. The decrease in abundance reflects both changes in biological status and changes in ocean conditions. For the years 2011 through 2015, the 5-year SSB mean was 97.9 million spawners. For the years 2016 through 20214, the 6-year SSB mean was 40.2 million spawners. However, the 2021 estimate (96.4 million spawners) was nearly equivalent to the 2011-2015 mean (NMFS 2022).

The eulachon spawning migration typically begins when river temperatures are between 0°C and 10°C, which usually occurs between January and April in the Columbia River. Spring freshets carry larvae to the Columbia River Estuary, and juveniles will disperse onto the continental shelf within the first year of life (Gustafson 2015). Migration of adults into the Columbia River and its tributaries occurs from December through May, with peak abundances and spawning during February and March over sandy substrates in LCR tributaries. Eggs and larvae are present from February until early June, as they drift in currents downstream to the Columbia River Estuary. Common threats to eulachon are described in Table 5.

Table 5. Physical and biological threats to eulachon and their relative level of severity (NMFS 2022h).

Threats	Level of Severity
Climate change impacts on ocean conditions	High
Dams / water diversions	Moderate
Eulachon by-catch	High
Climate change impacts on freshwater habitat	Moderate
Predation	Moderate
Water quality	Moderate
Catastrophic events	Low
Disease	Very low
Competition	low
Shoreline construction	Moderate
Tribal fisheries	Very low
Non-indigenous species	Very low
Recreational harvest	low
Commercial harvest	low
Scientific monitoring	Very low
Dredging	Moderate

Green Sturgeon

Green sturgeon utilize the action area during the summer and early fall months and are likely to be present in the action area during project construction and operations (Moser & Lindley, 2007; Moser *et al*., 2016). Commercial catches of green sturgeon peak in October in the Columbia River estuary, and records from other estuarine fisheries (Willapa Bay and Grays Harbor, Washington) support the conclusion that sturgeon are present in these estuaries from June until October (Moser & Lindley, 2007). Green sturgeon spawn in freshwater portions of southern Oregon and central California rivers, and they spend most of their lives migrating in coastal marine waters and spending time in estuaries from the Sacramento River, California to Alaska. Green sturgeon and their prey are associated with substrates in estuarine and coastal marine environments. Adults and subadults, the only life history stages known in the Columbia River, migrate in the Pacific Ocean and use the Columbia River estuary in the summer and fall months for foraging and to optimize growth (Moser and Lindley 2007). Their presence in the Columbia River typically occurs from June through October. Green sturgeon can live to 60 years old and grow to approximately 256-270 cm.

Leatherback Sea Turtles.

Along the coast of Washington, past and present population status is difficult to quantify, but research using satellite telemetry indicates that the Washington's outer coast (especially the area near the Columbia River plume) is an important foraging area for the species (Benson *et al.* 2011). Leatherback sea turtles regularly occur off the coast of Washington, especially off the mouth of the Columbia River (i.e., within the action area) during the summer and fall when large aggregations of jellyfish form (WDFW 2012). The NMFS Pacific Leatherback Sea Turtle Work Group tracks the total annual authorized incidental take in past biological opinions for inclusion in the Environmental Baseline of new biological opinions. This information is summarized in table 6 below.

Table 6. Summary of annual authorized take of Pacific leatherback sea turtles in NMFS Incidental Take Statements by life stage and type of take (last updated January, 2021).

Life Stage	**Annual Authorized Take (based on rounded up numbers above)**		
	Sublethal (minor injury)	**Sublethal (behavioral harassment or TTS)**	**Dead or serious injury**
Juvenile (includes one juvenile/subadult from HMS Deep-set Longline BiOp)	23	0	27
Subadult/Adult (includes not specified)	310	207	11

Blue Whales

Blue whales are very rare in the action area. The Eastern North Pacific population feeds off California in the summer and fall. Vessel surveys conducted in Washington waters in 1996 and 2001 did not find any blue whales (Carretta *et al*. 2013) however some individuals have been sighted in recent years off the coasts of Oregon and Washington. The Eastern North Pacific population is stable and includes about 1,900 individuals (WDFW 2025).

Sei Whales

Sei whales are rare off the coast of Washington. The Eastern North Pacific population is quite small, including about 500 animals (WDFW 2025). Trends in abundance are unknown.

Fin Whales

Fin whales along the coasts of California, Oregon, and Washington are composed of a single population with about 9,000 individuals. Trends in abundance have increased in recent years (WDFW 2025). They are common off the Washington coast.

Humpback Whales

Humpback whales are common off the Washington coast during summer months. They are highly migratory. The Central America DPS is listed as federally endangered, and the Mexico DPS is federally threatened. Population trends have been increasing.

Sperm Whales

Most of the sperm whales in Washington coastal waters belong to the California/ Oregon/ Washington population, which has approximately 2,000 whales, and slowly increasing in abundance. Sperm whales are most likely to be found in deeper water off the continental shelf.

SRKW

Southern Resident killer whales are common in the action area. Three pods (J,K, and L) make up the Southern Resident DPS. There are 73 SRKW remaining (newly born calves are not counted before they are at least 6 months old due to high calve mortality rates).

Critical habitat in the action area

This section of the environmental baseline examines the designated critical habitat affected by the proposed action by examining the current condition and trends of essential physical and biological features throughout the designated areas. These features are essential to the conservation of the listed species because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NOAA Fisheries 2005). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (e.g., one of a very few spawning areas), a unique contribution of the population it served (e.g., a population at the extreme end of geographic distribution), or if it serves another important role (e.g., obligate area for migration to upstream spawning areas).

For each recovery domain, the CHART assessed biological information pertaining to occupied by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. A complete review of all primary constituent elements ((PCEs) or physical and biological features (PBFs) and associated scoring for each fifth-field hydrologic unit code (HUC5) is available at NOAA Fisheries (2005). Below, we describe generally describe the environmental baseline for critical habitat in the action area.

On the mainstem of the Columbia River, hydropower projects, including the Federal Columbia River Hydropower System (FCRPS), have significantly degraded salmon and steelhead habitats (Bottom *et al*. 2005, Fresh *et al.* 2005, NMFS 2011, NMFS 2013). The series of dams and reservoirs that make up the FCRPS block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts.

Industrial harbor and port development are also significant influences on the Lower Willamette and Lower Columbia rivers (Bottom *et al*. 2005, Fresh *et al*. 2005, NMFS 2011, NMFS 2013). Since 1878, 100 miles of river channel within the mainstem Columbia River, its estuary, and Oregon's Willamette River have been dredged as a navigation channel by the USACE. Originally dredged to a 20-foot minimum depth, the Federal navigation channel of the Lower Columbia River is now maintained at a depth of 43 feet and a width of 600 feet. The Lower Columbia River supports five ports on the Washington State side: Kalama, Longview, Skamania County, Woodland, and Vancouver. In addition to loss of riparian habitat, and disruption of benthic habitat due to dredging, high levels of several sediment chemicals — such as arsenic and polycyclic aromatic hydrocarbons — have been identified in Lower Columbia River watersheds in the vicinity of the ports and associated industrial facilities.

The most extensive urban development in the Lower Columbia River subbasin has occurred in the Portland/Vancouver area. Outside of this major urban area, the majority of residences and businesses rely on septic systems. Common water quality issues with urban development and residential septic systems include higher water temperatures, lowered dissolved oxygen, increased fecal coliform bacteria, and increased chemicals associated with pesticides and urban runoff.

The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species (Bottom *et al*. 2005, Fresh *et al*. 2005, NMFS 2011, NMFS 2013). Edges of marsh areas provide sheltered habitats for juvenile salmon and steelhead where food, in the form of amphipods or other small invertebrates which feed on marsh detritus, is plentiful, and larger predatory fish can be avoided. Historically, floodwaters of the Columbia River inundated the margins and floodplains along the estuary, allowing juvenile salmon and steelhead access to a wide expanse of low-velocity marshland and tidal channel habitats. In general, the riverbanks were gently sloping, with riparian and wetland vegetation at the higher elevations of the river floodplain becoming habitat for salmon and steelhead during flooding river discharges or flood tides. Sherwood *et al*. (1990) estimated that the Columbia River estuary lost 20,000 acres of tidal swamps, 10,000 acres of tidal marshes, and 3,000 acres of tidal flats between 1870 and 1970. This study further estimated an 80 percent reduction in emergent vegetation production and a 15 percent decline in benthic algal production.

Habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon (Bottom *et al*. 2005, Fresh *et al*. 2005, NMFS 2011, NMFS 2013). Diking and filling have reduced the tidal prism and eliminated emergent and forested wetlands and floodplain habitats. These changes have likely reduced the estuary's salmon-rearing capacity. Moreover, water and sediment in the Lower Columbia River and its tributaries have toxins that are harmful to aquatic resources (LCREP 2007). Contaminants of concern include dioxins and furans, heavy metals, polychlorinated biphenyls (PCBs) and organochlorine pesticides such as DDT. Simplification of the population structure and life-history diversity of salmon possibly is yet another important factor affecting juvenile salmon viability. Restoration of estuarine habitats, particularly diked emergent and forested wetlands, reduction of avian predation by terns, and flow manipulations to restore historical flow patterns have likely begun to enhance the estuary's capacity to support salmon, although historical changes in population structure and salmon life histories may prevent salmon from making full use of estuarine habitats.

A team similar to the CHARTs, referred to as a Critical Habitat Review Team (CHRT), identified and analyzed the conservation value of particular areas occupied by southern green sturgeon, and unoccupied areas they felt are necessary to ensure the conservation of the species (USDC 2009). The CHRT identified several activities that threaten the PCEs in coastal bays and estuaries and necessitate the need for special management considerations or protection. The application of pesticides is likely to adversely affect prey resources and water quality within the bays and estuaries, as well as the growth and reproductive health of Southern DPS green sturgeon through bioaccumulation. Other activities of concern include those that disturb bottom substrates, adversely affect prey resources, or degrade water quality through re-suspension of contaminated sediments. Of particular concern are activities that affect prey resources. Prey resources are affected by: commercial shipping and activities generating point source pollution and non-point source pollution that discharge contaminants and result in bioaccumulation of contaminants in green sturgeon; disposal of dredged materials that bury prey resources; and bottom trawl fisheries that disturb the bottom (but result in beneficial or adverse effects on prey resources for green sturgeon). In addition, petroleum spills from commercial shipping and proposed hydrokinetic energy projects are likely to affect water quality or hinder the migration of green sturgeon along the coast (USDC 2009).

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.2).

For this consultation, we consider climate change where relevant to status of the species or environmental baseline, but do not consider any potential future impacts from climate change on listed species in the action area to be effects of the action. It is true that greenhouse gasses (GHGs) would be emitted when biofuel or SAF produced under the proposed action are later used.

However, we cannot show a causal connection between such emissions of GHGs and specific localized climate change as it impacts listed species or critical habitat with reasonable certainty for the following reasons:

1. The ultimate fate of the biofuel and SAF developed or produced is unknown. Depending on market conditions, biofuel could be blended with crude oil and refined into gasoline or diesel and burned in automobiles. Also, it could be synthesized into other consumer products including plastics. These products could be used anywhere in the world after

production. Due to this high degree of uncertainty, we cannot identify any specific effect from the burning or processing of these biofuels that is reasonably certain to occur.

2. We cannot make the requisite causal connections between the emissions of greenhouse gasses from the proposed action and specific localized climate change as it impacts the listed species or critical habitat. By some standards, biofuel and SAF production is itself carbon-neutral after considering the sequestration of carbon by plants used in the feedstock.

3. Additionally, even if we assume that all of the biofuel and SAF would be burned to produce energy, and this is a step in a causal chain toward a change in temperature in the area where listed species occur, the magnitude of that effect pathway is likely to be too small to constitute an effect on the listed species or critical habitat. The amount of GHGs produced would be a small fraction of GHGs produced world-wide. Even if it were possible to make such an attribution, the global temperature change attributable to such emissions would be miniscule and we are unable to meaningfully analyze any resulting impacts on ESA-listed species and critical habitat.

2.5.1 Effects on Listed Species

Effects of the proposed action on species are based, in part, on habitat effects as described in detail below. Because no in-water work is proposed, there are no in-water work windows. The proposed action will result in temporary effects from the construction of the facility (i.e., water quality effects from turbidity, vessel noise associated with off-loading equipment, and migration obstruction effects due to vessel presence at the docks) which will affect juvenile salmonids and eulachon; and enduring effects from the ongoing operations of the facility (i.e., water quality effects [waste water and stormwater runoff], wake stranding, and migration obstruction effects). Enduring effects will affect juvenile and adult salmonids, all life stages of eulachon, and adult and sub-adult green sturgeon. Additionally, enduring effects will include effects associated with increased ship traffic to and from the NEXT facility on some marine mammals and turtles as described below.

Short-term Effects

Water Quality

Turbidity

The proposed bio-refinery will result in the development of 122.5 acres, and expose upland soil as a result of construction activities. Despite the use of erosion control measures, including silt fencing, fine sediment delivery to the drainage waterways and ultimately to the Columbia River will increase until soils stabilize. Suspended fine sediment has the potential to harm juvenile fishes, including ESA-listed juvenile salmonids and adult and larval eulachon. The source of elevated turbidity will largely occur with the construction of the drainage ponds and associated waterways. We anticipate that most of the fine sediment suspended in the ponds and waterways will remain there until the ponds require maintenance. However, some suspended sediment will escape the ponds and route to McLean Slough and ultimately, the Columbia River.

Juvenile salmonids and adult eulachon exposed to elevated turbidity would react by moving into deeper water from the shoreline and avoiding the area. Due to juveniles mainly occupying shallow water habitat, the risk of exposure to turbidity is greater for sub-yearlings than yearling salmonids. According to Wilber and Clarke (2001), juveniles exposed to 10–100 milligrams per liter of suspended sediment for 8 hours would experience sub-lethal physiological effects. These effects include reduced feeding and behavioral effects such as startle responses followed by relocation. Elevated levels of suspended sediment also reduce the ability of juvenile salmonids to seek refugia (Korstrom and Birtwell 2006). Given the dispersed area of the constructed ponds and the lengthy catchments for suspended sediment to settle, the expected short duration of suspended sediment expected during construction, and the capacity of the fishes to avoid turbid areas, we expect effects among juvenile salmon and eulachon exposed to turbidity to be minor.

Adult salmonids will typically be in the main river channel at depths of 10 to 20 feet below the water surface and off the bottom (Johnson *et al*. 2005). This suggests that the potential for adults to encounter areas of high suspended sediment is low. Studies show that salmonids are able to detect and distinguish turbidity and other water quality gradients (Bisson and Bilby 1982), and adult salmon have swimming abilities to more easily avoid waters affected by suspended sediment to find refuge and/or passage conditions within unaffected adjacent areas. We anticipate adult salmonids will pass through the action area without experiencing adverse effects due to the brevity of exposure and therefore should not experience reduced fitness.

We anticipate very minor effects to green sturgeon as they are often associated with turbid conditions on the benthos where similar species, Atlantic (*A. oxyrinchus)* and shortnose (*A. brevirostrum)* sturgeon, show little to no obvious turbidity effects (Johnson 2018).

Noise

Noise from ships and barges off-loading equipment in preparation for construction are temporary but would occur periodically until construction is complete (one to two years). This would occur whenever vessels moor or travel from the NEXT facilities to deliver and remove construction related equipment. In response to ship moorage and traffic with such high frequency, fish behaviors will be altered. Nicholes *et al*. (2015) found that boat noise can induce stress responses via increased cortisol concentration in fishes. Behaviors affected include rearing, feeding, flight responses, and migration. It is highly likely that moorage and traffic of tankers and barges will coincide with juvenile salmonid or adult eulachon presence, and it is likely to temporarily disrupt normal fish behavior. However, vessel noise is likely to last only for one to two hours per vessel as they will likely stop their engines (ships) or to drop off barges (tug boats) to load and off-load equipment. The number of vessels is expected to include less than 10 vessels during construction. Therefore, the number of fish affected will be very small and effects to them will be short in duration and limited to small avoidance behaviors. Effects from short term noise related to ship and barge traffic during construction will be minor.

Migration obstruction

While construction-related vessels are moored at the NEXT facility to load and off-load equipment, they may remain at the dock for weeks or months. The presence of barges or ships at the dock will increase over-water shade. Shade effects on fish are well known. The moored vessels would create areas of cover that decrease water velocity and create shade. These conditions may create favorable habitat for predators such as the Northern pikeminnow, smallmouth bass, and largemouth bass (Faler *et al*., 1988; Isaak & Bjornn, 1996). The Northern pikeminnow and smallmouth bass have consistently been shown to use low-velocity habitats (Faler *et al*., 1988; Isaak & Bjornn, 1996; Martinelli & Shively, 1997). In Columbia River reservoirs, their preference for low velocity habitats associated with overwater structures places them in the paths of the out-migrating juveniles (Carrasquero, 2001). In the McNary reservoir, smallmouth bass have also been found to prefer low velocity habitats (Tabor *et al*., 1993). Additional studies cited by Rondorf *et al*. (2010) found similar findings on these juvenile salmonid and eulachon predators. These studies found that pikeminnow and smallmouth bass actively search for low velocity habitats, prefer shaded areas, and utilize overwater structures such as moored vessels at the NEXT facility. Shade can delay migration as individual fish will stall active migration when confronted with over-water shade and deeper water.

It is highly likely that moorage and traffic of ships and barges will coincide with juvenile salmonid and eulachon presence, and it is likely to temporarily disrupt normal fish behavior. Vessels (barges and ships) are anticipated to remain moored at the NEXT dock facility for weeks to months at a time as equipment is used to construct the NEXT facility. Additionally, the number of vessels is expected to include up to 10 vessels during construction. Therefore, the number of juvenile salmonids and all life histories of eulachon affected will be in the thousands or tens of thousands. Most individuals will delay their migrations but will ultimately pass the moored vessels. Adult eulachon are likely to respond to permanent habitat effects by slightly adjusting their migration pathway. Adult eulachon are typically 6–8 inches in size, which is beyond the gape limit of all but the largest piscine predators in the LCR (NMFS, 2017a). However, hundreds of individual juvenile salmonids and egg and larval life history stages of eulachon will be consumed by lie-in-wait predators associated with moored vessels over the duration of construction activities lasting months. Therefore, individual juvenile salmonids and larval eulachon will be harmed because predation caused by the migration obstruction of moored ships during construction will harbor known predators.

Enduring Effects

Water Quality Effects

Contaminants produced by the NEXT facility Discharge at NEXT processing facility (wastewater and some stormwater) will be treated differently than the surrounding landscape (stormwater), as described in more detail below. The NEXT facility will produce and route wastewater and stormwater containing toxic chemicals (contaminants), which are incompletely removed by treatment processes. The facility's main wastewater system is designed to route wastewater produced from converting 50,000 barrels per day of vegetable oil and animal fats to renewable fuel and SAF. Wastewater would be collected and treated based on various chemicals in the waste stream. Once treated, the wastewater and stormwater would be comingled and processed through the tertiary filters before routing through a heat exchanger for cooling prior to entering the existing Port Westward wastewater collection system (in Ditch 1) for eventual discharge at the Port's outfall to the Columbia River. Treated water (discharge) would be released continuously throughout the year.

Runoff sources from the surrounding landscape (i.e., not the main NEXT processing facility) would include bare soil, aggregate, asphalt, and concrete from multiple areas surrounding the main facility. Stormwater runoff will be routed by sheet flow through multiple drainage ditches, waterways, and constructed wetlands prior to release into McLean Slough and ultimately routed to the Clatskanie and Columbia rivers. All stormwater runoff will be routed to the ditches and drainage ponds described in the Proposed Action, above (Section 1.3). Runoff would mobilize small amounts of contaminated sediments, which would settle onto the top layer of the waterway and wetland substrates where the contaminants would remain biologically available for years. Detention ponds are sized to release stored water over 10 days following a 100-year, 24-hour storm. NEXT detention ponds are designed with an inverted elbow outlet so that particles floating on the surface of the pond would remain in the pond and trapped on or near the bottom when the pond drains. Nevertheless, stormwater with a large and complex mix of contaminants will escape the drainage ponds to the Columbia and Clatskanie rivers daily and when large storm events occur.

As described in the proposed action (Section 1.3), the NEXT facility will generate 72.6 acres of new PGIS. Additionally, the industrial complex will facilitate 667 new vehicle trips daily with the capacity for 3,000 additional vehicles trips. The proposed action also adds 60 semi-trucks and 1,220 rail cars monthly (ELS 2023). The addition of impervious surfaces with vehicles will generate increased toxic contaminants above the environmental baseline. Stormwater runoff, combined stormwater / wastewater from the NEXT facility, and accidental spills will route these the contaminants to drainage ponds and ditches. ESA-listed species in the Clatskanie and Columbia rivers would be exposed to concentrations of discharge and stormwater constituents that escape from the detention ponds. Many of the fuels, lubricants, and other fluids commonly used in motorized vehicles and construction equipment are petroleum-based hydrocarbons that contain Polycyclic Aromatic Hydrocarbons (PAHs), which are known to be injurious to fish. Other contaminants likely to result from the proposed action at the NEXT facility include 6PPD-Q, metals, herbicides, Polychlorinated Biphenyls (PCBs), and other organic compounds. Below, we describe the delivery and toxicity of NEXT facility contaminants, followed by the likely effects to listed species.

PAHs comprise a large fraction of the total cumulative toxic load present in stormwater runoff (treated or untreated) and are often bound or complexed with or carried by sediments (Grant et al. 2003). Petroleum-based contaminants include more than 100 different chemicals, and usually occur as complex mixtures in the environment (Ecology 2021). NEXT-facility sources of PAHs released to the environment would be from vehicle emissions, plastics including tire wear particles, improper motor oil disposal, leaks, and asphalt sealants (ELS 2023; Ecology 2021). PAHs are lipophilic, persistent, interact synergistically with bio-accumulative and redox-active metals and other contaminants, and may disperse long-distances in water (Gauthier et al. 2014, 2015; Arkoosh et al. 2011; Ecology 2021). PAHs at the NEXT facility are likely to accumulate in drainage ponds and persist for weeks to years in sediments.

The 6PPD chemical acts as a preservative in tires. As tires wear with age and road-wear, tire particles, in the presence of ozone, transform into 6PPD-Quinone (6PPD-Q) and are transported from roads and parking lots to rivers and streams in stormwater runoff. The optimum treatment BMP for 6PPD and 6PPD-Q removal is infiltration (WDEQ 2022; Fardel et al. 2020), which is unavailable at this site because of the high groundwater level. Large tire particles have negative buoyancy and sink to the bottom of the detention pond but microscopic tire particles have large surface area to volume ratios and can have neutral or positive buoyancy due to the surface tension of water. Particles on the surface are likely to remain trapped in the pond for extended periods because the outlet is an inverted elbow and 6PPD-Q does not biodegrade rapidly without biofiltration (Challis et al. 2021; Johannessen et al. 2021). 6PPD and 6PPD-Q have low solubility so the dissolved fraction is low. Instead, 6PPD and 6PPD-Q molecules released from microscopic tire particles partition to organic matter in suspended sediment and over time, settle. Thus, the effectiveness of 6PPD and 6PPD-Q removal by detention ponds is rated medium by Ecology (2022).

