UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 N.E. Lloyd Boulevard, Suite 1100
Portland, Oregon 97232

January 21, 2022

Environmental Consultation Organizer
Record Number: WCRO-2021-03390

Dr. Scott Hecht
Acting Division Director
Fish Ecology Division
Northwest Fisheries Science Center
2725 Montlake Blvd. East
Seattle, Washington 98112

Re: Endangered Species Act Section 7(a)(2) Biological Opinion for the Acoustic Characterization and Sampling of Eulachon Larvae in the Lower Columbia River

Dear Mr. Hecht:

Thank you for your letter of November 4, 2021, 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 "Implementing high-priority recovery actions for ESA-listed eulachon: a pilot study assessing larval identification, timing, distribution, and condition at ocean entry through federal-state partnership" research project. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action. However, after reviewing the proposed action, we concluded that it would not adversely affect EFH, therefore, no EFH consultation is required.

In this opinion, we conclude that the proposed action is not likely to jeopardize the continued existence of the southern distinct population segment (DPS) of eulachon (*Thaleichtys pacificus*).

We also conclude that the proposed action is not likely to adversely affect the Lower Columbia River (LCR) Chinook salmon (*Oncorhynchus tshawytscha*), Snake River (SR) Fall-run Chinook salmon, SR Spring/Summer-run Chinook salmon, Upper Columbia River (UCR) Spring-run Chinook salmon, Upper Willamette River (UWR) Chinook salmon, LCR steelhead (*O. mykiss*), Middle Columbia River (MCR) steelhead, Snake River Basin (SRB) steelhead, UCR steelhead, UWR steelhead, Columbia River (CR) chum salmon (*O. keta*), LCR coho salmon (*O. kisutch*), SR sockeye salmon (*O. nerka*), or the southern DPS of North American green sturgeon (*Acipenser medirostris*) or result in the destruction or adverse modification of designated critical habitat for species considered in this opinion.

Please contact Hanna Miller, Seattle, Washington, 206.735.8388 if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

FOR Chris E. Yates

Barry A. Thom
Regional Administrator

cc: Robert Anderson, WCR/PRD
Administrative File: 151422WCR2022PR00028

National Marine Fisheries Service Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion

Consultation on the Acoustic Characterization and Sampling of Eulachon Aggregations in the Lower Columbia River

NMFS Consultation Number: WCR-2021-03390

Action Agency: National Marine Fisheries Service, Northwest Fisheries Science Center

Affected Species and 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 *(O. tshawytscha)*	Threatened	No	No	No	No
Upper Willamette River Chinook salmon *(O. tshawytscha)*	Threatened	No	No	No	No
Upper Columbia River Spring-Run Chinook salmon *(O. tshawytscha)*	Endangered	No	No	No	No
Snake River Spring/Summer Run Chinook salmon *(O. tshawytscha)*	Threatened	No	No	No	No
Snake River Fall-Run Chinook salmon *(O. tshawytscha)*	Threatened	No	No	No	No
Columbia River Chum salmon (*O. keta*)	Threatened	No	No	No	No
Lower Columbia River coho salmon (*O. kisutch*)	Threatened	No	No	No	No
Sockeye salmon (*O. nerka*)	Threatened	No	No	No	No
Lower Columbia River steelhead (*O. mykiss*)	Threatened	No	No	No	No
Upper Willamette River steelhead *(O. mykiss)*	Threatened	No	No	No	No
Middle Columbia River steelhead (*O. mykiss*)	Threatened	No	No	No	No
Upper Columbia River steelhead *(O. mykiss)*	Threatened	No	No	No	No
Snake River Basin steelhead (*O. mykiss*)	Threatened	No	No	No	No
Southern DPS of Eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	No	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?
Southern DPS of North American Green Sturgeon (*Acipenser medirostris*)	Threatened	No	No	No	No

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: For Chris E. Yates
Barry A. Thom
Regional Administrator

Date: January 21, 2022

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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 this biological opinion (opinion) and incidental take statement portions of this document in accordance with section 7(b) of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.) and implementing regulations at 50 CFR 402.

The NMFS has not yet promulgated an ESA section 4(d) rule prohibiting take of threatened southern distinct population segment (DPS) of eulachon (hereafter, "eulachon").

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 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. In this case, we concluded that the proposed actions would not adversely affect EFH. Thus, consultation under the MSA is not required for this action.

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 within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Protected Resources Division in the Portland, Oregon office of NMFS's West Coast Region.

1.2 Consultation History

NMFS received a request for consultation on November 15, 2021, from the Northwest Fisheries Science Center (NWFSC). The NWFSC proposed to conduct research on eulachon in the lower Columbia River and their request included a biological assessment (BA) of the action. NMFS initiated consultation on November 15, 2021.

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). The proposed action is to authorize the NWFSC to carry out research on eulachon in the lower Columbia River. The research comprises the following elements:

1.3.1 Plankton net sampling and laboratory processing of larval samples

The NWFSC proposes to use plankton nets to capture eulachon eggs and larvae in the Columbia River estuary from river kilometer (rkm) 0 to the saltwater intrusion at Tongue Point, Oregon (rkm 29). The plankton net would be deployed from a 28-foot long research vessel to collect weekly samples during the months of January to April. The plankton net would have a 60cm diameter and 300-µm mesh. NMFS would use an oblique tow in the water column from within 1 to 3 m of the bottom to the water surface and the net would never touch the bottom. Flow would be measured during the towing by a General Oceanic Model 2030R mechanical flowmeter on the net to allow for calculating larval density (number per cubic meter). Samples would be collected at six stations: two in the north channel, two in the south channel, and two in the main channel where the north and south channels merge. Approximately two 4-6 hour days per week would occur to sample at all six stations weekly for approximately 17 weeks (for a total of 34 sampling days) from early to mid-January through the end of April, 2022.

1.3.2 Lab processing

Once the samples are collected via the plankton tows, they would be examined and specimens determined to be eulachon would be counted and digitally photographed. Larval length, yolk sac presence/absence, and length-width-depth of the yolk sac would be measured. Confirmation of species would be conducted by NWFSC and Washington Department of Fish and Wildlife (WDFW) personnel.

1.3.3 Hydrographic profiles of temperature and salinity

NWFSC would deploy a conductivity-temperature-depth probe (CTD) from the vessel davit to sample water properties from the surface to within 1-2 m of the bottom of the water column. This would collect hydrographic profiles of water temperature and salinity from each sampling event, along with the sound speed in the water column.

1.3.4 Scientific Echosounder Use and Calibration

NWFSC would use a hull-mounted, downward-facing, split-beam scientific echosounder (38 kHz Simrad EK-60), in coordination with the vessel GPS, to determine vessel location, water depth, and bottom topography. The echosounder would transmit sound within the characteristics provided in Table 1.

Table 1. Sound transmission characteristics for echosounder recordings (NWFSC 2021).

Acoustic parameter	Value for data collection
Transmission frequency	38 kHz
3 dB beam width, alongships	11.83 degrees
3 dB beam width, athwartships	11.67 degrees
Maximum transmit power	1000 Watts
Pulse width	512 µs or 1024 µs
Source level	214.14 dB re:1µPa@1m
Pings per second	2

NWFSC would conduct both a field calibration of the split-beam echo-sounder and an acoustic noise analysis. Post-season calibration would occur during April to August, 2022 between rkm 29 and rkm 109. Acoustic noise from the vessel, environment, and other sources will be measured by running the transducer only in "record" mode over a variety of vessel speeds and recording acoustic signals.

The proposed actions also have the potential to affect the Lower Columbia River (LCR) Chinook salmon (Oncorhynchus tshawytscha), Snake River (SR) Fall-run Chinook salmon, SR Spring/Summer-run Chinook salmon, Upper Columbia River (UCR) Spring-run Chinook salmon, Upper Willamette River (UWR) Chinook salmon, LCR steelhead (O. mykiss), Middle Columbia River (MCR) steelhead, Snake River Basin (SRB) steelhead, UCR steelhead, UWR steelhead, Columbia River (CR) chum salmon (O. keta), LCR coho salmon (O. kisutch), SR sockeye salmon (O. nerka), and the southern DPS of North American green sturgeon (Acipenser medirostris) and their critical habitat. We concluded that the proposed activities are not likely to adversely affect any of these species or their critical habitat and the full analysis for that conclusion is found in the "Not Likely to Adversely Affect" Determinations section (2.12).

