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

Effects of the Pacific Coast Salmon Fishery Management Plan on the Southern Oregon / Northern California Coast Coho Salmon Evolutionarily Significant Unit Listed Under the Endangered Species Act.

NMFS Consultation Number: WCRO-2021-03260

Action Agency: National Marine Fisheries Service (NMFS)

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Southern Oregon / Northern California Coast Coho salmon (*Oncorhynchus kisutch*)	Threatened	Yes	No	No	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	No	No
Pacific Coast Groundfish Fishery Management Plan	No	No
Coastal Pelagic Species Fishery Management Plan	No	No
Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species	No	No

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

Issued By: ______________________________

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West Coast Region
National Marine Fisheries Service

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Acronyms and Abbreviations

BLM Bureau of Land Management
CDFW California Department of Fish and Wildlife
CFR Code of Federal Regulations
CORPS U.S. Army Corps of Engineers
CRT critical risk threshold
CWT coded-wire tag (or tagged)
DPS distinct population segment
DQA Data Quality Act
EEZ exclusive economic zone
EFH essential fish habitat
ER exploitation rate
ESA Endangered Species Act
ESU evolutionarily significant unit
FMP fishery management plan
FR Federal Register
FRAM Fisheries Regulation Assessment Model
HCR harvest control rule
HGMP hatchery genetic management plan
HVT Hoopa Valley Tribe
IP intrinsic potential
ISAB Independent Scientific Advisory Board
ITMF individual tribal member fishery
ITS incidental take statement
MSA Magnuson-Stevens Fishery Conservation Act
NMFS National Marine Fisheries Service
NOAA National Oceanic and Atmospheric Administration
OCN Oregon Coast Natural
ODFW Oregon Department of Fish and Wildlife
PBF physical or biological features
PCE primary constituent element
pHOS proportion of hatchery-origin spawners
PFMC Pacific Fisheries Management Council
PST Pacific Salmon Treaty
PVA Population Viability Analysis
QET quasi-extinction threshold
RA risk assessment
RPA Reasonable and Prudent Alternative
SONCC Southern Oregon / Northern California Coast
STNF Shasta-Trinity National Forest
TRRP Trinity River Restoration Program
USFWS U.S. Fish and Wildlife Service
VSP viable salmonid population

1. Introduction

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

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) (Sections 1.1 through 2.8) and incidental take statement (ITS) (Section 2.9) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402, as amended. This opinion documents consultation on the action proposed by NMFS, Sustainable Fisheries Division, West Coast Region.

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 600.

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

1.2. Consultation History

NMFS promulgates ocean fishing regulations within the west coast Exclusive Economic Zone (EEZ) of the Pacific Ocean. The following summary describes the consultation history on the effects of the fisheries managed by NMFS and the Pacific Fishery Management Council (Council) under the Pacific Coast Salmon Fishery Management Plan (FMP) on ESA listed species encountered in Council salmon fisheries including the proposed harvest control rules for SONCC coho salmon that are the subject of this opinion. The summary provides additional detail regarding the sequence of biological opinions that considered the effects of Council salmon fisheries on the ESA-listed Southern Oregon / Northern California Coast (SONCC) Coho Salmon Evolutionarily Significant Unit (ESU).

Since 1991, 28 salmon ESUs and steelhead Distinct Population Segments (DPSs) on the West Coast of the U.S. have been listed under the ESA (Table 1) as well as several non-salmonid species. The incidental take of these species associated with the proposed action is addressed in existing biological opinions (Table 2).

Table 1. Status and critical habitat designations for ESA listed species (Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered).

Species	Listing Status, Federal Register Notice		Critical Habitat Designated	
Chinook salmon (*Oncorhynchus tshawytscha*)				
Sacramento River winter-run	E: 70 FR 37160	6/28/05	58 FR 33212	06/16/93
Snake River fall-run	T: 70 FR 37160	6/28/05	58 FR 68543	12/28/93
Snake River spring/summer-run	T: 70 FR 37160	6/28/05	64 FR 57399	10/25/99
Puget Sound	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Lower Columbia River	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Upper Willamette River	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Upper Columbia River spring-run	E: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Central Valley spring-run	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
California Coastal	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Chum salmon (*O. keta*)				
Hood Canal Summer-run	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Columbia River	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Coho Salmon (*O. kisutch*)				
Central California Coast	E: 70 FR 37160	6/28/05	64 FR 24049	05/05/99
S. Oregon/N. California Coasts	T: 70 FR 37160	6/28/05	64 FR 24049	05/05/99
Lower Columbia River	T: 70 FR 37160	6/28/05	81 FR 9251	02/24/16
Oregon Coast	T: 76 FR 35755	6/20/11	73 FR 7816	02/11/08
Sockeye Salmon (*O. nerka*)				
Snake River	E: 70 FR 37160	6/28/05	58 FR 68543	12/28/93
Ozette Lake	T: 70 FR 37160	6/28/05	70 FR 52630	09/02/05
Steelhead (*O. mykiss*)				
Southern California	E: 71 FR 834	1/05/06	70 FR 52630	09/02/05
South-Central California Coast	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Central California Coast	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Northern California	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Upper Columbia River	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Snake River Basin	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Lower Columbia River	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
California Central Valley	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Upper Willamette River	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Middle Columbia River	T: 71 FR 834	1/05/06	70 FR 52630	09/02/05
Puget Sound Steelhead	T: 72 FR 26722	5/11/07	81 FR 9251	02/24/16
North American Green Sturgeon (*Acipenser medirostris*)				
Southern DPS of Green Sturgeon	T: 71 FR 17757	4/07/06	74 FR 52300	10/09/09
Killer Whales (*Orcinus orca*)				
Southern Resident Killer Whale DPS	E: 70 FR 69903	11/18/05	71 FR 69054	11/29/06
Steller Sea Lion (*Eumetopias jubatus*)				
Western DPS	E: 62 FR 24345	5/05/97	58 FR 45269	08/27/93
Pacific Eulachon (*Thaleichthys pacificus*)				
Southern DPS	T: 75 FR 13012	3/18/10	76 FR 65324	10/20/11
Puget Sound/Georgia Basin Rockfish (*Sebastes spp.*)				
Bocaccio	E: 79 FR 20802	4/14/14	79 FR 68041	11/13/14
Yelloweye	T: 79 FR 20802	4/14/14	79 FR 68041	11/13/14
Canary	T: 79 FR 20802	4/14/14	79 FR 68041	11/13/14

Table 2. NMFS ESA determinations regarding ESUs and DPS affected by Council salmon fisheries and the date of the 4(d) Limit determination or biological opinion (BO). (Only those decisions currently in effect are included).

Date (Decision type)	Duration	Citation	Species Considered
		Salmonid Species	
March 8, 1996 (BO)	until reinitiated	(NMFS 1996)	Snake River spring/summer and fall Chinook, and sockeye salmon
April 28, 1999 (BO)	until reinitiated	(NMFS 1999)	Central California Coast coho salmon Oregon Coast coho salmon Southern Oregon / Northern California coho salmon
April 28, 2000 (BO)	until reinitiated	(NMFS 2000)	Central Valley Spring-run Chinook salmon California Coastal Chinook salmon
September 14, 2001 (BO, 4(d) Limit)	until withdrawn	(NMFS 2001b)	Hood Canal summer-run chum salmon
April 30, 2001 (BO)	until reinitiated	(NMFS 2001a)	Upper Willamette River Chinook salmon Columbia River chum salmon Ozette Lake sockeye salmon Upper Columbia River spring-run Chinook salmon Ten listed steelhead DPSs
June 13, 2005 (BO)	until reinitiated	(McInnis 2005)	California Coastal Chinook salmon
June 10, 2004 (BO)	until reinitiated	(NMFS 2004)	Puget Sound Chinook salmon
April 27, 2012 (BO)	until reinitiated	(NMFS 2012)	Lower Columbia River Chinook salmon
March 30, 2018 (BO)	until reinitiated	(NMFS 2018)	Sacramento River winter-run Chinook salmon
April 9, 2015 (BO)	until reinitiated	(NMFS 2015)	Lower Columbia River coho salmon
		Non Salmonid species	
April 30, 2007 (BO)	until reinitiated	(NMFS 2007)	North American Green Sturgeon Southern DPS
April 21, 2021 (BO)	until reinitiated	(NMFS 2021)	Southern Resident Killer Whales
April 30, 2011 (BO)	until reinitiated	(NMFS 2010a)	Puget Sound/Georgia Basin Rockfish
April 30, 2011 (BO)	until reinitiated	(NMFS 2011)	Pacific Eulachon – Southern DPS

NMFS issued new biological opinions as new species were listed or reinitiated consultation on existing listed species when appropriate. In most cases, NMFS determined that the fisheries would have no effect, were not likely to adversely effect, or were not likely to jeopardize the survival and recovery of the species, and determined the action would not adversely modify designated critical habitat. In cases where NMFS determined that the proposed action would jeopardize the existence of the species (e.g., the 1996 opinion for SONCC coho salmon), we provided a Reasonable and Prudent Alternative (RPA) that would not jeopardize the species. The effects of the fisheries managed by NMFS and the Council under the FMP on SONCC Coho Salmon were last considered by NMFS in 1999 (NMFS 1999).

In 1997, the Council adopted and NMFS approved a management plan (Amendment 13 to the Pacific Coast Ocean Plan) that constrained allowable fishery impacts on the Oregon Coast Natural (OCN) Coho Salmon ESU (NMFS 1999). The management plan was built around a harvest matrix that allowed harvest impacts to vary depending on brood year escapement and marine survival. NMFS consulted on implementation of the FMP (including the proposed Amendment 13) and concluded that it was likely to jeopardize the continued existence of SONCC coho salmon (NMFS 1999) because the proposed action was likely to appreciably reduce the likelihood of survival and recovery of SONCC coho salmon. NMFS developed a three-part RPA to the proposed action that when taken together was found not likely to jeopardize the species. The RPA required: (1) that management measures developed under the FMP achieve an ocean exploitation rate on SONCC coho salmon, as indicated by Rogue/Klamath coho salmon hatchery stocks, of no more than 13 percent (the lowest exploitation rate (ER) allowed in the matrix for Amendment 13), (2) prohibition of coho salmon-directed fisheries and coho salmon retention in Chinook salmon-directed fisheries off of California, and (3) that sampling and monitoring of Council fisheries be conducted. Council salmon fisheries have been managed consistent with the RPA since that time and the 13 percent ER limit for the incidental harvest of SONCC coho salmon was incorporated in to the FMP as a harvest control rule for limiting fishery impacts on the ESU.

The Council, in collaboration with NMFS, established an ad-hoc technical Workgroup (hereafter "Workgroup") in June 2020 to develop recommendations to inform the Council's selection of a new harvest control rule (HCR) for the SONCC Coho Salmon ESU [1]. The Workgroup submitted a final draft risk assessment (RA) which evaluated the risk of extinction of representative population units within the ESU and effects to fisheries over a range of HCRs to the Council at its November 2021 meeting (PFMC 2021d). At its November meeting, the Council took final action to adopt a harvest control rule that had not previously been considered by the Workgroup.

The Workgroup's final draft RA report (PFMC 2021d) described alternative HCRs and their effects on SONCC coho salmon, which were not previously considered by NMFS in its 1999 opinion (NMFS 1999). Therefore on December 14, 2021, per 50 CFR 402.16, NMFS requested to reinitiate consultation, under Section 7 of the ESA (Bishop 2021). On December 17, 2021, NMFS concurred with the request to reinitiate consultation of the effects of FMP implementation on the SONCC Coho Salmon ESU (Wulff 2021).

The Council met on January 21, 2022 to further discuss the action adopted at the November 2021 meeting, consider rescinding the action and to provide further direction and consider an amendment to the FMP as appropriate. During the January 2022 meeting, the Council rescinded its November 2021 motion and adopted a new motion proposing to amend the FMP's HCR for SONCC coho salmon. This proposed amendment would replace the current HCR with two HCRs.. The first HCR would limit total fishery exploitation rates (ERs) on each of five individual representative population units within the SONCC Coho Salmon ESU to no more than 15 percent annually, except for the Trinity River population unit (represented by the Upper Trinity River, Lower Trinity River, and South Fork Trinity River populations). The second HCR would limit the total ER on Trinity River population unit to 16 percent. Both HCRs account for

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[1] The FMP defines harvest control rules as the operative guidance for the annual preseason planning process used to

all ocean and inland sources of fishery mortality annually and include landed and non-landed mortality of age-3 adult SONCC coho salmon. Finally, the Council's motion stated that coho-directed salmon fisheries and retention of coho salmon in Chinook-directed salmon fisheries would remain prohibited in the EEZ off of California. The proposed action for this opinion is NMFS' continuing authorization of the fishery through approval of the salmon FMP, including the Council's recommended control rule for SONCC coho salmon, and approval and implementation of regulations for the fishery.

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 (50 CFR 402.02). NMFS has dual responsibilities as both the action agency that authorizes the fisheries under the MSA and as the consulting agency under the authority of the ESA. The proposed action is NMFS's authorization of the ocean salmon fishery in the west coast EEZ (3 to 200 nautical miles off the coast of Washington, Oregon, and California) through approval of the FMP including the proposed amendment and promulgation of regulations implementing the FMP. The proposed FMP amendment would constrain Council fisheries, through implementation of annual management measures, to total ER limits of (1) 16 percent for the Trinity population unit (Upper Trinity River, Lower Trinity River, South Fork Trinity River; and, (2) 15 percent for each of the remaining individual populations within the ESU as represented by the Rogue River, the Scott River, the Shasta River, Freshwater Creek and Bogus Creek. These ER limits account for all ocean and inland sources of fishery mortality on age-3 adult SONCC coho salmon, including landed and non-landed mortality. Therefore, the annual ER for the ocean salmon fisheries managed by the Council will be less than the 15 or 16 percent total ERs. Coho-directed fisheries and coho retention in Chinook directed fisheries would remain prohibited in the EEZ off of California. All other provisions required either by the FMP or by existing consultations and applicable RPAs (Table 2) would continue to apply. Hatchery coho salmon containing coded-wire tags (CWT) released within the Rogue and Klamath Rivers are used to represent SONCC coho salmon ocean distributions in the coho salmon Fishery Regulation Assessment Model (FRAM). In combination with CWT information from other coho salmon stocks along the entire Pacific Coast, coho FRAM is used to assign total ocean fishery impacts to a stock-specific level.

During its annual salmon preseason planning process, the Council would plan ocean fisheries using the coho salmon FRAM so that, when combined with the expected freshwater ERs from state and tribal fisheries, the preseason projected total ER does not exceed the applicable total ER. Postseason ERs for SONCC coho salmon would be estimated for each year once available postseason harvest and abundance estimates become available. The in-river population unit-specific ER inputs will be determined using projections provided by co-managing agencies (i.e., the Oregon Department of Fish and Wildlife, Yurok Tribe, Hoopa Valley Tribe, or California Department of Fish and Wildlife). For purposes of analysis in this opinion we are assuming that co-managers will manage state and tribal fisheries to the total 15 percent or 16 percent ERs for the ESU; while these fisheries are not managed under the FMP and are thus not part of this proposed action, their impact on SONCC coho would be considered part of the total fishery limit for purposes of determining if the ER limit for the ESU has been exceeded. We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not. While the co-managers are reasonably certain to manage their fisheries to the total

15 or 16 percent ERs, and thus we evaluate the effect of the total ER on the ESU, those fisheries occur independent of the proposed action.

The ocean salmon fisheries in the EEZ are recreational and commercial troll fisheries that use hook-and-line gear to catch salmon. Chinook salmon (*Oncorhynchus tshawytscha*), coho salmon (*O. kisutch*), and pink salmon (*O. gorbuscha*) are the main species caught in Council-managed salmon fisheries and they are the species for which the FMP designates fishery management objectives. Salmon of U.S. and Canadian origin and caught in the EEZ are managed under the FMP except for species that are managed by another management entity with primary jurisdiction (*i.e.,* sockeye and pink salmon by the Fraser River Panel of the Pacific Salmon Commission in the Fraser River Panel Area of the U.S. between 49°N latitude and 48°N latitude). Catches of other salmon species (i.e., sockeye, chum and steelhead) are inconsequential (low hundreds of fish or less each year) to very rare (PFMC 2021b). The fisheries are mixed-stock fisheries, where fish encountered typically represent more than one stock[2] or ESU of Chinook or coho salmon. SONCC coho salmon are incidentally encountered while Council salmon fisheries target healthy and more abundant Chinook or coho salmon.