Metals, such as copper, zinc, cadmium, or mercury, can have a range of acute and chronic physiological and behavior effects on fish. There are three known physiological pathways of metal exposure and uptake within salmonids: (1) gill surfaces can uptake metal ions which are then rapidly delivered to biological proteins (Niyogi et al. 2004); (2) olfaction (sense of smell) receptor neurons (Baldwin et al. 2003), and; (3) dietary uptake. For dissolved metals, the most direct pathway to fish and other aquatic organisms is through the gills. Relative toxicity of metals can be altered by hardness, water temperature, pH, suspended solids, and presence of other metals. Water hardness affects the bio-available fraction of metals from gill surfaces; as hardness increases; metals are less bio-available, and therefore less toxic (Hansen et al. 2002; Niyogi et al. 2004). However, Baldwin et al. (2003) did not find any influence of water hardness on the inhibiting effect of copper on salmon olfactory functions. Copper is a neurotoxicant that directly damages the sensory capabilities of salmonids at low concentrations. These effects are generally among the more sensitive fish responses and underlie important behaviors involved in growth, reproduction, and survival (Hecht et al. 2007).

Herbicide applications are proposed for the NEXT project. NMFS identified three pathways for the analysis of herbicide application effects: (1) Runoff from riparian application; (2) application within perennial ponds, wetlands, waterways, and intermittent channels; and (3) runoff from impervious surfaces, ponds and ditches. Surface water contamination with herbicides can occur when herbicides are applied intentionally or accidentally into ditches, drainage ponds or other bodies of water, or when soil-applied herbicides are carried away in runoff to surface waters. Accidental contamination of surface waters can occur when drainage ponds are sprayed with herbicides or when buffer zones around water sources are not wide enough. Glyphosate is proposed to be used to prevent regrowth of weeds after the bio-refinery site is stripped and graded to control weeds competing with native plants at the mitigation site, and to control weeds along roads and the railway. It is degraded by soil microorganisms and has a field half-life of 2-197 days.

Even though PCBs were banned in the United States in 1979, they persist at high concentrations in sediments and aquatic foodwebs in the Columbia River. The influx and transport of cleaner sediments, the flushing of flows, and the dredging and disposal of sediments through time was expected to reduce and bury these contaminants below biologically available access; however, PCBs still occur at very high concentrations in surface sediment and are biologically available to fish and their prey (Counihan et al. 2014). Lower Columbia River sediments are composed of primarily sand and silt. These fine-grained materials are not uniformly distributed in the river, which is important because fine-grained material frequently contains more organic carbon, and organic material is most frequently associated with contaminants, such as PCBs. Total organic carbon is also important for invertebrate production, which can lead to bioaccumulation of PCB concentration in the higher trophic levels of salmon, and green sturgeon. In the lower Columbia River, PCBs increased inversely with RM, although the Longview reach had the highest concentration of PCBs in sediment samples (Counihan *et al*. 2014), although see Hermann (2008) for very high concentrations observed in the Hanford reach, upstream of the action area.

Effects to listed species from contaminants

The proposed action would result in increased PGIS at the Port Westward area which would degrade water quality in the action area. All stormwater discharge from the NEXT facility is expected to contain concentration levels of constituents and chemical mixtures that are toxic to fish and aquatic life. Depending on the contaminant, its concentration, and/or the duration of exposure, exposed fish may experience effects that can range from avoidance of an affected area, to reduced growth, altered immune function, and mortality (Beitinger and Freeman 1983; Brette *et al*. 2014; Feist *et al*. 2011; Gobel *et al*. 2007; Incardona *et al*. 2004, 2005, and 2006; McIntyre *et al*. 2012; Meadore *et al*. 2006; Sandahl *et al*. 2007; Spromberg *et al*. 2015). Fish can uptake contaminants directly through their gills, and through dietary exposure (Karrow *et al*. 1999; Lee and Dobbs 1972; McCain *et al*. 1990; Meador *et al*. 2006; Neff 1982; Varanasi *et al*. 1993).

The incremental addition of contaminants over time are a source of adverse effects to salmonids. Adverse effects occur even when the source load cannot be distinguished from ambient levels because many contaminants bioaccumulate in the tissues of aquatic organisms and in benthic sediments. Adult and juvenile fishes will be exposed to stormwater contaminants during migration, spawning, and rearing life history stages.

Lipophilic chemicals such as PAH's tend to bioaccumulate in the tissues of aquatic organisms, particularly those at the top of trophic food chains such as salmonids and SRKW's. Increased levels of PAHs, oils, and other contaminants would be widely dispersed, and can have detrimental effects at very low levels of exposure either directly or indirectly through the consumption of contaminated prey or exposure to contaminants in the water column. As the concentration of these constituents increases in the environment the likelihood that organisms such as SRKW are harboring dangerous chemical loads increase concurrently. Environmental and biological accumulation of these chemicals can result in adverse long-term ecosystem impacts including altering species behavior, reproduction, and growth. PAHs and their metabolites are acutely toxic to salmonids and may cause lethal narcosis at low levels of exposure, can bioaccumulate through food webs (water, groundwater, soil, and plants; Bravo *et al*. 2011; Zhang *et al*. 2017), and can also cause chronic sub-lethal effects to aquatic organisms at very low levels (Neff 1985; Varanasi *et al*. 1985; Meador *et al*. 1995).

6PPD-Q is among the most toxic chemicals known for aquatic organisms, especially to coho salmon (LC_{50} 0.08 µg/L) (Tian *et al*. 2022) and ranks as among the most potently acute aquatic toxicants when compared to chemicals with existing Clean Water Act Aquatic Life Ambient Water Quality Criteria (Ecology 2022). Toxicity of 6PPD-Q does not follow a phylogenetic relationship. Species within the *Oncorhynchus* genus show radically different acute toxicities, from an LC_{50} as low as 0.040 µg/L in coho fry to no mortality observed in sockeye at 50 µg/L (Lo *et al*. 2023; Greer *et al*. 2023). 6PPD-Q is also highly toxic to *O. mykiss* (LC_{50fry} 0.47 – $LC_{50juvenile}$ 2.26 µg/L), and moderately toxic to Chinook salmon (LC_{50} 67.3 µg/L) (Roberts *et al.*

2024; Lo *et al.* 2023). Sublethal concentrations of 6PPD-Q can disrupt aerobic metabolism, swimming performance, and cardiovascular function in *O. mykiss* (steelhead) and lake trout (*Salvelinus namaycush*), potentially affecting fish survival (Selinger 2025).

Exposure to metal mixtures may result in sublethal effects that reduce growth or immune system functions that could persist after juvenile Chinook salmon leave their natal streams. Arkoosh *et al.* (1998) determined that alteration in disease resistance was sustained even after Chinook salmon were removed from the source of contaminants for 2 months and concluded that immune alteration in early life stages could persist into their early marine residency. Individual metal concentrations, and some mixture concentrations and combinations, have been tested with Chinook and coho salmon and steelhead. Results range from lethal to sublethal effects, which include reduced growth, fecundity, avoidance, reduced stamina, and neurophysiological and histological effects on the olfactory system (Eisler 1998; Playle 2004).

Glyphosate is practically non-toxic to fish (Solomon and Thompson 2003) with an LC_{50} to rainbow trout of 55 mg/L. Stehr *et al.* (2009) found that the low levels of herbicide delivered to surface waters are unlikely to be toxic to the embryos of ESA-listed salmon, steelhead and trout. However, mortality or sub-lethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior are likely to occur with some surfactants, which are mixed with glyphosate. Toxicity studies, particularly acute aquatic toxicity studies, show that formulated products can be more toxic than the glyphosate active ingredient alone. For example, one class of surfactants used in glyphosate formulations are the polyethoxylated tallow amines (POEA) and this class has been shown to be more toxic to aquatic animals than glyphosate alone (USEPA 2015; USEPA 2020).

PCBs are highly toxic to juvenile salmon (Meador et al. 2010). Meador *et al*. (2002) estimated 2,400 ng ∑PCBs/g lipid as the adverse health threshold for PCBs based on a broad range of toxicological studies on juvenile salmonids with effects ranging from enzyme induction to mortality. Johnson *et al*. (2013) observed concentrations of 22 to 6,900 ng/g lipid in juvenile Chinook salmon in the lower Columbia River. Subyearling life history types had the highest concentration due to their extended rearing in the lower river. Johnson *et al*. (2007) observed that high concentrations of PCBs in the stomach contents of juvenile Chinook and coho salmon indicates that they were accumulating these contaminants through their prey. In both whole body and stomach concentrations, Chinook salmon had higher concentrations of PCBs than coho salmon, which may indicate that juvenile Chinook salmon were consuming prey at higher trophic levels (Johnson *et al*. 2007). Exposure to PCBs may lead to altered immune function and increased disease susceptibility (Arkoosh *et al*. 1994, 1998, 2001; Bravo et al. 2011), poor growth, or metabolic dysfunction (Meador *et al*. 2002, 2006) and altered behavior (Scholz *et al*. 2000; Sandahl *et al*. 2005), all of which increase the risk of mortality in juvenile salmon.

Juvenile and adult salmonids and eulachon, and sub-adult green sturgeon would be exposed to the outfalls of the drainage ponds at the NEXT facility. The exact number of years that detectable amounts of operations-related contaminants would be biologically available at the site is uncertain, but is expected to persist for 50 years or more. Similarly, the annual numbers of juvenile salmon and eulachon that may be exposed to operations-related contaminated forage are uncertain. However, the best available information about the number of populations and number of individuals from those populations suggest that the number of individual fish that annually move through the project area would be very high. There is a reasonable likelihood that some coho salmon and steelhead fry that reside for short periods of time near the NEXT facility will die from acute exposure to 6PPD-Q and PAHs. However, most stormwater contaminants that escape the detention ponds will coincide with large rain events in the fall, which is when juvenile salmonids and eulachon are least likely to be abundant. There is also a reasonable likelihood that many individual juvenile salmonids and eulachon will be exposed to sublethal effects from contaminants.

Similarly, the amounts of contaminated prey that individual fish may consume, or the intensity of effects that exposed individuals may experience are uncertain and likely to be highly variable. However, the number of contaminants that would be mobilized suggests that the number of prey subject to consumption by juvenile salmonids or eulachon would be moderately high, especially with PAHs, which do not degrade quickly and are likely to persist well downstream of the facility outfalls. This suggests that the probability of trophic connectivity to the contamination would be moderate for any individual fish.

Green sturgeon are also susceptible to contaminants. There have been reports identifying concentrations of metals and pesticides in the blood plasma of green sturgeon from Grays Harbor (Layshock *et al*., 2022). Copper and selenium concentrations ranged from 100 to 1000 nanograms per milliliter and 200 to 400 nanograms per milliliter respectively. Pesticide concentrations ranged from 2–10 nanograms per milliliter of blood plasma (Layshock *et al*., 2022). Although metals and pesticides have known toxic effects in green sturgeon, the toxicity threshold for blood plasma concentrations of these compounds is unknown for green sturgeon. Nevertheless, there is a reasonable likelihood that contaminants escaping into the Columbia River would expose green sturgeon to the toxics remaining after treatment from the detention ponds that bioaccumulate to their blood plasma concentrations and increase toxicity. We anticipate that individual green sturgeon may be harmed or injured by this contamination.

Water quality would be impaired as a consequence of the development and operation of the NEXT facility. Contaminants including PAHs, 6PPD-Q, herbicides, heavy metals, PCBs, and other toxic chemicals would be produced and delivered to the Columbia and Clatskanie Rivers by escaping from drainage ponds and ditches. These contaminants will harm individual salmonids, eulachon, and green sturgeon directly and through trophic interactions daily for at least the next 50 years. Fall freshets are likely to carry the highest concentration of chemicals released due to stormwater on the landscape, whereas wastewater/stormwater discharge from the main facility would likely be continuous throughout the life of the NEXT facility. Therefore, we do not anticipate that contaminants in the water column would return to pre-NEXT facility levels. Additionally, some contaminants will accumulate in the benthos, which will impair forage opportunities of green sturgeon at least 25 miles downstream of the NEXT facility. The swift currents of the Columbia River will likely disperse some chemicals in the water column as they drift downstream, and some will accumulate in substrates. Degraded water quality will persist into the foreseeable future. Additionally, many individual fish will be affected by sublethal effects (such as swimming impairment) and become susceptible to increased predation. Some individual fish are likely to die from direct and indirect exposure to contaminants produced as a consequence of the proposed action.

Migration Obstruction

The presence of barges or ships at the dock to load or unload biofuel will increase over-water shade. Shade effects on fish are well known. The moored vessels would create areas of cover that decrease water velocity and create shade. These conditions may create favorable habitat for predators such as the Northern pikeminnow, smallmouth bass, and largemouth bass (Faler *et al*., 1988; Isaak & Bjornn, 1996). The Northern pikeminnow and smallmouth bass have consistently been shown to use low-velocity habitats (Faler *et al*., 1988; Isaak & Bjornn, 1996; Martinelli & Shively, 1997). In Columbia River reservoirs, their preference for low velocity habitats associated with overwater structures places them in the paths of the out-migrating juveniles (Carrasquero, 2001). In the McNary reservoir, smallmouth bass have also been found to prefer low velocity habitats (Tabor *et al*., 1993). Additional studies cited by Rondorf *et al*. (2010) found similar findings on these juvenile salmonid and eulachon predators. These studies found that pikeminnow and smallmouth bass actively search for low velocity habitats, prefer shaded areas, and utilize overwater structures such as moored vessels at the NEXT facility. Shade can delay migration as individual fish will stall active migration when confronted with over-water shade and deeper water. When juvenile fish encounter areas of diminished prey, competition for those limited resources increases, and less competitive individuals are forced into suboptimal foraging areas (Auer *et al*. 2020). Further, individuals with an inherently higher metabolism tend to be bolder and competitively dominant, and may outcompete other individuals for resources within a microhabitat, potentially increasing interspecific mortality (Biro and Stamps 2010).

It is highly likely that moorage and traffic of ships and barges will coincide with juvenile salmonid and eulachon presence, and it is likely to temporarily disrupt normal fish behavior. The NEXT facility will facilitate 171 new OGV trips each year. Vessels (barges and ships) are anticipated to moor at the NEXT dock facility for 2 – 3 days to load and off-load product. Thus, for about 342 days/year, the NEXT dock will obstruct the migration and rearing habitat of juvenile salmonids and eulachon. The number of juvenile salmonids and all life histories of eulachon affected will be in the thousands or tens of thousands. Most individuals will delay their migrations but will ultimately pass the moored vessels. Adult eulachon are likely to respond to permanent habitat effects by slightly adjusting their migration pathway. Adult eulachon are typically 6–8 inches in size, which is beyond the gape limit of all but the largest piscine predators in the LCR (NMFS 2017a). However, hundreds of individual juvenile salmonids and egg and larval life history stages of eulachon will be consumed by lie-in-wait predators associated with moored vessels.

Feedstock or biofuel spills

Biodiesel is likely to harm or kill fish, whales, and turtles in the event of a large biodiesel fuel spill. Pure "neat" biodiesel does not contain complex hydrocarbons as petroleum products do, and is typically less toxic to fish and other aquatic organisms. However, pure biodiesel is subject to degradation through time, and additives, including petroleum-based diesel, are frequently added ("blended") to stabilize the product. In laboratory experiments conducted by Khan *et al.* (2007), neat biodiesel was found to have half the toxicity as petroleum-based diesel. However, biodiesel remains toxic and in small concentrations (< 4 ppm) kills 50% (LC_{50}) of a zooplankton (*Daphnia magna*) within 24 hours, and 50% of rainbow trout (*O. mykiss*) in 1073 ppm concentrations within 24 hours (Khan *et al.* 2007). Additionally, effects to three species of microalgae as a result of biodiesel exposure revealed that pure diesel was more toxic than petroleum-based diesel (Pikula *et al.* 2018). The potential harm to listed species from an oil spill is dependent on the size of the spill, the availability of protection measures (which differs between the Columbia River and the Pacific Ocean), and exposure to individual species. Below, we differentiate between the risks and effects to listed species from large oceanic and Columbia River biofuel or feedstock spills.

Oceanic feedstock or biofuel spill risk

Oceanic biofuel or feedstock spills have the potential to affect whales and turtles. Tanker ships and barges will deliver raw oil feedstocks such as vegetable oils, used cooking oil, animal tallow, and inedible corn oil to the storage tanks at the NEXT facility. The NEXT facility will convert the feedstocks to non-petroleum biodiesels and sustainable aviation fuel where they will again be transported to the Pacific Ocean by ship or barge (ELS 2023). Large spills from commercial vessels are considered in general terms to be "low probability/high consequence events" (WDOE 2015). There is inherent risk of transiting through the action area where an accident could be caused by a multitude of factors from mechanical failure, human error, bad weather, or an unfortunate chain of events. Risk mitigation measures i.e., best management practices (BMPs), industry standards, traffic separation schemes, mechanical inspections, etc., partially reduce overall risk among all vessel traffic. The most basic assumption that NMFS is making regarding risk in this opinion is that more feedstock or biofuel-carrying ships per year above the baseline equates to more risk associated with the proposed action. Each additional ship transiting the action area contributes to an incremental increase in the risk profile of NEXT individually and in the overall traffic scheme in the action area.

In the event of an oceanic spill, killer whales appear to not have the wherewithal to avoid oiled waters. Matkin *et al*. (1994) reported that killer whales did not attempt to avoid oil-sheened waters following the Exxon Valdez oil spill in Alaska. After the Exxon Valdez oil spill in 1989, six of the 36 members of the northeastern Pacific AB pod were missing within one week of the spill after being seen in heavily oiled waters and eight more disappeared within two years. These absences were followed by the deaths of two orphaned calves in the winter of 1993-1994, as well as two adult males (including one fairly young individual) in 1994 and 1997 whose dorsal fins collapsed soon after the spill, indicating stress or ill health. AT1 pod lost eight of its 22 members by 1990 and two others by 1992. These mortality rates are unprecedented for the northeastern Pacific (NMFS 2008a). As the direct toxicity effects on SRKW from biodiesel are unknown, it is unclear how a large biofuel spill will affect them in the Pacific Ocean. It is equally unclear how bioaccumulation through the food chain would affect SRKW. However, as discussed below we think the risks to SRKW are low because the likelihood of a spill is low (NMFS 2022i), and they are unlikely to be exposed to oil in the action area.

An oceanic spill on the outer coast could disperse over many, many miles, which could expose more individual whales to spilled biofuel or feedstock, but potentially avoid acute toxic exposure because the product and vapors would rapidly dilute (if the biofuel or feedstock is toxic to whales or turtles). When biofuel of feedstock is spilled in the ocean, it would initially spread primarily on the surface, depending on its relative density and composition. Some of the product would evaporate. An oil slick may remain cohesive, or may break up in rough seas. Waves, currents, and wind can push oil into coastal areas and affect marine and terrestrial habitats in the path of the drift. Over time, oil waste would weather (deteriorate) and disintegrate by means of photolysis and biodegradation. The rate of biodegradation depends on the availability of nutrients, oxygen, and microorganisms, as well as temperature. Based on the description above, we conclude that risk to individual whales and turtles as a result of an oceanic spill is very low due to the unlikely event of a spill, the dispersal of the oil, and the low abundance and infrequent presence of the whales and turtles in the action area. The effects of an oceanic spill on salmonids, eulachon or green sturgeon is discountable because they are below the surface and highly mobile in the ocean.

Columbia River feedstock or biofuel spill risk

Although there is a risk of a large spill occurring in the Columbia River, the likelihood of a significant spill is low because of CPBR oil spill contingency plans with the EPA, USCG, and ODEQ that quickly mobilize against potential spills in the Columbia River. In addition to the above-mentioned plans, CRC stages over 6,500 feet of containment boom, skimmers, and two deployment vessels at the Port Westward facility. CPBR also pre-booms all OGVs prior to fuel transfer. CPBR stages over 6,500 feet of containment boom, skimmers, and two deployment vessels at the Port Westward facility and pre-booms all OGVs prior to oil transfer. A containment boom is placed around each OGV until the transfer is complete. OGVs approaching and leaving Port Westward are also required to have their own Vessel Response Plan. Once OGVs enter the Columbia River, the Maritime Fire and Safety Association becomes an additional oil spill response organization. In the event that additional resources are needed, CPBR is covered by the Strategic Northwest Area Contingency Plan. EPA administers surprise simulated spills. CPBR received the highest marks for simulated spill response and cleanup. In addition, CPBR contracts with several OSROs that are on-call in the event of a spill. In the event of a spill, CPBR and the OSROs could likely respond to and contain a small-scale spill before it becomes a significant incident. For these reasons, we do not consider a significant spill in the Columbia River as reasonably certain to occur. We do not consider impacts from a significant spill to be effects of the action for the purposes of this analysis.

Stranding on beaches by OGV wake waves.

Ship wakes from vessel traffic transiting to and from the NEXT facility would strand juvenile salmonids and eulachon in the Columbia River. Four studies (Bauersfeld 1977, Hinton and Emmett 1994, Ackerman 2002, Pearson *et al.*, 2006) have indicated that under certain conditions, deep draft vessels can produce wakes that strand juvenile salmon on shallow beaches in the Columbia River. Between 1974 and 1975, Bauersfeld (1977) estimated that 14,500 juvenile Chinook, 1,359 juvenile coho, and 4,771 juvenile chum salmon were stranded (killed) because of ship wakes from 180 deep draft vessels. Pearson *et al*., (2006) monitored 126 deep-draft vessel transits, and stranding occurred at three sites over all three seasons ranging from a low of 15% at Sauvie Island near Portland to a high of 53% at Barlow Point near Longview.

The NEXT facility would be downstream of 2 of the 3 known wake stranding beaches and is likely downstream of 2/3 of the unknown stranding beaches that meet Pearson *et al.* (2011) criteria for slope. The NEXT facility would result in up to 128 (=9/12 of 171) total OGVs up and down the river each year during 9 months of the year when young-of-the-year salmonids are migrating or rearing in shallow water along the margins of the Columbia River. Eulachon juveniles and eggs would be most susceptible to wake stranding from February through April. OGVs to and from the NEXT facility would pass the County Line Park stranding beach, about two miles downstream from Point Westward, but OGVs approaching or leaving the NEXT facility would be slowing down from 10 nautical miles per hour or accelerating to 10 nautical miles per hour as they pass County Line Park (ELS 2023), which may be a speed that reduces stranding at County Line Park than reported by Pearson *et al.* (2011). Wake stranding will likely occur at about 11 miles of other known stranding beaches downstream of the proposed NEXT facility.

Despite the reduced speed by ships and barges at some known stranding beaches, the increase in the number of vessels arriving and departing the NEXT facility will increase the mortality of juvenile salmonids and larval and egg life stages of eulachon. Ocean-type salmonids (typically, fall Chinook and chum salmon) are susceptible to wake stranding as passing ship wakes displace them from the water onto adjacent beaches. The small size of Chinook and chum salmon fry (35-55mm) obligates them to migrate near the shoreline to avoid piscine predators where they are highly susceptible to ship wake stranding mortality. These fish are incapable of avoiding these events when they swim or drift near shallow slope beaches and ships pass. Hundreds to thousands of individual salmon and eulachon fry are expected to die or be injured annually, especially during early spring, as small fry and large ship wakes co-occur.