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not.

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 NWFSC determined the proposed action is not likely to adversely affect the LCR Chinook salmon, SR Fall-run Chinook salmon, SR Spring/Summer-run Chinook salmon, UCR Spring-run Chinook salmon, UWR Chinook salmon, LCR steelhead, MCR steelhead, SRB steelhead, UCR steelhead, UWR steelhead, CR chum salmon, LCR coho salmon, SR sockeye salmon, or the southern DPS of North American green sturgeon nor their critical habitat. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.12).

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 designations of critical habitat for the species analyzed in this opinion use 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.

For eulachon, the NMFS has not promulgated protective regulations under section 4(d). Promulgation of section 4(d) take prohibitions for eulachon shall result in a reinitiation of this opinion if the effects of the research program considered in this opinion results in take that is prohibited by the section 4(d) rule.

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 Eulachon and Eulachon Critical Habitat

This opinion examines the status of eulachon that are 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.

2.2.1 Climate Change

One factor affecting the status of eulachon 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 eulachon, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote et al. 2014, Mote 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013, Mote et al. 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1-1.4°F as an annual average, and up to 2°F in some seasons (based on average linear increase per decade; Abatzoglou et al. 2014; Kunkel et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014). Decreases in summer precipitation of as much as 30% by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur during October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2013; Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

Overall, about one-third of the current cold-water habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Mantua et al. 2010; Isaak et al. 2012). Temperature increases shift timing of key life cycle events for eulachon and species forming the base of their aquatic food webs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can also result in reduced oxygen (Meyer et al. 1999; Winder and Schindler 2004, Raymondi et al. 2013). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Wainwright and Weitkamp 2013; Raymondi et al. 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for eggs and larvae, and may flush some eggs and larvae from rivers to estuaries before they are physically mature, increasing stress and reducing survival (McMahon and Hartman 1989; Lawson et al. 2004).

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by 1.0-3.7^{o}C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011, Reeder et al. 2013).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012, Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10-32 inches by 2081-2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding, and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011, Reeder et al. 2013). Estuarine-dependent fish are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of cold water fish, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to affect a wide range of listed aquatic species (Tillmann and Siemann 2011, Reeder et al. 2013).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these evolutionarily significant units (ESUs) (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of listed species in the future.

2.2.2 Status of the Species

For Pacific salmon and steelhead—and eulachon—NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: spatial structure, diversity, abundance, and productivity (McElhany et al. 2000). These "viable salmonid population" (VSP) criteria therefore encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment– even if the species in question is not a salmonid. These attributes are influenced by survival, behavior, and experiences throughout a species' entire life cycle, and these characteristics, in turn, are influenced by habitat and other environmental conditions.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends fundamentally on habitat quality and spatial configuration and the dynamics and dispersal characteristics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation at single genes to complex life history traits (McElhany et al. 2000).

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

"Productivity," as applied to viability factors, refers to the entire life cycle; i.e., the number of naturally-spawning adults produced per parent. When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, NMFS assesses the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

A species' status thus is a function of how well its biological requirements are being met: the greater the degree to which the requirements are fulfilled, the better the species' status. For the purposes of our later analysis, all the species considered here require functioning habitat and adequate spatial structure, abundance, productivity, and diversity to ensure their survival and recovery in the wild. Table 2 provides a summary of listing and recovery plan information, status summaries and limiting factors for the species addressed in this opinion.

2.2.2.1 Southern DPS of Eulachon

The southern DPS of eulachon (*Thaleichthys pacificus*) is listed as a threatened species (75 FR 12012). NMFS reaffirmed its threatened status conclusion in its most recent 5-year status review (NMFS 2016). The status and limiting factors are summarized in Table 2.

Table 2. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for eulachon.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Southern DPS of eulachon	Threatened 3/18/10	NMFS 2017	Gustafson et al. 2016	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

Eulachon are smelt native to the eastern North Pacific waters from the Bering Sea to Monterey Bay, California **Figure 1**; NMFS 2016). Eulachon spend the majority of their life at sea and adult eulachon are found in coastal and offshore marine habitats (NMFS 2017). The southern DPS is composed of four subpopulations: the Klamath, Columbia, Fraser, and British Columbia. The majority of spawning is believed to occur in the Columbia River and its tributaries (Gustafson et al. 2010). Spawning typically occurs in January through March, but small runs can occur as early as November or December (NMFS 2017).

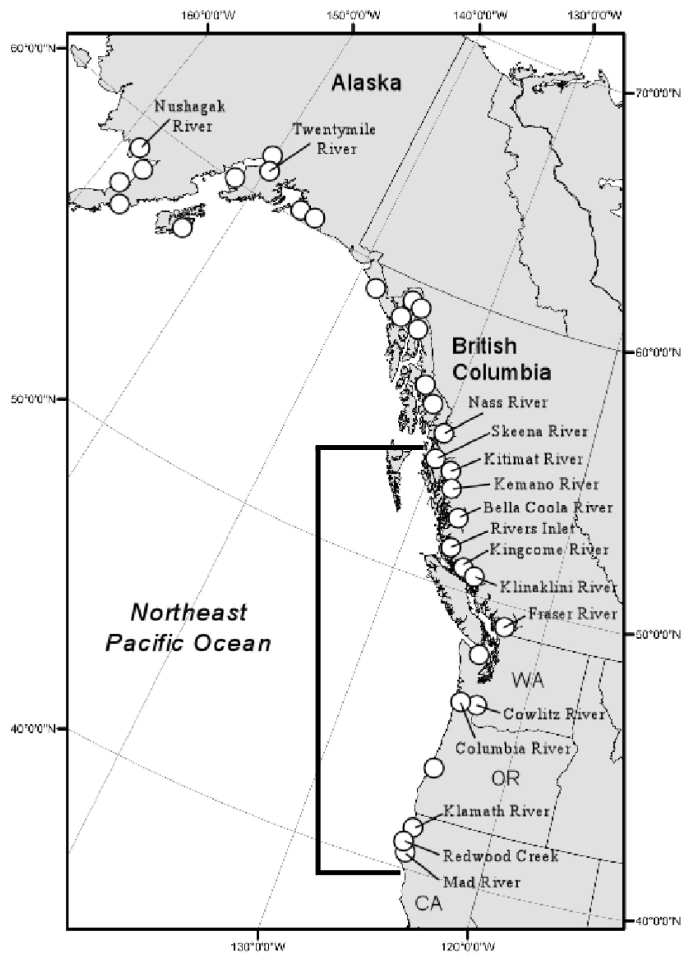

Figure 1. Distribution of the southern Distinct Population Segment of eulachon (NMFS 2016).

Starting in 1994, southern DPS eulachon experienced an abrupt decline in abundance throughout its range. Eulachon abundance in monitored rivers improved in the 2013 to 2015 return years, but recent poor conditions in the northeastern Pacific Ocean appear to have driven sharp declines in the river systems in 2016 and 2017.

At the time of listing, the primary factors responsible for the decline of eulachon were destruction, modification, or curtailment of habitat and inadequacy of existing regulatory mechanisms (75 FR 13012), specifically the lack of regulations concerning bycatch of eulachon in commercial fisheries. Further research and review by the NMFS Biological Review Team (BRT) has shown that climate change impacts, especially on ocean conditions, represent significant threats to eulachon (NMFS 2017). Climate-related impacts on ocean habitat are the most serious threat to eulachon persistence (Gustafson et al. 2010). Other threats to the species include climate-related impacts on freshwater habitat and habitat alteration and degradation from various activities. Additionally, hydroelectric dams block access to historical eulachon spawning grounds in the Columbia basin and affect spawning substrate quality through flow management, altered coarse sediment delivery, and siltation. During the eulachon spawning run, dredging in the Columbia River and harvest activities may entrain and kill fish or otherwise decrease spawning success.