The FMP sets the framework under which the Council develops recommended annual management measures governing the ocean salmon fisheries. The annual management measures apply to the period from May 16 of the current year through May 15 of the following year. Under the FMP, each salmon stock or stock complex is managed subject to a specified conservation objective (e.g. harvest control rules). In a given year, if one stock is at an abundance that is compatible with relatively high fishing pressure, but a weaker stock requires lower fishing pressure, then the ocean fishery is managed by the limiting rate for the weaker stock. This “weak stock management” leaves some of the harvestable fish from the stronger stock uncaught. Some stocks and stock complexes are managed to annual catch limits, which are set annually using harvest control rules described in the FMP. Others are managed under the Pacific Salmon Treaty (PST) with Canada, and have objectives related to that agreement. For ESA-listed species, the conservation objectives are referred to as consultation standards, which equate to levels of take (in some cases combined with additional management measures) that NMFS has determined, through ESA section 7 consultation, are not likely to jeopardize the continued existence of the species (refer to Table 2). The amount of fishing and associated catch allowed in fisheries will vary from year to year depending on stock specific run sizes, catches anticipated in other fisheries, and fishery allocation decisions, but Council salmon fisheries are managed under the FMP such that impacts of Council fisheries are consistent with all of these conservation objectives (PFMC 2021b). For an example describing the Council salmon fisheries, refer to the most current

[2] The National Standard 1 Guidelines provide a structure for classifying stocks in and around the fishery, and organizing stock complexes (PFMC 2021b). As described in the FMP, individual stocks can also be formed into stock complexes for management and assessment purposes. Stock complexes are groups of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impacts of management actions on the stocks are similar (PFMC 2021b). Stock complexes may be formed to facilitate management requirements. Each stock complex has one or more indicator stocks to establish annual harvest constraints based on status of those indicator stocks. A detailed listing of the individual stocks and stock complexes managed under the FMP are provided in Table 1-1 (PFMC 2021b).

Council Preseason Report III published at the conclusion of the preseason planning process in April located on the Council website.

Upon completion of its preseason planning process in April of each year, the Council transmits its annual management measure recommendations to the Secretary of Commerce, who promulgates the measures in a final rule if they are determined to be consistent with the MSA and other applicable law, such as the ESA and obligations under the PST. While the FMP and implementing regulations apply only in the EEZ, salmon fisheries in state waters (zero to three miles off the coast, hereinafter referred to as “state ocean waters,”) are generally managed consistent with the federal regulations. Quotas established in federal regulations account for Chinook and coho salmon catch in state ocean waters, and catch in those waters is included in modeling exercises to determine if the objectives in the FMP will be met, given the annual fishery management measures. In short, state management of salmon fisheries in state ocean waters is closely coordinated with federal management. In regards to the ESU considered in this opinion, the SONCC Coho Salmon ESU, the Yurok and Hoopa Valley Tribes conduct in-river fisheries that catch stocks also caught in the ocean fisheries. These Tribes are entitled to 50 percent of the harvestable fish passing through the river reaches within their reservations. *Parravano v. Babbitt* (*70 F.3d 539 (9th Cir. 1995))*. These tribal fishing rights are considered “other applicable law” under the MSA, and are taken into account by the Council and NMFS during development of the annual management measures for the federally-managed ocean fisheries.

Successful management of the Council salmon fisheries requires monitoring to collect information on the fish stocks, the amount of effort for each fishery, the harvests that occurs in each fishery, the timing of harvest, and other biological and fishery statistics. In general, the information can be divided into that needed for in-season management and that needed for annual and long-term management. The data needs and reporting requirements for the fishery are described in the FMP (PFMC 2021b). Catch, escapement, and compliance with conservation objectives are reported annually in the Council’s preseason documents including, in particular, the annual Review of Ocean Salmon Fisheries (PFMC 2021c). The Review of Ocean Salmon Fisheries document (PFMC 2021c) is available at each year’s March Council meetings and is located on the Council website (e.g. Stock Assessment and Fishery Evaluation documents).

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.

2.1. Analytical Approach

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

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

The designation(s) of critical habitat for SONCC coho salmon use(s) the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

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

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

2.2. Rangewide Status of the Species and Critical Habitat

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

2.2.1. Climate Change and Other Ecosystem Factors

One factor affecting the rangewide status of the SONCC Coho Salmon ESU and aquatic habitat in general is climate change. Climate change has negative implications for designated critical habitats along the Pacific Coast (Climate Impacts Group 2004; Scheuerell 2005; Zabel et al. 2006; ISAB 2007). Average annual air temperatures have increased by approximately 1.8ºF since 1900, or about 50 percent more than the global average over the same period (ISAB 2007). The latest climate models project a warming of 0.1 ºF to 0.6 ºF per decade over the next century. According to the Independent Scientific Advisory Board (ISAB), these effects pose the following impacts over the next 40 years:

- Warmer air temperatures will result in diminished snow pack and a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season.
- With a smaller snowpack, these watersheds will see their runoff diminished earlier in the season, resulting in lower stream-flows in the June through September period. River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.
- Water temperatures are expected to rise, especially during the summer months when lower stream-flows co-occur with warmer air temperatures.

These changes will not be spatially homogeneous across the entire Western Coast of the United States. We know this as climate conditions experienced over the past 10 to 15 years as water year 2015 stands out as the warmest year on record, while water year 2018 is the second warmest year on record for California (PFMC 2021d). Low-lying areas are likely to be more affected. Climate change may have long-term effects that include, but are not limited to, depletion of important cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species (ISAB 2007).

Coho salmon are particularly vulnerable to climate change due to their need for year-round cool water temperatures since they rear for one or more years in freshwater, unlike some other salmonid species (Moyle 2002). By increasing air and water temperatures, climate change is expected to decrease the amount and quality of coho salmon habitat, reducing the productivity of populations, and exacerbating the decline of the species. Climate change effects on stream temperatures within Northern California are already apparent. For example, in the Klamath River, Bartholow (2005) observed an increase in water temperature of 0.5°C per decade since the early 1960s.

In coastal and estuarine ecosystems, the threats from climate change largely come in the form of sea level rise, loss of coastal wetlands, and changes in precipitation patterns. Sea levels are predicted to rise exponentially over the next 100 years, with possibly a 50–80 cm rise by the end of the 21st century (Intergovernmental Panel on Climate Change 2007). This rise in sea level will alter the habitat in estuaries and will either provide increased opportunity for feeding and growth or, in some cases, will lead to the loss of estuarine habitat and a decreased potential for estuarine rearing. Marine ecosystems face a unique set of stressors related to global climate change, all of which may have deleterious impact on growth and survival while at sea. In general, the effects of changing climate on marine ecosystems are not well understood given the high degree of complexity and the overlapping climatic shifts that are already in place (e.g., El Niño-Southern Oscillation and Pacific Decadal Oscillation) and will interact with global climate changes in unknown and unpredictable ways. Overall, climate change is believed to represent a growing threat, and will challenge the resilience of salmonids in Northern California, including SONCC coho salmon.

To mitigate for the effects of climate change on listed salmonids, ISAB (2007) recommends planning now for future climate conditions by implementing protective tributary, mainstem, and estuarine habitat measures, as well as protective hydropower mitigation measures. In particular, ISAB (2007) suggests increased summer flow augmentation from cool/cold storage reservoirs to reduce water temperatures or to create cool water refugia in mainstem reservoirs and the estuary; and the protection and restoration of riparian buffers, wetlands, and floodplains.

2.2.2. Rangewide Status of the Species

The SONCC Coho Salmon ESU was listed as threatened under the ESA on May 6, 1997 (62 FR 24588). The listing was most recently reaffirmed on June 28, 2005 (70 FR 37159). Critical habitat for SONCC Coho Salmon was designated on May 5, 1999 (64 FR 24049). In 2005, the Final 4(d) protective regulations were published (70 FR 37159, June 28, 2005). A recovery plan was finalized in 2014 (NMFS 2014). Subsequently, NMFS evaluated the available information on the status of the ESU in its 2016 status review, and concluded that there was no change in extinction risk (Williams et al. 2016). Therefore, the ESU remains listed as threatened at the time of this opinion. A new status review is currently underway but will not be complete before finalization of this document. However, the information contained in this opinion has been updated to contain the best scientific information available on the status of SONCC coho salmon.

The SONCC Coho Salmon ESU includes all naturally spawned populations of coho salmon in coastal streams between Cape Blanco, Oregon and Punta Gorda, California, as well as coho salmon produced by three artificial propagation programs: Cole Rivers Hatchery (Rogue River), Trinity River Hatchery, and Iron Gate Hatchery (Klamath River). The ESU includes coastal watersheds from the Elk River (Oregon) in the north to the Mattole River (California) in the south (Figure 1). The ESU is distributed across three large basins and numerous smaller basins across a diverse landscape. The ESU is divided into seven diversity strata comprising 40 populations (Figure 1, Table 3) (NMFS 2014).

In order to determine the current risk of extinction of the SONCC Coho Salmon ESU, NMFS utilized the population viability criteria and the concept of Viable Salmonid Populations (VSP) to evaluate populations (McElhany et al. 2000). A viable salmonid population is defined as one that has a negligible risk of extinction over 100 years. Viable salmonid populations are described in terms of four parameters: *abundance*, *population productivity*, *spatial structure*, and *diversity*. These parameters are predictors of extinction risk, and reflect general biological and ecological processes that are critical to the growth and survival of salmon (McElhany et al. 2000). In a recovered ESU, viability criteria for all four parameters would be met. The VSP criteria for the SONCC Coho Salmon ESU represent an extension of an approach developed by (Allendorf et al. 1997), and include metrics related to population abundance (effective population size), population decline, catastrophic decline, spawner density (depensation threshold), hatchery influence, and population viability assessment.

Viability

Viability is the likelihood that a population will sustain itself over a 100-year time frame (McElhany et al. 2000). Viability criteria are the means by which a viable ESU is defined, and by which extinction risk is evaluated.

The viability of an ESU depends on several factors, including the number and status of populations, spatial distribution of populations, the characteristics of large-scale catastrophic risk, and the collective diversity of the populations and their habitat (Lindley et al. 2007). In order for the SONCC Coho Salmon ESU to be viable, at least 50 percent of the independent populations (i.e., Functionally Independent or Potentially Independent) in each diversity stratum must be viable, and the abundance of these viable independent populations collectively must make up at least 50 percent of the total abundance modeled for all of the independent populations in that stratum (Williams et al. 2008). The independent populations that are chosen to meet the population viability criteria are called “core.” Many recovery scenarios with different core populations could result in a recovered ESU. Based on new information about population status or habitat conditions, NMFS’ designation of core and non-core populations may change to achieve recovery more quickly or efficiently. Although not all populations are required to be viable, the ESU viability criteria are intended to ensure representation of the diversity throughout the ESU, buffer the ESU against potential catastrophic risks, and provide sufficient connectivity among populations to maintain long-term demographic and genetic processes.

The ESU viability criteria of abundance, population productivity, spatial structure and diversity incorporate the principles of representation, redundancy, and connectivity (Table 3). Representation relates to the genetic and life-history diversity of the ESU, which is needed to conserve its adaptive capacity. Redundancy addresses the need to have a sufficient number of populations so the ESU can withstand catastrophic events (Williams et al. 2008). Connectivity refers to the dispersal capacity of populations to maintain long-term demographic and genetic processes. The overarching goal of these rules was to determine an appropriate number and arrangement of populations that allow populations to track changes in environmental conditions (Williams et al. 2008).

Table 3. ESU viability criteria for SONCC coho salmon (Williams et al. 2008).

ESU Viability Characteristic	Criteria
Representation	1. All diversity strata should be represented by viable populations.
Redundancy and Connectivity	2. a) At least fifty percent of historically independent populations in each diversity stratum should be demonstrated to be at low risk of extinction according to the population viability criteria. AND b) Total aggregate abundance of the populations selected to satisfy 2a must meet or exceed 50% of the aggregate viable population predicted for the stratum based on the spawner density. 3. All dependent and independent populations not expected to meet low-risk threshold within a stratum should exhibit occupancy indicating sufficient immigration is occurring from the "core populations". 4. The distribution of extant populations, both dependent and independent, needs to maintain connectivity across the stratum as well as with adjacent strata.

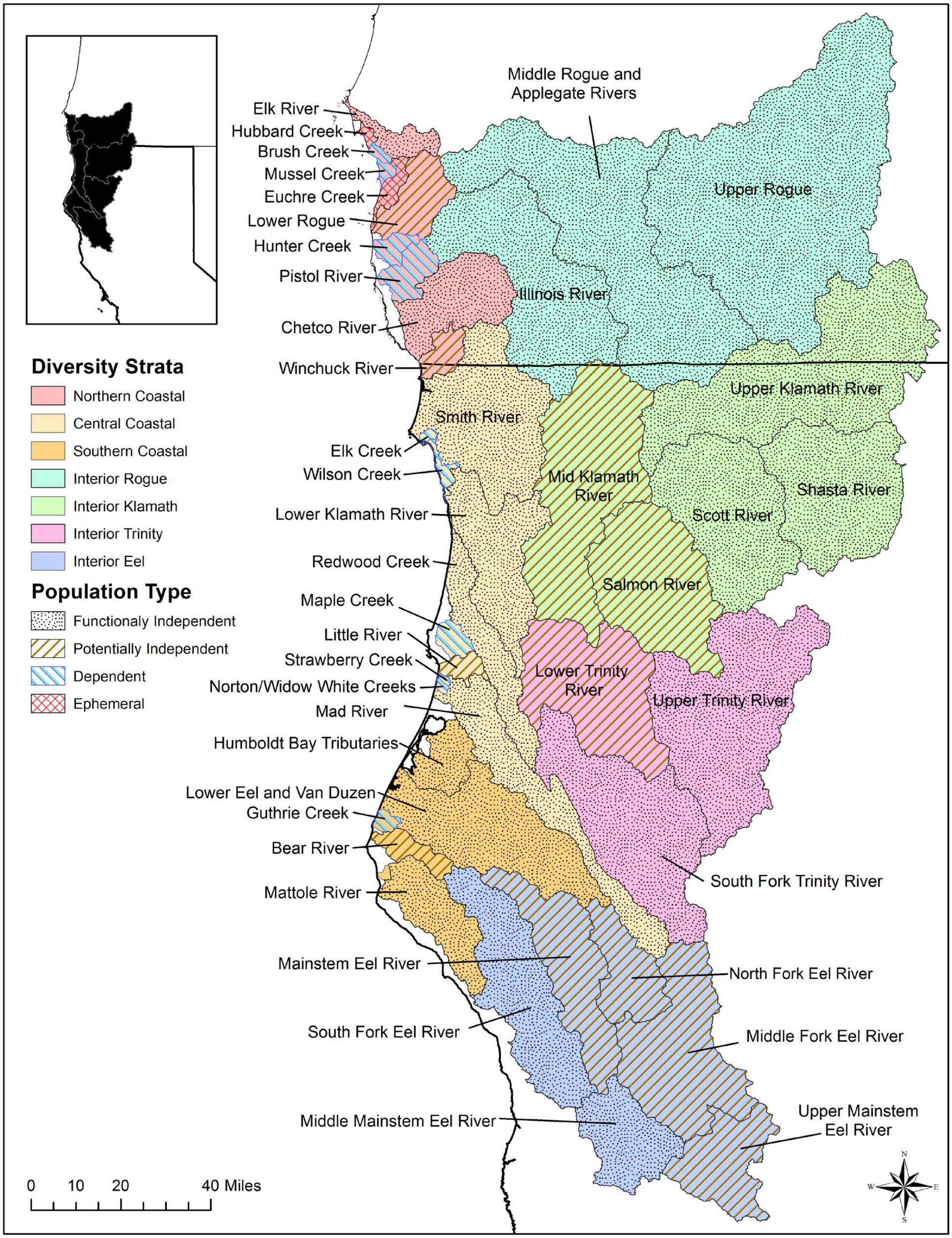

Figure 1. Population type and diversity strata of the SONCC Coho Salmon ESU (NMFS 2014).

Table 4. Diversity strata, populations, extinction risk, minimum target extinction risk, recovery criteria, and depensation thresholds for the SONCC Coho Salmon ESU (NMFS 2014). Core populations are bold.