OGVs strikes and marine mammals and turtles

Collisions with large ships remain a source of anthropogenic mortality or serious injury for both sea turtles and whales. The action area includes approximately 4,680 square nautical miles of the Pacific Ocean where SRKW, humpback, sei, fin, blue and sperm whales and leatherback sea turtles spend part of the year in sufficient densities that encounters and collisions with OGVs are likely. The proposed NEXT facility will rely upon 115 third party OGVs to supply feedstock and 56 third party OGVs to export bio refinery fuels. Below, we assess the general co-occurrence of ships and animals, and qualitatively consider the degree of additional risk posed to individuals in the action area and the potential consequences to the respective populations.

OGV strikes on killer whales are considered infrequent (NMFS 2022i). When they occur, ship strikes can result in injury or mortality (Gaydos and Raverty 2007). In 2016, an 18-year old male, J34, was found dead near Sechelt, British Columbia. The necropsy indicated that the whale died of blunt force trauma to the head, and Raverty *et al*. (2020) determined this was consistent with a vessel strike. From 2002 to 2016, two Southern Resident killer whales (subadult L98 and adult J34) perished from collisions with vessels[3]. Two others (adult L60 and subadult L112) died of trauma from unknown sources (NMFS 2021). Vessel strikes on killer whales are considered more uncommon than larger whale strikes because killer whale swimming and social behavior is dolphin-like (killer whales are the largest animal in the dolphin family). Because SRKW are highly agile and capable of evading approaching OGVs and because the expanse of the action area decreases the likelihood of ship strikes, we conclude that SRKW are unlikely to be harmed by OGV strikes.

The large whales in the action area are vulnerable to injury and death from vessel collisions (Vanderlaan and Taggart 2007). The occurrence and density is variable for the different species in the action area. In U.S. waters, ship strikes account for tens of large whale deaths per year (Conn and Sibler 2013, Henry *et al.* 2012, Van der Hoop *et al.* 2012). The documented number

[3] SRKW L98 was habituated to boats and humans

of vessel collisions is an underestimate of the actual number of collisions because vessel collisions have a low probability of detection (Laist *et al.* 2001, Conn and Sibler 2013).

Ship strike injuries to whales include propeller wounds characterized by external gashes or severed tail stocks, blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae (Laist *et al.* 2001), and hemorrhaging that sometimes lacks external expression (Conn and Sibler 2013). Vessel size and speed are associated with the number and severity of vessel collisions with whales. In one study, of the known collisions that killed whales, at least 87 percent involved ships more than 250 feet long (Laist *et al.* 2001). There is a significant positive relationship between ship speed and the probability of a lethal injury (Conn and Sibler 2013).

The 2021 Humpback Whale Recovery Plan outline identifies ship strike as a general threat. Of the humpback whales within the action area, NMFS presumes that 9 percent are from the Central America DPS and 28 percent are from the Mexico DPS. Along the entire West Coast range of this stock, the 2019 Humpback Whale Stock assessment (NMFS 2019a) identified 2.2 observed vessel collisions per year from 2013-2017 with total estimated vessel collisions per year of 22 (based on Rockwood el al. 2017). This estimate of 22 vessel collisions per year is for the combined CA/OR/WA stock across its range, of which the action area is a small portion and signals at a low reporting or observation rate of vessel strikes. Carretta *et al*. (2018) estimates an additional 10.8 serious injuries/deaths per year during this same time period. Fourteen vessel strike cases involving humpback whales were observed in CA-OR-WA waters during 2016 - 2020 (8 in CA, 1 in OR, and 5 in WA), or 2.6 whales per year (Carretta et al. 2022). Neilson *et al*. (2012) summarized 108 large whale vessel-strike events in Alaska from 1978 to 2011, 25 of which are known to have resulted in the whale’s death. Eighty-six percent of these reports involved humpback whales. Humpback whale strikes by OGVs are vastly underreported (NMFS 2022k), which likely means that the actual number of humpback whale strikes and mortality is much higher. The 2015 Status Review (NMFS 2015b) concludes that vessel collisions are considered likely to moderately reduce the population size or growth rate of the Central America humpback whale DPS. Taking this information into account and considering that the entire population size of the Central America DPS is in the 100’s of animals, NMFS concludes that both DPSs of humpback whales use the action area and are susceptible to OGV strikes. Over the course of the 50-year operation of the NEXT facility, and approximately 8,550 vessel trips, it is reasonable that one or more humpback whales could be injured of killed by vessel traffic.

Blue whales are extremely rare in the action area (Figure 4). The Eastern North Pacific population feeds off California in the summer and fall. Vessel surveys conducted in Washington waters in 1996 and 2001 did not find any blue whales (Carretta *et al*. 2013; Figure 39) however some groups and individuals have been sighted in recent years off the coasts of Oregon and Washington. The incremental increase in risk from the proposed action in any given year is likely small, however, over the course of the 50-year operations of the NEXT facility we can reasonably estimate that at least one blue whale from this DPS will be struck as a result of the proposed action.

The risk of ship strikes to fin whales in the action area in any given year is low. The best-estimate of abundance is taken as the estimate from 2018, or 11,065 (CV=0.405) animals (Becker et al. 2020), which is a significant increase from the estimated 2,636 fin whales reported to occur off the coasts of California, Oregon, and Washington in 2001 and 2005 (NMFS 2010a), with the concentrations of sightings increasing through Oregon and becoming more abundant off Washington. Fin whales typically feed well offshore along the continental slope. Fin whales have been reported struck and killed by large ships along the entire West Coast with an estimated 19 whales struck from 1998-2013 (WCR Stranding Database). Between 1991 and 2001 there were 20 reported ship strikes of fin whales along the U.S. West Coast. From 2010 to 2014 along the U.S West Coast there were nine reported ship strikes to fin whales (Carretta *et al*., 2017). Since 2002, 10 out of the 12 stranded fin whales in Washington have showed evidence attributed to a large ship strike (Carretta *et al*., 2017). The 2010 Fin Whale Recovery Plan identifies vessel collisions as a high threat with a "medium severity, but with high level of uncertainty, the relative impact to recovery of fin whales due to ship strikes is ranked as unknown but potentially high." Although fin whales have been struck in the action area, the main hot spots for fin whale ship strikes are off California. The primary range of fin whales is south of the action area; however, a moderate number of them have been struck by OGVs in recent years. Over the course of the 50-year NEXT facility operations, it is reasonable to assume that at least one fin whale will be struck.

Known ship strikes on sei whales is uncommon in the eastern North Pacific Ocean, but is poorly understood. There are relatively few documented accounts of vessel strikes with sei whales, and it is suspected that strikes on this species are underreported because the whales do not typically strand. One ship strike death was reported in the eastern North Pacific Ocean (off Washington) in 2003 (NMFS 2018). No vessel strikes of sei whales have been documented during the most-recent 5-yr period (2017 - 2021) (Carretta *et al*. 2023). There are approximately 35,000 sei whales in the eastern North Pacific Ocean (NMFS 2021). Sei whales are often observed in the same foraging area for many years and then disappear for prolonged periods of time, only to reappear years later (Jonsgård and Darling 1977; Schilling *et al*. 1992), which complicates efforts to track abundance trends through time. Despite the poor understanding of ship strikes on sei whales, we conclude that ship strikes on these whales is likely in the action area due to their abundance off the Washington Coast, the underreporting of strikes, their tendency to avoid stranding, and the 50-year expected operation of the NEXT facility.

The abundance estimates for sperm whales off California, Oregon, and Washington, out to 300 nautical miles (nm) ranged from 2,000 to 3,000 animals (Moore and Barlow 2014; Becker et al. 2020). For the most recent 5-year period of 2017-2021, no vessel strike deaths or serious injuries were observed, though one was recorded in 2007 (Carretta et al. 2013). Due to the low probability of a sperm whale carcass washing ashore, estimated vessel strike deaths are likely underestimated. The 2010 Sperm Whale Recovery Plan identifies vessel strike as one of several main threats to species recovery (NMFS 2010b). Sperm whales spend long periods of time "rafting" and socializing at the surface after deep dives, typically up to 10 minutes at a time, making them vulnerable to ship strikes. Population trends appear neutral (NMFS 2024d) Although no sperm whales are known to have been struck by OGVs in recent years, vessel strikes are largely unreported or unobserved. They are social animals and are frequently found at the surface, which increases their risk of ship strikes. Over the course of the 50-year license, it is reasonable that at least one sperm whale will be struck by an OGV originating from or going to the NEXT facility.

Because all sea turtles must spend time at the surface to breathe, rest, bask, and feed, these fundamental behaviors make turtles vulnerable to ship strikes. Although a number of (presumably) recreational propeller strikes on leatherback sea turtles are known, ship strikes are not reported. Based on telemetry data for leatherback turtles (n=15) on the northeastern U.S. shelf, leatherback turtles spent over 70 percent of their time in the top 15 m (Dodge *et al.* 2014). Thus, despite the lack of known strikes, vessel strikes pose a threat to the West Pacific DPS. Of leatherback strandings documented in central California between 1981 and 2016, 11 were determined to be the result of vessel strikes (7.3 percent of total; NMFS unpublished data). Leatherback turtles are known to feed off the Washington Coast, including the Columbia River plume; however, the main feeding areas are off California.

The likelihood that leatherback sea turtles will be exposed to collisions with vessels from the project is higher for about 100 days of the year during the summer and fall months because there is an abundance of forage species in the action area during that time. During the cooler approximately 265 days of the year, leatherback turtles are not expected to be present in the action area in enough numbers to result in ship strikes (NMFS and USFWS 2020). The increased risk in some years to any one individual turtle in the action area from ship strikes is small, but not insignificant. During summer, turtles are likely to occur in the action area making the odds of encountering additional NEXT-associated ships likely over the course of the 50-year NEXT operations. At least some leatherback sea turtles are likely to be harmed by OGV strikes.

Noise

Noise and disturbance from the boat/vessel activities associated with the operation of the NEXT facility would occur periodically with ship and vessel traffic. This would occur whenever boats/vessels moor or travel from the NEXT facilities. Moored vessels are anticipated to take approximately 2 days to load and off-load product, which combined with the number of vessels anticipated over the course of a year, amounts to about 350 days (ELS 2023). Elevated in-water noise at levels capable of causing detectable effects in exposed fish would be caused by episodic tugboat and tanker ship operations.

The effects caused by a fish's exposure to noise vary with the hearing characteristics of the fish, the frequency, intensity, and duration of the exposure, and the context under which the exposure occurs. At low levels, effects may include the onset of behavioral disturbances such as acoustic masking (Codarin *et al*. 2009), startle responses and altered swimming (Neo *et al*. 2014), abandonment or avoidance of the area of acoustic effect (Mueller 1980; Picciulin *et al*. 2010; Sebastianutto *et al*. 2011; Xie *et al*. 2008) and increased vulnerability to predators (Simpson *et al*. 2016). At higher intensities and/or longer exposure durations, the effects may rise to include temporary hearing damage (a.k.a. temporary threshold shift or TTS, Scholik and Yan 2002) and increased stress (Graham and Cooke 2008). At even higher levels, exposure may lead to physical injury that can range from the onset of permanent hearing damage (a.k.a. permanent threshold shift or PTS) and mortality. The best available information about the auditory capabilities of the fish considered in this opinion suggest that their hearing capabilities are limited to frequencies below 1,500 Hz, with peak sensitivity between about 200 and 300 Hz (Hastings and Popper 2005; Picciulin *et al*. 2010; Scholik and Yan 2002; Xie *et al*. 2008).

A study found that boat noise can induce stress responses via increased cortisol concentration in fishes (Nicholes *et al*., 2015). In response to ship moorage and traffic with such high frequency, fish behaviors will be altered. These behaviors include rearing, feeding, sheltering, and migration. It is highly likely that moorage and traffic of tankers and barges will coincide with juvenile salmonid or adult eulachon presence, and it is likely to temporarily disrupt normal fish behavior, resulting in harm to salmonids and eulachon.

Green sturgeon are likely to be affected by vessel noise. Ship traffic will occur year-round at the NEXT facility, and increase the likelihood that green sturgeon will be present in the action area. Senecal *et al*. (2024) observed that Atlantic sturgeon were displaced from ship traffic in the St. Lawrence River from distances over 1 km. from approaching ships. Because the displacement exceeded the visual distance of the sturgeon, the authors attributed the movement of sturgeon to hearing the ships approach. Displacement of the Atlantic sturgeon lasted a median of 31 min. before they were redetected (Senecal *et al*. 2024). Green sturgeon use the lower Columbia River to feed and grow. The displacement of green sturgeon from the action area would likely be over short durations in the lower river as ships and tug boats pass through the area. However, as ships and barges are docked at the NEXT site, running motors could displace sturgeon for extended periods of time as ELS (2023) reports that ships and barges will occupy the site for about 350 days/yr. Thus, although no green sturgeon are likely to be killed by the ships, the NEXT site will likely preclude foraging by green sturgeon for distances of up to 1 km from the site with a recurring frequency of every 2-3 days.

It is well known that anthropogenic sound from a variety of human activities (e.g. seismic surveys, pile driving, use of explosives, high intensity sonar operations, aircraft and ship noise, etc.) can cause detrimental effects to marine mammals. These effects can cause behavioral changes, mask communication sounds, exclude marine mammals from their habitat, and induce auditory injury or death (Southall *et al*. 2014; Pirotta *et al*. 2014; Verfuss *et al*. 2018). Marine mammals and turtles rely on sound to communicate and obtain information about their environment. There is growing concern about the effect of increasing ocean noise levels due to anthropogenic sources on marine organisms, particularly marine mammals. Specific effects of noise exposure on marine organisms can be characterized by the following physical and behavioral responses (Richardson *et al*. 1995):

1. Behavioral reactions such as startle responses, changes or interruptions in feeding, diving, or respiratory patterns, cessation of vocalizations and temporary or permanent displacement from habitat.
2. Reduction in ability to detect communication or other relevant sound signals below elevated levels of background noise.
3. Temporary and fully recoverable reduction in hearing sensitivity caused by exposure to sound.
4. Permanent, irreversible reduction in hearing sensitivity due to damage or injury to ear structures caused by prolonged exposure to sound or temporary exposure to very intense sound.
5. Effects of sound exposure on tissues in non-auditory systems either through direct exposure or as a consequence of changes in behavior, (*e.g.*, resonance of respiratory cavities or growth of gas bubbles in body fluids).

OGVs produce sound at frequencies from 20-10,000 Hz. Blue, humpback, sei, sperm, and fin whales are all known to be sensitive to sounds within the frequency ranges of OGV noise. Blue whales vocalize at frequencies between 12.5-200 Hz (Au 2000). Sperm whales produce loud broad-band clicks from about 100 Hz to 20,000 Hz (Weilgart 2007; Goold and Jones 1995). None of the noise associated with OGV activity is expected to reach levels that would potentially cause direct physical injury *(i.e.,* ear drum damage) to marine mammals but all OGV-related noise is continuous, and has the potential to result in some type of behavioral disturbance or harassment, including displacement, site abandonment (Reeves and Whitehead 1997; Bryant *et al*.1984), and masking (Richardson *et al*. 1995). These disturbances could cause minor, short-term displacement and avoidance behaviors, alteration of diving or breathing patterns, and less responsiveness when feeding. Vessel noise can also cause acoustically induced stress (Miksis-Olds *et al*. 2018; NRC 2003), which can cause changes in hear rate, blood pressure, and gastrointestinal activity. Stress can also involve activation of the pituitary-adrenal axis, which stimulates the release of more adrenal corticoid hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987, Rivest and Rivier 1995) and altered metabolism (Elasser *et al*. 2000), immune competence (Blecha 2000) and behavior.

OGVs will produce sound frequencies in the hearing range of blue, fin, sei, sperm, and humpback whales. The sound pressures levels will be transient and will attenuate to background ambient sound levels a short distance from the OGV; however, even transient noise can affect the ability of whales to communicate, especially when whales may be far apart from each other. Individuals may react to noise generated, or the presence of, OGVs by changing the direction of their movements, decreased communication, or increasing their swimming speed. These reactions could increase an individuals' energy budget. Consequently, the effects of noise are likely to be temporary but recurring. As a result, we anticipate that blue, fin, sei, sperm, and humpback whales will alter their behavior as a result of noise occurring from OGV traffic, but these behavioral effects will be minor and transitory, and won't result in physical injury or mortality of any whales.

Veirs *et al*., 2016, found that noise from large ships extends into frequencies used by SRKW for echolocation. This means that vessels can impair the whales' ability to find food and interact with each other. Recent evidence indicates there is a higher energetic cost of surface-active behaviors and vocal effort resulting from vessel disturbance (Williams *et al*. 2006; Noren *et al*. 2012; Noren *et al*. 2013; Holt *et al*. 2015). Holt et al. (2021a) found that the probability of capturing prey for SRKW increased as salmon abundance increased, but decreased as vessel speed increased. SRKW made longer dives to capture prey and descended more slowly during these foraging dives while vessels emitted navigational sonar, Whales descended more quickly when noise levels were higher and vessel approaches were closer. Further, Holt et al. (2021b) found a sex and vessel distance effect on these foraging dives, suggesting that females and males respond differently to nearby vessels with female killer whales at greater risk to close approaches by vessels. These studies provide evidence of behavioral responses by SRKW resulting from vessels and noise.

SRKW are known to forage off the Columbia River plume (i.e., within the action area). Numerous studies have documented the importance of Columbia River salmon populations

(Chinook salmon, in particular) to SRKW in the action area (Zamon *et al*. 2007; Ward *et al*. 2013; Hanson *et al.* 2021; Couture *et al*. 2022). The NEXT facility's increased tanker traffic (about 171 OGVs per year) would add about one additional vessel to the action area every other day. This increases the likelihood that SRKW will encounter noise from these vessels when the whales are in the area. Thus, the likelihood of OGVs disturbing SRKW feeding and communication is reasonably likely. Although none of the noise generated from NEXT-associated ships is expected to cause direct physical injury (i.e. eardrum damage), NMFS concludes that the proposed action will result in periodic harm to SRKW in the action area. Thus, noise from OGVs is likely to adversely affect individual SRKW over the course of the 50-year NEXT facility operation by disrupting their ability to find and obtain prey in known foraging habitat.

Sea turtles are thought to be far less sensitive to noise effects than marine mammals. Leatherback sea turtles may be exposed to potentially disturbing levels of sound during OGV transit. Temporary, short-term behavioral effects, such as decreased ability to monitor its acoustic environment, cause habituation, or sensitization (decreases or increases in behavioral response) (Piniak *et al.*, 2012), during OGV transit are possible. However, a single individual's exposure to OGV noise is likely to be transient, as all of the turtles in the action area are migratory, and a single individual is not likely to be within the zone of impact year-round. Thus, effects to turtles from noise is insignificant.

Wetland mitigation

The wetland mitigation site will restore approximately 466.1 acres of wetlands and waterways southwest of the proposed facility approximately 0.25 miles south of the impact area on approximately 590 acres that will be owned by the applicant (ELS 2023). Waterway impacts will be mitigated at this site by creating dendritic channels within the restored wetlands. The mitigation plan objective is to offset permanent impacts to wetlands and waterways by restoring hydrology and vegetation at the mitigation site to improve wetland functions. Restoration actions will include riparian plantings with native plants. Wetland mitigation is not anticipated to appreciably benefit or negatively impact the listed species considered in this opinion as there is no planned surficial connection to waterways where these species occur.

2.5.2 Effects on Critical Habitat

As mentioned in Section 2.2, portions of the action area include designated critical habitat for each of the 13 ESA-listed ESUs/DPSs of salmonids within the LCR, the southern DPS of green sturgeon, the southern DPS of eulachon, SRKW, two DPSs of humpback whale, and leatherback turtles. Critical habitat has not been designated for the following species: blue whale, fin whale, sei whale, and sperm whale. Critical habitat includes Physical and Biological Features (PBFs) necessary to support various life stages of salmonid and non-salmonid listed species (i.e., rearing, migration). NMFS reviews effects on critical habitat affected by a proposed action by examining how the PBFs of critical habitat would be altered, and the duration of such changes.

Effects to habitat features include enduring impediments to migration, increased predation, decreased forage opportunities (i.e., prey), and diminishment of water quality upon juvenile salmonids and eulachon, and diminished prey and water quality upon green sturgeon. Timing, duration, and intensity of the effects on critical habitat are considered in the analysis below.

Effects on critical habitat for salmonids, eulachon, and green sturgeon

Three of the six PBFs established for salmonid critical habitat are present in the action area. Those PBFs are:

1. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

2. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner.

3. Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

All three of the PBFs established for the southern DPS of eulachon are present within the action area. Those PBFs are:

1. Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles.

2. Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted.

3. Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter, 2000; WDFW and ODFW, 2001), unidentified malacostracans (Sturdevant, 1999), cumaceans (Smith and Saalfeld, 1955) mysids, barnacle larvae, and worm larvae (WDFW and ODFW, 2001).

Critical habitat for green sturgeon extends within about 25 miles of the proposed NEXT facility. Three freshwater PBFs established for green sturgeon are present in the action area:

1. Abundant prey items for larval, juvenile, subadult, and adult life stages.

2. Water quality, including temperature, salinity, oxygen content, and other chemical characteristics necessary for normal behavior, growth, and viability of all life stages. Suitable water quality would also include water containing acceptably low levels of contaminants. Water with acceptably low levels of such contaminants (i.e., pesticides, organochlorines, elevated levels of heavy metals, etc. would protect green sturgeon from adverse impacts on growth, reproductive development, and reproductive success.

3. Sediment quality (i.e., chemical characteristics) necessary for normal behavior, growth, and viability of all life stages. This includes sediments free of elevated levels of contaminants (e.g., selenium, polyaromatic hydrocarbons (PAHs), and organochlorine pesticides) that may adversely affect green sturgeon. Based on studies of white sturgeon, bioaccumulation of contaminants from feeding on benthic species may adversely affect the growth, reproductive development, and reproductive success of green sturgeon.

Noise

Underwater noise will disrupt normal migration routes of juvenile salmonids and eulachon. Thus, underwater noise will affect PBF #1, #2, and #3 for all salmonid ESUs/DPSs and PBF #1 and #2 for eulachon. Fish can detect and respond to underwater sound greater than 150 dB by altering their behavior, including delaying migration and increasing their susceptibility to predation (NMFS 2023a). Noise from ships and barges off-loading equipment in preparation for construction are temporary but would occur periodically until construction is complete (one to two years). This would occur whenever vessels moor or travel from the NEXT facilities to deliver and remove construction related equipment. Enduring effects of underwater noise would result from about 171 ships and barges to the NEXT facility to process biofuel for at least the next 50 years (the anticipated life of the facility). The effects may include the onset of behavioral disturbances such as acoustic masking (Codarin *et al*., 2009), startle responses and altered swimming (Neo *et al*., 2014), abandonment or avoidance of the area of acoustic effect (Mueller, 1980; Picciulin *et al*., 2010; Sebastianutto *et al*. 2011; Xie *et al*. 2008) and decreased pursuit of prey and increased vulnerability to predators (Simpson *et al*., 2016).

Migration obstruction

The presence of barges or ships at the dock will increase over-water shade impairing critical habitat for all salmonid ESUs/DPSs and the sDPS of eulachon. Thus, over-water shade will affect PBF #1, #2, and #3 for all salmonid ESUs and PBF #1 and #2 for eulachon. Shade effects on fish are well known. The moored vessels would create areas of cover that decrease water velocity and create shade. Shade from the moored vessels can delay migration of juvenile salmonids as individual fish will stall active migration when confronted with over-water shade and deeper water (Heiser and Finn, 1970; Able *et al*., 1998; Simenstad, 1988; Southard *et al*., 2006; Toft *et al*., 2013). One consequence of juvenile salmon avoiding over-water vessels is that some of them will swim around the structure (Nightingale and Simenstad, 2001). Swimming around structures lengthens the migration distance and is correlated with increased predation (Faler *et al*., 1988; Isaak and Bjornn, 1996; Martinelli & Shively, 1997; Carrasquero, 2001; Tabor *et al*., 1993).