2.2.3 Status of 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).

On October 20, 2011, NMFS designated critical habitat eulachon (76 FR 65324). The 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. The PBFs identified for eulachon critical habitat are: (1) freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, (2) freshwater and estuarine migration corridors 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, and (3) nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival (76 FR 65324). Table 3. Provides a summary of the status of critical habitat for eulachon.

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
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.

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). The action area for the Scientific research acoustic surveys, trawl activity, will take place includes the main-stem, tidal freshwater portion of the Columbia River between river kilometer (rkm) 0 (denoted on **Figure 2** as a dotted line extending directly north across the Columbia River from Tongue Point, OR to Grays Point, WA) and rkm 109 (Cowlitz River mouth/Cottonwood Island). The project area is located entirely within United States Geological Survey Hydrologic Unit Codes (USGS HUCs) 17080006 (Lower Columbia River) and 17080003 (Lower Columbia River-Clatskanie). The plankton net sampling will occur between rkm 0 to rkm 29. The hydrographic profiling and scientific echosounder use will occur between rkm 0 to rkm 109, with post-season calibration of the echosounder occurring only between rkm 29 and rkm 109.

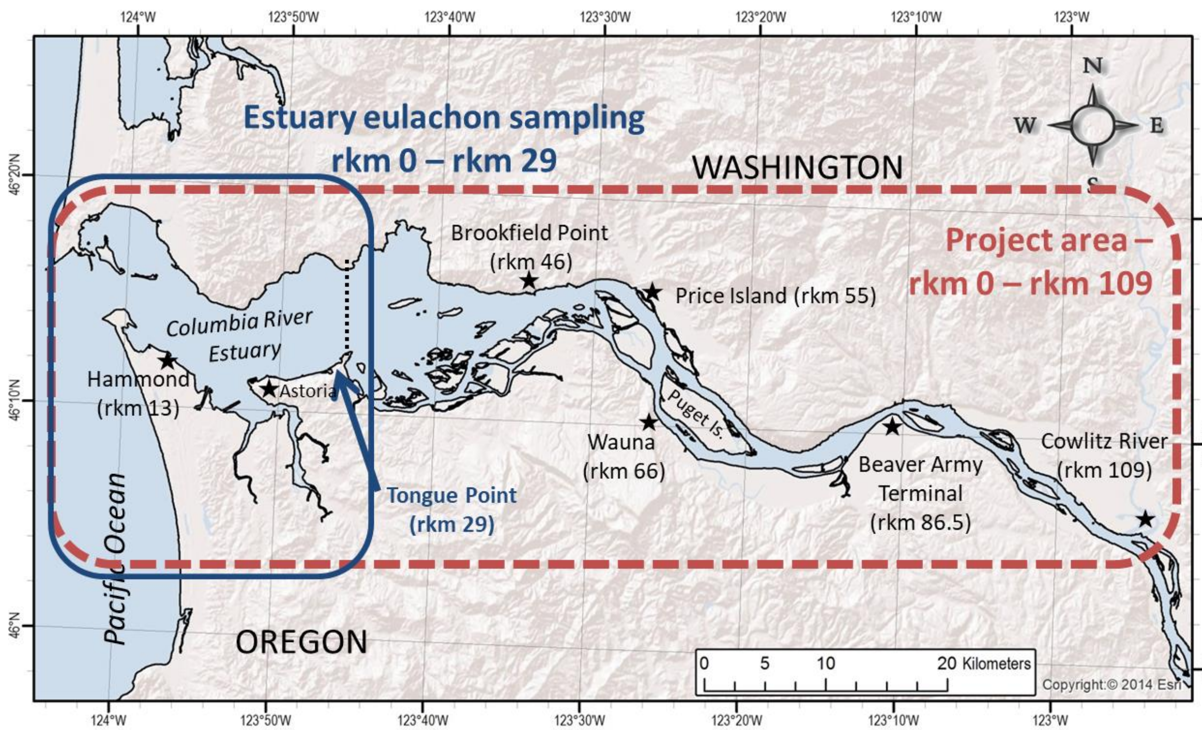

Figure 2. Map of the proposed project area where net sampling will capture, kill, etc. larval eulachon in the estuary. Sampling for eulachon larvae will only take place between rkm 0 and rkm 29 (within the blue box). The hydrographic profile sampling and scientific echosounder use will take place from rkm 0 to rkm 29. Post-season calibration of the scientific echosounder would occur between rkm 29 and rkm 109.

2.4 Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its 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 best scientific information presently available demonstrates that a multitude of factors, past and present, have contributed to the decline of eulachon. Eulachon face a number of habitat-related threats. Very generally, these include harvest and hatchery practices and habitat degradation and curtailment caused by human development and resource extraction. **Figure 3** displays the annual eulachon run size estimates (spawning stock biomass estimations) are provided for the years 2000 through 2019 for the Columbia River subpopulation.

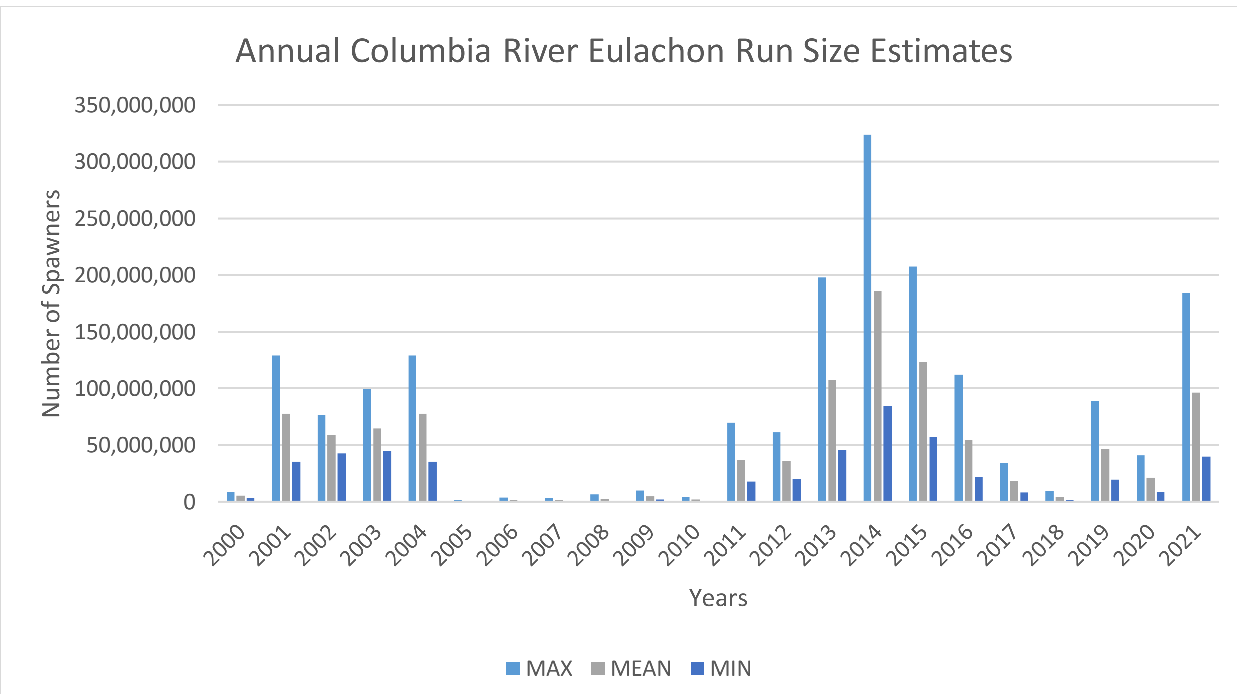

Figure 3. Columbia River subpopulation run size estimates for the years 2000 through 2021.