Stratum	Populations	Risk Status	Risk Goal[a]	Recovery Role	Recovery Criteria	Depensation Threshold[b]
Northern Coastal Basin	**Elk R**	High	Low	**Core**	2,400	63
	Brush Crk	High	Juveniles	Dependent	--	--
	Mussel Crk	High	Juveniles	Dependent	--	--
	Lower Rogue R	High	Moderate	Non-core 1	320	81
	Hunter Crk	High	Juveniles	Dependent	--	--
	Pistol Crk	High	Juveniles	Dependent	--	--
	Chetco R	High	Low	**Core**	4,500	135
	Winchuck R	High	Moderate	Non-core 1	230	57
Central Coastal Basin	**Smith R**	High	Low	**Core**	6,800	325
	Elk Crk	High	Juveniles	Dependent	--	--
	Wilson Crk	High	Juveniles	Dependent	--	--
	Lower Klamath R	High	Low	**Core**	5,900	205
	Redwood Crk	High	Low	**Core**	4,900	151
	Maple Crk/Big Lagoon	--	Juveniles	Dependent	--	--
	Little R	Moderate	Moderate	Non-core 1	140	34
	Strawberry Crk	--	Juveniles	Dependent	--	--
	Norton/Widow White Crk	--	Juveniles	Dependent	--	--
	Mad R	High	Moderate	Non-core 1	550	136
Southern Coastal Basin	**Humboldt Bay tributaries**	Moderate	Low	**Core**	5,700	191
	Lower Eel/Van Duzen R	High	Low	**Core**	7,900	394
	Guthrie Crk	--	Juveniles	Dependent	--	--
	Bear R	High	Juveniles	Non-core 2	--	--
	Mattole R	High	Moderate	Non-core 1	1,000	250
Interior Rogue	**Illinois R**	High	Low	**Core**	11,800	590
	Middle Rogue/Applegate R	High	Moderate	Non-core 1	2,400	603
	Upper Rogue R	Moderate	Low	**Core**	13,800	689
Interior Klamath	Middle Klamath R	Moderate	Moderate	Non-core 1	450	113
	Upper Klamath R	High	Low	**Core**	8,500	425
	Shasta R	High	Low	**Core**	4,700	144
	Scott R	Moderate	Low	**Core**	6,500	250
	Salmon R	High	Moderate	Non-core 1	450	114
Interior Trinity	**Lower Trinity R**	High	Low	**Core**	3,600	112
	South Fork Trinity R	High	Moderate	Non-core 1	970	242
	Upper Trinity R	Moderate	Low	**Core**	5,800	365
Interior Eel	**Mainstem Eel R**	High	Low	**Core**	2,600	68
	Middle Mainstem Eel R	High	Low	**Core**	6,300	232
	Upper Mainstem Eel R	High	Juveniles	Non-core 2	--	--
	Middle Fork Eel R	High	Juveniles	Non-core 2	--	--
	South Fork Eel R	Moderate	Low	**Core**	9,300	464
	North Fork Eel R	High	Juveniles	Non-core 2	--	--

[a] *"Juveniles" indicates that there is no minimum number of adult spawners specified as the occupancy goal in the recovery scenario, but that juveniles will occupy the habitat in measurable levels.*

[b] *Based on spawners per kilometer of intrinsic potential.*

In 2006, NMFS modeled the historic population structure of the SONCC Coho Salmon ESU (Williams et al. 2006). Each population is described in terms of its modeled capacity to support rearing juvenile coho salmon based on the intrinsic ability of the habitat to support this life stage. This capacity is described as Intrinsic Potential (IP). Williams et al. (2006) calculated the number of kilometers of IP for each population. The role each population played in the historic function of the ESU is primarily based on how much IP each population contained at the time Williams et al. (2006) estimated it, drawing inferences of historical population structure. Populations with more than 34 IP-km are described as independent because, due to their size, they are not dependent on strays from nearby populations to persist over time. Populations with from 5 to 34 IP-km are described as dependent because they are too small to persist without immigration from independent populations. NMFS grouped populations with similar geologic and genetic features into the seven diversity strata (Williams et al. 2006). The depensation threshold in Table 4 is the number of spawning adults below which a population is subject to depensatory effects such as not being able to find a mate, or having all adults eaten by predators before they can reproduce. Williams et al. (2008) defined the depensation threshold as 1 spawner per IP-km. To meet the recommendation of Williams et al. (2008), most non-core independent populations would be at moderate (not high) risk of extinction in a recovered ESU and so would consistently have more spawners than the depensation threshold.

Currently, over three quarters of the independent populations that comprise the SONCC Coho Salmon ESU are at high risk of extinction (Figure 2). In a recovered ESU, these populations would be at moderate or low risk of extinction.

Based on the criteria laid out above, each designated population in the ESU is classified based on its historical structure and functional role within the ESU (Table 4). The four population classifications are:

- *Functionally independent populations*: populations with a high likelihood of persisting over 100-year time scales and that conform to the definition of independent "viable salmonid populations" (McElhany et al. 2000).
- *Potentially independent populations*: populations with a high likelihood of persisting over 100-year time scales, but that were too strongly influenced by immigration from other populations to be demographically independent.
- *Dependent populations*: populations believed to have had a low likelihood of sustaining themselves over a 100-year time period in isolation and that received sufficient immigration to alter their dynamics and extinction risk.
- *Ephemeral populations*: populations that were both small enough and isolated enough that they were only intermittently present.

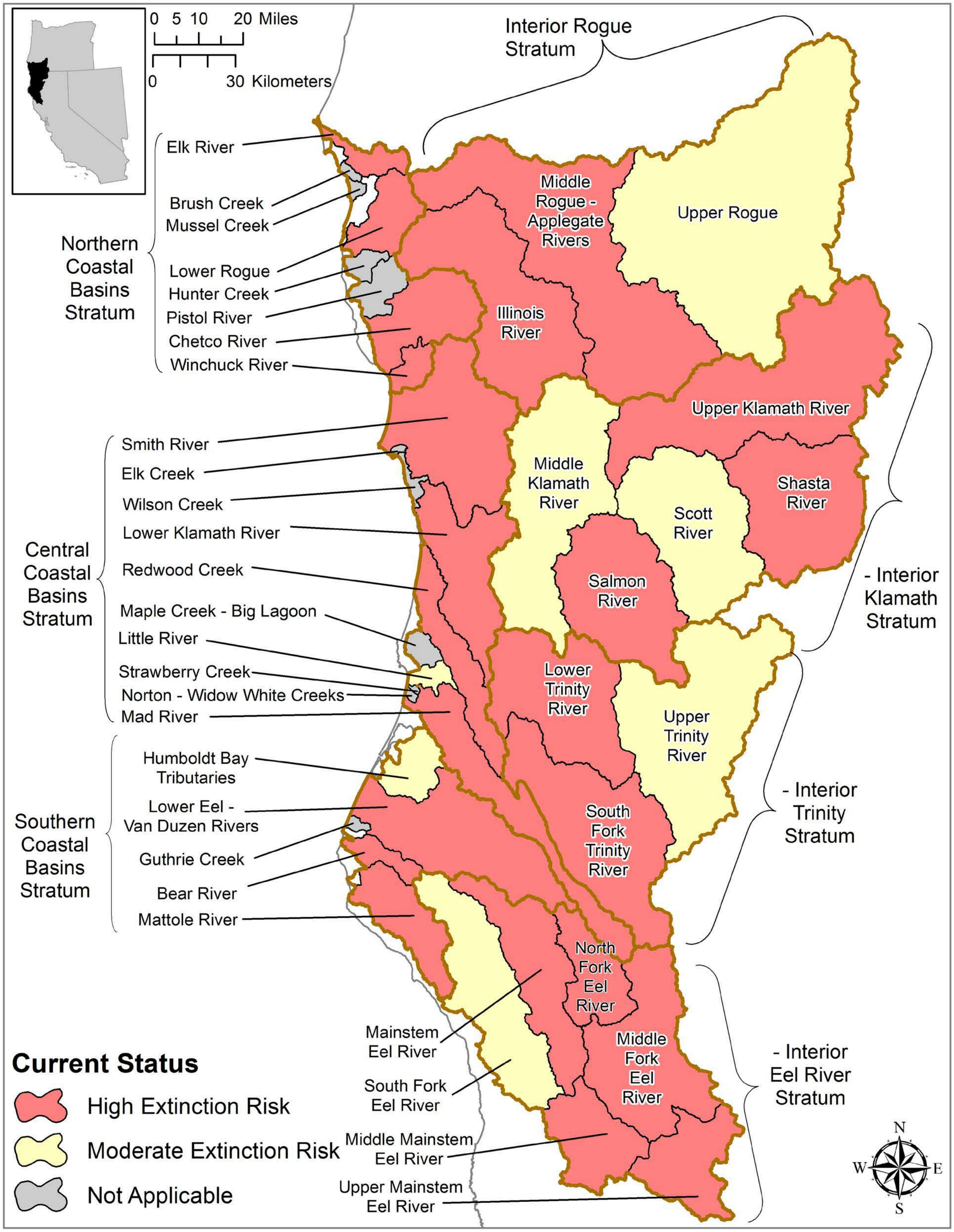

Figure 2. Current extinction risk of independent populations in the SONCC Coho Salmon ESU (NMFS 2014).

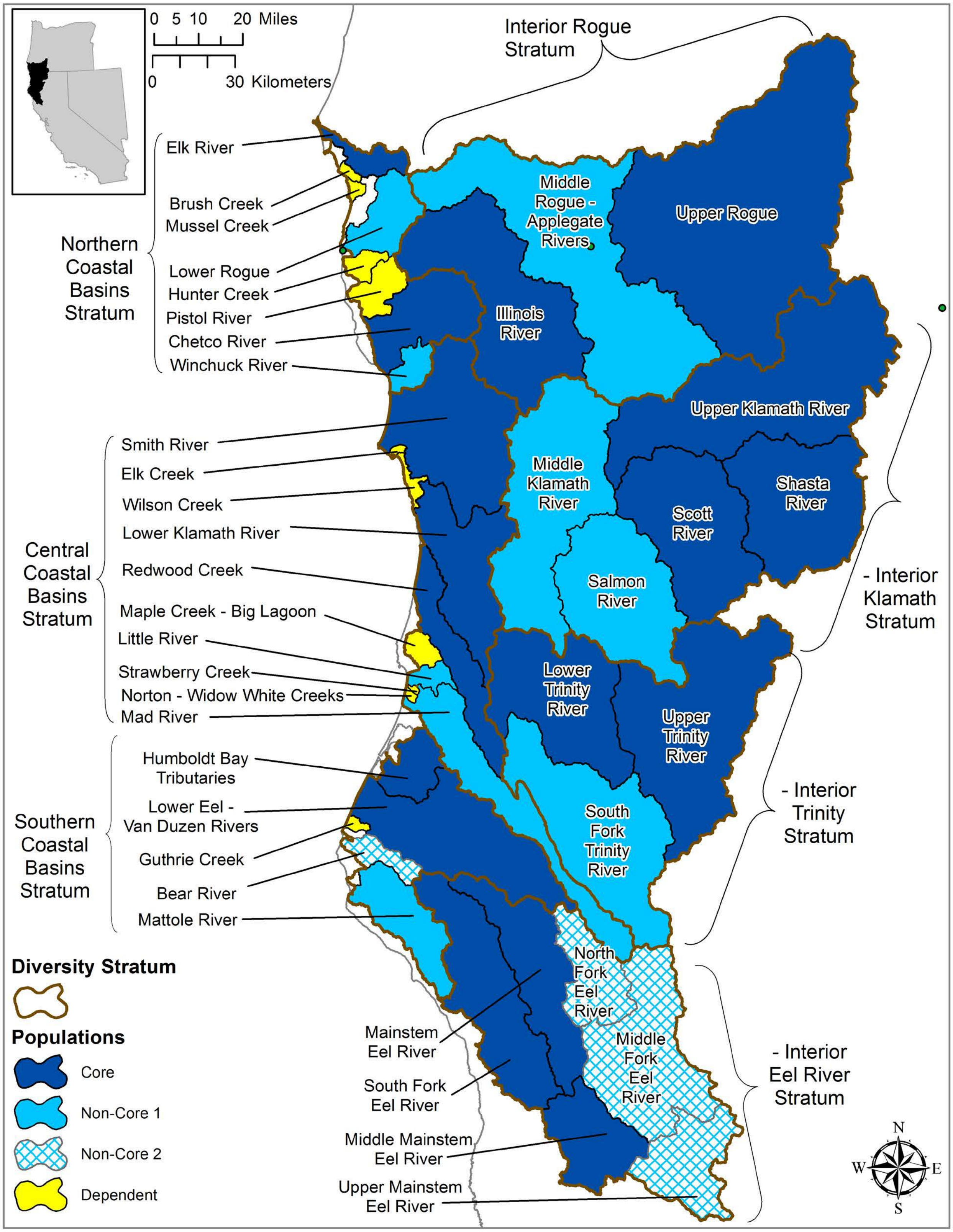

Figure 3. The role of each population in the recovery of SONCC Coho Salmon ESU (NMFS 2014).

Williams et al. (2008) builds on the VSP concept (McElhany et al. 2000) to establish viability criteria at the population and SONCC Coho Salmon ESU level. Populations that fail to satisfy several viability metrics are likely at greater risk than those that fail to satisfy a single metric. A viable population must have a low extinction risk for all the population metrics.

To align with the ESU viability criteria described in Table 3, NMFS identified the four population categories from Table 4 we discussed above with different targets based on their role in meeting these criteria. Core populations are those needed to meet Criteria 2a and 2b in Table 3.[3] These populations must be at low risk of extinction, or viable, in order to delist. Using the categorizations from Table 4, Non-Core 1 populations are those independent populations needed to meet Criterion 3[4], and should be at no greater than moderate risk of extinction for the ESU to be viable. Non-Core 2 populations are those independent populations that may be at higher than moderate risk of extinction in a recovered ESU, because there is no evidence they supported coho salmon, or because the amount of IP habitat in them is very low. Non-Core 2 and Dependent populations must meet Criterion 3 for the ESU to be viable. Non-Core 2 populations and dependent populations have no target extinction risk. The recovery plan (NMFS 2014) identifies demographic recovery criteria for each population, categorized by VSP parameter (Table 5).

[3] Criterion 2. a) At least fifty percent of historically independent populations in each diversity stratum should be demonstrated to be at low risk of extinction according to the population viability criteria.
AND
b) Total aggregate abundance of the populations selected to satisfy 2a must meet or exceed 50% of the aggregate viable population predicted for the stratum based on the spawner density.

[4] Criterion 3. All dependent and independent populations not expected to meet low-risk threshold within a stratum should exhibit occupancy indicating sufficient immigration is occurring from the "core populations".

Table 5. Demographic recovery criteria for SONCC Coho Salmon populations (NMFS 2014).

VSP Parameter	Population Role	Biological Recovery Objective	Biological Recovery Criteria
Abundance	Core	Achieve a low risk of extinction	The geometric mean of wild adults over 12-years meets or exceeds the “low risk threshold” of spawners for each core population
	Non-Core	Achieve a moderate or low risk of extinction	The annual number of wild adults is greater than or equal to four spawners per IP-km for each non-core population
Productivity	Core and Non-Core	Population growth rate is not negative	Slope of regression of the geometric mean of wild adults over the time series ≥ zero
Spatial Structure	Core and Non-Core	Ensure populations are widely distributed	Annual within-population juvenile distribution ≥ 80% of habitat
	Non-Core and Dependent	Achieve inter- and intra-stratum connectivity	≥ 80% of accessible habitat is occupied in years following spawning of cohorts that experienced high marine survival
Diversity	Core and Non-Core	Achieve low or moderate hatchery impacts on wild fish	Proportion of hatchery-origin spawners (pHOS)
	Core and Non-Core	Achieve life-history diversity	Variation is present in migration timing, age structure, size, and behavior. The variation in these parameters is retained.

As some of the parameters are related or overlap, the evaluation is at times necessarily repetitive. Viable ESUs are defined by some combination of multiple populations, at least some of which exceed “viable” thresholds, and that have appropriate geographic distribution, protection from catastrophic events, and diversity of life histories and other genetic expression. The following subsection provides the evaluation of the risk of extinction for SONCC coho salmon based the four VSP parameters.

Population Abundance

Quantitative population-level estimates of adult spawner abundance spanning more than nine years are scarce for SONCC coho salmon so it is difficult to assess trends and status for the majority of populations in the ESU. The populations for which we have data are captured in Table 6. New data since publication of the 2011 (Williams et al. 2011) and 2016 (NMFS 2016) status reviews consists of continuation of a few time series of adult abundance, expansion of efforts in coastal basins of Oregon to include SONCC coho salmon populations, and continuation and addition of several “population unit” scale (i.e., combined populations or population components) monitoring efforts in California. Although long-term data are scarce, the available monitoring data indicate that spawner abundance has generally declined for populations in this ESU based on the changes from the long-term average to the more recent 10-year average (Table 6).

Table 6. Escapement of adult SONCC coho salmon to natural spawning areas for return years 2000–2019 (PFMC 2021d).

Strata	North Coastal and Interior Rogue R.		Southern Coastal	Interior Klamath						Interior Trinity	
Return Year	Rogue River[a]		Freshwater Creek	Scott River		Shasta River		Bogus Creek[b]		Trinity River	
	Hatchery	Wild	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild	Hatchery	Wild
2000	10,116	10,978	177							6,297	288
2001	14,013	12,015	701							15,770	2,945
2002	12,739	8,460	1,807							7,440	372
2003	7,296	6,805	731							10,991	3,264
2004	9,092	24,509	974					97	298	15,287	7,830
2005	5,339	9,957	789					41	46	9,974	1,728
2006	3,496	3,911	396					14	19	7,454	1,416
2007	2,275	5,136	262	0	1,529	5	244	71	126	1,612	940
2008	158	414	399	0	59	22	8	33	72	2,204	861
2009	518	2,566	89	0	76	2	7	2	3	1,718	438
2010	752	3,671	455	0	913	11	33	41	105	2,146	624
2011	1,157	4,545	624	0	344	42	17	80	27	2,403	991
2012	1,423	5,474	318	2	186	54	22	59	8	6,335	1,577
2013	1,999	11,210	155	0	2,631	61	99	353	85	8,935	3,948
2014	829	2,409	718	0	383	4	1	18	4	6,405	823
2015	1,620	4,072	449	0	188	0	43	4	9	166	459
2016	1,201	6,302	466	0	226	0	46	21	29	482	635
2017	886	4,526	535	4	364	0	38	8	29	107	34
2018	325	8,266	560	0	712	0	36	3	23	502	1
2019	195	2,156	303	0	338	0	50	5	47	358	63
Average	3,771	6,869	545	0	611	15	50	53	58	5,329	1,462
Recent 10-yr Average	1,039	5,263	458	1	629	17	39	59	37	2,784	916

[a] *Escapement estimated at Huntley Park; inclusive of escapement to hatchery and natural areas.*

[b] *Bogus Creek is a tributary to the Upper Klamath just downstream of Iron Gate Dam and part of the Upper Klamath River population with a video weir to assess escapement.*

Though population-level estimates of abundance for most independent populations are lacking, the best available data indicate that none of the seven diversity strata appears to support a single viable population (one at low risk of extinction) as defined by in the viability criteria. In fact, most of the 30 independent populations in the ESU are at high risk of extinction for abundance because they are below or likely below their depensation threshold (Table 4). Populations that are below their depensation thresholds have increased likelihood of being extirpated. Here we review the information we have for abundance by diversity strata. For diversity stratum or populations not listed in Table 6 it is very difficult to determine if their current abundance is below or above their respective depensation threshold. Table 7 indicates that hatchery contribution from hatchery programs to natural spawning areas (pHOS) is highest in Interior Klamath, Interior Trinity, and Interior Rogue (NMFS 2014).