The moorage of ships and barges would coincide with juvenile salmonid and eulachon presence, and it is likely to disrupt normal fish behavior. Harm to this PBF would result from about 171 ships or barges moored at the NEXT facility to process biofuel for at least the next 50 years (the anticipated life of the facility). Most individual juvenile salmonids will delay their migrations but will ultimately pass the moored vessels. We anticipate that tens of thousands of individual juvenile salmon, and egg and larval life history stages of eulachon will be consumed by lie-in-wait predators associated with moored vessels over the duration of NEXT facility operations lasting 50 years or longer. Therefore, we expect that moorage at the NEXT facility would affect the value or function of the migration and predation PBFs for salmonids and eulachon within the action area.

Water Quality

Water quality is an essential element of the PBFs of salmonid, eulachon, and green sturgeon. The water quality effects from wastewater and stormwater are expected to affect the critical habitat of all ESUs/DPSs of salmonid species (PBFs #1, #2, and #3), eulachon (PBFs #1, #2, and #3), and green sturgeon (PBFs #1, #2, and #3). The proposed permit would authorize the NEXT facility to develop a new biofuel processing plant on approximately 122.5 acres. Effects to water quality due to construction and operations can include the generation of turbidity and releases of contaminated stormwater and wastewater, which would include PAHs, 6PPD-Q, heavy metals, herbicides, and other toxic chemicals.

Turbidity - Temporary and localized increases in turbidity are expected in the immediate vicinity of the NEXT facility during initial construction activities (one to two years). However, the contractor will be responsible for monitoring turbidity levels at the point of compliance (300 ft. from activity) as a condition of the Section 401 Water Quality Certification. As a result, the area of effect from construction runoff will be far more localized than the entirety of the action area and will minimize potential impacts. As the currents within the mainstem LCR are swift, turbidity would likely disperse quickly and the function of this PBF element would rapidly return to its existing condition for salmonids and eulachon.

Releases of contaminated stormwater and wastewater - The NEXT facility would produce and route wastewater and stormwater containing toxic chemicals, which are not completely removed by treatment processes. Wastewater would be collected and, once treated, the wastewater and stormwater would be comingled and processed prior to entering the NEXT wastewater collection system. Stormwater runoff will be routed by sheet flow through multiple drainage ditches, waterways, and constructed wetlands. Both wastewater and stormwater would be released into McLean Slough and ultimately routed to the Columbia River. Incompletely treated discharge would be released continuously throughout the year. Wastewater and stormwater discharges would include petroleum hydrocarbons, PAHs, total suspended sediments, heavy metals, 6PPD-q, and glyphosate. Effects could occur in the water, sediments, and most can bioaccumulate in fish and their prey.

Contaminants in sediments and dissolved in-water can have varying levels of toxicity in fish, and the discharge (wastewater) and recurring suspension (stormwater) of these contaminants would degrade the water quality PBF for salmonids, eulachon, and green sturgeon for the time that these toxins were resuspended within large concentrations in the water column. Concentrations of chemicals in suspension would vary with the specific chemical and timing of release. Fall freshets are likely to carry the highest concentration of chemicals released due to stormwater, whereas wastewater discharge would likely be continuous throughout the life of the NEXT facility, an estimated 50 years. Therefore, we do not anticipate that contaminants in the water column would return to pre-NEXT facility levels. Additionally, some contaminants will accumulate in the benthos, which will impair forage opportunities of green sturgeon into their designated critical habitat, 25 miles downstream of the NEXT facility. The swift currents of the Columbia River will likely disperse some chemicals in the water column as they drift downstream, and some will accumulate in substrates. Degraded water quality associated with this PBF element will persist into the foreseeable future.

Herbicide applications - Surface water contamination with herbicides will occur when herbicides are applied intentionally or accidentally into ditches, irrigation channels or other bodies of water, or when soil-applied herbicides are carried away in runoff to surface waters. Under the proposed action, some formulas of herbicide can be applied within the bankfull elevation of ponds and waterways, in some cases up to the water's edge. Any juvenile salmonid or larval eulachon adjacent to the NEXT facility outfalls are more likely to be exposed to herbicides as a result of overspray, inundation of treatment sites, percolation, surface runoff, or a combination of these factors. Stehr *et al.* (2009) found that the low levels of herbicide delivered to surface waters are unlikely to be toxic to the embryos of ESA-listed salmonids. However, mortality or sub-lethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior are likely to occur. The degradation of herbicides is expected to occur prior to reaching green sturgeon critical habitat downstream. Due to the swift current within the LCR, herbicides would likely disperse quickly within the water column, returning this PBF element to its existing condition in a short period of time and in a short distance from the outfall.

Water quality summary - The enduring diminishment of water quality include the chronic and system-wide introduction and extended existence of contaminants from wastewater and stormwater. Increased levels of PAHs, oils, 6-PPD-Q, and other contaminants will be widely dispersed, and can have detrimental effects at very low levels of exposure either directly or indirectly through the consumption of prey contaminated by their own exposure in the water column. This will impair the value of critical habitat for growth and maturation of each of the 13 salmonid ESUs/DPSs, sDPS eulachon, and sDPS green sturgeon. Accordingly, we consider the combined effects of temporary and enduring effects on water quality will create an incremental and chronic diminishment of the water quality PBF for all of the listed species with designated critical habitat in the Columbia River portion of the action area, throughout the new useful life of the NEXT facility (about 50 years).

Effects on critical habitat for SRKW, humpback whales and leatherback turtles

NMFS identified three PBFs essential for the conservation of SRKW:

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.

3. Passage conditions to allow for migration, resting, and foraging.

NMFS identified one PBF for the two DPSs of humpback whale and leatherback turtles.

1. Essential prey resources.

Oceanic biofuel or feedstock spill risk - An actual large spill would affect water quality and prey resources in the vicinity of a spill that could indirectly affect SRKW, humpback whales, and leatherback turtles through ingestion of toxics directly through the water column or through contaminated prey. Therefore, the proposed action indirectly adversely affects SRKW PBFs #1 and #2, and humpback whale and leatherback turtle PBF #1 by incrementally increasing biofuel or feedstock spill risk in the action area. The addition of about 171 vessels by NEXT-associated ships and barges in the action area increases the probability of an oil spill. However, the overall risk of a spill is very low. Further, the toxicity of biofuels is far less than crude oil and it disperses more quickly. We conclude that the risk to SRKW PBFs #1 (water quality) and #2 (prey resources), and humpback whale and leatherback turtle PBF #1 are minor.

Vessel noise - Vessel noise associated with the proposed action directly affects SRKW PBF #2 (prey resources) and PBF #3 (passage conditions), and humpback whale PBF #1 (prey resources). The impacts to prey resources are through acoustic masking. SRKW and humpback whales produce a wide variety of clicks, whistles, and pulsed calls (Schevill and Watkins 1966, Ford 2009, Thomsen *et al*. 2001) that are used for communication among individuals. Viers *et al*. (2015) found that noise from large ships extends into frequencies used by SRKW and humpback whales for echolocation. Vessel noise and the physical presence of ships can interrupt SRKW and humpback whale movement, communication, and feeding efficiency. We expect that NEXT tanker traffic would cause high stress and disturbance to feeding because NEXT-associated ship traffic disturbance coincides with whale presence. Therefore, vessel noise adversely affects critical habitat PBF #2 (prey resources) and PBF #3 (passage conditions), but does not adversely modify critical habitat. Vessel noise is not anticipated to diminish leatherback turtle critical habitat.

For SRKW, discharge events from stormwater and wastewater would reduce quality and quantity of prey including juvenile Chinook salmon (PBF #2). As PS Chinook salmon are a PBF of SRKW critical habitat, their repeated/chronic exposure to contaminants in successive cohorts, directly through diminished water quality, and via contaminated prey, both described above, results in a diminishment of the forage PBF of SRKW critical habitat. Both quantity and quality of prey will slightly decline as a result of impacts to water quality, as these effects are likely to cause latent health effects on salmon that slightly reduce adult abundance, and also reduce the quality of adult salmon that do return and serve as SRKW prey, due to bioaccumulated contaminants.

Given the total quantity of prey available to SRKWs throughout their range numbers in the millions, the reduction in prey related to short-term construction effects from the proposed action is extremely small. Therefore, NMFS anticipates that the short-term reduction of Chinook salmon from temporary effects would have little effect on SRKWs. However, episodic and enduring declines of SRKW's prey as a result of the proposed action is also expected. Sufficient quantity, quality, and availability of prey are an essential feature of the critical habitat designated for Southern Residents. Increasing the risk of a permanent reduction in the quantity and availability of prey, and the likelihood for local depletions in prey populations in multiple locations over time, reduces the conservation value of critical habitat for SRKWs.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation [50 CFR 402.02]. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of Rangewide Status of the Species and Critical Habitat section (Section 2.2).

However, it is reasonably certain that over the operational life of the project, that climate effects such as modified water temperatures, altered river hydrograph, and shifting salinity will collectively exert additional influence on habitat quality and reduce carrying capacity. NMFS expects State and private activities near and upriver from the proposed action will contribute to cumulative effects in the action area. Therefore, our analysis considers 1) effects caused by specific future non-federal activities in the action area; and 2) effects in the action area caused by future non-federal activities in the Columbia basin.

Future upland development activities lacking a federal nexus are expected to result in increased pollution-generating impervious surface, runoff, and non-point source discharges. Human population growth in Clark and Multnomah Counties are likely to remain high, which will require greater infrastructure development to support and sustain this trend. State, county, and city regulations should minimize and mitigate for the adverse effects of this development so that the overall environmental quality of the action area remains constant, albeit degraded relative to its restored condition.

The legacy of resource-based industries (e.g., agriculture, hydropower facilities, timber harvest, fishing, and metal and gravel mining) caused long-lasting environmental changes that harmed

ESA-listed species and their critical habitats. Stream channel morphology, roughness, and cover, estuarine rearing habitats, wetlands, floodplains, riparian areas, water quality, fish passage, and habitat refugia have been degraded throughout the LCR basin. Those changes reduce the ability of populations of ESA-listed species to sustain themselves in the natural environment by altering or interfering with their behavior in ways that reduce their survival throughout their life cycle.

While widespread degradation of aquatic habitat associated with intense natural resource extraction is no longer common, ongoing land management actions are likely to continue to adversely affect the estuary and delay natural recovery of aquatic habitat in the CR basin including the action area. This trend is somewhat countered by non-federal aquatic habitat restoration occurring in the LCR. The Lower Columbia River Estuary Partnership has over 100 regional partners in the LCR and has completed 284 projects with a total of 35,342 acres of habitat restored (LCREP, 2024). Projects include land acquisitions and conservation easements, adding large logs to streams to create fish habitat, planting trees to shade and cool streams, and removing barriers to fish passage. Still, when considered together, the net cumulative effects are likely to have an adverse effect on ESA-listed fish within the action area.

We are reasonably certain that the States of Washington and Oregon will continue to issue and renew NPDES permits to public and private applicants to discharge stormwater and wastewater to tributaries of the Columbia River and to the Columbia River. These permits add contaminants to the lower Columbia River and estuary that are similar or the same as the contaminants discussed above. Likewise, state, local and private parties will continue to increase the area of impervious surfaces that create stormwater that ultimately enters the Columbia River. Ports and industrial facilities on the Columbia River will continue to import and export products delivered by OGVs, which will cause juvenile salmon to be killed on wake wave stranding beaches on the Columbia River and cause marine mammals and turtles to be struck and injured or killed in the Pacific Ocean.

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

2.7.1 ESA Listed Species – Integration and Synthesis

Salmon and steelhead

Eleven of the salmon and steelhead species addressed by this consultation are "threatened." Upper Columbia River spring-run Chinook salmon, and Snake River sockeye salmon are "endangered". The status of the constituent populations range from very high risk to moderate risk of extirpation. The total abundance of all salmon and steelhead species is very low relative to historical levels. Their historic range and spatial structure is curtailed or modified. Multiple limiting factors prevent natural fish production from significantly increasing productivity, abundance and diversity.

The environmental baseline includes developed urban areas, land use practices, degraded estuarine and nearshore habitat, degraded floodplain connectivity and function, altered streamflow and channel complexity, reduced large wood and substrate recruitment, predation, contaminants, and OGV wake wave stranding. The proposed NEXT facility would likely operate for decades. Climate change is likely to include greater variability in Pacific Northwest river systems, more frequent droughts, larger floods and higher temperatures. Estuaries and oceans will have higher water temperatures, decreased salinity and increased acidity. The (non-federal) cumulative effects in the coming decades are expected to be incrementally negative for habitat conditions, even when recovery actions are considered, based on the widespread costs of degradation relative to the local benefits of restoration.

We added the effects of the proposed action on species and habitat to determine the likely changes in abundance, productivity, spatial structure, and genetic diversity of the affected species and the implication for species viability. Endangered UCR spring-run Chinook salmon and SR sockeye salmon along with threatened SR spring/summer-run Chinook salmon, SR fall-run Chinook salmon, MCR steelhead, UCR steelhead and SRB steelhead will pass through the action area as larger juveniles, use a greater variety of (deeper) habitats, and swim faster than fish that originate in the Lower Columbia River and Willamette River. Still, all salmon species will be affected by the persistent moorage-associated effects of the proposed action, and all species of salmonids, eulachon, and green sturgeon will be affected by the water quality impairments resulting from the NEXT facility. Salmonid fry typically originating from the Willamette and lower Columbia rivers and eulachon larvae and eggs will be subjected to increased wake stranding effects. LCR and UWR Chinook, LCR and WR steelhead, LCR coho and CR chum salmon rely more on the shallow water in the action area and thus have more exposure to the effects of the action, including noise and migration obstruction. The increase in LCR contaminant mass from NEXT wastewater and stormwater outfalls and the increase in wake wave stranding from the OGVs carrying feedstocks to or product from the NEXT facility, added to the environmental baseline and cumulative effects, is likely to reduce the current abundance of SR, CR and UWR salmonid ESU/DPSs, sDPS eulachon, and sDPS green sturgeon.

Columbia River estuary critical habitat has high conservation value because of the critical function it serves to species using it for migration to and from spawning areas and for rearing. The critical habitat quality and quantity is limited by water quality, altered hydrology, lack of floodplain connectivity and shallow-water habitat, and lack of complex habitat to provide forage and cover. Most adverse effects to the quality and function of critical habitat PBFs from this project will take place in a small part of the Columbia River. The effects on water quality from stormwater and wastewater contaminants that escape drainage ponds will accumulate and persist for decades. This adverse effect to water quality does not substantially alter the function of the critical habitat at the action area scale, or at the 5^{th}-level HUC scale.

Marine mammals and turtles
The proposed action affects Central America and Mexico humpback, blue, fin, sperm, and sei whale species (collectively referred to as large whale species) with incrementally increased ship strike risk and SRKW with increased noise. In the Effects of the Action section, we assessed each of these risks individually in light of each species' status in the action area, its range, abundance, life history characteristics, trajectory for recovery, key limiting factors, etc., and vulnerability to the risks. Those analyses were based heavily on information from the species' listings, recovery plans, and 5-year status reviews, if available. Individually, we found that each pathway of effect did not present a significant risk to the population of whales, although some individual large whales are likely to be directly affected as a result of ship strikes and SRKW affected as result of noise in the action area.

For all of the large whale species, ship strikes are identified as threats to varying degrees. For the coastal species, blue whales, humpback whales, and fin whales are most susceptible to ship strikes. For SRKW, vessel noise is identified as a threat. Although effects to individual whales is likely, we found that increased vessel strike risk to large whales and increased vessel noise risk to SRKW within the action area would likely not have bearing on the population trends of these whales, primarily because all of these listed whale species are sparsely distributed in the action area (or the relative numbers of individuals that frequent the action area is small in proportion to the respective populations (e.g. Mexico DPS humpbacks) and the action area is a very small portion of whales' range. Taking all of these threats together, in light of the status of each species, the environmental baseline, the effects of the action, and cumulative effects, we conclude that the proposed action does not appreciably reduce the likelihood of both the survival and recovery of the listed large whale species.

The proposed action results in periodically increased risk of vessel collisions to leatherback turtles. Climate change will continue to threaten leatherbacks with episodic, recurring events in the action area (e.g., ocean cycles, climate change, storms, and natural mortality) will continue to influence leatherback sea turtles and may increase in frequency and/or severity as has been observed in recent years. Cumulative effects associated with increasing human population will also continue to affect leatherbacks (e.g. water quality degradation, increased boating). Because leatherback turtles occur in low abundance in the action area, the limited exposure of individual leatherback turtles to the adverse effects of the proposed action presents an extremely small additional risk the western Pacific leatherback sea turtle population. Given the best available information, we conclude that the proposed action is likely to harm individual leatherback turtles, but is not likely to appreciably reduce the likelihood of survival or recovery of this species at the global scale (and at the West Pacific population scale). This conclusion is made in consideration of the environmental baseline, status of the species, direct and indirect consequences of the proposed action, together with cumulative effects.

2.7.2 Critical Habitat – Integration and Synthesis

Salmon, steelhead, eulachon, and green sturgeon
The environmental baseline for CR, SR, and WR salmon critical habitat in the action area is degraded, primarily from water quality impacts from human development and extensive shoreline armoring on the Columbia River basin. Climate change presents a great threat to the

condition of the riverine and estuarine habitat, as sea level rise and hydrology changes to the basin could bring further loss of shoreline habitat and result in additional shoreline armoring. As described in detail in Section 2.5, the tangible effects of the project on salmonid, eulachon, and to a lesser extent, green sturgeon critical habitat are minor. These include ship noise, migration obstructions, and contaminants (PAHs, 6PPD-Q, heavy metals, herbicides, and other toxic chemicals). Together the effect of the action, when added to the environmental baseline and cumulative effects, does not appreciably diminish the value of critical habitat for the conservation of CR, SR, or WR salmonids. We draw the same conclusions for eulachon and green sturgeon. Despite degraded baseline conditions, uncertainty from climate change, and cumulative effects, the additive effects of the action do not appreciably diminish the value of critical habitat for the conservation of these designated critical habitats in the action area.

SRKW, Mexico and Central America humpback whale, leatherback turtle
The proposed action directly affects passage conditions for SRKW (SRKW PBF #3) from ship noise, and humpback whales and leatherback turtles (PBF #1) from increased ship strike in some years. The physical presence of ships can interrupt SRKW and humpback whale movement, communication, and feeding efficiency. The NMFS expects a general increase of OGV vessels to occur with the proposed action decreasing critical habitat for these species.

Stormwater and wastewater would reduce quality and quantity of prey for SRKW, including Chinook salmon (PBF #2). The repeated and chronic exposure to contaminants in successive juvenile Chinook salmon cohorts, directly through diminished water quality, and via contaminated prey, both described above, results in a diminishment of the forage PBF of SRKW critical habitat. Both quantity and quality of prey will slightly decline as a result of impacts to water quality and these effects are likely to slightly reduce adult salmon abundance, and also reduce the quality of adult salmon that do return and serve as SRKW prey, through bioaccumulated contaminants.

Considering the combined effects of the action together with baseline conditions and cumulative effects, we conclude that the proposed action will not appreciably diminish the value of designated or proposed critical habitat for the conservation of these species.

2.8. Conclusion

After reviewing and analyzing the current 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 cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of:

1. Lower Columbia River Chinook salmon
2. Upper Willamette River Chinook salmon
3. Upper Columbia River spring Chinook salmon
4. Snake River spring/summer Chinook salmon
5. Snake River fall Chinook salmon
6. Lower Columbia River coho salmon
7. Columbia River chum salmon
8. Snake River Sockeye salmon

9. Lower Columbia River steelhead
10. Middle Columbia River steelhead
11. Upper Columbia River steelhead
12. Upper Willamette River steelhead
13. Snake river Basin steelhead
14. Eulachon sDPS
15. Green sturgeon sDPS
16. Southern Resident killer whale
17. Humpback whale-Central America DPS
18. Humpback whale Mexico DPS
19. Leatherback sea turtle

or destroy or adversely modify their designated critical habitat.

After reviewing and analyzing the current status of the listed species, 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 cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of:

20. Blue whale
21. Fin whale
22. Sei whale
23. Sperm whale

Critical habitat has not been designated or proposed for blue whale, fin whale, sei whale, or sperm whale; therefore, none was analyzed.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

This incidental take statement (ITS) provides a take exemption for the action agency and applicant for any take caused by the effects of the action. For salmonids, green sturgeon, and eulachon, those effects include harm and injury caused by water quality impacts from stormwater and wastewater-associated contaminants, predation impacts from migration obstructions, and prey impacts from noise resulting from ships transiting the action area and moored at the NEXT facility, and injury and death caused by wake stranding.

This ITS provides take exemption for the action agencies and applicants for any incidental take caused by the consequences of the proposed action. This ITS does not include an exemption for incidental take of marine mammals caused by third party activities associated with OGV traffic, such as ship strikes for humpback, blue, fin, sperm, and sei whale species (collectively referred to as large whale species), and vessel noise for SRKW in the Pacific Ocean, from vessels arriving or departing from the NEXT facility. An exemption is not provided for the primary reason that the ESA does not allow NMFS to exempt incidental take of marine mammals unless a permit authorizing the take is requested and obtained under the MMPA.

2.9.1 Amount or Extent of Take

For incidental take of ESA-listed fish, take in the form of harm, injury and death cannot be accurately quantified as a number of individuals, because the presence, distribution, and abundance of the individuals in the action area is highly variable over time, and is influenced by factors that cannot be easily predicted, observed, or monitored. Additionally, the duration of exposure is highly variable based on species behavior patterns, and the wide variability in numbers exposed and duration of exposure creates a range of responses, many of which cannot be observed without research and rigorous monitoring. There is no practicable means to monitor for the number of fish taken through elevated sound levels, increased predation from obstructed migration, and reduced water quality. In these circumstances, we will identify an "extent" of take which is a habitat indicator that will serve as a surrogate for incidental take. The surrogate is proportionally and causally related to the amount of harm that would result, and each surrogate provided below may be effectively monitored for compliance and re-initiation purposes. Thus, they will serve as a meaningful reinitiation trigger.

In addition, the NEXT facility will increase vessel traffic on the Columbia River by up to 171 OGV round trips per year. In turn, the additional OGV trips are expected to proportionally increase wake stranding events and are expected to result in injury and death to juvenile salmonids and eulachon. At this time, there is limited understanding on the variables that contribute to wake stranding events and the limited data associated with wake stranding is considered insufficient to provide an exact take estimate. NMFS' analysis and no jeopardy determination is based on potential wake stranding assuming the maximum number of ship trips associated with the NEXT facility. NMFS is using the number of OGV trips (which translates to potential wake stranding incidents) as a surrogate for quantifying take consistent with 50 CFR § 402.14(i)(1)(i). Using OGV trips as a surrogate establishes a clear standard for determining when the level of anticipated take has been exceeded. For example, if the OGV round trips supported by the NEXT facility exceeds 171 per year then we expect that anticipated effects and resulting take would also be exceeded. Thus, even though the surrogate mirrors the maximum amount of assumed vessel traffic, it nevertheless functions as an effective check on the ongoing validity of the jeopardy analysis (which underpins the take exemption) because it is an annual measurement that can be monitored by the applicant. That means there is an opportunity each year to check whether the assumption of maximum 171 vessels round trips per year has been exceeded. Thus, we believe that OGV trips is an easily assessed, effective and reliable take surrogate that meets the legal standards as they relate to a reinitiation trigger.