Aquatic habitats have been significantly modified in the lower Columbia River by a variety of anthropogenic activities, including dams and water diversions, dredging, urbanization, agriculture, silviculture, and the construction and operation of port and shipping terminals. Since the development of the Canadian and the U.S. Federal Columbia River Power System (FCRPS) storage and power production projects in the Columbia basin (1940s through 1970s), water is stored during spring and released for power production and flood control during winter, shifting the annual hydrograph. Water withdrawals and flow regulation in the Columbia River basin have reduced the Columbia River's average flow, altered its seasonality, and altered sedimentation processes and seasonal turbidity events, e.g., estuary turbidity maximum (Simenstad et al. 1982, 1990; Sherwood et al. 1990; Weitkamp 1994; NRC 1996). Water withdrawals and flow regulation have significantly affected the timing, magnitude, and duration of the spring freshet through the Columbia River estuary such that they are about one-half of the pre-development levels (NMFS 2008), all of which are important for eulachon adult, larval, and egg life stages.

In the Columbia River estuary, both the quantity and timing of instream flows have changed from historical conditions (Fresh et al. 2005). Jay and Naik (2002) reported a 16% reduction of annual mean flow over the past 100 years and a 44% reduction in spring freshet flows. Jay and Naik (2002) also reported a shift in flow patterns in the Columbia to 14 to 30 days earlier in the year, meaning that spring freshets are occurring earlier in the season. In addition, the interception and use of spring freshets (for irrigation, reservoir storage, etc.) have caused increased flows during other seasons (Fresh et al. 2005). It is unknown what effect these changes in hydrology may have on habitat for species considered in this opinion.

Dredging in the Columbia River is required to maintain adequate depth of navigation channels. Dredging activities, which include the disposal of dredged material, may affect depth, sediment quality, water quality, and prey resources for species considered in this opinion. Dredging and the aquatic disposal of dredged material can remove, and/or alter the composition of, substrate materials at the dredge site, as well as bury them at the disposal site, potentially altering the quality of substrate for use as a spawning site.

Several types of in-water construction or alterations occur in the Columbia River and its tributaries including bridge and road construction and repair; construction or repair of breakwaters, docks, piers, and boat ramps; gravel removal or augmentation; pile driving; and bank stabilization (LCFRB 2004). These types of activities may affect essential habitat features for species considered in this opinion by altering the water and sediment quality, substrate composition, and eulachon migratory corridors.

Pollution and runoff from urbanized areas, industrialized areas, and agricultural lands in the lower Columbia River basin may affect essential habitat features for species considered in this opinion by altering the water quality, sediment quality, and substrate composition.

The construction and operation of port and shipping terminals in the lower Columbia River pose the risk of leaks, spills, or pipeline breakage and may affect water quality. In addition, activities associated with the construction, operation, and maintenance of these projects may affect water quality, sediment quality, and prey resources for species considered in this opinion.

NMFS consulted on a research project by WDFW (WCRO-2020-03011) that will take up to 500,000 eulachon eggs and larvae across 2021 and 2022 in the Columbia River. The project will use plankton tows in a manner consistent with the proposed action. There was historically a eulachon fishery in the Columbia River that was managed by WDFW and the Oregon Department of Fish and Wildlife (ODFW). This fishery was discontinued from 2011-2013, but starting in 2014 ODFW, WDFW, and NMFS have coordinate a research-level eulachon fishery on Cowlitz River. NMFS does not consult on this fishery because it is a Washington state action, and an activity not subject to the ESA or its implementing regulations as NMFS has not yet promulgated an ESA section 4(d) rule prohibiting take of threatened eulachon.

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 (see 50 CFR 402.02). 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 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

2.5.1 Effects on Eulachon

2.5.1.1 Effects of Plankton Net Sampling and Processing

The proposed action will take up to 250,000 eulachon eggs/larvae during plankton net sampling, with an average of 2,450 egg/larvae per estuary net sampling event over the 17 weeks of sampling activity. All captured eulachon eggs and larvae are expected to die. This estimate is consistent with estimates from other research actions using the same sampling technique used further upstream from the action area (plankton net sampling at rkm 55 analyzed in WCRO-2020-03011). This estimate is likely higher than the actual number of eggs/larvae that would be collected and killed by the proposed action due to the natural mortality and larval dilution that would occur between rkm 55 and the sampling involved in the proposed action between rkm 0 and rkm 29. The anticipated amount of eulachon eggs/larvae anticipated to be killed by the proposed action represents less than 0.000001% of the average minimum Columbia River egg/larval production during 2015-2019 (NWFSC 2021).

NMFS does not expect adult eulachon to be captured in the plankton nets. We base this expectation on the fact that during the past eight years that WDFW has been conducting similar plankton net surveys for eulachon in the Columbia River, they have never caught any adult eulachon in the plankton nets. Therefore, the likelihood of adult eulachon being captured in the plankton nets is extremely small.

While there will be a minor increase in boat traffic associated with the plankton net surveys and correspondingly minor increases in sound levels (decibel – dB), these activities will be intermittent and of short duration and frequency. Given that dozens to hundreds of boats can be found in the action area on any given day, and all eulachon (adults) would be moving rapidly through the action area in any case, the increase in boat traffic and associated sound levels is unlikely to be detectable above background. Therefore, it is unlikely that the minor increase in boat traffic would cause any changes in foraging or migration behavior, among eulachon (adults) in the action area, and as a result, plankton net surveys would likely have no adverse physiological, behavioral, or reproductive effects on eulachon.

2.5.1.2 Effects of Hydrographic profile of temperature and salinity

This component of the proposed action involves moving a cylindrical device through the water column. The profiling instrument would not touch the bottom substrate and each profile would take approximately 5 minutes to complete. The slow deployment and retrieval speeds will allow any adult eulachon to swim away from the temporary disturbance from the instrument. The larvae that may come in contact with the profiling instrument would be washed away by the water flow past the instrument as it is moved in the water column. Therefore, instrument deployment/retrieval is not likely to adversely affect eulachon.

2.5.1.3 Effects of Scientific Echosounder Activity

For the proposed action, the acoustic parameters to project sound into the water column are provided in Table 1. NMFS does not expect the sounds produced by either the split-beam echo-sounder or the research vessel to have an adverse effect on species considered in this opinion. Firstly, the regular, rapid, and short duration of echosounder pulses is not likely to elicit a stress response. Experimental evidence shows that sound sources, such as those produced by echo-sounders, do not result in statistically significant increases of the stress hormone cortisol in giant kelpfish, *Heterostichus rostratus* (Nichols et al. 2015). Secondly, previous acoustic survey work in the Columbia River by the NWFSC (as cited in the BA) did not show any behavioral reaction of salmonids (such a diving or horizontal movement) to the vessel, thus we applied the results of the experiments on giant kelpfish and prior field observations as this was the best available science to evaluate potential effects on salmon and steelhead from sound-related activities. Thirdly, sound levels produced by the NWFSC research vessel would add one vessel trip a day. On any given day, hundreds of vessels can be in the action area. The additional sounds created by the proposed action are unlikely to be detectable above background. Finally, the sound cone generated at all possible river depths in the action area (~1-30 m) is narrow, so that the area and volume of water (and hence the number of individual fish) experiencing direct impingement of the sound pressure wave will be small relative to median daily flow of 7,645.5[1] $m3 \cdot s^{-1}$ in the Columbia River **Table 4**). Therefore, the effects of the split-beam echo-sounder and the research vessel are likely to be minimal at best.

Table 4. Depth-dependent geometry of 3 dB conical acoustic pressure wave generated by an echo-sounder pulse.

Distance from transducer face	Radius of sound pressure disturbance relative to beam axis[2]	Volume of water affected by sound pressure disturbance[3]
1 m	0.2 m	0.042 m^3
10 m	2.1 m	41.9 m^3
20 m	4.3 m	378.3 m^3
30 m	6.4 m	1,286.8 m^3

[1] Calculated from mean daily flow values at USGS Beaver Army Terminal hydrological station, 1968-2018.

[2] Calculated as tan (12 degrees) X distance from transducer face

[3] Calculated as the volume of a right circular cone with a height corresponding to the distance from the transducer face and a radius as per Footnote 2 above.

2.5.2 Effects of Actions on Critical Habitat

The proposed research activities do not involve any kind of habitat impacts other than intermittent increase in sound levels (dB). As previously described, these intermittent sound levels will to be too low and short in duration to affect the conservation value of the PBFs in the action area. Therefore, we expect the likelihood of effects on critical habitat PBFs for the species considered in this opinion would be too small to meaningfully measure, detect or evaluate, and therefore are likely to be completely negligible.