Table 7. Estimated population level percent contribution of hatchery fish (created using table 3-4 and definitions from Appendix B in from NMFS 2014).

Stratum	Populations	Hatchery Stress	pHOS stress estimate[1]
Northern Coastal Basin	Elk R	Low	< 5%
	Brush Crk	Low	< 5%
	Mussel Crk	Low	< 5%
	Lower Rogue R	Moderate	5%> but <10%
	Hunter Crk	Low	< 5%
	Pistol Crk	Low	< 5%
	Chetco R	Low	< 5%
	Winchuck R	Low	< 5%
Central Coastal Basin	Smith R	Moderate	5%> but <10%
	Elk Crk	Low	< 5%
	Wilson Crk	Low	< 5%
	Lower Klamath R	Moderate	5%> but <10%
	Redwood Crk	Low	< 5%
	Maple Crk/Big Lagoon	Low	< 5%
	Little R	Low	< 5%
	Strawberry Crk	Low	< 5%
	Norton/Widow White Crk	Low	< 5%
	Mad R	Moderate	5%> but <10%
Southern Coastal Basin	Humboldt Bay tributaries	Low	< 5%
	Lower Eel/Van Duzen R	Low	< 5%
	Guthrie Crk	Low	< 5%
	Bear R	Low	< 5%
	Mattole R	Low	< 5%
Interior Rogue	Illinois R	Moderate	5%> but <10%
	Middle Rogue/Applegate R	Moderate	5%> but <10%
	Upper Rogue R	Moderate	5%> but <10%
Interior Klamath	Middle Klamath R	Moderate	5%> but <10%
	Upper Klamath R	Very High	30%>
	Shasta R	High	10%> but <30%
	Scott R	Moderate	5%> but <10%
	Salmon R	Moderate	5%> but <10%

Stratum	Populations	Hatchery Stress	pHOS stress estimate[1]
Interior Trinity	Lower Trinity R	Very High	30%>
	South Fork Trinity R	Low	< 5%
	Upper Trinity R	Very High	30%>
Interior Eel	Mainstem Eel R	Low	< 5%
	Middle Mainstem Eel R	Low	< 5%
	Upper Mainstem Eel R	Low	< 5%
	Middle Fork Eel R	Low	< 5%
	South Fork Eel R	Low	< 5%
	North Fork Eel R	Low	< 5%

1 The percent of observed adults of hatchery origin is used as an indicator of relative genetic risk to a coho salmon population. Use of less than 5 percent as the threshold for low risk is consistent with the approach described in Williams et al. (2008). Ecological effects of hatcheries are accounted for in the Medium stress and threat rank, which is assigned if there is a salmonid hatchery in the basin.

Interior Eel Stratum

Core populations in the Interior Eel Stratum historically supported significant spawners (e.g., 50,000 to 100,000 per year; (Yoshiyama and Moyle 2010)). The number of spawners in these populations have declined in number. Yoshiyama and Moyle (2010) concluded that coho salmon populations in the Eel River basin appear to be headed for extirpation by 2025. One of the four Core populations in this basin has already been extirpated (i.e., Middle Fork Eel River; (Moyle et al. 2008; Yoshiyama and Moyle 2010)) and one Non-Core 2 population contains critically low numbers (i.e., Upper Mainstem Eel River, with only a total of seven adult coho salmon counted at the Van Arsdale Fish Station in over six decades; Jahn, J., pers. comm. 2010). Although long term spawner data are not available, both NMFS and California Department of Fish and Wildlife (CDFW) believe the Core Middle Mainstem Eel River population, and Core Mainstem Eel River population are very likely below the depensation threshold, and thus are at a high risk of extinction (NMFS 2014). The only population in the Interior Eel Stratum that is likely to be above its depensation threshold is the Core population of the South Fork Eel River, which has also declined from historical numbers in the tens of thousands before 1950 (Taylor 1978).

Southern Coastal Basin

Populations in the Southern Coastal Basin Stratum, the Bear River (Non-Core 2) and Mattole River (Non-Core1) populations, have similar trajectories. The Bear River population is likely extirpated or severely depressed. Despite multiple surveys over several years, no coho salmon have been found in the Bear River watershed (NMFS 2014). In 1996 and 2000, the CDFG surveyed most tributaries of the Bear River, and did not find any coho salmon (CDFG 2004). In addition, CDFG sampled the mainstem and South Fork Bear River between 2001 and 2003 and found no coho salmon (NMFS 2014). In the Mattole River, surveys of live fish and carcasses since 1994 indicate the population is severely depressed and well below the depensation threshold of 250 spawners. Recent spawner surveys in the Mattole River resulted in only three and nine coho salmon for 2009 and 2010, respectively. These low numbers, along with a recent decline since 2005, indicate that the Mattole River population is at a high risk of extinction.

Information representing the Humboldt Bay Tributaries is represented by the only life cycle station in this stratum, Freshwater Creek (Table 6). The recent 10-year average estimate of escapement to natural areas for Freshwater Creek is lower than the long-term average (Table 6). There is no estimate of abundance for the Lower Eel/Van Duzen Rivers population, the other independent population in this stratum. These surveys encompass what information we currently have on the Southern Coastal Basin Stratum.

Central Coastal Basin, Interior Klamath, Interior Trinity
Population-level estimates of abundance are available for two of the five independent populations in the Central Basin, Interior Klamath, and Interior Trinity strata as summarized in Table 6, but declining abundance is a prevalent feature among these populations. Adult returns of naturally produced coho salmon to the Trinity, Shasta, and Scott rivers have been highly variable. Overall, the average annual escapement for these systems in the last decade (2010– 2019; Table 6, Figure 4) was only 1,583 naturally produced fish. While this data are useful for capturing some level of directional change in these diversity stratum, escapement data are sparse or lacking for the other major populations in the ESU (Eel, Smith, and Chetco rivers) and for the numerous smaller coastal populations.

Northern Coastal Basin, Interior Rogue
There is a long-term composite estimate that includes portions of all four independent populations in the Interior-Rogue Diversity stratum that provides insight into trends of coho salmon in the Rogue River Basin. These estimates are derived from mark-recapture estimates based on returns to Cole River Hatchery expanded by the mark rate observed at Huntley Park and they represent a composite of four independent populations and two diversity strata (in the Rogue River and Northern Coastal strata). The Huntley Park data has been recently revised by the Oregon Department of Fish and Wildlife (ODFW) based on a review by ODFW that identified methodological issues in the way that unmarked hatchery fish were accounted for in previous Huntly Park estimates, as the data were highly variable. For example, estimates derived from the beach seine surveys at Huntley Park on the Rogue River ranged between 414 and 24,509 naturally produced adults from 2000 to 2019 (Table 6). The new method was applied to data from 1996 to present (C. Lorion, ODFW, personal communication). The composite method indicates the recent 10-year average (5,263) is lower than the long-term average (6,869) for natural origin spawners (Table 6)

<u>*Overall ESU abundance*</u>
In the 2016 status review, NMFS (2016) concluded that many independent populations in the ESU are well below their recovery targets (listed in Table 4), and several, including the Shasta River, are below the high-risk depensation thresholds specified by the Recovery Plan (NMFS 2014) (Table 6). Escapement of adult wild coho salmon for return years 2000 through 2019 for which long term data series are available are shown in Table 6 with trends shown in Figure 4. The trends depicted in Figure 4 also incorporate the result of reductions in hatchery production. Table 6 indicates that the recent 10-year wild and hatchery spawner escapements has declined across the available dataset. These data continue to support the conclusions of the 2016 status review. Though population-level estimates of abundance for most independent populations are lacking, none of the seven diversity strata appear to currently support a single viable population as defined by the viability criteria. However, all diversity strata are occupied indicating that the ESU is still

extant across its entire range.

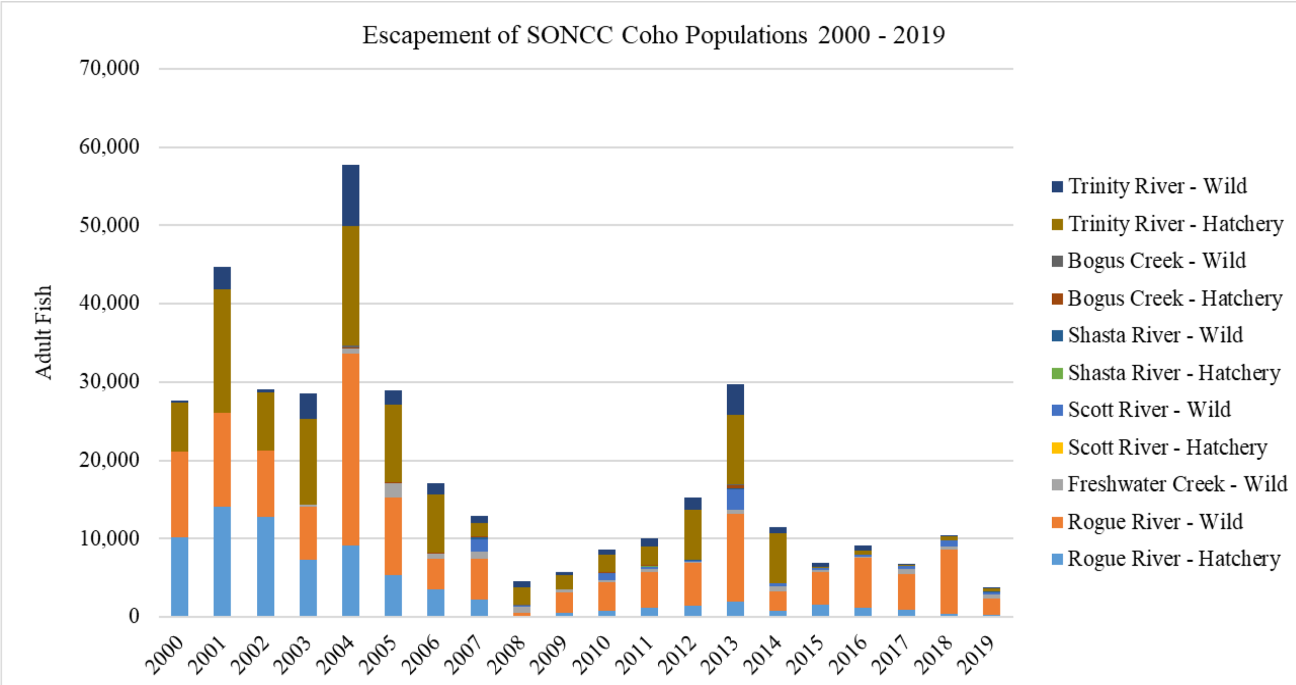

Figure 4. Trends in escapement for populations summarized in Table 6.

Productivity
The productivity of a population (i.e., production over the entire life cycle) can reflect conditions (e.g., environmental conditions, habitat capacity, hatchery effects) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape, habitats in which it exists, and its response to those habitats (McElhany et al. 2000). In general, declining productivity equates to declining population abundance.

Available data show that for almost all SONCC coho salmon populations, whether the slope of the regression line indicating recent five year changes in productivity is negative or positive cannot be determined. For the populations where data are available (Williams et al. 2016), there is 95 percent confidence that the slope of the regression line is negative, indicating a decreasing trend. This is the case for Mill Creek in the Smith River and Freshwater Creek in Humboldt Bay Tributaries. The only observed contrast, where there is 95 percent confidence that the slope of the regression line is positive, indicating an increasing trend, is at Gold Ray Dam in the Upper Rogue River.

Spatial Structure
Understanding the spatial structure of a population is important because the population structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species' environment (McElhany et al. 2000). Spatial structure and the distribution of appropriate amounts and types of habitat (and ecological processes), as well as fragmentation of populations should be considered the foundation of population and ESU viability.

The viability report for the SONCC Coho Salmon ESU explicitly described spatial structure and concluded data were insufficient to set specific population spatial structure targets (Williams et al. 2008). In the absence of such targets, McElhany et al. (2000) suggested the following: "As a default, historical spatial processes should be preserved because we assume that the historical population structure was sustainable but we do not know whether a novel spatial structure will be", where "historical" means "before the recent or severe declines that have been observed in many populations (McElhany et al. 2000)."

An ESU persists in places where it is able to adapt to environmental changes, and becomes extinct if it fails to keep up with the shifting distribution of suitable habitat (Thomas 1994; Williams et al. 2008). If freshwater habitat shrinks due to climate change (Battin et al. 2007) or habitat degradation, certain areas such as inland rivers and streams could become inhospitable to coho salmon, which would change the spatial structure of the SONCC Coho Salmon ESU and affect the risk of species extinction.

Extant populations can still be found in all major river basins within the range of the ESU (70 FR 37159). However, the distribution of SONCC coho salmon within the ESU's range is reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which SONCC coho salmon are now absent (Williams et al. 2011; Williams et al. 2016). Extirpations, loss of brood years, and sharp declines in abundance of SONCC coho salmon in several streams throughout the range of the ESU indicate that the SONCC coho salmon spatial structure is more fragmented at the population-level than at the ESU scale. NMFS concluded in its most recent status review (NMFS 2016) that none of the seven diversity strata currently support a single viable population as defined by the Recovery Plan criteria, although all diversity strata are occupied (Brown et al. 1994; CDFG 2004; Good et al. 2005; Moyle et al. 2008; Yoshiyama and Moyle 2010).

Diversity

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics. The more diverse these traits (or the more these traits are not restricted), the more diverse a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany et al. 2000). However, when this diversity is reduced due to loss of life-history strategies or to loss of habitat used by fish exhibiting variation in life-history traits, the species is less resilient to environmental variation and other stressors.

The ESU's current reduced genetic variability and variation in life-history likely contribute significantly to the long-term risk of extinction. Because many of the Core populations in the SONCC coho salmon ESU (i.e., Klamath River, and Trinity River) remain heavily influenced by hatcheries and have little natural production in mainstem rivers, many of the populations likely have reduced genetic diversity (NMFS 2014). As discussed previously, some populations in the ESU are extirpated or nearly extirpated (i.e., Middle Fork Eel, Bear River, Upper Mainstem Eel) and with no to very low returns in some years and areas (e.g., Shasta River, Scott River, Mattole

River, Mainstem Eel River). This pattern further restricts the diversity present in the ESU as the populations are subject to depensation effects at these low abundances where spawners may have a difficult time finding mates. This leads to potential genetic bottlenecks for spawning populations, as brood years with low abundance would be subject to spawning events where genetic variability was reduced due to low number of successful spawners. As natural populations get smaller, stochastic processes may cause alterations in genetics, breeding structure, and population dynamics that may undermine their ability to take advantage of improved habitat conditions and reduction of other threats. Given the recent trends in abundance across the ESU (Figure 4) and the fragmented nature of coho distribution across the ESU, the genetic and life-history diversity of populations is likely currently very low and is inadequate to contribute to a viable ESU (Williams et al. 2016).

Beside their role in conserving genetic resources, hatchery programs also are a tool that can be used to help improve viability (i.e., supplementation of natural population abundance through hatchery production). In general, hatchery programs operated in this manner can increase the number and spatial distribution of naturally spawning fish by increasing the natural production with returning hatchery adults. These programs are not, however, a proven technology for achieving sustained increases in adult production (ISAB 2003), and the long-term benefits and risks of hatchery supplementation remain untested (Christie et al. 2014). Hatchery-origin fish may also pose risk to listed species through genetic, ecological, or harvest effects. For example, the reproductive success of hatchery-born salmonids spawning in the wild can be less than that of naturally produced fish (Araki et al. 2007). In that case, the higher the proportion of hatchery-born spawners, the lower the overall productivity of the population. Hatcheries that produce and affect SONCC coho salmon are now managed under approved hatchery genetic management plans (HGMPs) that are intended to limit potential negative impacts of hatchery operations on wild production of SONCC coho salmon (NMFS 2020a) and should provide positive long term effects on diversity.