For leatherback sea turtles, NMFS is using the same surrogate as for wake stranding, i.e., a maximum of 171 OGV round trips per year. This surrogate is causally linked to the incidental take because the risk of ship strikes increases as the number of vessel trips does. In addition, for the reasons set out above with respect to wake stranding, this surrogate establishes a clear standard for determining when the level of anticipated take has been exceeded and functions as an effective check on the ongoing validity of the jeopardy analysis, which underpins the take exemption.

For whales in this Opinion, the proposed action is reasonably certain to harm individual large whales by ship strikes and SRKW by noise due to vessel traffic associated with operation of the proposed action. The best available incidental take surrogate associated with shipping is the number of OGV round trips per year, i.e. a maximum of 171 OGV round trips per year. This surrogate is causally linked to the incidental take that will occur because an increase in vessel traffic translates into a proportional increase in the risk of ship strikes to these species. In addition, for the reasons set out above with respect to wake stranding, this surrogate establishes a clear standard for determining when the level of anticipated take has been exceeded and functions as an effective check on the ongoing validity of the jeopardy analysis, which underpins the take exemption. As explained in the introduction to this section, the ITS does not include an exemption for any future incidental take of marine mammals caused by third party activities associated with OGV traffic.

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur and the best available indicators for the extent of take are as follows:

1. Take in the form of harm of ESA-listed salmonids, green sturgeon, and eulachon[4] from underwater noise and migration obstruction during docking and mooring, at the NEXT facility by ships and tug boats with associated barges. The extent of take for underwater noise and migration obstruction for the NEXT facility is a total of 171 vessels annually. This surrogate indicator of take is both easily observable and causally linked to incidental take by hydroacoustic impacts, and physical presence of the vessels because the amount of take increases incrementally with each trip. It functions as meaningful reinitiation trigger because it can be readily monitored, thus reinitiation could be triggered at any time during the operation of the facility.

2. Take in the form of harm and injury of ESA-listed salmonids, eulachon,[5] and green sturgeon from diminished water quality due to water column suspension and benthic settlement of contaminants while discharging stormwater and wastewater. The extent of

[4] The NMFS has not yet promulgated an ESA section 4(d) rule prohibiting take of threatened eulachon. Anticipating that such a rule may be issued in the future, we have included a prospective incidental take exemption for eulachon. The elements of this ITS for eulachon would become effective on the date on which any future 4(d) rule prohibiting take of eulachon becomes effective. Nevertheless, the amount and extent of eulachon incidental take, as specified in this statement, will serve as one of the criteria for reinitiation of consultation pursuant to 50 C.F.R. § 402.16(a), if exceeded.
[5] Ibid.

take is the 72.6 acres of impervious surfaces created by the development of the NEXT catchment. This surrogate indicator of take is both easily observable and causally linked to incidental take by the amount of contaminated area because a larger area would likely increase the amounts of contaminated water and sediment, and expose more listed fish to this degraded habitat condition. It functions as an effective reinitiation trigger because it is a clear, measurable limit that is easily monitored for exceedance, so reinitiation could be triggered at any time during the operation of the facility.

3. Take in the form of death and injury of ESA-listed salmonids and eulachon due to wake stranding events, turtles and large whale species due to vessel strikes, and SRKW due to vessel noise from an increase in vessel traffic of 171 OGVs. The extent of take for wake stranding and OGV strikes is the number of vessels that will access the NEXT facility. In this case take will be exceeded if more than 171 vessels dock at the NEXT facility, As explained above, the ITS does not include an exemption for any future incidental take of marine mammals by third party activities associated with OGV traffic.

2.9.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" refer to those actions the Director considers necessary or appropriate to minimize the impact of the incidental take on the species (50 CFR 402.02). The USACE shall ensure that the applicant:

1. Minimize incidental take caused by vessel noise and migration obstruction,
2. Minimize incidental take caused by contaminants released from stormwater and wastewater, and
3. Monitor and report the vessel use of the facility and NEXT- associated contaminants in discharge.

2.9.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

The following terms and conditions implement reasonable and prudent measure 1:

1. Require the applicant to limit the length of time that ships and tugboats run their engines at the Port Westward dock to the minimum necessary to safely moor and disembark from the dock.
2. Require the applicant to record the number of vessels that moor and off-load feedstock and load biofuel from the NEXT facility and limit those vessels to 171 ships/barges annually.

The following terms and conditions implement reasonable and prudent measure 2:

1. Require the applicant to verify the total acreage of pollution-generating impervious surfaces (PGIS) created at the facility;
2. Report the final area of new PGIS.

The following terms and conditions implement reasonable and prudent measure 3:

1. Require the applicant to submit annual monitoring and construction reports to NMFS at the end of each calendar year, including reporting the number of vessels that accessed the NEXT facility and the acreage of impervious surfaces draining to the NEXT catchment during the calendar year. Send reports to:

   projectreports.wcr@noaa.gov
   Reference Project No.: WCRO-2023-00488
   cc: david.price@noaa.gov

2.10. Reinitiation of Consultation

This concludes formal consultation for the NEXT Renewable Fuels, Oregon, LLC Renewable Green Fuels Facility.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

2.11. "Not Likely to Adversely Affect" Determinations

This assessment was prepared pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402 and agency guidance for preparation of letters of concurrence. As described in Section 2 or below, the applicant's BA had concluded that the proposed action would have no effect or is not likely to adversely affect the following species (Table 8):

Table 8. NMFS' disposition of species determined by the USACE as "may affect, not likely to adversely affect".

Species	USACE species determination	USACE critical habitat determination	NMFS species determination	NMFS critical habitat determination	Further described
sDPS Green sturgeon	NLAA	NE	LAA	LAA	Section 2, above
sDPS Eulachon	NLAA	NLAA	LAA	LAA	Section 2, above
Southern resident killer whale	NLAA	NLAA	LAA	LAA	Section 2, above
Western North Pacific gray whale	NLAA	N/A	NLAA	N/A	Section 3, below
North Pacific right whale	NLAA	NLAA	NLAA	NLAA	Section 3, below
Green sea turtles	NLAA	N/A	NLAA	N/A	Section 3, below
Loggerhead turtles	NLAA	N/A	NLAA	N/A	Section 3, below
Olive ridley sea turtles	NLAA	N/A	NLAA	N/A	Section 3, below
Guadalupe fur seals	NLAA	N/A	NLAA	N/A	Section 3, below

The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. The effects analysis in this section relies heavily on the descriptions of the proposed action and project site conditions discussed in Sections 1.3 and 2.4, and on the effects analysis presented in Section 2.5.

Gray whales – Western North Pacific DPS

Western North Pacific gray whales (*Eschrichtius robustus*) feed during summer and fall in the Okhotsk Sea off northeast Sakhalin Island, Russia, and in the Bering Sea off southeastern Kamchatka (2020 Stock Assessment Report). The Western North Pacific gray whales are rare, with a population estimate of only 290 individuals (2018 Stock Assessment Report). Recently, information from tagging, photo-identification, and genetic studies show that Western North Pacific gray whales have been observed migrating in the winter to the eastern North Pacific off the outer coast of North America from Vancouver, B.C to Mexico (Lang 2011, Mate *et al.* 2011, Weller *et al.* 2012). Although there is potential for Western North Pacific gray whales to occur in the action area, the available data on their migration patterns and low abundance indicate their occurrence is rare.

Due to the rare occurrence of Western North Pacific gray whales in the action area, it is extremely unlikely there would be an interaction between Western North Pacific gray whales and OGVs from the NEXT facility. Therefore, the risk of ship strikes and effects from vessel sound on Western North Pacific gray whales is discountable.

North Pacific right whales

North Pacific right whales (*Eubalaena japonica*) are rarely found off the U.S. West Coast and have primarily been documented foraging in the Bering Sea and the Gulf of Alaska, where critical habitat was designated in 2006. Due to the rare occurrence of North Pacific right whales in the action area it is extremely unlikely there would be an interaction between North Pacific right whales and OGVs from the NEXT facility. Therefore, the risk of ship strikes and effects from vessel sound on North Pacific right whales is discountable.

Green sea turtle- East Pacific DPS

Green sea turtles (*Chelonia mydas)* use open ocean convergence zones and coastal areas for benthic feeding of macroalgae and sea grasses. There are no known resting areas along the U.S. West Coast. In the eastern North Pacific, green sea turtles commonly occur south of Oregon, but have been sighted as far north as Alaska (NMFS and USFWS 1998b). Stranding reports indicate that the green sea turtle appears to be a resident in waters off San Diego Bay, California (NMFS and USFWS 1998b) and in the San Gabriel River and surrounding waters in Orange and Los Angeles counties, California. Although there is potential for green sea turtles to occur along the Washington and Oregon coasts, available data indicate that occurrence is likely to be rare in the action area. Due to the rare occurrence of green sea turtles in the action area it is extremely unlikely there would be encounters between green sea turtles and OGVs and that the risk of ship strikes is discountable. Therefore the proposed action is not likely to adversely affect green sea turtles.

Loggerhead sea turtles

Loggerhead sea turtles (*Caretta caretta)* inhabit continental shelves, bays, estuaries, and lagoons in the Atlantic, Pacific, and Indian Oceans (NMFS and USFWS 1998c). On the U.S. West Coast, most sightings of loggerhead turtles are of juveniles. Most sightings are off California; however there are also a few sighting records from Washington and Alaska (Bane 1992). There are no known resting areas along the U.S. West Coast. Although there is potential for loggerhead sea turtles to occur along the Washington and Oregon coasts, available data indicate that occurrence is likely to be rare in the action area. Therefore, the risk of ship strikes is discountable and the proposed action is not likely to adversely affect loggerhead sea turtles.

Olive Ridley sea turtles

Olive ridley sea turtles (*Lepidochelys olivacea)* have a mostly pelagic distribution, but they have been observed to inhabit coastal areas. They are the most common and widespread sea turtle in the eastern Pacific. On the U.S. West Coast, they primarily occur off California although stranding records indicate olive ridley turtles have been killed by gillnets and boat collisions in Oregon and Washington waters (NMFS and USFWS 1998d). In the eastern Pacific, nesting largely occurs off southern Mexico and northern Costa Rica (NMFS and USFWS 1998d). Although there is potential for olive ridley sea turtles to occur along the Washington and Oregon coasts, available data indicate that occurrence is likely to be rare in the action area. Therefore, the risk of ship strikes is discountable and the proposed action is not likely to adversely affect olive ridley sea turtles.

Guadalupe fur seals
Guadalupe fur seals (*Arctocephalus townsendi)* occur primarily near Guadalupe Island, Mexico, their primary breeding area. As a non-migratory species, they are only occasionally found north of the U.S.-Mexican border and therefore, their encounter rate with marine vessels in the action area can be considered discountable. In addition, according to the NMFS Northwest Marine Mammal Stranding Network records, maintained by the NMFS Northwest Region, no human-caused Guadalupe fur seal mortality or serious injuries were reported from non-fisheries sources in 1998-2004. The lack of interactions with ships through reporting or the stranding network lead us to conclude that the exposure risk of collision from OGVs is discountable. Therefore the proposed action is not likely to adversely affect Guadalupe fur seals.

3. MAGNUSON–STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific Coast groundfish (Pacific Fishery Management Council (PFMC 2005, 2019), and Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction section to this document. The action area includes areas designated as EFH for various life-history stages of groundfish, and Chinook and coho salmon.

In addition, the project occurs within the Columbia River estuary, which is designated as a habitat area of particular concern (HAPC) (estuarine and seagrass) for various federally managed fish species within the Pacific Coast Salmon and Pacific Coast Groundfish FMP. HAPC are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under the MSA; however, federal projects with potential adverse impacts on HAPC will be more carefully scrutinized during the consultation process.

Two PFMC-managed salmon species are known to occur in the Columbia River and estuary: coho and Chinook salmon. In estuarine and marine areas, salmon EFH extends from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the exclusive economic zone (200 nautical miles) offshore of Washington (PFMC 2022). Within these areas, EFH consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and adult holding habitat.

As described in Section 2.4, the action area includes important juvenile rearing, and juvenile and adult migration habitat and for five Chinook salmon ESUs and one coho salmon ESU.

The overall extent of groundfish EFH for all FMU species is identified as all waters and substrate within the following areas:

- Depths less than or equal to 3,500 m (1,914 fm) to mean higher high water level (MHHW) or the upriver extent of saltwater intrusion, defined as upstream and landward to where ocean-derived salts measure less than 0.5 ppt during the period of average annual low flow.
- Seamounts in depths greater than 3,500 m as mapped in the EFH assessment geographic information system (GIS).
- Areas designated as HAPCs not already identified by the above criteria.

3.2. Adverse Effects on Essential Fish Habitat

Migratory Pathway Obstruction
The proposed mooring of NEXT facility-associated ships and barges at Port Westward would increase migratory pathways for outmigration of juvenile salmonids due to physical presence of new ships and barges up to 342 days per year. The presence of the ships and barges will contribute to migration delay of juvenile salmonids and increase piscine predators at the facility. Impairment of migratory pathways would persist for the duration of the facility's operation (at least 50 years).

Water Quality
The NEXT facility will produce and route wastewater and stormwater containing toxic chemicals, which are not completely removed by treatment processes. Discharge would be released continuously throughout the year. Runoff sources from the surrounding landscape would include bare soil, aggregate, asphalt, and concrete from multiple areas surrounding the main facility. Stormwater runoff will be routed by sheet flow through multiple drainage ditches, waterways, and constructed wetlands prior to release into the Columbia river. Contaminants would enter the rivers through wastewater and stormwater discharges and potential operations-related spills. Salmonids and groundfish can uptake contaminants directly through their gills and through dietary exposure. Many of the fuels, lubricants, and other fluids commonly used in

motorized vehicles and construction equipment are petroleum-based hydrocarbons that contain Polycyclic Aromatic Hydrocarbons (PAHs), which are known to be highly injurious to fish. Other contaminants can include 6ppd-Q, metals, pesticides, Polychlorinated Biphenyls (PCBs), phlalates, and other organic compounds. The LC50 (95 ng/L) for coho salmon suggests that 6PPD-Q is among the most toxic chemicals known for aquatic organisms. Depending on the pollutant, its concentration, and/or the duration of exposure, exposed fish may experience effects that can range from avoidance of an affected area, to reduced growth, altered immune function, and mortality.

The normal behaviors of juvenile Chinook and coho salmon in the freshwater out-migration phase of their life cycle include a strong tendency toward shoreline obligation, which means that they are biologically compelled to follow and stay close to streambanks and shorelines and the outfalls associated with the NEXT effluent discharge. Additionally, increased contaminant levels from discharge is likely to kill some prey organisms, reducing the number, size, and diversity of prey species that are available to foraging juvenile salmonids that pass through the affected area.

The extent to which toxic chemicals would reach the estuary from the NEXT facility and affect groundfish EFH depends on many factors that are impossible to fully characterize. However, many of these contaminants are long-lived and, over the life of the NEXT facility, it is reasonable that some contaminants would increase the level of toxins in the water and sediment, and decrease the quality of groundfish EFH, including HAPCs in the Columbia River estuary.

Based on information provided in the biological assessment, the analysis of effects presented here and in the ESA portion of this document, NMFS determined that the proposed actions would have adverse effects on EFH by creating new shoreline migration impairment and the reduction of in-water and sediment quality. Further, these effects are likely to persist for the duration of the NEXT facility operations, about 50 years.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH.

1. Monitor water quality at the discharge ports of the NEXT facility for toxic contaminants.
    a. Report results annually to NMFS
    b. Develop and implement action plans to contain and reduce the release of contaminants in Section 2.
2. Develop shoreline restoration actions that can be implemented by the applicant (or partnering restoration entity, such as LCREP or the LCFRB) to improve shoreline habitat in the Columbia River reach that will house the NEXT facility.
    a. Restoration actions should include a minimum of 300 ft of restored access to shoreline habitat to offset the length of ships that are proposed for moorage at the NEXT facility.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the USACE must provide a detailed response in writing to NMFS within 30 days after receiving an EFH conservation recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH conservation recommendations unless NMFS and the federal agency have agreed to use alternative time frames for the federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the conservation recommendations, the federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The USACE must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the USACE. Other interested users could include NEXT. Individual copies of this opinion were provided to the USACE. The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR part 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

5. REFERENCES

Able, K.W., J.P. Manderson, and A.L. Studholme. 1998. The distribution of shallow water juvenile fishes in an urban estuary: The effects of manmade structures in the lower Hudson River. Estuaries. 21:731-744.

Ackerman, N.K., 2002. Effects of wake stranding of juvenile salmonids in the lower Columbia River, 2002. A pilot study.

Adams, J., J. Felis, J.W. Mason, and J.Y. Takekawa. 2014. Pacific Continental Shelf Environmental Assessment (PaCSEA): Aerial Seabird and Marine Mammal Surveys off Northern California, Oregon, and Washington, 2011–2012. Bureau of Ocean Energy Management, Camarillo, CA.

Alizadeh, M.R., J.T. Abatzoglou, C.H. Luce, J.F. Adamowski, A. Farid, and M. Sadegh. 2021. Warming enabled upslope advance in western US forest fires. *P Natl Acad Sci USA*. 118.

Arkoosh, M. R., E. Clemons, M. S. Myers, and E. Casillas. 1994. Suppression of B-cell mediated immunity in juvenile Chinook Salmon (Oncorhynchus tshawytscha) after exposure to either a polycyclic aromatic hydrocarbon or to polychlorinated biphenyls. Immunopharmacology and Immunotoxicology 16:293–314.

Arkoosh, M.R., Casillas, E., Clemons, E., Kagley, A.N., Olson, R., Reno, P. and Stein, J.E., 1998. Effect of pollution on fish diseases: potential impacts on salmonid populations. Journal of Aquatic Animal Health, 10(2), pp.182-190.

Arkoosh, M. R., E. Clemons, P. Huffman, A. N. Kagley, E. Casillas, N. Adams, H. R. Sanborn, T. K. Collier, and J. E. Stein. 2001. Increased susceptibility of juvenile Chinook Salmon to vibriosis after exposure to chlorinated and aromatic compounds found in contaminated urban estuaries. Journal of Aquatic Animal Health 13:257–268.

Arkoosh, M., S. Strickland, A. Gaest, G. Ylitalo, L. Johnson, G. Yanagida, T. Collier, J. Dietrich. 2011. Trends in organic pollutants and lipids in juvenile Snake River spring Chinook salmon with different out-migrating histories through the Lower Snake and Middle Columbia Rivers. Science of the Total Environment 409: 5086-5100.

Au, W.W., 2000. Hearing in whales and dolphins: An overview. Hearing by whales and dolphins, pp.1-42.

Auer, S.K., R.D. Bassar, D. Turek, G.J. Anderson, S. McKelvey, J.D. Armstrong, K.H. Nislow, H.K. Downie, T.A.J. Morgan, D. McLennan, and N.B. Metcalfe. Metabolic rate interacts with resource availability to determine individual variation in microhabitat use in the wild. The American Naturalist. 196: 132-144.

Azzellino, A., S. Gaspari, S. Airoldi, and B. Nani. 2008. Habitat use and preferences of cetaceans along the continental slope and the adjacent pelagic waters in the western Ligurian Sea. *Deep-Sea Res Pt I*. 55:296-323.

Baldwin, D.H., J.A. Spromberg, T.K. Collier, and N.L. Scholz. 2009. A fish of many scales: extrapolating sub-lethal pesticide exposures to the productivity of wild salmon populations. Ecological Applications 19: 2004-2015.

Baldwin, D.H., Sandahl, J.F., Labenia, J.S. and Scholz, N.L., 2003. Sublethal effects of copper on coho salmon: Impacts on nonoverlapping receptor pathways in the peripheral olfactory nervous system. Environmental Toxicology and Chemistry, 22(10), pp.2266-2274.

Barlow, J. 2010. Cetacean abundance in the California Current from a 2008 ship-based line transect survey. 19.

Barlow, J. 2016. Cetacean Abundance in the California Current Estimated from Ship-based Line-transect Surveys in 1991–2014. Southwest Fisheries Science Center, La Jolla, CA. Administrative Report LJ-16-01. Southwest Fisheries Science Center, National Marine Fisheries Service 8604 La Jolla Shores Drive, La Jolla, CA 92037.

Barlow, J., J. Calambokidis, E.A. Falcone, C.S. Baker, A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Gabriele, R. LeDuc, D.K. Mattila, T.J. Quinn, L. Rojas-Bracho, J.M. Straley, B.L. Taylor, J. Urban, P. Wade, D. Weller, B.H. Witteveen, and M. Yamaguchi. 2011. Humpback whale abundance in the North Pacific estimated by photographic capture-recapture with bias correction from simulation studies. *Mar Mammal Sci*. 27:793-818.

Bauersfeld, K., 1977, Effects of peaking (stranding) of Columbia River dams on juvenile anadromous fishes below The Dalles Dam, 1974 and 1975: Report by the State of Washington Department of Fisheries, Olympia, Washington, for the U.S. Army Corps of Engineers, Portland District, Portland, Oregon.

Becker, E.A., K.A. Forney, P.C. Fiedler, J. Barlow, S.J. Chivers, C.A. Edwards, A.M. Moore, and J.V. Redfern. 2016. Moving Towards Dynamic Ocean Management: How Well Do Modeled Ocean Products Predict Species Distributions? *Remote Sens-Basel*. 8.

Becker, E.A., Karin A. Forney, David L. Miller, Paul C. Fiedler, Jay Barlow, and Jeff E. Moore. 2020. Habitat-based density estimates for cetaceans in the California Current Ecosystem based on 19912018 survey data, U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC638.

Beitinger, T.L. and L. Freeman. 1983. Behavioral avoidance and selection responses of fishes to chemicals. In: Gunther F.A., Gunther J.D. (eds) Residue Reviews. Residue Reviews, vol 90. Springer, New York, NY.

Benson, S.R., P.H. Dutton, C. Hitipeuw, B. Samber, J. Bakarbessy, and D. Parker. 2007a. Postnesting migrations of leatherback turtles (Dermochelys coriacea) from Jamursba-Medi, Bird’s Head Peninsula, Indonesia. *Chelonian Conservation and Biology*. 6(1):5.

Benson, S.R., T. Eguchi, D.G. Foley, K.A. Forney, H. Bailey, C. Hitipeuw, B.P. Samber, R.F. Tapilatu, V. Rei, P. Ramohia, J. Pita, and P.H. Dutton. 2011. Large-scale movements and high-use areas of western Pacific leatherback turtles, Dermochelys coriacea. *Ecosphere*. 2.

Benson, S.R., K.M. Kisokau, L. Ambio, V. Rei, P.H. Dutton, and D. Parker. 2007b. Beach use, internesting movement, and migration of leatherback turtles, Dermochelys coriacea, nesting on the north coast of Papua New Guinea. *Chelonian Conservation and Biology*. 6:7-14.