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 and 402.17(a)). 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 environmental baseline (Section 2.4).

Within the action area, non-Federal actions are likely to include human population growth, water withdrawals (i.e., those pursuant to senior state water rights) and land use practices. In the action area, state, tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives, shoreline growth management and resource permitting. For example, currently, all commercial and recreational eulachon fisheries are extremely limited in the states of Washington and Oregon. Therefore, effects of harvest on eulachon productivity and abundance is minimal (a low-level tribal subsistence fishery still occurs on the Cowlitz River).

As cities exist and expand along the Columbia River, diffuse and extensive growth will increase overall volume of contaminant loading from wastewater treatment plants and sediments from sprawling urban and suburban development into riverine, estuarine, and marine habitats. Impacts from heightened agricultural production will likely result in two negative impacts on eulachon. The first impact is the greater use and application of pesticide, fertilizers, and herbicides and their increased concentrations and entry into freshwater systems. Second, increased output and water diversions for agriculture may also place greater demands upon limited water resources. Water diversions will reduce flow rates and alter habitat throughout freshwater systems. As water is drawn off, contaminants will become more concentrated in these systems, exacerbating contamination issues in habitats for eulachon.

Although these factors are ongoing to some extent and likely to continue in the future, past occurrence is not a guarantee of a continuing level of activity. That will depend on whether there are economic, administrative, and legal impediments or safeguards in place. Therefore, although NMFS finds it likely that the cumulative effects of these activities will have adverse effects commensurate with or greater than those of similar past activities; it is not possible to quantify these effects.

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.

As described in section 2.5, Effects of the Action, we expect the maximum number of eggs and larvae that may be captured by plankton net tows would be 250,000 per year, or 2,450 egg/larvae per estuary net sampling event. Using the average of the minimum egg/larvae estimates for 2014-2019 for the Columbia River subpopulation, we calculated that this level of effect represents a reduction of less than 0.000001% of the estimated annual egg/larvae production for the Columbia River subpopulation, and at the species scales. Furthermore, it is very likely that fewer fish would be killed by the research than stated. In fact, for the vast majority of scientific research permits, history has shown that researchers generally take far fewer than the allotted number of fish every year.

There is little fisheries-independent data available for eulachon that provide an adequate estimate of abundance and trends. Historical abundance estimates of eulachon were based on commercial landing statistics. The research on eulachon being carried out by WDFW and would continue to improve our understanding of trends in abundance for the species (project goal), which is providing critical data that is beneficial to the management and conservation of the species.
The environmental baseline within the action area includes extensive development for residential, commercial and recreational use, rivers with highly regulated streamflow, simplified channel habitats, and rivers that are disconnected from their floodplains. We estimate that these habitat-related effects are likely to continue affecting eulachon, but we cannot quantify the degree to which short and long-term habitat-related effects are likely to impact the species' structure, diversity, productivity, or abundance because the precise distribution and abundance of eulachon within the action area are not a simple function of the quantity, quality, or availability of predictable habitat resources within the action area. Nonetheless, we do not expect the effects of this action to adversely affect these habitat features in the action area or further degrade the environmental baseline.

Non-Federal actions are likely to continue affecting eulachon. The cumulative effects in the action area are difficult to analyze because of the uncertainties associated with government and private actions, and the changing economies of the region. Whether these effects will increase or decrease is a matter of speculation; however, given the trends in the region, the adverse cumulative effects are likely to increase. Although Federal, state, tribal, and local governments have developed recovery plans and initiatives to benefit listed species, they must be applied and sustained in a comprehensive way before NMFS can consider them in its analysis of cumulative effects.

The effects of climate change are also likely to continue to be negative. Climate change conditions are unlikely to change measurably during the course of the proposed action. Additionally, the action would in no way contribute to climate change (even locally). The proposed action would help monitor the effects of climate change by noting estuary temperatures, salinity, flows, etc. So while we can expect both cumulative effects and climate change to continue their negative trends, it is unlikely that the proposed actions would have any additive impact to the pathways by which those effects are realized (e.g., a slight reduction in eulachon abundance would have no effect on increasing stream temperatures or continuing land development).

Therefore, the effects of the proposed action, when added to the environmental baseline, and cumulative effects, will not reduce appreciably the likelihood of both the survival and recovery of the species considered in this opinion.

As previously discussed, we do not expect the proposed action to have any appreciable effect on the species' critical habitat, as the actions' short duration, minimal intrusion, and overall lack of measurable effects signify that even when taken together they would have no discernible impact on critical habitat.

The detrimental effect of the research activities contemplated in this opinion—even when they are added to the effects already contemplated in the region—are expected to be minimal. Because these effects are so small, the actions would have only a slight negative effect on the species' abundance and productivity. And because that slight impact is in most cases distributed throughout the subpopulation, it would be so attenuated as to have no appreciable effect on spatial structure or diversity. The abundance and productivity reductions are so small as to have no more than a negligible effect on the species' survival and recovery, and the research is designed to benefit the species' survival in the long term.

Therefore, we expect the detrimental effects on the species to be minimal and be limited to slight reductions in abundance and productivity. Because these reductions to the individual species are so slight, the proposed action would have no appreciable effect on the species' diversity or distribution. Moreover, the actions are expected to provide lasting benefits for the species, and all habitat effects would be inconsequential.

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 eulachon or destroy or adversely modify its designated critical habitat.

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 incidental take statement.

As noted previously, we have not yet promulgated an ESA section 4(d) rule prohibiting take of threatened eulachon. Nonetheless, the amount of incidental take must be considered due to the fact that it could affect the species' viability.

In this instance, and for the actions considered in this opinion, there is no incidental take at all. The reason for this is that all the take contemplated in this document is intentional take that would be carried out as a consequence of the funding (proposed action). The actions are considered to be direct take rather than incidental take because its actual purpose is to take the animals while carrying out a lawful activity. Thus, the take cannot be considered "incidental" under the definition given above. Because the action would not cause any incidental take, we are not specifying an amount or extent of incidental take that would serve as a reinitiation trigger. Nonetheless, the amounts of direct take have been specified and analyzed in section 2.5, Effects of the Action. Those amounts constitute hard limits on both the amount and extent of take allowed as part of the proposed action. Those amounts are also noted in the reinitiation clause just below because exceeding them would likely trigger the need to reinitiate consultation.

2.9.3 Reasonable and Prudent Measures

“Reasonable and prudent measures” are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. The NWFSC shall monitor and report to NMFS on the implementation of the proposed research action on eulachon.

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 NWFSC 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.

1. To implement reasonable and prudent measure #1 (monitoring and reporting), the NWFSC shall:

    a. Ensure that eulachon are taken only at the levels, by the means, in the areas and for the purposes stated.

    b. Notify NMFS as soon as possible after any authorized level of take is exceeded or if such an event is likely (e.g., phone call or email). The NWFSC must submit a written report within 2 days detailing why the authorized take level was exceeded or is likely to be exceeded.

    c. The NWFSC shall report any unintentional captures of listed adult salmon or steelhead to NMFS within 24 hours.

    d. No later than 180 days of completing field research activities, NWFSC shall submit to NMFS a post-season report describing the results of the research activities, the number of listed eulachon taken and the location, the type of take, the number of eulachon intentionally killed and unintentionally killed, the take dates, and a summary of the research results.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, “conservation recommendations” are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). There are no conservation recommendations identified for the proposed action.

2.11 Reinitiation of Consultation

This concludes formal consultation for the proposed research project "Implementing high-priority recovery actions for ESA-listed eulachon: a pilot study assessing larval identification, timing, distribution, and condition at ocean entry through federal-state partnership".

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."

In the context of this opinion, there is no incidental take anticipated and the reinitiation trigger set out in § 402.16(a)(1) is not applicable. If any of the direct take amounts specified in this opinion's effects analysis (Section 2.5) are exceeded, reinitiation of formal consultation will be required because the regulatory reinitiation triggers set out in § 402.16(a)(2) and/or (a)(3) will have been met.