Populations have a lower risk of extinction if analysis of past or current hatchery operations conclude no or negligible ecological or genetic effects. Because Core populations in the SONCC Coho Salmon ESU (i.e., Klamath River, and Trinity River) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp et al. 1995; Good et al. 2005), some of these populations are at high risk of extinction relative to the genetic diversity parameter. While hatchery effects occur across the ESU, they are a high limiting factor for the Interior Klamath and Interior Trinity strata (Table 7), and considered a low to moderate limiting factor for the majority of populations in the ESU. Table 8 shows those populations in these strata where hatchery effects are considered high (greater than 10 percent and less than 30 percent hatchery-origin adults) and very high (greater than 30 percent hatchery-origin adults). Given the limited data we have, Table 8 summarizes the diversity risk related to hatchery effects across the for the specific population units that are a focus of this opinion.

Table 8. Populations with hatchery effects rated as high or very high stress and threat. Table shows percent hatchery spawners, and source (NMFS 2014).

Population	Stress and Threat Rank	Average Percentage Hatchery Origin Adults
Upper Klamath River	Very High	47% at Bogus Creek from 2004 to 2012, excluding 2006 and 2009
Shasta River	High	16% in 2001, 2003, 2004; 23% from 2001 to 2004; 43% from 2007 to 2012

Population	Stress and Threat Rank	Average Percentage Hatchery Origin Adults
Lower Trinity River	Very High	85-97% from 1997 to 2002; 60-100% from 1998 to 1999
South Fork Trinity River	Very High	36% in 1985
Upper Trinity River	Very High	97%

Summary

The available information continues to support the conclusion of the 2016 status review that none of the seven diversity strata appear to currently support a single viable population as defined by the viability criteria. However, all diversity strata are occupied. The available abundance data for populations within the SONCC-Coho Salmon ESU indicate that all populations remain well below the recovery targets in Table 4 and generally at high risk. For the few population units with sufficient monitoring data to calculate the spawning estimates (Table 6), four of the six population units are at high risk of extinction (Rogue River, Shasta River, Trinity River, and Upper Klamath (represented by Bogus Creek) due to escapements consistently below depensation levels. Of the time series available for this opinion, positive abundance trends were observed in only the Scott River. While the Rogue River abundance in Table 6 represents thousands of wild fish annually, it is a composite, and many of the components that make up this aggregate still fall below the population recovery targets identified in Table 4 for the Northern Coastal Basin and Interior Rogue diversity strata.

The composite estimates (those which include multiple independent populations in Table 6 for the Rogue River and the Trinity River) provide information at a larger spatial scale and include longer time series of abundance estimates. Neither includes the entire habitat of the diversity stratum, but both include large portions of the diversity stratum. The Rogue Basin short-term abundance trend is positive and the long-term abundance trend is negative, but the average abundance is lower in the most recent 10 years compared to the full time series in Table 6. The Trinity River short-term abundance trend and the long-term abundance trend are both negative. These composite abundance estimates do not represent a stratum-level abundance estimate, but they do provide some relative information on the number of fish in these strata. The 10-year average abundance estimate from the Trinity River Basin estimate is below the recovery target for the stratum in Table 4 (9,700 fish).

Where data are available, population productivity is below replacement, meaning populations continue to decline (Williams et al. 2016). Recent 10-year average spawner abundances support this characterization across the strata (Table 6) such as in the Smith River and Freshwater Creek. However, productivity and diversity VSP factors are expected to improve with approval of HGMPs that have received ESA approvals (NMFS 2020a) with these improvements likely to take some time to build into measurable positive increases, but remain poor for populations throughout the ESU that continue to experience low abundances due to depensation effects.

Spatial fragmentation remains largely unchanged since the 2016 status review, as distribution of SONCC coho salmon within the ESU's range remains reduced but extant populations can still be found in all major river basins within the range of the ESU. Spatial VSP criteria may also improve from ESA approved hatchery programs should they reconnect fragmented populations, but no information suggests this has occurred to date.

In summary, while data availability for this ESU remains generally poor, new information available since Williams et al. (2016) suggest the ESU is still not viable and most populations within the ESU are currently at moderate to high risk. Actions are in place that are expected to improve diversity and productivity.

Limiting Factors

Understanding the limiting factors and threats that affect the SONCC Coho Salmon ESU provides important information and perspective regarding the status of a species. One of the necessary steps in recovery and consideration for delisting is to ensure that the underlying limiting factors and threats have been addressed.

The SONCC Coho Salmon ESU recovery plan provides a detailed discussion of limiting factors and threats (see table 3-8 in NMFS 2014), and describes strategies for addressing each of them. The plan indicates fishing is currently a low threat and no longer considered a factor of decline (NMFS 2014). Factors contributing to the status of the ESU include: habitat loss due to dams; degradation of freshwater habitats due to a variety of agricultural and forestry practices; water diversions; urbanization; hatchery practices; mining; climate change; ocean conditions; and severe flood events exacerbated by land use practices (Good et al. 2005; NMFS 2014; Williams et al. 2016). The lack of floodplain and channel structure is a key limiting factor in nearly all coastal populations, and about half of interior populations (NMFS 2014). Sedimentation and loss of spawning gravels associated with poor forestry practices and road building are particularly chronic problems that can reduce the productivity of salmonid populations. Droughts and unfavorable ocean conditions in the late 1980s and early 1990s were identified as further likely causes of decreased SONCC coho salmon abundance (Good et al. 2005). From 2014 through 2016, the drought in California reduced stream flows and increased temperatures, further exacerbating stress and disease, and decreased the quantity and quality of spawning and rearing habitat available to SONCC coho salmon. Ocean conditions have generally been unfavorable in recent years (2014 to present) due to El Niño conditions and the warm water "Blob" which impacted the eastern Pacific, and reduced ocean productivity and forage for SONCC coho salmon. The Scott and Shasta rivers, both core populations in the Klamath River, are substantially impacted by water diversions annually.

2.2.3. Rangewide Status of Critical Habitat

This Section examines relevant critical habitat conditions for the SONCC Coho Salmon ESU. NMFS determines the range-wide status of critical habitat by examining the condition the SONCC Coho Salmon ESU's PBF (also called PCEs, in some designations) that were identified when critical habitat was designated. These features are essential to the conservation of the ESU because they support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration and foraging).

Critical habitat for SONCC coho salmon was designated as all accessible reaches of rivers (including estuarine areas and tributaries) between Cape Blanco, Oregon, and Punta Gorda, California (64 FR 24049, May 5, 1999). Critical habitat includes all waterways, substrate, and adjacent riparian zones below longstanding, naturally impassable barriers (i.e., natural waterfalls in existence for at least several hundred years). Tribal lands that were excluded in the critical habitat designation include: Big Lagoon Rancheria, Blue Lake Rancheria, Elk Valley Rancheria, Hoopa Valley Indian Reservation, Karuk Reservation, Laytonville Rancheria, Quartz Valley

Reservation, Resighini Rancheria, Round Valley Reservation, Sherwood Valley Rancheria, Smith River Rancheria, and Yurok Reservation.

In the critical habitat designation, NMFS identified five essential habitat types for SONCC coho salmon: (1) spawning areas; (2) adult migration corridors; (3) juvenile summer and winter rearing areas; (4) juvenile migration corridors; and (5) areas for growth and development to adulthood. Spawning and rearing are often located in small headwater streams and side channels. Adult and juvenile migration corridors include these tributaries as well as mainstem reaches and estuarine zones. Growth and development to adulthood occurs primarily in near-and off-shore marine waters, although final maturation takes place in freshwater tributaries when the adults return to spawn (64 FR 24049, May 5, 1999). Within these areas, essential features of coho salmon critical habitat include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. In addition, designated freshwater and estuarine critical habitat includes riparian areas that provide the following functions: shade, sediment, nutrient or chemical regulation, stream bank stability, and input of large woody debris or organic matter (64 FR 24049, May 5, 1999).

Habitat quality in the SONCC coho salmon ESU varies from excellent in wilderness and road-less areas to poor in areas subject to heavy agricultural and urban development. Critical habitat throughout much of the ESU's domain has been degraded by intense agriculture, alteration of stream morphology (i.e., through channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in developed areas, including those within this ESU domain (NMFS 2014).

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 analyzed in this opinion includes the U.S. Pacific Coast Exclusive Economic Zone (EEZ) (i.e., 3-200 nautical miles off the West Coast states of California, Oregon, and Washington) (Figure 5) which is where the fisheries managed under the proposed action will occur. The action area also includes the coastal waters of the states of Washington, Oregon, and California (zero to three miles off the coast where salmon fishery management is coordinated with federal management), and inland waters of Oregon and California where SONCC coho salmon may be affected by the action (i.e., potential changes in escapement if the fish are or are not caught by the Council fisheries).

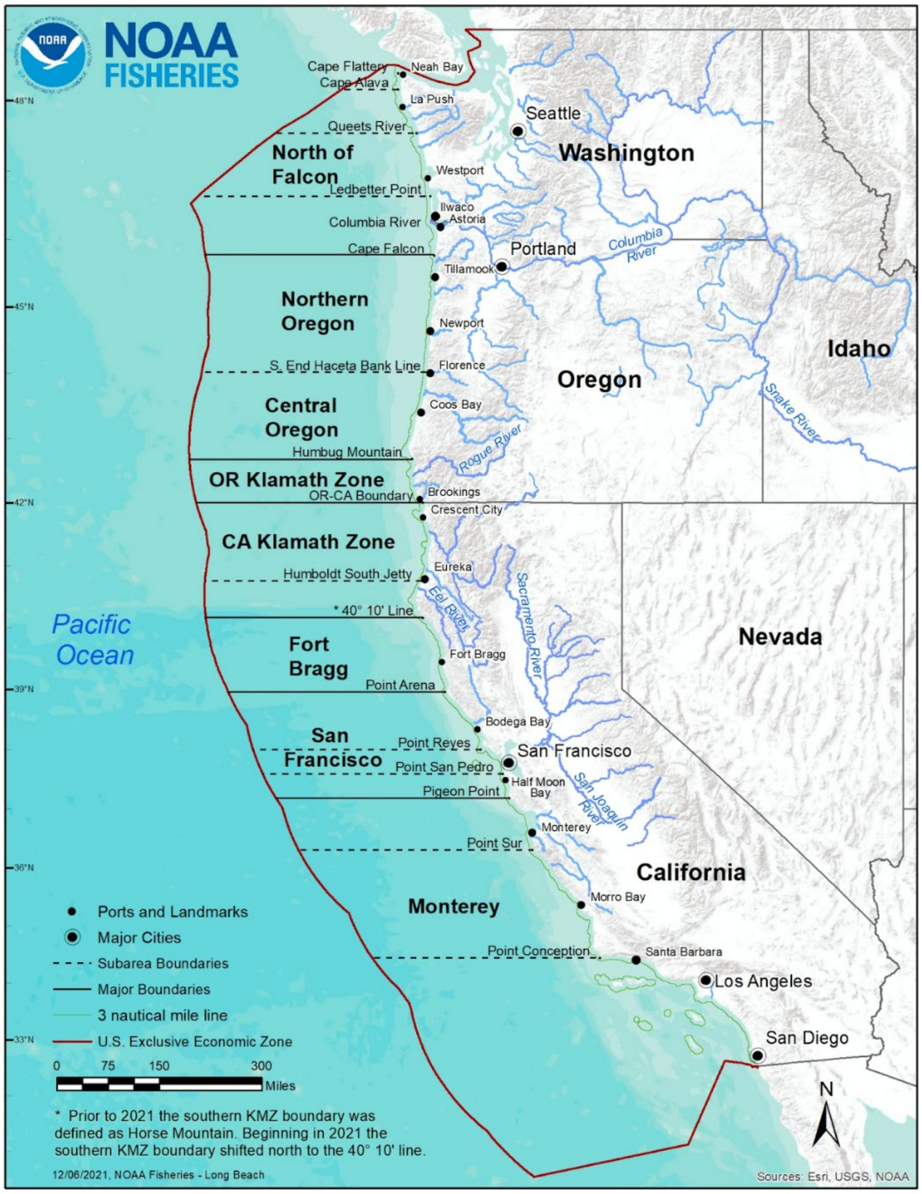

Figure 5. Map of Pacific Coast showing major salmon fishing ports, Council salmon management areas, and the EEZ.

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. While this includes effects of climate change, we describe the effects that climate change have on the status of the species in Section 2.2.1. 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).

2.4.1. Status of tribal Indian fisheries and their relationship to the Environmental Baseline

NMFS recognizes the unique status of tribal Indian fisheries and their relation to the environmental baseline. Implementation Indian fishing rights involves, among other things, application of the sharing principles of various legal principles established through multiple cases affecting Council salmon fishery implementation (e.g., *United States v. Oregon (302 F. Supp. 899, D. Or. 1969); Unites States v. Washington (384 F. Supp. 312, W.D. Wash. 1974), and Parravano v. Babbitt, (70 F.3d 539, 9th Cir. 1995))*. Exploitation rate calculations, escapements, and harvest levels to which the sharing principles apply, in turn, are dependent upon various biological parameters, including the estimated run sizes for the particular year, the mix of stocks present, status of other species intercepted, the allowable fisheries and the anticipated fishing effort.

Native Americans have lived along the western coast of the present-day United States for thousands of years. On the coast, native people lived at the mouths of the many rivers that spill into the Pacific Ocean. Generally a seafaring people, along the Washington Coast they also have hunted seals and whales. Along this coast, and further south, anthropological and archaeological evidence suggests that for more than 10,000 years Native Americans have fished for salmon and steelhead, as well as for other species for ceremonial, subsistence, and economic purposes (Campbell and Butler 2010). These people expressed their relationship to the fish and waters that sustained them in dance, song, ceremony, and social relationships. In the late 1800s, they ceded most of their ancient lands to the federal government as waves of settlers encroached west and forced treaties took their lands, rivers, and fishing rights.

Salmon and steelhead from the ocean have always had spiritual and cultural significance for tribes, and the fish had economic importance as both a trade and food item. Tribes developed elaborate rituals to celebrate the return of the first fish. These first-salmon ceremonies were intended to ensure that abundant runs and good harvests would follow. The health of Native Americans was heavily reliant on these resources whose diets traditionally included certain quantities and qualities of fish (Harper and Deward E. Walker 2015).

If, after completing this ESA consultation, circumstances change or unexpected consequences arise that necessitate additional Federal action to avoid jeopardy determinations for ESA listed species, such action will be taken in accordance with standards, principles, and guidelines established under Secretarial Order 3206, and other applicable laws and policies. Consistent with the September 23, 2004 Memorandum for the Heads of Executive Departments and Agencies pertaining to Government-to-Government Relationship with Tribal Governments and Executive Order 13175, Departmental and agency consultation policies guiding their implementation, and administrative guidelines developed to implement Secretarial Order 3206, these responses are to be developed through government-to-government discourse involving both technical and policy representatives of the West Coast Region and affected Indian tribes prior to finalizing a proposed course of action.

2.4.2. Harvest Actions

2.4.2.1 Groundfish Fisheries

The Council manages groundfish fisheries off the West Coast under the Pacific Coast Groundfish Fishery Management Plan (Groundfish FMP) (PFMC 2020). The Groundfish FMP includes 82 species, nearly all of which live on or near the ocean floor. Major types of fishes included in this group include rockfishes, flatfishes, roundfishes, sharks, and skates (PFMC 2020). Most groundfish are harvested using trawls, pots, and hook-and-line gear. Mid-water and bottom trawls have been known to catch salmon (Stelle 1999). NMFS completed reinitiated section 7 consultation on the Groundfish FMP in 2017 and produced a subsequent Biological Opinion (NMFS 2017).

From 2002 to 2020, coho salmon bycatch was generally lower (by an order of magnitude) than Chinook bycatch, with considerable amounts of inter-annual variability (Richerson et al. 2021). Bycatch in the hake fishery was higher in 2002, 2005, 2007, 2011, 2014, and 2019 when compared to other years (Figure 6). Bycatch in the non-catch shares (NCS) and shoreside non-hake catch shares fisheries has remained at low or moderate levels across all years, though NCS bycatch of coho salmon in 2018 and 2019 was higher than the preceding several years. In 2020, coho salmon bycatch in these sectors was low (Figure 6).