Benson, S.R.V., C. Hitipeuw, B. Samber, R. Tapilatu, J. Pita, P. Ramohia, P. Pakacha, J. Horoku, and B. Wurlanty. 2018. A tri-national aerial survey of leatherback nesting activity in New Guinea and the Solomon Islands. *In* 38th Annual Symposium on Sea Turtle Biology and Conservation Kobe, Japan.

Bettridge, S., C.S. Baker, J. Barlow, P.J. Clapham, M. Ford, D. Gouveia, D.K. Mattila, I. R. M. Pace, P.E. Rosel, G.K. Silber, and P.R. Wade. 2015. Status Review of the Humpback Whale (Megaptera novaeangliae) under the Endangered Species Act. Southwest Fisheries Science Center, La Jolla, CA.

Blecha F. 2000. Immune system response to stress. In: Moberg GP, Mench IA, eds. Biology of Animal Stress: Implications for Animal Welfare. Wallingford, Oxon, UK: CAB.

Biro, P. A., and J. A. Stamps. 2010. Do consistent individual differences in metabolic rate promote consistent individual differences in behavior? Trends in Ecology and Evolution 25:653– 659.

Braun, D.C., J.W. Moore, J. Candy, and R.E. Bailey. 2016. Population diversity in salmon: linkages among response, genetic and life history diversity. *Ecography*. 39:317-328.Bravo, C.F., L.R. Curtis, M.S. Myers, J.P. Meador, L.L. Johnson, J. Buzitis, T.K. Collier, J.D. Morrow, C.A. Laetz, F.J. Loge, and M.R. Arkoosh. 2011. Biomarker responses and disease susceptibility in juvenile rainbow trout Oncorhynchus mykiss fed a high molecular weight PAH mixture. Environmental Toxicology and Chemistry 30: 704-714.

Bravo, C. F., L. R. Curtis, M. S. Myers, J. P. Meador, L. L. Johnson, J. Buzitis, T. K. Collier, J. D. Morrow, C. A. Laetz, F. J. Loge, and M. R. Arkoosh. 2011. Biomarker responses and disease susceptibility in juvenile Rainbow Trout Oncorhynchus mykiss fed a high molecular weight PAH mixture. Environmental Toxicology and Chemistry 30:704–714.

Brette, F., B. Machado, C. Cros, J.P. Incardona, N.L. Scholz, and B.A. Block. 2014. Crude Oil Impairs Cardiac Excitation-Contraction Coupling in Fish. Science Vol 343. February 14, 2014. 10.1126/science.1242747. 5 pp.

Bryant, P.J., Lafferty, C.M. and Lafferty, S.K. 1984. Reoccupation of Laguna Guerrero Negro, Baja California, Mexico, by gray whales. pp. 375-387. In: M.L. Jones, S.L. Swartz, S. Leatherwood (eds.). The Gray Whale Eschrichtius robustus. Academic Press, San Diego, California. xxiv+600p.

Burke, B.J., W.T. Peterson, B.R. Beckman, C. Morgan, E.A. Daly, and M. Litz. 2013. Multivariate models of adult Pacific salmon returns. *Plos One*. 8:e54134.

Calambokidis, J. 2012. Summary of Ship-Strike Related Research on Blue Whales in 2011. Cascadia Research, Olympia, WA.

Calambokidis, J., and J. Barlow. 2013. Updated abundance estimates ofblue and humpback whales off the US west coast incorporating photo-identifications from 2010 and 2011. Pacific Scientific Review Group. 7.

Calambokidis, J., and J. Barlow. 2020. Updated abundance estimates for blue and humpback whales along the U.S. West Coast using data through 2018. U.S. Departmen tof Commerce.

Calambokidis, J., J. Barlow, J.K.B. Ford, T.E. Chandler, and A.B. Douglas. 2009a. Insights into the population structure of blue whales in the Eastern North Pacific from recent sightings and photographic identification. *Mar Mammal Sci*. 25:816-832.

Calambokidis, J., J.K. Barlow, K. Flynn, E. Dobson, and G.H. Steiger. 2017. Update on abundance, trends, and migrations of humpback whales along the U.S. West Coast (SC/A17/NP/13). International Whaling Commission, Cambridge, United Kingdom.

Calambokidis, J., E. Falcone, A. Douglas, L. Schlender, and J. Huggins. 2009b. Photographic identification o fHumpback and blue whales off the U. S. west coast: Results and updated abundance estimates from 2008 field season. Southwest Fisheries Science Center. 18.

Calambokidis, J., G.H. Steiger, C. Curtice, J. Harrison, M.C. Ferguson, E. Becker, M. DeAngelis, and S.M. Van Parijs. 2015. Biologically Important Areas for Selected Cetaceans Within US Waters - West Coast Region. *Aquat Mamm*. 41:39-53.

CalTrans. 2015. Technical Guidance for Assessment and Mitigation of the Hydroacoustic Effects of Pile Driving on Fish. Including Appendix 1 - Compendium of Pile Driving Sound Data. Division of Environmental Analysis California Department of Transportation, 1120 N Street Sacramento, CA 95814. November 2015. 532 pp.

Campbell, G.S., L. Thomas, K. Whitaker, A.B. Douglas, J. Calambokidis, and J.A. Hildebrand. 2015. Inter-annual and seasonal trends in cetacean distribution, density and abundance off southern California. *Deep-Sea Res Pt Ii*. 112:143-157.

Carrasquero, J. 2001. Overwater structures: Freshwater issues. White Paper. Submitted to the Washington Department of Fish and Wildlife, Washington Department of Ecology, and Washington Department of Transportation. 101 pp. without appendices.

Carretta, J.V., S. Wilkin, M.M. Muto, and K. Wilkinson. 2013. Sources of human-related injury and mortality for U.S. Pacific west coast marine mammal stock assessments, 2007-2011. NOAA-TM-NMFS-SWFSC-514. 91 p.

Carretta, J.V., K.A. Forney, E. M.Oleson, D.W. Weller, A.R. Lang, J. Baker, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, and R.L. Brownell. 2017. U.S. Pacific Marine Mammal Stock Assessments: 2016. U.S. Department of Commerce.

Carretta, J.V., K.A. Forney, E.M. Oleson, D.W. Weller, A.R. Lang, J. Baker, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, and R.L. Brownell. 2018. U.S. Pacific marine Mammal Stock Assessments: 2017.

Carretta, J. V., Forney, K. A., Oleson, E., Weller, D. W., Lang, A. R., Baker, J., … Brownell, R. L. J., Jr. (2018). U.S. Pacific marine mammal stock assessments: 2017 (NOAA Technical Memorandum NMFS-SWFSC-602). Washington, DC: U.S. Department of Commerce.

Carretta, J.V., K.A. Forney, E.M. Oleson, D.W. Weller, A.R. Lang, J. Baker, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, and R.L.B. Jr. 2019. U.S. Pacific Marine Mammal Stock Assessments: 2018 (NOAA Technical Memorandum). U.S. Department of Commerce, La Jolla, CA.

Carretta, J.V., K.A. Forney, E.M. Oleson, D.W. Weller, A.R. Lang, J. Baker, M.M. Muto, B. Hanson, A.J. Orr, H. Huber, M.S. Lowry, J. Barlow, J.E. Moore, D. Lynch, L. Carswell, R.L. Brownell. 2019. U.S. Pacific Marine Mammal Stock Assessments: 2018. U.S. Department of Commerce.

Carretta, J.V., E. Oleson, D.W. Weller, A.R. Lang, A.F. L., J. Baker, B. Hanson, K. Martien, M.M. Muto, M.S. Lowry, J. Barlow, D. Lynch, L. Carswell, R.L. Brownell, D.K. Mattila, and M.C. Hill. 2013. U.S. Pacific Marine Mammal Stock Assessments: 2012. National Marine Fisheries Service.

Carretta, J.V., J. Greenman, K. Wilkinson, L. Saez, D. Lawson, and J. Viezbicke. 2022. Sources of human-related injury and mortality for U.S. Pacific West Coast Marine Mammal Stock Assessments, 2016-2020. NOAA Technical Memorandum NMFS-SWFSC-670. 246 pp. https://doi.org/10.25923/d79a-kg51

Carretta, J.V., J. Greenman, K. Wilkinson, L. Saez, D. Lawson, and J. Viezbicke. 2023. Sources of human-related injury and mortality for U.S. Pacific West Coast marine mammal stock assessments, 2017-2021. NOAA Technical Memorandum NMFS-SWFSC-690. https://doi.org/10.25923/qwf2-9b97

Cascadia Research. 2017. Examination of fin whale reveals it was killed by collision with ship.

Challis JK, Popick H, Prajapati S, Harder P, Giesy JP, McPhedran K, Brinkmann M. 2021. Occurrences of Tire Rubber-Derived Contaminants in Cold-Climate Urban Runoff. Environmental Science & Technology Letters. doi:10.1021/acs.estlett.1c00682

Chapman, G.A. 1978a. Effects of Continuous Zinc Exposure on Sockeye Salmon during Adult-to-Smolt Freshwater Residency. *T Am Fish Soc*. 107:828-836.

Chapman, G.A. 1978b. Toxicities of Cadmium, Copper, and Zinc to 4 Juvenile Stages of Chinook Salmon and Steelhead. *T Am Fish Soc*. 107:841-847.

Chasco, B.E., B.J. Burke, L.G. Crozier, and R.W. Zabel. 2021. Differential impacts of freshwater and marine covariates on wild and hatchery Chinook salmon marine survival. *PLoS ONE* 16:e0246659. https://doi.org/0246610.0241371/journal.pone.0246659.

Codarin, A., L.E. Wysocki, F. Ladich, and M. Picciulin. 2009. Effects of ambient and boat noise on hearing and communication in three fish species living in a marine protected area (Miramare, Italy). Marine Pollution Bulletin 58 (2009) 1880–1887.

Cogan, J. 2015. 2015 Whale Sightings in the Salish Sea: Central Salish Sea and Puget Sound (Southern Resident Killer Whale Project). Center for Whale Research, Friday Harbor, WA.

Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere 4(4):43.

Counihan, T.D., Waite, I.R., Nilsen, E.B., Hardiman, J.M., Elias, E., Gelfenbaum, G. and Zaugg, S.D., 2014. A survey of benthic sediment contaminants in reaches of the Columbia River Estuary based on channel sedimentation characteristics. Science of the Total Environment, 484, pp.331-343.

Couture, F., Oldford, G., Christensen, V., Barrett-Lennard, L. and Walters, C., 2022. Requirements and availability of prey for northeastern pacific southern resident killer whales. PLoS One, 17(6), p.e0270523.

Crozier, L. 2011. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2010. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Crozier, L. 2012. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2011. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Crozier, L. 2013. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2012. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Crozier, L. 2014. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2013. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Crozier, L. 2015. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2014. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Crozier, L. 2016. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2015. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Crozier, L. 2017. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2016. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Crozier, L.G., M.M. McClure, T. Beechie, S.J. Bograd, D.A. Boughton, M. Carr, T.D. Cooney, J.B. Dunham, C.M. Greene, M.A. Haltuch, E.L. Hazen, D.M. Holzer, D.D. Huff, R.C. Johnson, C.E. Jordan, I.C. Kaplan, S.T. Lindley, N.J. Mantua, P.B. Moyle, J.M. Myers, M.W. Nelson, B.C. Spence, L.A. Weitkamp, T.H. Williams, and E. Willis-Norton. 2019. Climate vulnerability assessment for Pacific salmon and steelhead in the California Current Large Marine Ecosystem. *Plos One*. 14.

Crozier, L.G., and J. Siegel. 2018. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2017. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Curtis, K.A., J. Calambokidis, K. Audley, M.G. Castaneda, J.D. Weerdt, A.J.G. Chavez, F. Garita, P. Martinez-Loustalot, J.D. Palacios-Alfaro, B. Perez, E. Quintana-Rizzo, R.R. Barragan, N. Ransome, K. Rasmussen, J. Urban, F.V. Zurita, K. Flynn, T. Cheeseman, J. Barlow, D. Steel, and J. Moore. 2022. Abundance of humpback whales *(Megaptera novaeangliae)* wintering in Central America and southern Mexico from a one-dimensional spatial capture-recapture model. U.S. Department of Commerce.

Dalla Rosa, L., J.K.B. Ford, and A.W. Trites. 2012. Distribution and relative abundance of humpback whales in relation to environmental variables in coastal British Columbia and adjacent waters. *Cont Shelf Res*. 36:89-104.

Dodge, K.L., Galuardi, B., Miller, T.J. and Lutcavage, M.E., 2014. Leatherback turtle movements, dive behavior, and habitat characteristics in ecoregions of the Northwest Atlantic Ocean. PloS one, 9(3), p.e91726.

Donoso, M., and P.H. Dutton. 2010. Sea turtle bycatch in the Chilean pelagic longline fishery in the southeastern Pacific: Opportunities for conservation. *Biol Conserv*. 143:2672-2684.

Dutton, D.L., C. Hitipeuw, M. Zein, S.R. Benson, G. Petro, J. Pita, V. Rei, L. Ambio, and J. Bakarbessy. 2007. Status and genetic structure of nesting populations of leatherback turtles (Dermochelys coriacea) in the western Pacific. *Chelonian Conservation and Biology*. 6:6.

Ecology (Washington State Department of Ecology). 2021. https://ecology.wa.gov/waste-toxics/reducing-toxic-chemicals/addressing-priority-toxic-chemicals/pah [accessed on March 4, 2025].

Ecology (Washington State Department of Ecology). 2022. 6PPD in Road Runoff Assessment and Mitigation Strategies. Prepared for: Model Toxics Control Act Legislative Program, Washington State Legislature. Prepared by: Environmental Assessment and Water Quality Programs, Washington State Department of Ecology. Olympia, Washington. October 2022. Publication 22-03-020.

Eisler, R. 1993. Zinc hazards to fish, wildlife, and invertebrates: A synoptic review. U. S. Fish and Wildlife Service, Biological Report 10, Contaminant Hazard Reviews Report 26.

Eisler, R., 1998. Copper hazards to fish, wildlife, and invertebrates: a synoptic review (No. 33). US Department of the Interior, US Geological Survey.

Elasser, T.H., KC Klasing, N Flipov and F Thompson, 2000. The Metabolic consequences of stress: Targets for stress and priorities of nutrient use. In ‘The Biology of Animal Stress’, G P Moberg and J A Mench, pp77-110. CAB INTERNATIONAL. Wallingford.

ELS (Ecological Land Services). 2023. Biological Assessment, NEXT Renewable Fuels, Oregon, LLC. Renewable Green Fuels Facility. Port Westward, Columbia County, Oregon.

Emmons, C.K., M.B. Hanson, and M.O. Lammers. 2019. Monitoring the occurrence of Southern Resident killer whales, other marine mammals, and anthropologic sound in the Pacific Northwest. National Marine Fisheries Service, Northwest Fisheries Science Center, Seattle, WA.

Falcone, E.A., B. Diehl, A. Douglas, and J. Calambokidis. 2011. Photo-Identification of Fin Whales (Balaeanoptera physalus) along the US West Coast, Baja California, and Canada. Cascadia Research Collective, Olympia, WA.

Faler, M.P., Miller, L.M. and Welke, K.I., 1988. Effects of variation in flow on distributions of northern squawfish in the Columbia River below McNary Dam. North American Journal of Fisheries Management, 8(1), pp.30-35.

Fardel. A., et al., 2020. Performance of two contrasting pilot swale designs for treating zinc, polycyclic aromatic hydrocarbons and glyphosate from stormwater runoff. Science Total Env. 743:140503

Feist, B.E., E.R. Buhle, P. Arnold, J.W. Davis, and N.L. Scholz. 2011. Landscape ecotoxicology of coho salmon spawner mortality in urban streams. Plos One 6(8):e23424.

Ferguson, J.W., G.M. Matthews, R.L. McComas, R.F. Absolon, D.A. Brege, M.H. Gessel, and L.G. Gilbreath. 2005. Passage of adult and juvenile salmonids through federal Columbia River power system dams,. U.S. Department of Commerce. 160.

Ferrara, G. A., T. M. Mongillo, and L. M. Barre. 2017. Reducing Disturbance from Vessels to Southern Resident Killer Whales: Assessing the Effectiveness of the 2011 Federal Regulations in Advancing Recovery Goals. December 2017. NOAA Technical Memorandum NMFS-OPR-58. 82p.

FitzGerald, A.M., S.N. John, T.M. Apgar, N.J. Mantua, and B.T. Martin. 2021. Quantifying thermal exposure for migratory riverine species: Phenology of Chinook salmon populations predicts thermal stress. *Global Change Biol*. 27:536-549.

Ford, J.K., 2009. Killer whale: Orcinus orca. In Encyclopedia of marine mammals (pp. 650-657). Academic Press.

Freshwater, C., S.C. Anderson, K.R. Holt, A.M. Huang, and C.A. Holt. 2019. Weakened portfolio effects constrain management effectiveness for population aggregates. *Ecological Applications*. 29:14.

Gannier, A., and E. Praca. 2007. SST fronts and the summer sperm whale distribution in the north-west Mediterranean Sea. *J Mar Biol Assoc Uk*. 87:187-193.

Gaona, O., and A. Barragán. 2016. Las tortugas marinas en México: Logros y perspectivas para su conservación, Ciudad de México, México.

Gaspar, P., S.R. Benson, P.H. Dutton, A. Reveillere, G. Jacob, C. Meetoo, A. Dehecq, and S. Fossette. 2012. Oceanic dispersal of juvenile leatherback turtles: going beyond passive drift modeling. *Mar Ecol Prog Ser*. 457:265-284.

Gaspar, P., and M. Lalire. 2017. A model for simulating the active dispersal of juvenile sea turtles with a case study on western Pacific leatherback turtles. *Plos One*. 12.

Gauthier, P.T., W.P. Norwood, E.E. Prepas, and G.G. Pyle. 2014. Metal–PAH mixtures in the aquatic environment: A review of co-toxic mechanisms leading to more-than-additive outcomes. Aquatic Toxicology 154: 253-269.

Gauthier, P.T., W.P. Norwood, E.E. Prepas, and G.G. Pyle. 2015. Metal–polycyclic aromatic hydrocarbon mixture toxicity in *Hyalella azteca*. 2. metal accumulation and oxidative stress as interactive co-toxic mechanisms. Environmental Science and Technology. DOI: 10.1021/acs.est.5b03233

Gaydos, J. K., and S. Raverty. 2007. Killer whale stranding response. Final Report to National Marine Fisheries Service Northwest Regional Office.

Gobel, P., C. Dierkes, & W.C. Coldewey. 2007. Storm water runoff concentration matrix for urban areas. Journal of Contaminant Hydrology, 91, 26–42.

Goold, J.C. and Jones, S.E., 1995. Time and frequency domain characteristics of sperm whale clicks. The Journal of the Acoustical Society of America, 98(3), pp.1279-1291.

Gosselin, J.L., E.R. Buhle, C. Van Holmes, W.N. Beer, S. Iltis, and J.J. Anderson. 2021. Role of carryover effects in conservation of wild Pacific salmon migrating regulated rivers. *Ecosphere*. 12:e03618.

Graham, A.L., and S.J. Cooke. 2008. The effects of noise disturbance from various recreational boating activities common to inland waters on the cardiac physiology of a freshwater fish, the largemouth bass (Micropterus salmoides). Aquatic Conservation: Marine and Freshwater Ecosystems. 18:1315-1324.

Grant, S.B., N.V. Rekhi, N.R. Pise, R.L. Reeves, M. Matsumoto, A. Wistrom, L. Moussa, and S. Bay. 2003. A review of the contaminants and toxicity associated with particles in stormwater runoff. CALTRANS (California Department of Transportation), CTSW-RT-03-059.73.15, Sacramento, CA. 172pp.

Greer J.B., E.M. Dalsky, R.F. Lane, and J.D. Hansen. 2023. Establishing an in vitro model to assess the toxicity of 6ppd-quinone and other tire wear transformation products. Environmental Science & Technology Letters. https://doi.org/10.1021/acs.estlett.3c00196. doi:10.1021/acs.estlett.3c00196

Halofsky, J.E., D.L. Peterson, and B.J. Harvey. 2020. Changing wildfire, changing forests: the effects of climate change on fire regimes and vegetation in the Pacific Northwest, USA. *Fire Ecology*. 16.

Halofsky, J.S., D.R. Conklin, D.C. Donato, J.E. Halofsky, and J.B. Kim. 2018. Climate change, wildfire, and vegetation shifts in a high-inertia forest landscape: Western Washington, USA. *Plos One*. 13.

Hansen, J.A., Lipton, J., Welsh, P.G., Morris, J., Cacela, D. and Suedkamp, M.J., 2002. Relationship between exposure duration, tissue residues, growth, and mortality in rainbow trout (Oncorhynchus mykiss) juveniles sub-chronically exposed to copper. Aquatic toxicology, 58(3-4), pp.175-188.

Hanson, M.B., Emmons, C.K., Ford, M.J., Everett, M., Parsons, K., Park, L.K., Hempelmann, J., Van Doornik, D.M., Schorr, G.S., Jacobsen, J.K. and Sears, M.F., 2021. Endangered predators and endangered prey: Seasonal diet of Southern Resident killer whales. PloS one, 16(3), p.e0247031.

Harrison, A.L., D.P. Costa, A.J. Winship, S.R. Benson, S.J. Bograd, M. Antolos, A.B. Carlisle, H. Dewar, P.H. Dutton, S.J. Jorgensen, S. Kohin, B.R. Mate, P.W. Robinson, K.M. Schaefer, S.A. Shaffer, G.L. Shillinger, S.E. Simmons, K.C. Weng, K.M. Gjerde, and B.A. Block. 2018. The political biogeography of migratory marine predators. *Nat Ecol Evol*. 2:1571-1578.

Hastings, M.C., and A. N. Popper. 2005. Effects of sound on fish. Final Report # CA05-0537 – Project P476 Noise Thresholds for Endangered Fish. For: California Department of Transportation, Sacramento, CA. January 28, 2005, August 23, 2005 (Revised Appendix B). 85 pp.

Hay and McCarter. 2000. Status of the eulachon Thaleicthys pacificus in Canada. Research Document 2000/145. ISSN 1480-4883. Fisheries and Oceans Canada, Science Branch. Ottawa, Canada.

Hecht, S.A., D.H. Baldwin, C.A. Mebane, T. Hawkes, S.J. Gross, and N.L. Scholz. 2007. An overview of sensory effects on juvenile salmonids exposed to dissolved copper: Applying a benchmark concentration approach to evaluate sublethal neurobehavioral toxicity. U.S. Dept. Commer. 39.

Heiser, D.W., and E.L. Finn. 1970. Observations of Juvenile Chum and Pink Salmon in Marina and Bulkheaded Areas. State of Washington Department of Fisheries.

Henry, A. G., T. V. N. Cole, M. Garron, L. Hall, W.Ledwell, and A. Reid. 2012. Mortality and serious injury determinations for baleen whale stocks along the Gulf of Mexico, United States east coast and Atlantic Canadian provinces, 2006-2010. Ref-erence Document 12-11. U.S. Department of Com-merce, Northeast Fisheries Science Center, WoodsHole, Massachusetts, USA.

Henry A.E., Moore J.E., Barlow J., Calambokidis J., Ballance L.T., Rojas-Bracho, L., Urbán Ramírez, J. 2020. Report on the California Current Ecosystem Survey (CCES): Cetacean and Seabird Data Collection Efforts, June 26 – December 4, 2018, U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC-636.