2.12 "Not Likely to Adversely Affect" Determinations

NMFS's determination that an action "is not likely to adversely affect" listed species or critical habitat is based on our finding that the effects are expected to be discountable, insignificant, or completely beneficial (USFWS and NMFS 1998). Insignificant effects relate to the size of the impact and should never reach the scale where take occurs; discountable effects are those that are extremely unlikely to occur; and beneficial effects are contemporaneous positive effects without any adverse effects on the species or their critical habitat. The proposed action is not likely to adversely affect (NLAA) LCR Chinook salmon SR Fall-run Chinook salmon, SR Spring/Summer-run Chinook salmon, UCR Spring-run Chinook salmon, UWR Chinook salmon, LCR steelhead, Middle Columbia River steelhead, Snake River Basin steelhead, UCR steelhead, UWR steelhead, CR chum salmon, LCR coho salmon, SR sockeye salmon, the southern DPS of green sturgeon (hereafter, "green sturgeon") or their designated critical habitat. Table 5 provides information on listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for green sturgeon, and Table 11 provides information on the critical habitat, designation date, federal register citation, and status summary for critical habitat for green sturgeon.

2.12.1 Salmon and Steelhead

2.12.1.1 Status of ESA-listed Salmon and Steelhead

Each species of salmon and steelhead considered in this opinion is at risk of becoming endangered in the foreseeable future, with the exception of two species (UCR spring Chinook salmon, and SR sockeye salmon), which are currently endangered. Each species is ESA-listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic (and life history) diversity. Many of the component populations of these ESUs and DPSs are also at low levels of abundance or productivity; in many cases, decreases in the last few years are associated with poor ocean conditions. Several species have lost some of their historical population structure due to human activities, and the populations that remain in the available habitat face multiple limiting factors. Individuals from most of the ESA-listed component populations must move through or use parts of the action area at some point during their life history.

Table 5. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for each salmonid species considered NLAA by the proposed action.

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	NWFSC 2015	This ESU comprises 32 independent populations. Twenty-seven populations are at very high risk, 2 populations are at high risk, one population is at moderate risk, and 2 populations are at very low risk Overall, there was little change since the last status review in the biological status of this ESU, although there are some positive trends. Increases in abundance were noted in about 70% of the fall-run populations and decreases in hatchery contribution were noted for several populations. Relative to baseline VSP levels identified in the recovery plan, 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.	● 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	NWFSC 2015	This ESU comprises four independent populations. Three are at high risk and one is functionally extirpated. Current estimates of natural origin spawner abundance increased relative to the levels observed in the prior review for all three extant populations, and productivities were higher for the Wenatchee and Entiat populations and unchanged for the Methow population. However, abundance and productivity remained well below the viable thresholds called for in the Upper Columbia Recovery Plan for all three populations.	● 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
Snake River spring/summer-run Chinook salmon	Threatened 6/28/05	NMFS 2017a	NWFSC 2015	This ESU comprises 28 extant and four extirpated populations. All expect one extant population (Chamberlin Creek) are at high risk. Natural origin abundance has increased over the levels reported in the prior review for most populations in this ESU, although the increases were not substantial enough to change viability	● Degraded freshwater habitat ● Effects related to the hydropower system in the mainstem Columbia River, ● Altered flows and degraded water quality ● Harvest-related effects ● Predation

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	• Limiting Factors
				ratings. Relatively high ocean survivals in recent years were a major factor in recent abundance patterns. While there have been improvements in abundance and productivity in several populations relative to prior reviews, those changes have not been sufficient to warrant a change in ESU status.	
Upper Willamette River Chinook salmon	Threatened 6/28/05	ODFW & NMFS 2011	NWFSC 2015	This ESU comprises seven populations. Five populations are at very high risk, one population is at moderate risk (Clackamas River) and one population is at low risk (McKenzie River). Consideration of data collected since the last status review in 2010 indicates the fraction of hatchery origin fish in all populations remains high (even in Clackamas and McKenzie populations). The proportion of natural origin spawners improved in the North and South Santiam basins, but is still well below identified recovery goals. Abundance levels for five of the seven populations remain well below their recovery goals. Of these, the Calapooia River may be functionally extinct and the Molalla River remains critically low. Abundances in the North and South Santiam rivers have risen since the 2010 review, but still range only in the high hundreds of fish. The Clackamas and McKenzie populations have previously been viewed as natural population strongholds, but have both experienced declines in abundance despite having access to much of their historical spawning habitat. Overall, populations appear to be at either moderate or high risk, there has been likely little net change in the VSP score for the ESU since the last review, so the ESU remains at moderate risk.	• 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
Snake River fall-run Chinook salmon	Threatened 6/28/05	NMFS 2017b	NWFSC 2015	This ESU has one extant population. Historically, large populations of fall Chinook salmon spawned in the Snake River upstream of the Hells Canyon Dam complex. The extant population is at moderate risk for both diversity	• Degraded floodplain connectivity and function • Harvest-related effects • Loss of access to historical habitat above Hells Canyon and other Snake River dams

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	• Limiting Factors
				and spatial structure and abundance and productivity. The overall viability rating for this population is 'viable.' Overall, the status of Snake River fall Chinook salmon has clearly improved compared to the time of listing and compared to prior status reviews. 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 Dam complex.	• 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	NWFSC 2015	Overall, the status of most chum salmon populations is unchanged from the baseline VSP scores estimated in the recovery plan. A total of 3 of 17 populations are at or near their recovery viability goals, although under the recovery plan scenario these populations have very low recovery goals of 0. The remaining populations generally require a higher level of viability and most require substantial improvements to reach their viability goals. Even with the improvements observed during the last five years, the majority of populations in this ESU remain at a high or very high risk category and considerable progress remains to be made to achieve the recovery goals.	• 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
Lower Columbia River coho salmon	Threatened 6/28/05	NMFS 2013	NWFSC 2015	Of the 24 populations that make up this ESU, 21 populations are at very high risk, 1 population is at high risk, and 2 populations are at moderate risk. Recent recovery efforts may have contributed to the observed natural production, but in the absence of longer term data sets it is not possible to parse out these effects. Populations with longer term data sets exhibit stable or slightly positive abundance trends.	• 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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	• Limiting Factors
				Some trap and haul programs appear to be operating at or near replacement, although other programs still are far from that threshold and require supplementation with additional hatchery-origin spawners .Initiation of or improvement in the downstream juvenile facilities at Cowlitz Falls, Merwin, and North Fork Dam are likely to further improve the status of the associated upstream populations. While these and other recovery efforts have likely improved the status of a number of coho salmon populations, abundances are still at low levels and the majority of the populations remain at moderate or high risk. For the Lower Columbia River region land development and increasing human population pressures will likely continue to degrade habitat, especially in lowland areas. Although populations in this ESU have generally improved, especially in the 2013/14 and 2014/15 return years, recent poor ocean conditions suggest that population declines might occur in the upcoming return years	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 2015a	NWFSC 2015	This single population ESU is at very high risk dues to small population size. There is high risk across all four basic risk measures. Although the captive brood program has been successful in providing substantial numbers of hatchery produced fish for use in supplementation efforts, substantial increases in survival rates across all life history stages must occur to re-establish sustainable natural production In terms of natural production, the Snake River Sockeye ESU 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.	• Effects related to the hydropower system in the mainstem Columbia River • Reduced water quality and elevated temperatures in the Salmon River • Water quantity • Predation
Upper Columbia River steelhead	Threatened 1/5/06	Upper Columbia Salmon Recovery Board 2007	NWFSC 2015	This DPS comprises four independent populations. Three populations are at high risk of extinction while 1 population is at moderate risk.	• Adverse effects related to the mainstem Columbia River hydropower system • Impaired tributary fish passage