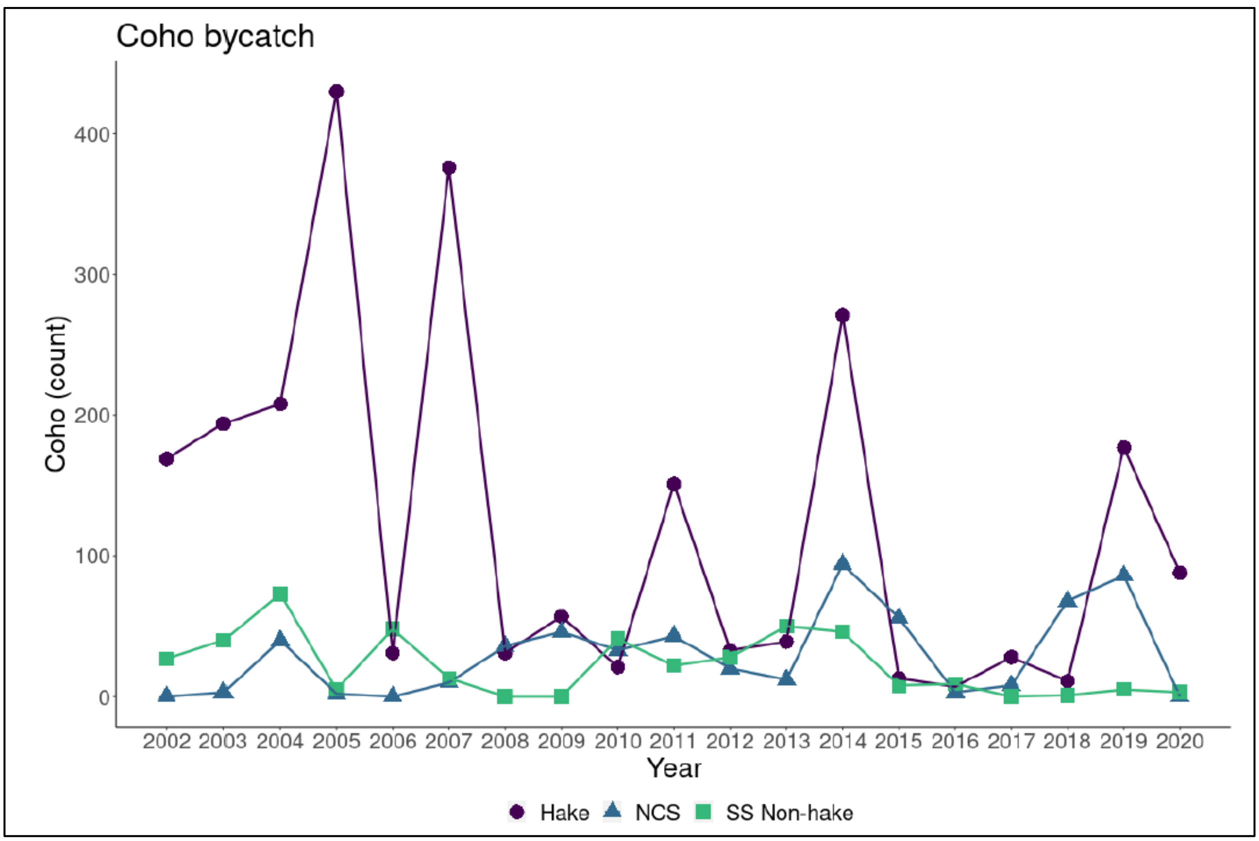

Figure 6. Coho salmon bycatch shown by fishery in Council U.S West Coast groundfish Fisheries from 2002 to 2020 (Richerson et al. 2021). Hake includes at-sea catcher processors, at-sea mothership catcher-vessels, and shoreside processors. NCS indicates non-catch shares fisheries and includes non-catch shares exempted fishing permits, sablefish primary, nearshore, open access California halibut, pink

shrimp, and open access hook and line. Shoreside (SS) non-hake includes shoreside limited entry and catch shares bottom trawl, catch shares fixed gear, catch shares midwater rockfish, and limited entry California halibut.

The coho salmon that are caught in the fishery are a mix of all hatchery and natural origin stocks from primarily the Washington and Oregon coast, the Columbia River, and Puget Sound with some additional contribution from California and Canada. The number of SONCC coho salmon in this bycatch is unknown, but likely small (i.e., 10 to 20 fish per year) (NMFS 2017).

2.4.2.2 Salmon Fisheries

Council salmon fisheries in 2022 and beyond are the subject of this opinion, so they are not included in the environmental baseline. However, historical salmon fisheries have contributed to the status of SONCC coho salmon in the action area and are therefore considered here, including harvest that has occurred in freshwater terminal areas.

2.4.2.2.1 Council Salmon Fisheries

In the marine environment, fish from the SONCC Coho Salmon ESU are primarily distributed off the coast of California and southern Oregon (PFMC 2021d) and are caught in ocean salmon fisheries in those areas as well as in river tribal and recreational fisheries. Overfishing in non-tribal fisheries was identified as a significant factor in the decline of the ESU (62 FR 24588, May 6, 1997). Significant overfishing occurred from the time marine survival significantly decreased for many stocks (ca. 1976) until the mid-1990s when harvest was substantially curtailed or prohibited. As described above in Section 1.3 Council managed salmon fisheries do not target SONCC coho, but SONCC coho are encountered incidentally while fishing effort is directed at Chinook or other healthy stocks of coho salmon.

SONCC coho salmon have been managed in Council salmon fisheries as part of the Oregon Coast Natural (OCN) coho salmon stock aggregate, which includes coho salmon produced from all Oregon river and lake systems south of the Columbia River and contributes primarily to ocean fisheries off Oregon and California (NMFS 2014). OCN coho salmon are part of a larger aggregate of natural and hatchery coho salmon production south of Leadbetter Point, Washington known as the Oregon Production Index (OPI) (NMFS 2014). SONCC coho salmon are vulnerable to incidental mortality due to hooking and handling in the commercial and recreational ocean fisheries that primarily target Chinook salmon. The Council has managed these fisheries according to the provisions of a biological opinion completed by NMFS in 1999 that established an RPA that specified a maximum ocean exploitation rate on SONCC coho, as indicated by hatchery Rogue/Klamath (R/K) coho salmon, of 13 percent (NMFS 1999). NMFS's rationale in choosing the exploitation rate ceiling of 13 percent was that little information was available on natural coho salmon spawning escapement levels in rivers of the California component of the SONCC coho salmon ESU, such that the status of parent-spawner recruitment was difficult to assess (NMFS 1999). An exploitation rate of 13 percent was the lowest exploitation rate proposed under Amendment 13 for OCN coho salmon sub-aggregates (Table 9) which was the harvest management framework in place at the time[5]. Ocean exploitation rates on R/K coho salmon at the time varied between 5 and 12 percent (NMFS 1999)(Figure 7). The 13 percent ceiling on the ocean exploitation rate was a conservative rate given the limited data on the ESU, and was meant to ensure that fishing mortality rates on California coho salmon would not increase until an adequate assessment of parent spawner recruitment rates was possible.

Council salmon fisheries in the majority of the SOF area (California coast) target Chinook salmon while incidentally encountering SONCC coho salmon. Coho salmon are targeted off the coasts of Oregon and Washington but ocean coho salmon fisheries are not allowed off the coast of California. Since 1999 the estimated exploitation rates on R/K hatchery coho salmon, and thus the assumed ER for SONCC coho salmon, have been considerably lower than 13 percent. Over the past ten years of available data (2010-2019) the average ocean fishery ER has been 5.5 percent for coho salmon originating from Bogus Creek, the Shasta River, the Scott River, the Interior Trinity River aggregate, and Freshwater Creek (Table 10). Due to a lack of life cycle monitoring stations and fishery monitoring effort, the effect of freshwater fisheries on most populations within the SONCC Coho Salmon ESU is unknown.

Table 9. Exploitation rate ceilings associated with conditions of marine survival and parent escapement for Oregon coho salmon as managed under Amendment 13 to the Council salmon FMP (NMFS 1999).

	Marine Survival		
	Low	**Medium**	**High**
High Parent Spawning Escapement	≤15%	≤30%	≤35%
Medium Parent Spawning Escapement	≤15%	≤20%	≤25%
Low Parent Spawning Escapement	≤15%	≤15%	≤15%
38% Below Low Parent Spawning Escapement	≤13%	≤13%	≤13%

Exploitation Rates

The estimated ocean exploitation rate has been low and relatively stable since the early 1990s (average = 5.4 percent for years 1994–2019), which contrasts sharply with the much higher rates estimated for the 1980s and early 1990s (Williams et al. 2016).

[5] Management for OCN coho salmon was subsequently modified by Amendment 16 which removed the southern sub-stock from the management matrix. Management for SONCC coho thereafter remained under the provisions of the 1999 opinion.

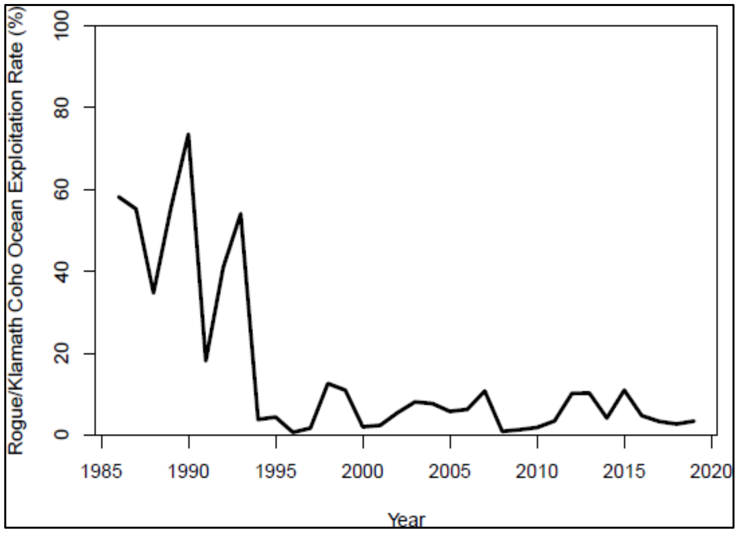

Figure 7. Ocean exploitation rates on Rogue and Klamath basin coho salmon, 1985-2019 (Source: J. Carey, NMFS).

Figure 7 and Table 10 summarize estimated ERs for SONCC coho salmon populations in the Council managed ocean salmon fisheries (PFMC 2021d). At the time of the completion of this opinion, ERs for 2020 and 2021 were not available. In non-tribal ocean fisheries, ERs include fish that were retained (usually by misidentification or unfamiliarity with the regulations), and release mortality that accrued in any specific year, since non-tribal fisheries cannot legally retain coho salmon in marine or freshwater areas in California.

Table 10. Exploitation rates estimated for coho salmon originating from five population units in Council-managed oceansalmon fisheries (PFMC 2021d).

Year	Bogus Creek	Shasta River	Scott River	Freshwater Creek	Interior Trinity River aggregate
1997	NA	NA	NA	NA	1.6%
1998	NA	NA	NA	NA	11.5%
1999	NA	NA	NA	NA	10.3%
2000	NA	NA	NA	2.0%	2.0%
2001	NA	NA	NA	2.4%	2.4%
2002	NA	NA	NA	5.2%	5.2%
2003	NA	NA	NA	8.1%	8.1%
2004	7.9%	NA	NA	7.9%	7.9%
2005	5.3%	NA	NA	5.3%	5.3%
2006	5.6%	NA	NA	5.6%	5.6%
2007	10.1%	10.1%	10.1%	10.1%	10.1%
2008	1.1%	1.1%	1.1%	1.1%	1.1%

Year	Bogus Creek	Shasta River	Scott River	Freshwater Creek	Interior Trinity River aggregate
2009	1.5%	1.5%	1.5%	1.5%	1.5%
2010	1.7%	1.7%	1.7%	1.7%	1.7%
2011	3.1%	3.1%	3.1%	3.1%	3.1%
2012	10.1%	10.1%	10.1%	10.1%	10.1%
2013	10.6%	10.6%	10.6%	10.6%	10.6%
2014	4.3%	4.3%	4.3%	4.3%	4.3%
2015	11.0%	11.0%	11.0%	11.0%	11.0%
2016	4.8%	4.8%	4.8%	4.8%	4.8%
2017	3.3%	3.3%	3.3%	3.3%	3.3%
2018	3.0%	3.0%	3.0%	3.0%	3.0%
2019	3.3%	3.3%	3.3%	3.3%	3.3%
Average	5.4%	5.2%	5.2%	5.2%	5.6%
10-yr average	5.5%	5.5%	5.5%	5.5%	5.5%

2.4.2.2.2 State and Tribal Fisheries

Coastal Marine Fisheries
There are commercial and recreational salmon fisheries that occur within coastal waters (0-3 nautical miles) off the coasts of Washington, Oregon, and California. These fisheries targeted at healthy or more abundant Chinook and coho salmon and may incidentally encounter SONCC coho. Coho salmon may be retained while caught in coastal waters off of Washington and Oregon but coho retention is prohibited off of California. The states manage their fisheries to be consistent with management of fisheries by the Council and NMFS.

Freshwater Recreational Fisheries
These fisheries are terminal river fisheries managed by either CDFW or ODFW depending on the state in which the river is located. Incidental impacts to SONCC coho salmon from freshwater recreational fisheries are largely unknown, but likely low and result from incidental mortalities in fisheries targeting Chinook salmon and steelhead in California and Oregon, and hatchery coho salmon in the Rogue River in Oregon (PFMC 2021d). Retention of coho salmon is prohibited in California and the mark-selective fisheries in Oregon are relatively small-scale. The information we have is focused within the Klamath and Trinity river basins, and indicates that recent 10 year average freshwater recreational fishery ER is near the long term average (e.g., the Klamath River long term average ER is 0.4 percent and the 10 year average ER is 0.5 percent)(Table 11).

Tribal Fisheries
These fisheries are terminal river fisheries managed by either the Yurok Tribe or HVT in the Klamath and Trinity river basins. While Tribal harvest occurs in the freshwater terminal areas where SONCC Coho Salmon ESU populations migrate through to their spawning areas, it was not considered a major factor in the decline of coho salmon in either the Klamath River Basin or Trinity River Basin (62 FR 24588, May 6, 1997). Tribal fisheries in the Klamath and Trinity

basins affect SONCC coho salmon through harvest of hatchery coho salmon and incidental mortalities in fisheries targeting other species like Chinook salmon or steelhead (SONCC coho salmon is the only species of coho salmon in these basins). Due to the locations of their respective fisheries, Yurok tribal fisheries encounter coho salmon populations returning to both the Klamath and Trinity rivers whereas HVT fisheries encounter coho salmon populations returning to the Trinity River.

The HVT Council manages fisheries for the benefit of its membership and conservation of the resource. The directed individual tribal member fishery (ITMF) includes harvest of both hatchery-origin and natural-origin coho salmon by gillnet and hook-and-line. A mark-selective harvest of marked hatchery-origin coho salmon is implemented annually through the deployment of a floating resistance board weir at the southern boundary of the Hoopa Valley Reservation. All un-marked coho salmon are released upstream of the weir to continue migration. Total coho salmon harvest in the ITMF and weir fishery have been reported to co-managers for years 1991–2019. Similar to other data over this time, the recent 10 year average ER for HVT Council fisheries on natural-origin coho populations in the Trinity River Basin is similar to the long-term average of just over three percent (Table 11). The HVT recently submitted to NMFS for approval under the ESA tribal 4(d) rule a Tribal Resource Management Plan (TRMP) setting limits for actions conducted under harvest, research, and monitoring activities for tribal fisheries affecting SONCC coho salmon in the portion of the Trinity River within the Hoopa Valley Reservation (87 FR 10174). NMFS has prepared a Proposed Evaluation and Pending Determination as to whether implementation of the TRMP will appreciably reduce the likelihood of survival and recovery of ESA-listed salmon and steelhead and an Environmental Assessment on the NMFS determination. Pending NFMS' final determination, this will align the HVT's fisheries and other activities with the current status and recovery objectives for populations within the Trinity River basin.

The Yurok Tribe also manages fisheries for the benefit of its members and conservation of the resource. Out of concern for the status of coho salmon, the Yurok Tribal Council began implementing conservation measures to minimize harvest impacts to coho salmon in the early 1990s, several years before SONCC coho salmon were listed under the ESA. Such conservation measures have continued through to recent years, and have typically consisted of partial closures (e.g., two days per week) to reduce harvest impacts to coho salmon. The Yurok Tribal Council has also annually made a choice whether to close its commercial fishery seasons near the beginning of coho salmon run timing in the Klamath River estuary to further reduce harvest impacts. Harvest impacts to coho salmon in the Yurok fishery during some years are also minimized when the fishery closes prior to the arrival of the coho salmon run, due to attainment of the Yurok fall-run Chinook salmon allocation. Similar to other data over this time, the recent 10 year average ER for Yurok Tribal fisheries on natural-origin coho returning to the Klamath and Trinity Rivers is similar to the long-term average of just over five percent (Table 11).

Table 11. Freshwater exploitation rates estimated for coho salmon originating from SONCC coho salmon populations (PFMC 2021d).