Hermann RM. 2008. Polychlorinated Biphenyl Presence in the Columbia River Corridor. Washington Closure Hanford, report WCH-208.

Herring, S.C., N. Christidis, A. Hoell, J.P. Kossssin, C.J. Schreck, and P.A. Stott. 2018. Introduction to Explaining Extreme Events of 2016 from a Climate Perspective. *B Am Meteorol Soc*. 99:S1-S6.

Hinton, S.A. and Emmett, R.L., 1994. Juvenile salmonid stranding in the lower Columbia River, 1992 and 1993.

Holden, Z.A., A. Swanson, C.H. Luce, W.M. Jolly, M. Maneta, J.W. Oyler, D.A. Warren, R. Parsons, and D. Affleck. 2018. Decreasing fire season precipitation increased recent western US forest wildfire activity. *P Natl Acad Sci USA*. 115:E8349-E8357.

Holsman, K.K., M.D. Scheuerell, E. Buhle, and R. Emmett. 2012. Interacting Effects of Translocation, Artificial Propagation, and Environmental Conditions on the Marine Survival of Chinook Salmon from the Columbia River, Washington, USA. *Conserv Biol*. 26:912-922.

Holt, M. M., D. P. Noren, R. C. Dunkin, and T. M. Williams. 2015. Vocal performance affects metabolic rate in dolphins: implications for animals communicating in noisy environments. Journal of Experimental Biology. 218: 1647–1654.

Horwood, J. 2009. Sei Whale Balaenoptera borealis. *Encyclopedia of Marine Mammals, 2nd Edition*:1001-1003.

Howell, M. D., & Uusitalo, N. (2000). *Eulachon (Thaleichthys pacificus) studies related to lower Columbia river channel deepening operations*: Oregon Department of Fish and Wildlife.

Incardona, J.P., T.K. Collier, and N.L. Scholz. 2004. Defects in cardiac function precede morphological abnormalities in fish embryos exposed to polycyclic aromatic hydrocarbons. Toxicology and Applied Pharmacology 196:191-205.

Incardona, J.P., M.G. Carls, H. Teraoka, C.A. Sloan, T.K. Collier, and N.L. Scholz. 2005. Aryl hydrocarbon receptor-independent toxicity of weathered crude oil during fish development. Environmental Health Perspectives 113:1755-1762.

Incardona, J.P., H.L. Day, T.K. Collier, and N.L. Scholz. 2006. Developmental toxicity of 4-ring polycyclic aromatic hydrocarbons in zebrafish is differentially dependent on AH receptor isoforms and hepatic cytochrome P450 1A metabolism. Toxicology and Applied Pharmacology 217:308-321.

IPCC. 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. V. Masson-Delmotte, P. Zhai, A. Pirani, S. L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekçi, R. Yu and B. Zhou editor. Cambridge University Press (https://www.ipcc.ch/report/ar6/wg1/#FullReport).

IPCC. 2022. Climate Change 2022: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

IPCC Working Group I. 2021. Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of teh Intergovernmental Panel on Climate Change. P.Z. V. Masson-Delmotte, A. Pirani, S. L. Connors, C. Pean, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M. I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B. R. Matthews, T. K. Maycock, T. Waterfield, O. Yelekci, R. Yu and B. Zhou, editor, Cambridge University Press.

IPCC Working Group II. 2022. Climate Change 2022: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to teh Sixthe Assessment Report of the Intergovernmental Panel of Climate Change. D.C.R. H.O. Portner, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Algria, M. Craig, S. Langsdorf, S. Loschke, V. Moller, A. Okem, and B. Rama, editor. Cambridge University Press.

Islam, M.S., and M.M. Hossain. 2013. Acute toxicity of the mixtures of grease and engine wash oil on fish, pangasius sutch, under laboratory condition. *International Jounrnal of Life Sciences Biotechology and Pharma Research*. 2:11.

Isaak, D.J. and Bjornn, T.C., 1996. Movement of northern squawfish in the tailrace of a lower Snake River dam relative to the migration of juvenile anadromous salmonids. Transactions of the American Fisheries Society, 125(5), pp.780-793.

Jacox, M.G., M.A. Alexander, N.J. Mantua, J.D. Scott, G. Hervieux, R.S. Webb, and F.E. Werner. 2018. Forcing of multi-year extreme ocean temperatures that impacted Californiz Current living marine resources in 2016. *Bull. Amer. Meteor. Soc*. 99.

Jarvela-Rosenberger, A. L., M. MacDuffee, A. G. J. Rosenberger, and P. S. Ross. 2017. Oil spills and marine mammals in British Columbia, Canada: Development and application of a risk-based conceptual framework. Archives of Environmental Contamination and Toxicology. 73(1): 131–153.

Johannessen C, Helm P, Lashuk B, Yargeau V, Metcalfe CD. 2021. The tire wear compounds 6PPD-quinone and 1,3-diphenylguanidine in an urban watershed. Archives of Environmental Contamination and Toxicology. https://doi.org/10.1007/s00244-021-00878-4. doi:10.1007/s00244-021-00878-4

Johnson, L.L., Ylitalo, G.M., Arkoosh, M.R., Kagley, A.N., Stafford, C., Bolton, J.L., Buzitis, J., Anulacion, B.F. and Collier, T.K., 2007. Contaminant exposure in outmigrant juvenile salmon from Pacific Northwest estuaries of the United States. Environmental Monitoring and Assessment, 124, pp.167-194.

Johnson, L., Anulacion, B., Arkoosh, M., Olson, O.P., Sloan, C., Sol, S.Y., Spromberg, J., Teel, D.J., Yanagida, G. and Ylitalo, G., 2013. Persistent organic pollutants in juvenile Chinook salmon in the Columbia River Basin: implications for stock recovery. Transactions of the American Fisheries Society, 142(1), pp.21-40.

Johnson, A. 2018. The Effects of Turbidity and Suspended Sediments on ESA-Listed Species from Projects Occurring in the Greater Atlantic Region. Greater Atlantic Region Policy Series 18-02. NOAA Fisheries Greater Atlantic Regional Fisheries Office - www.greateratlantic.fisheries.noaa.gov/policyseries/. 106p

Jones, T.T., B.L. Bostrom, M.D. Hastings, K.S. Van Houtan, D. Pauly, and D.R. Jones. 2012. Resource Requirements of the Pacific Leatherback Turtle Population. *Plos One*. 7.

Jonsgård, Å., and K. Darling. 1977. On the biology of the eastern North Atlantic sei whales, Balaenoptera borealis Lesson. Reports of the International Whaling Commission (Special Issue SC/27/Doc 17) 11:123-129.

Karrow, N., H.J. Boermans, D.G. Dixon, A. Hontella, K.R. Soloman, J.J. White, and N.C. Bols. 1999. Characterizing the immunotoxicity of creosote to rainbow trout (Oncorhynchus mykiss): a microcosm study. Aquatic Toxicology. 45 (1999) 223–239.

Khan, N., Warith, M.A. and Luk, G., 2007. A comparison of acute toxicity of biodiesel, biodiesel blends, and diesel on aquatic organisms. Journal of the Air & Waste Management Association, 57(3), pp.286-296.

Koopman, B.O. 1956. The Theory of Search .1. Kinematic Bases. *Oper Res*. 4:324-346.

Korstrom, J. S., & Birtwell, I. K. 2006. Effects of Suspended Sediment on the Escape Behavior and Cover-Seeking Response of Juvenile Chinook Salmon in Freshwater. *Transactions of the American Fisheries Society*, *135*(4), 1006–1016. https://doi.org/10.1577/T05-194.1Laist, D.W., A.R. Knowlton, J.G. Mead, A.S. Collet, and M. Podesta. 2011. Collisions between ships and whales. Marine Mammal Science 17:35-75.

Layshock, J.A., Webb, M.A., Langness, O.P., Garza, J.C., Heironimus, L.B. and Gundersen, D., 2021. Organochlorine and metal contaminants in the blood plasma of green sturgeon caught in Washington coastal estuaries. Archives of Environmental Contamination and Toxicology, pp.1-13.

Lee, R. and G. Dobbs. 1972. Uptake, Metabolism and Discharge of Polycyclic Aromatic Hydrocarbons by Marine Fish. Marine Biology. 17, 201-208.

Lo, B., V. Marlatt, X. Liao, S. Reger, C. Gallilee, and T. Brown. 2023. Acute toxicity of 6PPD-quinone to early life stage juvenile Chinook (Oncorhynchus tshawytscha) and coho (Oncorhynchus kisutch) salmon. Environmental Toxicology and Chemistry. doi:doi: 10.1002/etc.5568

MacFadyen, A., B.M. Hickey, and W.P. Cochlan. 2008. Influences of the Juan de Fuca Eddy on circulation, nutrients, and phytoplankton production in the northern California Current System. *J Geophys Res-Oceans*. 113.

Mackenzie. 2021. Transportation Impact Analysis for NEXT Renewable Fuels. For Columbia County and ODOT, January 8.

Martin, S.L., and coauthors. 2020. Assessing the population level impacts of North Pacific loggerhead and western Pacific leatherback interactions in the Hawaii-based shallow set longline fishery.

Martinelli, T.L. and Shively, R.S., 1997. Seasonal distribution, movements and habitat associations of northern squawfish in two lower Columbia River reservoirs. Regulated Rivers: Research & Management: An International Journal Devoted to River Research and Management, 13(6), pp.543-556.

Matkin, C. O., E. L. Saulitis, G. M. Ellis, P. Olesiuk, and S. D. Rice. 2008. Ongoing population-level impacts on killer whales Orcinus orca following the 'Exxon Valdez' oil spill in Prince William Sound, Alaska. Marine Ecology Progress Series. 356: 269-281.

McCain, B., D.C. Malins, M.M. Krahn, D.W. Brown, W.D. Gronlund, L.K. Moore, and S-L. Chan. 1990. Uptake of Aromatic and Chlorinated Hydrocarbons by Juvenile Chinook Salmon (Oncorhynchus tshawytscha) in an Urban Estuary. Arch. Environ. Contam. Toxicol. 19, 10-16 (1990).

McIntyre, J.K, D.H. Baldwin, D.A. Beauchamp, and N.L. Scholz. 2012. Low-level copper exposures increase visibility and vulnerability of juvenile coho salmon to cutthroat trout predators. Ecological Applications, 22(5), 2012, pp. 1460–1471.

Meador, J.P., J.E. Stein, W.L. Reichert, and U. Varanasi. 1995. Bioaccumulation of polycyclic aromatic hydrocarbons by marine organisms. Reviews of Environmental Contamination and Toxicology 143: 79-165.

Meador, J. P., T. K. Collier, and J. E. Stein. 2002. Use of tissue and sedimentbased threshold concentrations of polychlorinated biphenyls (PCBs) to protect juvenile salmonids listed under the US Endangered Species Act. Aquatic Conservation 12:493–516.

Meador, J.P., F.C. Sommers, G.M. Ylitalo, and C.A. Sloan. 2006. Altered growth and related physiological responses in juvenile Chinook salmon (*Oncorhynchus tshwaytscha*) from dietary exposure to polycyclic aromatic hydrocarbons (PAHs). Canadian Journal of fisheries and Aquatic Sciences. 63: 2364-2376.

Meador, J.P., Ylitalo, G.M., Sommers, F.C. and Boyd, D.T., 2010. Bioaccumulation of polychlorinated biphenyls in juvenile chinook salmon (Oncorhynchus tshawytscha) outmigrating through a contaminated urban estuary: dynamics and application. Ecotoxicology, 19, pp.141-152.

Miksis-Olds, J.L., Martin, B. and Tyack, P.L., 2018. Exploring the ocean through soundscapes. Acoust. Today, 14(9), pp.26-34.

Moberg, GP. 1987. Influence of the adrenal axis upon the gonads. Oxford Reviews of Reproductive Biology 9 456–496.

Monnahan, C.C., T.A. Branch, and A.E. Punt. 2015. Do ship strikes threaten the recovery of endangered eastern North Pacific blue whales? *Mar Mammal Sci*. 31:279-297.

Moore J.E., and Barlow J.P. 2014. Improved abundance and trend estimates for sperm whales in the eastern North Pacific from Bayesian hierarchical modeling. Endang. Species Res 25:141-150.Moore J.E. and Barlow, J.P. 2013. Declining Abundance of Beaked Whales (Family Ziphiidae) in the California Current Large Marine Ecosystem. PLoS ONE 8(1):e52770. doi:10.1371/journal.pone.0052770.

Morace, J.L. 2006. Water-quality data, Columbia River Estuary, 2004-05. *In* U.S. Geological Survey Data Series 213. 18.

Moser, M.L. and Lindley, S.T., 2007. Use of Washington estuaries by subadult and adult green sturgeon. *Environmental Biology of Fishes*, *79*, pp.243-253.

Mueller, G. 1980. Effects of Recreational River Traffic on Nest Defense by Longear Sunfish. Transactions of the American Fisheries Society. 109:248-251.

Munsch, S.H., C.M. Greene, N.J. Mantua, and W.H. Satterthwaite. 2022. One hundred-seventy years of stressors erode salmon fishery climate resilience in California's warming landscape. *Global Change Biology*.

Myers, J.M., J. Jorgensen, M. Sorel, M. Bond, T. Nodine, and R. Zabel. 2018. Upper Willamette River Life Cycle Modeling and the Potential Effects of Climate Change. Draft Report to the U.S. Army Corps of Engineers. Northwest Fisheries Science Center.

Nadeem, K., J.E. Moore, Y. Zhang, and H. Chipman. 2016. Integrating population dynamics models and distance sampling data: a spatial hierarchical state-space approach. *Ecology*. 97:1735-1745.

National Oceanic and Atmospheric Administration. 2017. 2016 West Coast Entanglement Summary. National Marine Fisheries Service, Seattle, WA.

Neff, J.M. 1982. Accumulation and release of polycyclic aromatic hydrocarbons from water, food, and sediment by marine animals. Pages 282-320 in N.L. Richards and B.L. Jackson (eds.). Symposium: carcinogenic polynuclear aromatic hydrocarbons n the marine environment. U.S. Environ. Protection Agency Rep. 600/9-82-013.

Neff, J. 1985. Polycyclic aromatic hydrocarbons. Pages 416-454 in G.M. Rand and S.R. Petrocelli, editors. Fundamentals of aquatic toxicology. Hemisphere Publishing, Washington, D.C.

Neilson, J. L., C. M. Gabriele, A. S. Jensen, K. Jackson, and J. M. Straley. 2012. Summary of reported whale-vessel collisions in Alaskan waters. J. Mar. Biol. 2012:106282. DOI: dx.doi.org/10.1155/2012/106282Neo, Y.Y., J. Seitz, R.A. Kastelein, H.V. Winter, C. Cate, H. Slabbekoorn. 2014. Temporal structure of sound affects behavioural recovery from noise impact in European seabass. Biological Conservation 178 (2014) 65-73.

Nichols, T. A., Anderson, T. W., & Širović, A. (2015). Intermittent noise induces physiological stress in a coastal marine fish. PLoS One, 10(9), e0139157.

Nightingale, B., and C.A. Simenstad. 2001. Overwater Structures: Marine Issues. University of Washington, Washington State Transportation Center. 133.

Niyogi, S. and Wood, C.M., 2004. Biotic ligand model, a flexible tool for developing site-specific water quality guidelines for metals. Environmental Science & Technology, 38(23), pp.6177-6192.

NMFS. 1991. Final Recovery Plan for the Humpback Whale (*Megaptera novaeangliae*). National Marine Fisheries Service Office of Protected Resources.

NMFS and USFWS. 1998. Recovery plan for U.S. Pacific populations of the leatherback turtle (Dermochelys coriacea). National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Springs, MD.

NMFS. 2008a. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). National Marine Fisheries Service, Seattle, Washington. 251p.

NMFS. 2010a. Final Recovery Plan for the Fin Whale. Recovery plan for the fin whale (*Balaenoptera physalus*). National Marine Fisheries Service, Silver Spring, MD. 121 pp.

NMFS. 2010b. Final Recovery Plan for the Sperm Whale. National Marine Fisheries Service. 2010. Recovery plan for the sperm whale (*Physeter macrocephalus*). National Marine Fisheries Service, Silver Spring, MD. 165pp.

NMFS. 2012. Endangered Species Act Section 7 Consultation and Magnuson-Stevens Essential Fish Habitat Response for the Pest Management Program for Corps of Engineers Managed Lands in the Walla Walla District in Oregon, Idaho, and Washington. NMFS 2012/00353. August 29, 2012.

NMFS, and USFWS. 2013. Leatherback sea turtle (*Dermochelys coriacea*) 5 Year Review: Summary and Evaluation. NMFS Office of Protected Resources and USFWS Southeast Region.

NMFS. 2015b. Status Review of the Humpback Whale Under the Endangered Species Act. NOAA-TM-NMFS-SWFSC-540.

NMFS. (2017a). Endangered Species Act Recovery Plan for the Southern Distinct Population Segment of Eulachon (*Thaleichthys pacificus*). National Marine Fisheries Service, West Coast Region, Protected Resources Division, Portland, OR.

NMFS. 2018. Sei whale (*Balaenoptera borealis borealis*): Eastern North Pacific Stock. Stock Assessment Report.

NMFS. 2019a. Humpback Whale (*Megaptera novaeangliae*): California/Oregon/Washington Stock. National Marine Fisheries Service, Silver Springs, MD.

NMFS. 2019b. Fin Whale (*Balaenoptera physalus*): Summary and Evaluation. https://www.fisheries.noaa.gov/s3//dam-migration/508_compliant_final_feb_2019_finwhale_5-year_review.pdf

NMFS. 2020a. Blue Whale. (*Balaenoptera musculus*) 5-year Review: Summary and Evaluation https://repository.library.noaa.gov/view/noaa/27400

NMFS. 2020b. Recovery Plan for the Blue Whale (*Balaenoptera musculus*): first revision. National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD. https://repository.library.noaa.gov/view/noaa/27399

NMFS 2021. Diverse Threats Imperil Northeast Pacific Killer Whales, Including Southern Residents. Southern Resident Connections - Post 14. https://www.fisheries.noaa.gov/feature-story/diverse-threats-imperil-northeast-pacific-killer-whales-including-southern-residents#:~:text=Eleven%20of%20the%2088%20killer,identified%20as%20a%20major%20threat. [Accessed March 5, 2025]

NMFS (National Marine Fisheries Service). 2020c. Endangered Species Act Biological Opinion, Conference Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Millennium Coal Export Terminal, Columbia River (5th Field HUC 1708000302), Cowlitz County, Washington (Corps No.: NWS-2010-1225). NMFS WCRO-2018-00153.

NMFS and USFWS. 2020. Endangered Species Act status review of the leatherback turtle (*Dermochelys coriacea*). Report to the National Marine fisheries Service Office of Protected Resources and U.S. Fish and wilalife Service.

NMFS. 2021b. Sei whale (*Balaenoptera borealis*) 5-Year Review: Summary and Evaluation. https://repository.library.noaa.gov/view/noaa/32073

NMFS. 2021a. Southern Distinct Population Segment of North American Green Sturgeon (*Acipenser medirostris*) 5-Year Review: Summary and Evaluation. California Central Valley Office, Sacramento, CA. 61pp.

NMFS. 2022a. 2022 5-year review: Summary & Evaluation of Lower Columbia River Chinook Salmon, Columbia River Chum Salmon, Lower Columbia River Coho Salmon, and Lower Columbia River Steelhead. https://www.fisheries.noaa.gov/resource/document/2022-5-year-review-summary-evaluation-lower-columbia-river-chinook-salmon

NMFS. 2022b. 2022 5-year review: Summary & Evaluation of Upper Columbia River Spring-run Chinook Salmon and Upper Columbia River Steelhead. https://www.fisheries.noaa.gov/resource/document/2022-5-year-review-summary-evaluation-upper-columbia-river-spring-run-chinook

NMFS. 2022c. 2022 5-year review: Summary & Evaluation of Snake River Spring/Summer Chinook Salmon. https://www.fisheries.noaa.gov/resource/document/2022-5-year-review-summary-evaluation-snake-river-spring-summer-chinook-salmon

NMFS. 2022d. 2022 5-year review: Summary & Evaluation of Snake River Sockeye Salmon. https://www.fisheries.noaa.gov/resource/document/2022-5-year-review-summary-evaluation-snake-river-sockeye-salmon

NMFS. 2022e. 2022 5-year review: Summary & Evaluation of Snake River Fall-run Chinook Salmon.

NMFS. 2022f. 2022 5-year review: Summary & Evaluation of Middle Columbia River Steelhead. https://www.fisheries.noaa.gov/resource/document/2022-5-year-review-summary-evaluation-middle-columbia-river-steelhead

NMFS. 2022g. 2022 5-year review: Summary & Evaluation of Snake River Basin Steelhead. https://www.fisheries.noaa.gov/resource/document/2022-5-year-review-summary-evaluation-snake-river-basin-steelhead

NMFS. 2022h. 2022 5-year review: Summary & Evaluation of Eulachon, Southern DPS. https://www.fisheries.noaa.gov/resource/document/2022-5-year-review-summary-evaluation-eulachon-southern-dps#:~:text=Resources-,2022%205%2DYear%20Review%3A%20Summary%20%26,Evaluation%20of%20Eulachon%2C%20Southern%20DPS&text=NOAA%20Fisheries%20recommends%20the%20Southern%20DPS%20of%20eulachon%20remain%20classified%20as%20threatened.

NMFS. 2022i. 2022 5-year review: Summary & Evaluation of Southern Resident Killer Whales. https://www.fisheries.noaa.gov/action/5-year-review-southern-resident-killer-whales

NMFS. 2022j. Recovery Outline for the Central America, Mexico, and Western North Pacific Distinct Population Segments of Humpback Whales. https://www.fisheries.noaa.gov/resource/document/recovery-outline-central-america-mexico-and-western-north-pacific-distinct

NMFS. 2022k. Marine Mammal Stock Assessment Reports by Species/Stock: Humpback Whale (*Megaptera novaeangliae kuzira*) Central America / Southern Mexico - California-Oregon-Washington Stock. https://www.fisheries.noaa.gov/s3/2023-08/Humpback-Whale-CASMEX-2022.pdf [Accessed on March 5, 2025]

NMFS. 2022l. Marine Mammal Stock Assessment Reports by Species/Stock: HUMPBACK WHALE (*Megaptera novaeangliae*): California/Oregon/Washington Stock. https://media.fisheries.noaa.gov/2022-08/2021-HumpbackWhale-CaliforniaOregonWashington%20Stock.pdf

NMFS. 2023a. National Marine Fisheries Service: Summary of Endangered Species Act Acoustic Thresholds (Marine Mammals, Fishes, and Sea Turtles). January 2023. Accessed on 12/31/2024.

NMFS. 2023b. 2023 West Coast Whale Entanglement Summary. https://storymaps.arcgis.com/stories/267aaa6e6a494d44be437b597f3993a3. Accessed on February 24, 2025.

NMFS. 2024. 2024 5-year Review: Summary & Evaluation of Upper Willamette River Steelhead and Upper Willamette River Chinook Salmon.