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	• Limiting Factors
				Upper Columbia River steelhead populations have increased relative to the low levels observed in the 1990s, but natural origin abundance and productivity remain well below viability thresholds for three out of the four populations. The status of the Wenatchee River steelhead population continued to improve based on the additional year's information available for the most recent review. The abundance and productivity viability rating for the Wenatchee River exceeds the minimum threshold for 5% extinction risk. However, the overall DPS status remains unchanged from the prior review, remaining at high risk driven by low abundance and productivity relative to viability objectives and diversity concerns.	• 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	NWFSC 2015	This DPS comprises 23 historical populations, 17 winter-run populations and six summer-run populations. Nine populations are at very high risk, 7 populations are at high risk, 6 populations are at moderate risk, and 1 population is at low risk. The majority of winter-run steelhead populations in this DPS continue to persist at low abundances. Hatchery interactions remain a concern in select basins, but the overall situation is somewhat improved compared to prior reviews. Summer-run steelhead populations were similarly stable, but at low abundance levels. The decline in the Wind River summer-run population is a source of concern, given that this population has been considered one of the healthiest of the summer-runs; however, the most recent abundance estimates suggest that the decline was a single year aberration. Passage programs in the Cowlitz and Lewis basins have the potential to provide considerable improvements in abundance and spatial structure, but have not produced self-sustaining populations to date. Even with modest improvements in the status of several winter-run DIPs, none of the populations appear to be at	• 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
				fully viable status, and similarly none of the	
Upper Willamette River steelhead	Threatened 1/5/06	ODFW & NMFS 2011	NWFSC 2015	This DPS has four demographically independent populations. Three populations are at low risk and one population is at moderate risk. Declines in abundance noted in the last status review continued through the period from 2010-2015. While rates of decline appear moderate, the DPS continues to demonstrate the overall low abundance pattern that was of concern during the last status review. The causes of these declines are not well understood, although much accessible habitat is degraded and under continued development pressure. The elimination of winter-run hatchery release in the basin reduces hatchery threats, but non-native summer steelhead hatchery releases are still a concern for species diversity and a source of competition for the DPS. While the collective risk to the persistence of the DPS has not changed significantly in recent years, continued declines and potential negative impacts from climate change may cause increased risk in the near future.	• 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 2009	NWFSC 2015	This DPS comprises 17 extant populations. The DPS does not currently include steelhead that are designated as part of an experimental population above the Pelton Round Butte Hydroelectric Project. Returns to the Yakima River basin and to the Umatilla and Walla Walla Rivers have been higher over the most recent brood cycle, while natural origin returns to the John Day River have decreased. There have been improvements in the viability ratings for some of the component populations, but the DPS is not currently meeting the viability criteria in the MCR steelhead recovery plan. In general, the majority of population level viability ratings remained unchanged from prior reviews for each major population group within the DPS.	• 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

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	• Limiting Factors
Snake River basin steelhead	Threatened 1/5/06	NMFS 2017a	NWFSC 2015	This DPS comprises 24 populations. Two populations are at high risk, 15 populations are rated as maintained, 3 populations are rated between high risk and maintained, 2 populations are at moderate risk, 1 population is viable, and 1 population is highly viable. Four out of the five MPGs are not meeting the specific objectives in the draft recovery plan based on the updated status information available for this review, and the status of many individual populations remains uncertain A great deal of uncertainty still remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites within individual populations.	• 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

2.12.1.2 Status of Salmon and Steelhead 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.

Table 6 provides a summary of the status of critical habitats for salmon and steelhead species considered herein.

Table 6. Critical habitat, designation date, federal register citation, and status summary for critical habitat for ESA-listed salmon and steelhead considered herein.

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.
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	2/24/16	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 55 occupied watersheds, as well as the

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
coho salmon	81 FR 9252	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 2015a). 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.
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.

2.12.1.3 Effects of the Action on Salmon and Steelhead

Only 10 of the 13 listed species of adult salmon and steelhead are expected to occur in the lower Columbia River during the period of research activities: Snake River spring/summer Chinook salmon, Upper Columbia River Chinook salmon, Upper Willamette River Chinook salmon, Snake River Sockeye, Lower Columbia River Coho salmon, Upper Columbia River Steelhead, Middle Columbia River Steelhead, Snake River Steelhead, Upper Willamette River steelhead, and Lower Columbia River steelhead. However, not all of these species would have a peak abundance that would overlap with the proposed action. **Figure** 4 shows the seasonal use of the Columbia River by adult and juvenile salmonids.

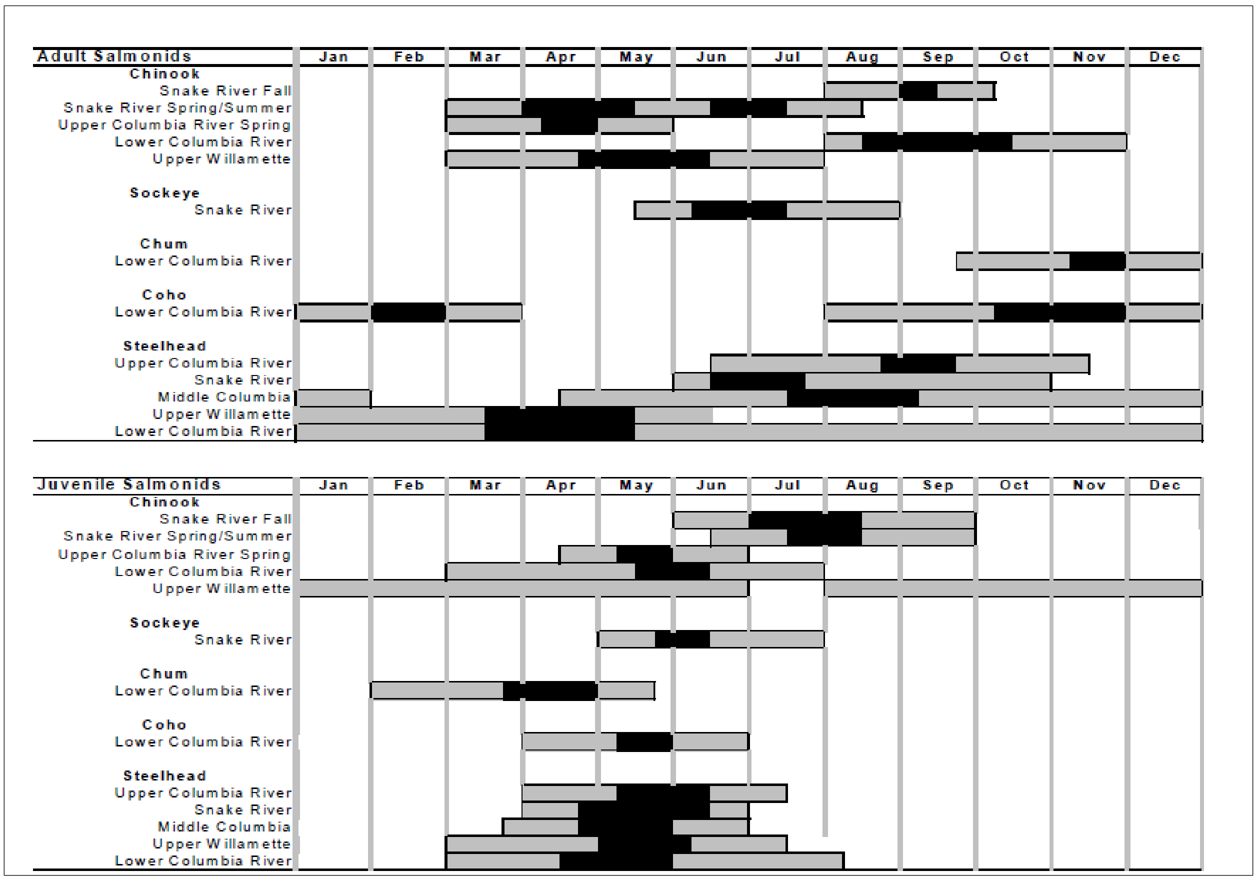

Figure 4. Seasonal patterns of occurrence for ESA-listed salmon and steelhead in the lower Columbia River. Black regions indicate times of peak abundance (NWFSC 2021).

2.12.1.3.1 Effects of Plankton Net Sampling

NMFS does not expect juvenile or adult salmon and steelhead to be captured in the plankton nets. We base this expectation on the fact that during the past nine years of use in the lower Columbia River have never caught any juvenile or adult salmon or steelhead in the plankton nets. Additionally, the size of the net and the slow towing speeds are only capable of capturing weakly swimming larval fishes and planktonic invertebrates. Salmon fry that could potentially be captured by the plankton nets are only found in freshwater tributaries, which are outside of the action area for plankton net sampling. Therefore, the likelihood of salmon and steelhead of any age being captured in the plankton nets is extremely small and effects from this activity are therefore discountable.