Year	Bogus Creek[1]		Shasta River[2]		Scott River[3]		Interior Trinity River aggregate			
	Yurok Tribal fisheries	Klamath River recreational fisheries	Yurok Tribal fisheries	Klamath River recreational fisheries	Yurok Tribal fisheries	Klamath River recreational fisheries	Yurok Tribal fisheries	Hoopa Valley Tribal fisheries	Klamath River recreational fisheries	Trinity River Recreational fisheries
1997	NA	NA	NA	NA	NA	NA	1.9%	5.2%	0.0%	0.0%
1998	NA	NA	NA	NA	NA	NA	2.5%	4.5%	0.0%	0.0%
1999	NA	NA	NA	NA	NA	NA	6.4%	5.5%	0.1%	0.0%
2000	NA	NA	NA	NA	NA	NA	4.4%	5.0%	0.2%	0.0%
2001	NA	NA	NA	NA	NA	NA	12.9%	2.8%	0.3%	0.0%
2002	NA	NA	NA	NA	NA	NA	11.0%	3.6%	0.9%	0.0%
2003	NA	NA	NA	NA	NA	NA	1.5%	0.4%	0.1%	0.0%
2004	5.3%	0.1%	NA	NA	NA	NA	4.4%	0.9%	0.1%	0.0%
2005	6.0%	0.1%	NA	NA	NA	NA	4.5%	0.7%	0.0%	0.0%
2006	9.8%	0.0%	NA	NA	NA	NA	6.7%	1.9%	0.0%	0.0%
2007	2.4%	0.0%	2.4%	0.0%	2.4%	0.0%	2.4%	1.0%	0.0%	0.0%
2008	9.8%	0.4%	9.8%	0.4%	9.8%	0.4%	9.8%	4.2%	0.4%	0.0%
2009	7.9%	1.0%	7.9%	1.0%	7.9%	1.0%	7.9%	4.1%	1.0%	0.0%
2010	6.7%	0.5%	6.7%	0.5%	6.7%	0.5%	6.7%	6.4%	0.5%	0.0%
2011	6.1%	0.6%	6.1%	0.6%	6.1%	0.6%	6.1%	1.6%	0.6%	0.0%
2012	5.1%	0.6%	5.1%	0.6%	5.1%	0.6%	5.1%	0.3%	0.6%	0.0%
2013	10.1%	0.4%	10.1%	0.4%	10.1%	0.4%	10.1%	2.6%	0.4%	0.0%
2014	0.8%	2.7%	0.8%	2.7%	0.8%	2.7%	0.8%	5.0%	2.7%	0.0%
2015	8.4%	0.3%	8.4%	0.3%	8.4%	0.3%	8.4%	5.5%	0.3%	0.0%
2016	5.4%	0.0%	5.4%	0.0%	5.4%	0.0%	5.4%	1.6%	0.0%	0.0%
2017	0.3%	0.0%	0.3%	0.0%	0.3%	0.0%	0.3%	0.0%	0.0%	0.0%
2018	6.7%	0.0%	6.7%	0.0%	6.7%	0.0%	6.7%	--	0.0%	0.0%

Year	Bogus Creek[1]		Shasta River[2]		Scott River[3]		Interior Trinity River aggregate			
	Yurok Tribal fisheries	Klamath River recreational fisheries	Yurok Tribal fisheries	Klamath River recreational fisheries	Yurok Tribal fisheries	Klamath River recreational fisheries	Yurok Tribal fisheries	Hoopa Valley Tribal fisheries	Klamath River recreational fisheries	Trinity River Recreational fisheries
2019	3.9%	0.0%	3.9%	0.0%	3.9%	0.0%	3.9%	8.0%	0.0%	0.0%
Average	5.9%	0.4%	5.7%	0.5%	5.7%	0.5%	5.6%	3.2%	0.4%	0.0%
10-yr average	5.4%	0.5%	5.4%	0.5%	5.4%	0.5%	5.4%	3.4%	0.5%	0.0%

1 a component of the Upper Klamath River population, an interior Klamath River population

2 an interior Klamath River population

3 an interior Klamath River population

-- The 2018 ER is considered an outlier due high uncertainty in abundance estimates (PFMC 2021d).

2.4.3. Hatchery Actions

This Section includes the effects of hatchery operations in the action area for the operation of hatcheries prior to this consultation, as well as the continued operation of hatchery programs that have already undergone a separate ESA Section 7 consultation. The effects of future operations of hatchery programs with expired ESA Section 7 consultation and those programs yet to undergo ESA Section 7 consultation are not included in the environmental baseline, except when effects are ongoing (e.g., returning adults from past hatchery releases).

Productivity of natural-origin SONCC coho salmon can be affected by hatchery production levels. Hatchery actions designed to benefit salmon viability sometimes produce only limited positive results. One potential reason for this is that other factors (i.e., limiting factors and threats) can offset or out-weigh the benefits from hatchery actions. Hatchery programs can serve an important conservation role when habitat conditions in freshwater depress juvenile survival or when access to spawning and rearing habitat is blocked. Under circumstances like these, and in the short-term, the demographic risks of extinction of such populations likely exceed genetic and ecological risks to natural-origin fish that would result from supplementing the natural population through hatchery actions. Benefits like this should be considered *transitory*, or short-term, and these benefits do not contribute to survival rate changes necessary to meet recovery plan abundance and productivity viability criteria. These hatchery programs help “to preserve remaining genetic diversity, and likely have prevented the loss of several populations” (NMFS 2005; Ford 2011). However, until the factors limiting salmon productivity are addressed, the full benefit (i.e., potential contributions to increased viability) of hatchery actions designed to benefit salmon viability may not be realized. Therefore, fixing the factors limiting viability is the key to long-term viability.

Coho salmon produced from three artificial propagation programs are included as part of the SONCC Coho Salmon ESU: the Cole Rivers Hatchery (Rogue River); Trinity River Hatchery; and Iron Gate Hatchery (Klamath River) Coho Salmon programs (70 FR 37160, June 28, 2005). Current annual production goals at these hatcheries are 75,000, 300,000, and 75,000 coho salmon smolts, respectively. These coho salmon programs are summarized below. Steelhead and Chinook salmon are also reared and released at these and other hatcheries within the area of the SONCC Coho Salmon ESU with an approximately 14.2 million salmonids annually released into rivers within the SONCC Coho Salmon ESU competing for resources and space (NMFS 2019). Hatchery production in the area of the SONCC Coho Salmon ESU is shown in Table 12.

Table 12. Hatchery salmonids released within the SONCC Coho Salmon ESU (CDFW and PacifiCorp 2014; ODFW 2016; NMFS 2019; ODFW 2020; PFMC 2021d).

State	Hatchery	Species	Current ReleaseGoal	Marking/Tagging	Release Location
Oregon	Cole Rivers	Coho	75,000	Adipose Clip +CWT	Rogue River
California	IronGate	Coho	75,000	Left Maxillary Clip	Klamath River
	TrinityRiver	Coho	300,000	Right Maxillary Clip	Trinity River

In 2020, NMFS approved the Trinity River coho salmon HGMP which proposed to collect and spawn adult coho salmon, and release coho salmon smolts (yearlings), into the Trinity River near Lewiston, California (U.S. Department of the Interior and CDFW 2017; NMFS 2020a). The U.S. Bureau of Reclamation provides funding for Trinity River Hatchery and CDFW operates the facility. This coho salmon program is operated as an integrated program as defined by the Hatchery Scientific Review Group (HSRG 2014). The intent of an integrated program is to have the natural environment drive the adaptation and fitness of a composite population of fish that spawn both in the hatchery and in the wild. A fundamental purpose of an integrated program is to increase adult abundance, productivity, and fitness while minimizing genetic divergence of hatchery broodstock from the naturally spawning population (NMFS 2020a). The resulting approval of these programs for compliance under the ESA in terms of their associated hatchery effects is expected to increase the productivity, capacity, diversity, fitness and abundance of naturally produced coho salmon in the Trinity River and specifically in the Upper Trinity River coho salmon population (NMFS 2020a) and should improve VSP scores in both productivity and diversity in the short-term and long-term.

Most recently in 2022, a Hoopa Valley Tribe Fisheries Department (HVTFD) proposal to begin rearing coho salmon eyed eggs at the Hoopa Valley Tribe Hatchery (HVTH) was approved by NMFS (NMFS 2022). Beginning in the spring and summer of 2022, the Hoopa Valley Tribe (HVT) will release coho salmon at the parr life stage into tributaries of the lower Trinity River on the Hoopa Valley Reservation (HVR). Releases are planned initially for 50,000 coho salmon parr, up to 100,000 parr the second year, and up to 200,000 parr in subsequent years. The purpose of the HVTH is to encourage reseeding of HVT tributaries with coho salmon and to provide a harvest benefit while minimizing ecological and genetic impacts to ESA-listed coho salmon. With so few naturally spawning coho salmon returning to the lower Trinity River, this hatchery action is expected to be beneficial to the interior-Trinity River diversity stratum and the SONCC Coho Salmon ESU in the short-term by increasing abundance, spatial structure, and lowering demographic risks. Productivity and diversity are expected to increase in the short-term, as there are currently so few naturally returning adult coho salmon to the action area. The long-term outlook for the effects of this specific hatchery action on the productivity and diversity of the interior Trinity River diversity stratum, and the SONCC Coho Salmon ESU, will depend upon the availability and use of naturally produced coho salmon for broodstock (NMFS 2022)

2.4.4. Habitat Actions

Activities that affect SONCC coho salmon habitat such as agriculture, forestry, marine construction, levy maintenance, shoreline armoring, dredging, hydropower and irrigation operations, and new development continue to limit the ability of the habitat to produce salmon in the action area, primarily in the freshwater areas. Many of these activities have a federal nexus and have undergone section 7 consultation. Those actions have nearly all met the standard of not jeopardizing the continued existence of the listed salmonids or adversely modifying their critical habitat, and when they did not meet that standard, NMFS identified reasonable and prudent alternatives. In addition, the environmental baseline is influenced by many actions that pre-date the salmonid listings and that have substantially degraded salmon habitat and lowered natural production of ESA-listed coho salmon.

Since the 2016 status review NMFS is aware in 2019, the John D. Dingell Jr. Conservation, Management, and Recreation Act (Public Law 116-9; 133 Stat. 580) added miles to various National Wild and Scenic Rivers systems (https://www.rivers.gov/rivers/elk.php) that would provide protection for various SONCC coho salmon populations. The additions include:

- Approximately 46 miles of the Elk River to the previously designated 28 miles for a total of approximately 74 river miles (Elk River population);
- Approximately 119 miles of the Rogue River (and associated tributaries) including rivers miles that are part of the Applegate/Middle Rogue River population. Previously, approximately 175 miles were designated in both this population and in the Illinois River population, as well as the Lower Rogue River population in the Northern Coastal Stratum;
- Additionally, 19 miles of the Chetco River were permanently protected from mining activities, including mineral and geothermal extraction

The national system was created in 1968 (Public Law 90-542) to preserve regionally and nationally significant rivers with outstanding values in a free-flowing condition, and protections include boundaries of approximately 0.25 miles on either side of the river. These extended protections will assist with retaining and enhancing important habitat features for coho salmon including riparian areas, water quality, and off-channel habitat under the John D. Dingell Jr. Conservation, Management, and Recreation Act (Public Law 116-9; 133 Stat. 580).

In 2020, NMFS evaluated and provided exemptions from the take prohibition under the ESA for multiple restoration projects to be completed in the Trinity River Basin by the Bureau of Reclamation's (Reclamation) Trinity River Restoration Program (TRRP) (NMFS 2020b). Reclamation proposed to fund, implement, or facilitate restoration activities in the Trinity River watershed and monitoring and research activities in the Trinity and lower Klamath basins under the TRRP. The purpose of the TRRP is to mitigate impacts of the Trinity River Division of the Central Valley Project (CVP) on anadromous fish populations in the Trinity River by successfully implementing the 2000 Trinity ROD (U.S. Department of the Interior 2000) and achieving Congressionally-mandated restoration goals. TRRP's ongoing restoration activities are designed to increase in-river salmon and steelhead production by reestablishing habitat forming processes and complex instream habitat for salmonids. As participating federal agencies, the United States Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), Shasta-Trinity National Forest (STNF), and the U.S. Army Corps of Engineers (Corps) may also implement, fund, and/or permit restoration, monitoring, and/or research activities in the Trinity and lower Klamath basins. Restoration, monitoring, and research activities that may result from the TRRP and/or participating federal agencies include: channel rehabilitation, fine and coarse sediment management, infrastructure modifications and improvements, watershed restoration projects, and fish monitoring and research activities. In fiscal year 2020 Reclamation provided funding of $12.2 million to the TRRP (Trinity River Restoration Program 2021).

The implementation of the TRRP is expected to have an overall long-term positive effect on salmonid habitat in the Trinity River (NMFS 2020b). Current projections of improved habitat quantity and quality potentially achievable by the TRRP range up to 107 percent to 112 percent increases for steelhead and Chinook salmon rearing capacities, respectively (Beechie et al. 2014). An estimate for potential improvement of coho salmon rearing capacity, though not specifically provided by Beechie et al. (2014), is assumed to be similar to the range for Chinook salmon and steelhead, based on the observations reported by Goodman et al. (2014) and Alvarez et al. (2015) that habitat preferences of juvenile coho salmon in the mainstem Trinity River are similar to Chinook salmon (NMFS 2020b). Channel rehabilitation, fine sediment management, and watershed restoration activities will provide long-term benefits to water quality conditions for coho salmon in the mainstem and tributaries by improving and restoring channel structure and habitat complexity, floodplain connectivity, riparian vegetation structure and diversity, and by reducing excess accumulations of fine sediment in the river channel and sediment loads entering the river from tributaries (NMFS 2020b). Restored habitat resulting from restoration projects should improve adult spawning success, juvenile survival, and smolt outmigration, which will in turn lead to improved abundance, productivity, spatial structure, and diversity within each affected coho salmon population (NMFS 2020b). As individual population viability improves, the viability of the diversity strata and ESU will improve as well.

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 the species

The proposed action NMFS is consulting on is described in Section 1.3, but summarized for reference here as NMFS' ongoing authorization of the ocean salmon fisheries through approval of the FMP including the proposed SONCC coho salmon amendment, and implementing regulations. The proposed SONCC coho salmon amendment would limit the impacts of salmon fisheries to total ER limits of (1) 16 percent for the Trinity population unit (Upper Trinity River, Lower Trinity River, South Fork Trinity River populations); and, (2) 15 percent for each of the remaining individual populations within the ESU as represented by the Rogue River, the Scott River, the Shasta River, Freshwater Creek and Bogus Creek population units. These exploitation rate limits account for all ocean and inland sources of fishery mortality on age-3 adult SONCC coho salmon, including landed and non-landed mortality. While the HCR's for SONCC coho salmon included in the proposed action would only apply to Council-managed fisheries in the EEZ, the HCRs also consider fishing impacts from state and tribal fisheries. Therefore, for purposes of our analysis in this consultation, we assume that NMFS and the Council will coordinate with state and tribal co-managers such that the impacts of all fisheries are within the overall ERs of 16 percent for the Trinity population unit and 15 percent for the rest of the populations within the ESU. In this analysis we evaluate the impacts of a 15 percent and 16 percent HCR on SONCC coho salmon, although the actual ER, and thus level of fish encountered, in the ocean salmon fisheries would be lower than that rate since sharing principles between Council salmon fisheries coordinated with state and tribal co-managers will prohibit ocean fisheries fishing up to each limits' total. All other provisions required either by the FMP or by existing consultations and applicable RPAs (Table 2) for other salmon stocks would continue.

The proposed action may affect SONCC coho salmon in several ways. SONCC coho salmon are encountered incidental to fishing effort directed at healthy stocks of Chinook or coho salmon. Immediate mortality occurs from the capture, by hook, and subsequent retention of individual fish (known as 'landed mortality'). Retention of SONCC coho salmon is prohibited off of California and only occurs in the salmon fisheries off of Oregon. These effects are considered explicitly in the following subsection of this opinion.

In addition, other effects occur when fish that are caught and released alive but may be injured and subsequently die. This may result from compliance with non-retention requirements that may be related to species, or size limits, in mark-selective fisheries that target marked hatchery-origin fish for retention while requiring the release of unmarked fish, or from encounters with fishing gear (commonly referred to as 'drop off mortality'). Collectively this is generally termed "incidental mortality". Effects of catch and release include not only incidental mortality, but also include potential delayed returns to spawning areas thereby reducing fecundity and productivity, along with increased exposure to predation due to possible sustained long-term injury, and other stress related effects individual fish may experience associated with encountering fishing gear, fishing vessels, and subsequent release. As described in earlier sections of this opinion, the majority of the fishing-related mortality on SONCC coho salmon is incidental.

Because the proposed action includes a maximum rate of allowable fishing impacts based on projected encounters of hatchery fish representing the ESU, it is not possible for us to know exactly how many wild fish will be impacted by the proposed action either on an annual basis or over the course of the implementation of the proposed action. Therefore, NMFS will use estimates of fishery exploitation in this consultation as a proxy for assessing all effects of the proposed action on the SONCC Coho Salmon ESU. Both landed and incidental mortality is assessed and accounted for in determining the total impacts to the ESU from the proposed action.

The catch-and-release mortality rate varies for different gear types, different species, and different fishing conditions, and those absolute values are often not well known. Catch-and-release mortality rates have been estimated from available data and are used by the Council's Salmon Technical Team (STT) and co-managers in evaluating the impact of fisheries. The STT applies a 14.0 to 26.0 percent incidental mortality rate to coho salmon caught and released during recreational fishing and ocean troll activities in Council salmon fisheries, depending on the area caught and the age of the fish. A five percent incidental mortality rate is ascribed to freshwater sport fisheries. These mortality rates are the best scientific information available and are used in this consultation for evaluating the impacts of the proposed action.