NMFS. 2024b. Marine Mammal Stock Assessment Reports by Species/Stock: BLUE WHALE (*Balaenoptera musculus musculus*): Eastern North Pacific Stock. https://www.fisheries.noaa.gov/s3/2024-12/2023-sar-blue-whale-enp.pdf

NMFS. 2024c. Marine Mammal Stock Assessment Reports by Species/Stock: SEI WHALE (*Balaenoptera borealis borealis*): Eastern North Pacific Stock https://www.fisheries.noaa.gov/s3/2024-12/2023-sar-sei-whale-enp.pdf

NMFS. 2024d. Marine Mammal Stock Assessment Reports by Species/Stock: SPERM WHALE (*Physeter macrocephalus*): California/Oregon/Washington Stock. https://www.fisheries.noaa.gov/s3/2024-12/2023-sar-sperm-whale-CAORWA.pdf

NOAA Fisheries. 2005. Assessment of NOAA Fisheries' critical habitat analytical review teams for 12 evolutionarily significant units of West Coast salmon and steelhead. National Marine Fisheries Service, Protected Resources Division. Portland, Oregon.

NOAA NCEI. 2022. NOAA National Centers for Environmental Information (NCEI), State of the Climate: Global Climate Report for Annual 2021, published online January 2022, retrieved on February 28, 2022 from https://www.ncdc.noaa.gov/sotc/global/202113.

NOAA. 2022. Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for Parkside Apartments HOA's Sewer Line Protection and Skirting Removal project in Kirkland, Washington (USACE No. NWS-2021-387, HUC: 171100120400 – Lake Washington).

Noren, D. P., R. C. Dunkin, T. M. Williams, and M. M. Holt. 2012. Energetic cost of behaviors performed in response to vessel disturbance: One link the in population consequences of acoustic disturbance model. In: Anthony Hawkins and Arthur N. Popper, Eds. The Effects of Noise on Aquatic Life, pp. 427–430.

Noren, D. P., M. M. Holt, R. C. Dunkin, and T. M. Williams. 2013. The metabolic cost of communicative sound production in bottlenose dolphins (Tursiops truncatus). The Journal of Experimental Biology. 216: 1624-1629.

NRC (National Research Council). 2003. Ocean noise and marine mammals. National Academy Press, Washington, D.C.

Ohlberger, J., E.J. Ward, D.E. Schindler, and B. Lewis. 2018. Demographic changes in Chinook salmon across the Northeast Pacific Ocean. *Fish and Fisheries*. 19:13.

Oleson, E.M., J. Calambokidis, E. Falcone, G. Schorr, and J.A. Hildebrand. 2009. Acoustic and visual monitoring for cetaceans along the outer Washington coast. University of California San Diego Scripps Institution of Oceanography and Cascadia Research Collective., San Diego, CA.

Oleson, E.M., and J. Hildebrand. 2012. Marine Mammal Demographics Off the Outer Washington Coast and Near Hawaii. . U.S. Naval Postgraduate School, Monterey, CA.

Parente, W. D., & Snyder, G. R. (1970). A pictorial record of the hatching and early development of the eulachon (*Thaleichthys pacificus*). *Northwest Science, 44*(1), 50-57.

Pearson, W.H., and J.R. Skalski. 2011. Factors Affecting Stranding of Juvenile Salmonids by Wakes from Ship Passage in the Lower Columbia River. *River Res Appl*. 27:926-936.

Pearson, W.H., Skalski, J.R., Sobocinski, K.L., Miller, M.C., Johnson, G.E., Williams, G.D., Southard, J.A. and Buchanan, R.A., 2006. A Study of Stranding of Juvenile Salmon by Ship Wakes Along the Lower Columbia River Using a Before-and-After Design: Before-Phase Results (No. PNNL-15400). Pacific Northwest National Lab.(PNNL), Richland, WA (United States).

Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999. The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. *Mar Fish Rev*. 61:74.

PFMC (Pacific Fishery Management Council). 2022. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon. Pacific Fishery Management Council, Portland, Oregon. December 2022.

Picciulin, M., L. Sebastianutto, A. Codarin, A. Farina, and E.A. Ferrero. 2010. In situ behavioural responses to boat noise exposure of Gobius cruentatus (Gmelin, 1789; fam. Gobiidae) and Chromis chromis (Linnaeus, 1758; fam. Pomacentridae) living in a Marine Protected Area. Journal of Experimental Marine Biology and Ecology 386 (2010) 125–132.

Pikula K.S., Zakharenko A.M., Chaika V.V., Stratidakis A.K., Kokkinakis M., Waissi G., Rakitskii V.N., Sarigiannis D.A., Hayes A.W., Coleman M.D., Tsatsakis A., Golokhvast K.S. Toxicity bioassay of waste cooking oil-based biodiesel on marine microalgae. Toxicol Rep. 2018 Dec 29;6:111-117. doi: 10.1016/j.toxrep.2018.12.007. PMID: 30622905; PMCID: PMC6317304.

Piniak, W.D., Eckert, S.A., Harms, C.A. and Stringer, E.M., 2012. Underwater hearing sensitivity of the leatherback sea turtle (Dermochelys coriacea): Assessing the potential effect of anthropogenic noise. US Dept. of the Interior, Bureau of Ocean Energy Management, Headquarters, Herndon, VA. OCS Study BOEM, 1156, p.35.

Pirotta E, K. Brookes, I.M. Grahamh, and P.M. Thompson. 2014. Variation in harbour porpoise activity in response to seismic survey noise. Biology Letters 10.

Playle, R.C., 2004. Using multiple metal–gill binding models and the toxic unit concept to help reconcile multiple-metal toxicity results. Aquatic Toxicology, 67(4), pp.359-370.

Raverty, S., St. Leger, J., Noren, D.P., Burek Huntington, K., Rotstein, D.S., Gulland, F.M., Ford, J.K., Hanson, M.B., Lambourn, D.M., Huggins, J. and Delaney, M.A. 2020. Pathology findings and correlation with body condition index in stranded killer whales (Orcinus orca) in the northeastern Pacific and Hawaii from 2004 to 2013. PLoS ONE, 15(12), e0242505.

Reeves, R.R. and H. Whitehead. 1997. Status of the sperm whale, Physeter macrocephalus. Canadian Field Naturalist 111:293-307.

Richardson, W. J., C. R. Greene, C. I. Malme Jr., and D. H. Thomson. 1995. Marine Mammals and Noise. Academic Press, 525 B Street, Ste. 1900, San Diego, California 92101-4495.

Rivest S., and C Rivier C. 1995. The role of corticotropin-releasing factor and interleukin-1 in the regulation of neurons controlling reproductive functions. Endocr. Rev. 16, 177-99.

Roberts, C., Kohlman, E., Jain, N., Amekor, M., Alcaraz, A.J., Hogan, N., Brinkmann, M. and Hecker, M., 2024. Sub-chronic and acute toxicity of 6PPD-quinone to early-life stage rainbow trout (Oncorhynchus mykiss). *bioRxiv*, pp.2024-09. https://doi.org/10.1101/2024.09.25.614982 d

Rockwood RC, Calambokidis J, Jahncke J (2017) High mortality of blue, humpback and fin whales from modeling of vessel collisions on the U.S. West Coast suggests population impacts and insufficient protection. PLoS ONE 12(8): e0183052. https://doi.org/10.1371/journal.pone.0183052

Rondorf, D.W., Rutz, G.L. and Charrier, J.C., 2010. Minimizing effects of over-water docks on federally listed fish stocks in McNary Reservoir: a literature review for criteria.

Saez, L., D. Lawson, and M. DeAngelis. 2021. Large whale entanglements off the U.S. West Coast, from 1982-2017. NOAA Tech. Memo. NMFS-OPR-63A, 50 p.

Sandahl, J. F., D. H. Baldwin, J. J. Jenkins, and N. L. Scholz. 2005. Comparative thresholds for acetylcholinesterase inhibition and behavioral impairment in Coho Salmon exposed to chlorpyrifos. Environmental Toxicology and Chemistry 24:136–145.

Sandahl, J.F., D. Baldwin, J.J. Jenkins, and N.L. Scholz. 2007. A Sensory System at the Interface between Urban Stormwater Runoff and Salmon Survival. Environmental Science and Technology. 2007, 41, 2998-3004.

Sarti, L., S.A. Eckert, P.H. Dutton, A. Barragan, and N. Garcia. 1999. The current situation of the leatherback population of the Pacific Coast of Mexico and Central America, abundance and distribution of the nestings: an update. *In* 19th Annual Sea Turtle Symposium, South Padre Island, Texas.

Schindler, D.E., J.B. Armstrong, and T.E. Reed. 2015. The portfolio concept in ecology and evolution. *Frontiers in Ecology and the Environment*. 13:257-263.

Scholz, N. L., N. K. Truelove, B. L. French, B. A. Berejikian, T. P. Quinn, E. Casillas, and T. K. Collier. 2000. Diazinon disrupts antipredator and homing behaviors in Chinook Salmon (Oncorhynchus tshawytscha). Canadian Journal of Fisheries and Aquatic Sciences 57:1911–1918.

Scholik, A.R., and H.Y. Yan. 2002. Effects of boat engine noise on the auditory sensitivity of the fathead minnow, Pimephales promelas. Environmental Biology of Fishes. 63:203-209.

Sebastianutto, L., M. Picciulin, M. Costantini, and E.A. Ferrero. 2011. How boat noise affects an ecologically crucial behavior: the caser of territoriality in Gobius cruentatus (Gobiidae). Environmental Biology of Fishes. 92:207-215.

Seminoff, J.A., S.R. Benson, K.E. Arthur, T. Eguchi, P.H. Dutton, R.F. Tapilatu, and B.N. Popp. 2012. Stable Isotope Tracking of Endangered Sea Turtles: Validation with Satellite Telemetry and delta N-15 Analysis of Amino Acids. *Plos One*. 7.

Senecal, J.F., Dupuch, A., Lagrois, D., Mingelbier, M. and Chion, C., 2024. Approaching merchant ships elicit behavioral changes in Atlantic sturgeon (Acipenser oxyrinchus) in the St. Lawrence River, Canada. Journal of Fish Biology.

Schevill, W.E. and Watkins, W.A., 1966. Sound structure and directionality in Orcinus (killer whale). Woods Hole: Woods Hole Oceanographic Institution.

Schilling, M.R., I. Seipt, M.T. Weinrich, S.E. Frohock, A.E. Kuhlberg, and P.J. Clapham. 1992. Behavior of individually identified sei whales Balaenoptera borealis during an episodic influx into the southern Gulf of Maine in 1986. Fisheries Bulletin 90: 749-755.

Sherwood, C. R., D. A. Jay, R. B. Harvey, P. Hamilton and C. A. Simenstad (1990). "Historical changes in the Columbia River estuary." Progress in Oceanography 25(1-4): 299-352.

Shillinger, G.L., and coauthors. 2010. Four years and fourty-six turtles: tracking the movements and behaviors of leatherback sea turtles in the eastern Pacific. *In* 28th Annual Symposium on Sea Turtle Biology and Conservation. K. Dean and M.C.L. Castro, editors. National Marine Fisheries Service.

Shillinger, G.L., D.M. Palacios, H. Bailey, S.J. Bograd, A.M. Swithenbank, P. Gaspar, B.P. Wallace, J.R. Spotila, F.V. Paladino, R. Piedra, S.A. Eckert, and B.A. Block. 2008. Persistent leatherback turtle migrations present opportunities for conservation. *Plos Biol*. 6:1408-1416.

Shillinger, G.L., A.M. Swithenbank, H. Bailey, S.J. Bograd, M.R. Castelton, B.P. Wallace, J.R. Spotila, F.V. Paladino, R. Piedra, and B.A. Block. 2011. Vertical and horizontal habitat preferences of post-nesting leatherback turtles in the South Pacific Ocean. *Mar Ecol Prog Ser*. 422:275-289.

Siegel, J., and L. Crozier. 2020a. Impacts of Climate Change on Salmon of the Pacific Northwest: A review of the scientific literature published in 2019. National Marine Fisheries Service, Northwest Fisheries Science Center, Fish Ecology Division. .

Siegel, J., and L.G. Crozier. 2019. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2018. *Pages D1-D50 in Endangered Species Act Section 7(a)(2) supplemental biological opinion: consultation on remand for operation of the Federal Columbia River Power System. U.S. National Marine Fisheries Service, Northwest Region*.

Siegel, J., and L.G. Crozier. 2020b. Impacts of Climate Change on Columbia River Salmon: A review of the scientific literature published in 2019. *U.S. National Marine Fisheries Service, Northwest Region. https://doi.org/10.25923/jke5-c307*.

Simenstad, C.A. 1988. Summary and Conclusions from Workshop and Working Group Discussions. Pages 144-152 in Proceedings, Workshop on the Effects of Dredging on Anadromous Pacific Coast Fishes, Seattle, Washington, September 8-9, 1988. C.A. Simenstad, ed., Washington Sea Grant Program, University of Washington, Seattle, Washington.

Simpson, S.D., A.N. Radford, S.L. Nedelec, M.C.O. Ferrari, D.P. Chivers, M.I. McCormick, and M.G. Meekan. 2016. Anthropogenic noise increases fish mortality by predation. Nature Communications 7:10544 DOI: 10.1038/ncomms10544 www.nature.com/naturecommunications February 5, 2016. 7 pp.

Smith, W.E., and Saalfeld, R.W. 1955. Studies on the Columbia River smelt, Thaleicthys pacificus (Richardson). Washington Department of Fisheries, Fisheries Research Papers. 1(3): 3-26.

Solomon, K., & Thompson, D. (2003). Ecological Risk Assessment for Aquatic Organisms from Over-Water Uses of Glyphosate. Journal of Toxicology and Environmental Health, Part B, 6(3), 289–324. https://doi.org/10.1080/10937400306468.

Southall, B., J. Calambokidis and J. Barlow. 2014. Biological and behavioral response studies of marine mammals in Southern California, 2013 (“SOCAL-13”) final project report.

Southard, S.L., R.M. Thom, G.D. Williams, J.D. Toft, C.W. May, G.A. McMichael, J.A. Vucelick, J.T. Newell, and J.A. Southard. 2006. Impacts of Ferry Terminals on Juvenile Salmon Movement along Puget Sound Shorelines. Prepared for the Washington State Department of Transportation, Project Number 46820. Battelle Memorial Institute, Pacific Northwest Division. June 2006.

Spromberg, J.A, D.H. Baldwin, S.E. Damm, J.K. McIntyre, M. Huff, C.A. Sloan, B.F. Anulacion, J.W. Davis, and N.L. Scholz. 2015. Coho salmon spawner mortality in western US urban watersheds: bioinfiltration prevents lethal storm water impacts. Journal of Applied Ecology. DOI: 10.1111/1365-2264.12534.

Stadler, J.H., and D.P. Woodbury. 2009. Assessing the effects to fishes from pile driving: Application of new hydroacoustic criteria. 8 pp.

Stenstrom, M.K., and M. Kayhanian. 2005. First flush phenomenon characterization. California Department of Transportation, Division of Environmental Analysis. CTSW-RT-05-73-02.6. Sacramento, California. August. http://149.136.20.66/hq/env/stormwater/pdf/CTSW-RT-05-073-02-6_First_Flush_Final_9-30-05.pdf.

Stehr, C.M., Linbo, T.L., Baldwin, D.H., Scholz, N.L. and Incardona, J.P., 2009. Evaluating the effects of forestry herbicides on fish development using rapid phenotypic screens. North American Journal of Fisheries Management, 29(4), pp.975-984.

Sturdevant, M.V. 1999. Forage fish diet overlap, 1994-1996. Exxon Valdez Oil Spill (EVOS) Restoration Project final report 97163C, National Marine Fisheries Service, Alaska Fisheries Science Center, Auke Bay Laboratory. 103 p.

Tabor, R.A., Shively, R.S. and Poe, T.P., 1993. Predation on juvenile salmonids by smallmouth bass and northern squawfish in the Columbia River near Richland, Washington. North American Journal of Fisheries Management, 13(4), pp.831-838.

Thomsen, F., Franck, D. and Ford, J.K.B., 2001. Characteristics of whistles from the acoustic repertoire of resident killer whales (Orcinus orca) off Vancouver Island, British Columbia. The Journal of the Acoustical Society of America, 109(3), pp.1240-1246.

Tian, Z., Gonzalez, M., Rideout, C.A., Zhao, H.N., Hu, X., Wetzel, J., Mudrock, E., James, C.A., McIntyre, J.K. and Kolodziej, E.P., 2022. 6PPD-quinone: Revised toxicity assessment and quantification with a commercial standard. Environmental Science & Technology Letters, 9(2), pp.140-146.

Tiwari, M., and B. Wallace. 2013. *Dermochelys coriacea* (West Pacific Ocean subpopulation).

Toft, J.D., A.S. Ogston, S.M. Heerhartz, J.R. Cordell, and E.E. Flemer. 2013. Ecological response and physical stability of habitat enhancements along an urban armored shoreline. Ecological Engineering. 57:97-108.

USDC (2009). "Endangered and threatened wildlife and plants: Final rulemaking to designate critical habitat for the threatened southern distinct population segment of North American green sturgeon." U.S. Department of Commerce, National Marine Fisheries Service. Federal Register 74(195): 52300-52351.

USEPA. 1993. EPA Reregistration Eligibility Decision Facts Glyphosate.

USEPA. 2015. Registration Review - Preliminary Ecological Risk Assessment for Glyphosate and Its Salts. Pesticide Re-Evaluation Division.

EPA. 2020. Glyphosate Interim Registration Review Decision Case Number 0178. Pesticide Re-evaluation Division.

Vanderlaan, A.S.M. and C.T. Taggart. 2007. Vessel collisions with whales: The probability of lethal injury based on vessel speed. Mar. Mam. Sci. 22(3).

Van der Hoop, J. M., A. S. M. Vanderlaan, and C. T. Taggart. 2012. Absolute probability of lethal vessel strikes to North Atlantic right whales in Roseway Basin, Scotian Shelf. Ecological Applications 22:2021–2033.

Varanasi, U., W.L. Reichert, J.E. Stein, D.W. Brown, and H.R. Sanborn. 1985. Bioavailability and biotransformation of aromatic hydrocarbons in benthic organisms exposed to sediment from an urban estuary. Environmental Science and Technology 19: 836-841.

Varanasi, U., E. Casillas, M.R. Arkoosh, T. Hom, D.A. Misitano, D.W. Brown, S.L. Chan, T.K. Collier, B.B. McCain, and J.E. Stein. 1993. Contaminant Exposure and Associated Biological Effects in Juvenile Chinook Salmon (Oncorhynchus tshawytscha) from Urban and Nonurban Estuaries of Puget Sound. NOAA Technical Memorandum NMFS-NWFSC-8. NMFS NFSC Seattle, WA. April 1993. 69 pp.

Veirs, S., V. Veirs, and J. D. Wood. 2016. Ship noise extends to frequencies used for echolocation by endangered killer whales. PeerJ. 4: 1-35.

Verfuss, U.K., D. Gillespie, J. Gordon, T.A. Marques, B. Miller, R. Plunkett, J.A. Theriault, D.J. Tollit, D.P. Zitterbart, P. Hubert, and L. Thomas. 2018. Comparing methods suitable for monitoring marine mammals in low visibility conditions during seismic surveys. Marine Pollution Bulletin 126: 1-18.

Wallace, B.P., M. Tiwari, and M. Girondot. 2013. *Dermochelys coriacea* IUCN Red List of Threatened Species.

Ward, E.J., M.J. Ford, R.G. Kope, J.K.B. Ford, L.A. Velez-Espino, C.K. Parken, L.W. LaVoy, M.B. Hanson, and K.C. Balcomb. 2013. Estimating the impacts of Chinook salmon abundance and prey removal by ocean fishing on Southern Resident killer whale population dynamics. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-123.

WDEQ. 2022. 6PPD in Road Runoff, Assessment and Mitigation Strategies. Washington State Departmen tof Ecology, Olympia Washington.

WDFW and ODFW (Oregon Department of Fish and Wildlife). 2001. Washington and Oregon Eulachon Management Plan. October 2001. https://wdfw.wa.gov/sites/default/files/publications/00849/wdfw00849.pdf.

WDFW. 2012. Washington Department of Fish and Wildlife. 2013. Threatened and Endangered Wildlife in Washington: 2012 Annual Report. Listing and Recovery Section, Wildlife Program, Washington Department of Fish and Wildlife, Olympia. 251 pp.

WDFW. 2017. Draft conservation plan for reducing the impact of selected fisheries on ESA listed species in Puget Sound, with an emphasis on bocaccio and yelloweye rockfish. Prepared for the National Marine Fisheries Service by the Washington Department of Fish and Wildlife.

WDFW. 2025. https://wdfw.wa.gov/species-habitats/species/balaenoptera-musculus#desc-range. Accessed February 27, 2025.

WDOE. 2022. Vessel Entries and Transits for Washington Waters. Washington State Department of Ecology.

Weilgart, L. S. 2007. The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology. 85(11):1091-1116.

Whitehead, H. 2009. Sperm whale, Physeter macrocephalus. *In* Encyclopedia of Marine Mammals W.F. Perrin, B. Wursig, and J.G.M. Thewissen, editors. Academic Press, Cambridge, MA. 1091–1097.

Whitehead, H., A. Coakes, N. Jaquet, and S. Lusseau. 2008. Movements of sperm whales in the tropical Pacific. *Mar Ecol Prog Ser*. 361:291-300.

Williams, J.G., S.G. Smith, R.W. Zabel, W.D. Muir, M.D. Scheuerell, B.P. Sandford, D.M. Marsh, R.A. McNatt, and S. Achord. 2005. Effects of the Federal Columbia River Power System on salmon populations, U.S. Department of Commerce. U. S. Department of Commerce. 150.

Williams, R., L. Thomas, and . . 2007. Distribution and abundance of marine mammals in the coastal waters of British Columbia, Canada. *Journal of Cetacean Research and Management*:13.

Williams, R., D. Lusseauc, and P. S. Hammond. 2006. Estimating relative energetic costs of human disturbance to killer whales (Orcinus orca). Biological Conservation. 113: 301-311.

Wood, T.M. 2001. Herbicide use in the management of roadside vegetation, western Oregon, 1999-2000: Effects on the water quality of nearby streams. U.S. Geological Survey. Water-Resources Investigations Report 01–4065. Portland, Oregon. http://or.water.usgs.gov/pubs_dir/Pdf/01-4065.pdf.

WWF. 2019. Report of Sea Turtle Conservation Activities in Buru and Kei Islands, Maluku Province. World Wildlife Fund.

Xie, Y.B., C.G.J. Michielsens, A.P. Gray, F.J. Martens, and J.L. Boffey. 2008. Observations of avoidance reactions of migrating salmon to a mobile survey vessel in a riverine environment. Canadian Journal of Fisheries and Aquatic Sciences. 65:2178-2190.

Zamon, J.E., Guy, T.J., Balcomb, K. and Ellifrit, D., 2007. Winter observations of southern resident killer whales (Orcinus orca) near the Columbia River plume during the 2005 spring Chinook salmon (Oncorhynchus tshawytscha) spawning migration. Northwestern Naturalist, pp.193-198.

Zhang, S., H. Yao1, Y. Lu1, X. Yu1, J. Wang, S. Sun1, M. Liu, D. Li1, Y. Li and D. Zhang. 2017. Uptake and translocation of polycyclic aromatic hydrocarbons (PAHs) and heavy metals by maize from soil irrigated with wastewater. Scientific Reports 7: 12165. DOI:10.1038/s41598-017-12437-w