2.12.1.3.2 Effects of Hydrographic Profiling

For the same reasons described in Section 2.5.1.2, Effects of Hydrographic profile of temperature and salinity, NMFS does not expect any juvenile or adult salmon and steelhead to be impacted by the deployment and use of the hydrographic profiling instrument. The limited use and slow speed of movement within the water column will allow salmon and steelhead to sense the approaching instrument and avoid any collision. Therefore, the effects from this activity are discountable.

2.12.1.3.3 Effects of Scientific Echosounder Activity

For the proposed action, the acoustic parameters to project sound into the water column are provided in Table 1. NMFS does not expect the sounds produced by either the split-beam echo-sounder or the research vessel to have an adverse effect on salmon and steelhead considered in this opinion. Firstly, the regular, rapid, and short duration of echo-sounder pulses is not likely to elicit a stress response. Experimental evidence shows that sound sources, such as those produced by echo-sounders, do not result in statistically significant increases of the stress hormone cortisol in giant kelpfish, *Heterostichus rostratus* (Nichols et al. 2015). Secondly, previous acoustic survey work in the Columbia River by the NWFSC (as cited in the BA) did not show any behavioral reaction of salmonids (such a diving or horizontal movement) to the vessel, thus we applied the results of the experiments on giant kelpfish and prior field observations as this was the best available science to evaluate potential effects on salmon and steelhead from sound-related activities. Thirdly, sound levels produced by the NWFSC research vessel would add one vessel trip a day. On any given day, hundreds of vessels can be in the action area. The additional sounds created by the proposed action are unlikely to be detectable above background. Finally, the sound cone generated at all possible river depths in the action area (~1-30 m) is narrow, so that the area and volume of water (and hence the number of individual fish) experiencing direct impingement of the sound pressure wave will be small relative to median daily flow of 7,645.5[4] $m3 \cdot s^{-1}$ in the Columbia River. Therefore, the effects of the split-beam echo-sounder and the research vessel are likely to be minimal at best and would not adversely affect salmon or steelhead. As such, the effects of this activity are insignificant.

2.12.1.4 Effect of Action on Salmon and Steelhead Critical Habitat

As the proposed research activities do not involve any kind of habitat impacts other than intermittent increase in sound levels, we do not expect the proposed action to have adverse effects on designated critical habitat PBFs as these intermittent sound levels will to be too low and short in duration to affect the conservation value of the PBFs in the action area. Therefore, we expect the effects on salmonid critical habitat PBFs considered herein would be too small to meaningfully measure, detect or evaluate, and would therefore be insignificant.

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[4] Calculated from mean daily flow values at USGS Beaver Army Terminal hydrological station, 1968-2018.

2.12.1.5 Conclusion

Based on this analysis, NMFS has determined that the proposed action is not likely to adversely affect salmon, steelhead, or their designated critical habitats.

2.12.2 Green Sturgeon

2.12.2.1 Status of Green Sturgeon

NMFS listed the southern DPS of green sturgeon (*Acipenser medirostris*) as threatened in 2006 (71 FR 17757). Green sturgeon is an anadromous, long-lived, late maturing species that spawns in the Sacrament River Basin, in the Central Valley of California. It spends the majority of its life in nearshore marine environments, coastal bays, and estuaries along the West Coast of North America (NMFS 2018). **Table 7** summarizes the status and limiting factors for green sturgeon.

Table 7. Listing classification and date, recovery plan reference, most recent status review, status summary, and limiting factors for green sturgeon.

Species	Listing Classification and Date	Recovery Plan Reference	Most Recent Status Review	Status Summary	Limiting Factors
Green sturgeon	Threatened 4/7/06	8/8/2018	NMFS 2015b	The Sacramento River contains the only known green sturgeon spawning population in this DPS. The current estimate of spawning adult abundance is between 824-1,872 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

2.12.2.2 Status of Green Sturgeon Critical Habitat

NMFS designated critical habitat for green sturgeon in 2009 (74 FR 52300). The critical habitat extends from Monterey Bay, California to the U.S. boundary with Canada in Washington state and includes approximately 320 miles of freshwater river habitat, 897 square miles of estuarine habitat, 11,421 square miles of coastal marine habitat, 487 miles of habitat in the Sacramento-San Joaquin Delta, and 135 square miles of habitat within the Yolo and Sutter bypasses. The critical habitat status is summarized in **Table 8**.

Table 8. Critical habitat, designation date, federal register citation, and status summary for critical habitat for green sturgeon.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
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, as listed in Table 1 in 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).

2.12.2.3 Effects of the Action on Green Sturgeon

2.12.2.3.1 Effects of Plankton Net Sampling

NMFS does not expect green sturgeon to be captured in the plankton net sampling. We base this expectation on the fact that during the past nine years of use in the lower Columbia River have never caught any green sturgeon in the plankton nets. Additionally, the size of the net and the slow towing speeds are only capable of capturing weakly swimming larval fishes and planktonic invertebrates. Therefore, the likelihood of green sturgeon being captured in the plankton nets is extremely small and the effects from this activity are discountable.

2.12.2.3.2 Effects of Hydrographic Profiling

For the same reasons described in Section 2.5.1.2, Effects of Hydrographic profile of temperature and salinity, NMFS does not expect green sturgeon to be impacted by the deployment and use of the hydrographic profiling instrument. The limited use and slow speed of movement within the water column will allow green sturgeon to sense the approaching instrument and avoid any collision. Therefore, the effects from this activity are discountable.

2.12.2.3.3 Effects of Scientific Echosounder Activity

For the proposed action, the acoustic parameters to project sound into the water column are provided in Table 1. NMFS does not expect the sounds produced by either the split-beam echo-sounder or the research vessel to have an adverse effect on green sturgeon. Firstly, the regular, rapid, and short duration of echo-sounder pulses is not likely to elicit a stress response. Experimental evidence shows that sound sources, such as those produced by echo-sounders, do not result in statistically significant increases of the stress hormone cortisol in giant kelpfish, *Heterostichus rostratus* (Nichols et al. 2015). Secondly, previous acoustic survey work in the Columbia River by the NWFSC (as cited in the BA) did not show any behavioral reaction of salmonids (such a diving or horizontal movement) to the vessel, thus we applied the results of the experiments on giant kelpfish and prior field observations as this was the best available science to evaluate potential effects on salmon and steelhead from sound-related activities. Thirdly, sound levels produced by the NWFSC research vessel would add one vessel trip a day. On any given day, hundreds of vessels can be in the action area. The additional sounds created by the proposed action are unlikely to be detectable above background. Finally, the sound cone generated at all possible river depths in the action area (~1-30 m) is narrow, so that the area and volume of water (and hence the number of individual fish) experiencing direct impingement of the sound pressure wave will be small relative to median daily flow of 7,645.5[5] $m3 \cdot s^{-1}$ in the Columbia River. Therefore, the effects of the split-beam echo-sounder and the research vessel are likely to be minimal at best and would not adversely affect green sturgeon. As such, the effects from this activity are insignificant.

2.12.2.4 Effect of Action on Green Sturgeon Critical Habitat

As the proposed research activities do not involve any kind of habitat impacts other than intermittent increase in sound levels, we do not expect the proposed action to have adverse effects on designated critical habitat PBFs as these intermittent sound levels will to be too low and short in duration to affect the conservation value of the PBFs in the action area. Therefore, we expect the effects on green sturgeon critical habitat PBFs would be too small to meaningfully measure, detect or evaluate, and would therefore be insignificant.

2.12.2.5 Conclusion

Based on this analysis, NMFS has determined that the proposed action is not likely to adversely affect green sturgeon or its designated critical habitat.

3 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.

[5] Calculated from mean daily flow values at USGS Beaver Army Terminal hydrological station, 1968-2018.

3.1 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 NWFSC. Individual copies of this opinion were provided to the NWFSC. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

3.2 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.

3.3 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 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 reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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