Data sources for analysis

Historical fishing-related impacts to the SONCC coho salmon ESU in Council ocean salmon fisheries are reported in (e.g., PFMC 2014a; 2015) and summarized in Table 10. The harvest that occurs in state marine area (zero to three miles) fisheries, and freshwater ERs are reported in

Table 11.

Population Risk Assessment

As described above in Section 1.2, the Workgroup developed a RA to analyze the effects of a range of harvest control rules on the SONCC Coho Salmon ESU and the fisheries that encounter it. The Workgroup's RA (PFMC 2021d) provides background on the ESU (see Section 2.2) and the fisheries affecting the ESU and describes the risk assessment model, the analysis and the results of the Workgroup's risk assessment in detail. The RA uses the most recently available information relative to population status, viability parameters and fishery impacts (PFMC 2021d). NMFS has reviewed the RA and incorporates it into our analysis in this consultation as it represents the best scientific information available for SONCC coho salmon and the impacts of the proposed action. The analysis of effects below incorporates the results of the RA that examined the effects of a range of fixed-rate total ER HCRs on six representative population units in the SONCC coho ESU for which sufficient data are available and as described earlier in this consultation. The RA's analysis assumed (1) the HCR for SONCC coho salmon was the most constraining on the impacts of Council salmon fisheries to SONCC coho salmon (i.e., the Workgroup did not consider scenarios in which the conservation objectives for other salmon stocks such as Klamath fall Chinook salmon reduced fishery impacts to SONCC coho salmon below the levels allowed under proposed SONCC HCR alternatives) (2) ERs in freshwater and coastal fisheries fell within the range of ERs in Table 11, and (3) fisheries impacted SONCC coho salmon to the maximum extent possible under each HCR alternative assessed in the RA. The RA made no assumption regarding any allocation of impacts among the various fisheries.

The RA analyzed the effects of fishing on population status using a stochastic stock-recruitment model in a Population Viability Analysis (PVA) framework similar to that employed in other salmon ESA status assessments, fishery consultations and recovery plans. Spawner-recruit functions and extinction threshold levels were defined for all populations included in the analysis. Spawner-recruit functions and full seeding levels were developed or taken from the recovery plan for all population units included in the analysis. Methods for estimating spawner-recruit functions and seeding levels varied among populations, depending on available data. Detailed descriptions of the model, its spawner-recruit assessments, algorithms and assumptions are provided in Chapter 7 of the RA (PFMC 2021d).

The Workgroup's RA evaluated effects of HCRs based on six natural SONCC coho salmon populations or population aggregates (where aggregate is defined as a grouping of multiple populations) for which stock-recruitment data were available. Previously, only two population aggregates (Rogue and Klamath) were used in NMFS' analysis of Council salmon fisheries on effects to the SONCC Coho Salmon ESU (NMFS 1999). The populations and population aggregates evaluated in the Workgroup's analysis represented effects on populations within five of the seven diversity strata in the ESU (for diversity strata refer back to Figure 3). The populations or population units used in this analysis were:

- two populations (Shasta and Scott rivers);
- a component of the Upper Klamath River population (Bogus Creek);
- a component of the Humboldt Bay Tributaries population (Freshwater Creek), and
- two population aggregates (Rogue and Trinity rivers).

As discussed earlier in this consultation (Section 2.2.2), data on the populations within the ESU is extremely limited. This information, representing 6 population units of the 40 populations in the ESU across five of the seven diversity strata, is the most complete data set NMFS is aware that currently exists for the SONCC Coho Salmon ESU and is the best scientific information available for evaluating fishery actions. The population units assessed in the RA represent populations that are ether Core or Non-Core 1 populations and therefore essential to the recovery of the ESU (see Table 4). Therefore, the analysis, in NMFS's opinion, is representative of the entire SONCC Coho Salmon ESU. For these reasons, NMFS will use the same population units described in, and rely on information produced by the Workgroup's RA to assess effects of the Council's salmon fisheries.

Viability risks associated with the ER limits in the proposed action were modeled for each of the six selected representative population datasets. The Workgroup RA defines extinction risk as the probability that an ESA-listed unit (e.g., population) or stock would fall below some minimum size over a prescribed period of time. In the RA it was the probability that the average abundance of a generation of salmon (three years for coho) falls below a defined level over the course of a simulation (e.g., 20 years or 100 years). These levels, defined as "critical risk thresholds" for SONCC coho salmon populations in the RA, used individual population-specific or in some cases aggregated depensation thresholds identified in the Recovery Plan (Table 4 and Section 2.2.2). However, some of the population units evaluated in the RA were subcomponents of the populations identified in Table 4. For those population units (i.e., Freshwater Creek and Bogus Creek), a quasi-extinction threshold (QET) was used as the critical risk threshold. A QET is defined as a population size where functional extinction occurs due to the effects of small population processes (McElhany et al. 2006).[6] The Workgroup's RA model assumes that extinction occurs if the average annual population size over a moving-generational average falls below a QET threshold of 50 at any point over the course of a simulation (PFMC 2021d). Extinction risk for a population unit in the RA is thus estimated as the proportion of all simulations where the moving generational average spawner number falls below the defined threshold (CRT or QET) at any point in each simulation period. Hereafter, we refer to these defined thresholds as CRTs. The Workgroup assessed effects of the exploitation rate limits in the proposed action on SONCC coho salmon risk based on: 1) short-term (20-year) and 2) long-term (100-year) risk values and 3) median abundances (100-year) for all six populations (PFMC 2021d). The Workgroup evaluated the risk of the proposed exploitation rate limits against the risk at zero fishing. NMFS incorporated the results of the Workgroup's RA into our analysis.

As mentioned earlier, the information synthesized in the Workgroup's RA resulted in risk assessments along two separate timelines, one for 20 years and another for 100 years (for 100-year timeline estimates see PFMC 2021d) . In our effects analysis, we use the risk results for the 20 year time frame, since the information we currently have is limited and the significant

[6]Because empirical data on actual extinction and conservation risk levels is lacking, this QET value was based on theoretical numbers identified in the literature based on genetic risks (PFMC 2021d).

uncertainty in results projected over a 100-year time frame (Table 13). We considered several factors in concluding a 20-year time frame provides a more reliable assessment: the biology of the species, the changes in the environment relevant to the assumptions in the model and the changes in management and technology. We want to develop long-term harvest regimes that are protective of the resource. To do that we need to assess its effects over several generations. A 20 year time horizon allows us to assess the effects on the population units over multiple generations. Effects of changes to land use and habitat restoration efforts generally take decades to detect. Therefore, the effect of changes in land use and the improvements from current restoration efforts won't be measurable for at least another 20 years. Climate and its effects on salmon is becoming more variable. So it is reasonable to assume that conditions in the next twenty years might be similar to those observed over the past 10-15 years at most. Finally, management and technology are changing rapidly, and management plans can be expected to be revised periodically to incorporate new information. So it is likely that management 20 years from now may differ significantly from what is currently in place.

NMFS must make a determination as to whether the proposed action(s) will jeopardize the species, i.e., appreciably reduce the survival and recovery of the ESU. In assessing the effects of the proposed harvest actions on the SONCC Coho Salmon ESU, NMFS first analyzes the effects on individual salmon populations within the ESU using quantitative analyses where possible (i.e., where a sufficiently reliable time series of data is available) and more qualitative considerations where necessary. Risk to the survival and recovery of the ESU is then determined by assessing the distribution of risk across the populations within each strata and across the strata. We do so by using the surrogate population units we have information for as representatives for their respective diversity strata while also accounting for the relative role of each population to the viability of the ESU.

Population risk sensitivity to fishing

Table 13 summarizes risk values associated with a range of HCRs for the six populations evaluated in the Workgroup's RA (PFMC 2021d). Risk estimates reported in Table 13 are intended to provide a measure of relative risk and should not be interpreted as absolute extinction risk. Because estimates of absolute risk are extremely sensitive to the selection of the CRT, model-derived risks are most useful for relative comparisons, i.e., the change in viability risk to a population from effects from one HCR relative to another HCR.

Using the information generated from the Workgroup's RA for each population unit allows us to assess the relative risk of a range of HCRs, including those in the proposed action, to the individual population units. Since the consequences to SONCC coho salmon from the proposed action are from direct mortality in salmon fisheries or indirect mortality and impacts associated with catch and release in salmon fisheries and the level of fishing impacts is limited to the proposed HCRs, evaluating the risk of the HCRs to the ESU is the best way to evaluate the effects of the proposed action on SONCC coho salmon. We can calculate the change in risk associated with an increase in average exploitation rate from zero to 10 percent, or from 10 to 12 percent and so forth. We can then look at the risk across populations and strata to determine what the proposed action's effect is to the ESU, as well as evaluate that effect relative to status quo. We explain above that we assess the effect to the ESU relative to effects across the populations within each strata. Using all the information we have available for the population units described above represents effects across the ESU, representative of five of the seven diversity strata, as well as populations that have essential recovery roles (described above in Table 4). We later integrate and synthesize that effect with the status, environmental baseline, and cumulative effects to determine the proposed action’s overall effect relative to survival and recovery of the ESU in Section 2.7 of this opinion.

Table 13. Modeled effects of constant exploitation rates on short-term risk[1] (20-year) and median abundance (Median N, 100-year for SONCC natural coho salmon populations and change in risk from a no fishing scenario) (PFMC 2021d).

Parameter	**Population**	**Exploitation rate (total)**													
		0%	**7%**	**13%**	**14%**	**15%**	**16%**	**17%**	**18%**	**19%**	**20%**	**21%**	**22%**	**23%**	**24%**
p(20)	Rogue	0.135	0.172	0.210	0.222	0.234	0.239	0.252	0.261	0.272	0.285	0.332	0.341	0.354	0.908
	Bogus	0.747	0.811	0.857	0.864	0.871	0.880	0.887	0.894	0.902	0.907	0.928	0.931	0.938	1.000
	Scott	0.079	0.115	0.155	0.164	0.170	0.186	0.194	0.206	0.216	0.224	0.271	0.288	0.305	0.87
	Shasta	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	Trinity	0.640	0.725	0.792	0.800	0.810	0.826	0.835	0.845	0.850	0.855	0.88	0.884	0.889	1.000
	Freshwater	0.001	0.004	0.007	0.009	0.012	0.013	0.013	0.014	0.014	0.014	0.022	0.027	0.033	0.318
Median N escapement	Rogue	5,600	5,260	4,930	4,820	4,820	4,700	4,700	4,590	4,592	4,480	4,260	4,260	4,140	4,140
	Bogus	70	70	60	60	60	60	60	50	50	50	50	50	50	50
	Scott	700	640	600	600	590	570	570	560	560	550	520	520	500	500
	Shasta	10	0	0	0	0	0	0	0	0	0	0	0	0	0
	Trinity	1,190	1,060	860	860	860	790	790	790	730	730	660	660	590	590
	Freshwater	440	410	380	380	370	360	360	350	340	340	320	320	310	300
Change in risk from 0% ER	Rogue	0.0%	3.7%	7.5%	8.7%	9.9%	10.4%	11.7%	12.6%	13.7%	15.0%	19.7%	20.6%	21.9%	24.0%
	Bogus	0.0%	6.4%	11.0%	11.7%	12.4%	13.3%	14.0%	14.7%	15.5%	16.0%	18.1%	18.4%	19.1%	19.6%
	Scott	0.0%	3.6%	7.6%	8.5%	9.1%	10.7%	11.5%	12.7%	13.7%	14.5%	19.2%	20.9%	22.6%	25.1%
	Shasta	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	Trinity	0.0%	8.5%	15.2%	16.0%	17.0%	18.6%	19.5%	20.5%	21.0%	21.5%	24.0%	24.4%	24.9%	25.8%
	Freshwater	0.0%	0.3%	0.6%	0.8%	1.1%	1.2%	1.2%	1.3%	1.3%	1.3%	2.1%	2.6%	3.2%	3.8%

[1] Critical risk thresholds for SONCC coho salmon populations were based on depensation thresholds identified in the ESU recovery plan. Combined values of individual populations were used where SONCC coho salmon populations included an aggregate of individual populations. All simulations assumed that extinction occurs at a quasi-extinction threshold (QET) of 50, which was estimated as a moving average of years in one generation for the species in question (3 years for coho salmon) as per (McElhany et al. 2006)

Sensitivity of individual populations to increasing ERs can be greater for some populations than others, particularly among the smaller, less-productive populations evaluated (Table 13). Long-term population risks can be substantially reduced by reducing fishery impacts only for populations with significant intrinsic capacity or productivity. Smaller, less productive populations are less affected and cannot generally be brought to high levels of viability over the long term even at very low fishing rates. For example, at zero percent ER (no fishing), Bogus, Shasta, and Trinity population units have greater than a 64 percent probability of falling below their CRT over a 20-year period. Specifically, the respective extinction risk for the Shasta population is 100 percent, 75 percent for Bogus, and 64 percent for Trinity population units even without any harvest. These populations are at higher risk because escapement is lower relative to the critical threshold and therefore more likely to fall below the CRT. At zero percent ER the Rogue, Scott, and Freshwater population units have less than a 14 percent probability of falling below their CRT.

We can assess the change in extinction risk for the ER limits of the proposed action on the population units for which they apply. For the 15 percent ER limit, the risk increases depending on the population unit compared to zero harvest (the first column in the p(20) cell in Table 13). For the Bogus and Shasta population units the risk of extinction increases from 75 and 100 percent probability (Table 13) to 87 and 100 percent probability, respectively (Table 13). Essentially, the risk to the Shasta population does not change under any scenario, due to its extremely low population estimate and low productivity. This represents a change in viability risk from a no-fishing scenario for each of these populations to the proposed 15 percent exploitation rate limit of 12.4 and 0 percentage points for the Bogus and Shasta, respectively. At a 16 percent ER limit the Trinity population unit, the only population subject to this higher ER, viability risk increases from 64 to 82 percent probability (Table 13). Compared to the no-fishing scenario, it is a change in viability risk of 18.6 percent.

The change in risk compared to zero harvest for the Rogue, Scott, and Freshwater population units at a 15 percent ER is less than the other population units. Respectively, for the Rogue, Scott, and Freshwater population units the risk goes from 14, 8, and <1 to 23, 17, and 1 percent probability (Table 13). Comparing these changes to a no-fishing scenario results for each of these population units represents a change in risk of 9.9, 9.1, and 1.1 percent for the Rogue, Scott, and Freshwater respectively.

While we explain above our focus on the 20 year timeline simulation in the RA, the simulated escapement information is only available for the 100 year timeline. Also looking at the change in median escapements relative to their CRT for each population unit is another way to assess risk and provides a maximum effect (Table 13). The escapements for the Bogus and Shasta population units all decrease as the ER moves from zero percent to 15 percent. The Shasta population effectively shows no escapement above a seven percent ER and remains consistently well below its CRT even under a no-fishing scenario. The Bogus population unit remains above its CRT, losing 14 percent of its annual spawning escapement (which is 10 fish) when compared with a no-fishing scenario. At 16 percent, the Trinity population unit would lose 34 percent of its expected annual spawning escapement, still remaining above its CRT of 719 fish.

The Rogue, Scott, and Freshwater population units similarly follow a pattern of decreasing escapement when subjected to a 15 percent ER, losing respectively 14, 16, and 16 percent of their expected annual spawning escapement (Table 13) but remaining above their respective CRTs.

The comparisons above are useful to demonstrate the maximum effect of fishing as compared to a no-fishing scenario at a zero percent ER. They also represent the maximum effect, on both the increase in viability risk and reduction in escapement to each population unit when they are subjected to a 15 or 16 percent ER. However, as we mention earlier the ability to annually achieve a static 15 or 16 percent exploitation rate assumes no other limiting stocks are present in all fisheries where SONCC coho salmon might occur and that fisheries are precise enough to hit these limits exactly for long periods of time, both of which are not realistic such that it is likely that actual impacts on SONCC coho salmon will be below the proposed HCRs, but by assuming this it allows us to conservatively examine and report the effects of the HCR above. As reflected in the tables in this section, postseason estimates of the ERs may exceed the HCRs in some years due to the uncertainties in the forecast and the imprecision of management. That variability was incorporated by the Workgroup in its analysis and is taken into account in the evaluation of effects in this opinion.

It is also worth evaluating the change in risk when comparing the proposed action to the status quo, to determine if the proposed action increases or decreases risk relative to the effects of the current harvest control rule. In order to examine the change in risk from status quo (i.e., 13 percent ER limit in Council fisheries (NMFS 1999)) compared to the proposed action we must first convert the current consultation standard to a total ER to provide an equivalent comparison. Table 14 summarizes the estimated average freshwater exploitation rates by population units across the available dataset and at recent ten- and five-year intervals (the Rogue is not included as data for freshwater ERs are unavailable).

Table 14. Total post season freshwater ERs estimated for SONCC coho salmon population.

Year	Bogus Creek FW ER	Scott River FW ER	Shasta River FW ER	Freshwater Creek FW ER	Trinity River FW ER
1997				0.0%	7.1%
1998				0.0%	7.0%
1999				0.0%	12.0%
2000				0.0%	9.6%
2001				0.0%	16.0%
2002				0.0%	15.5%
2003				0.0%	2.0%
2004	5.4%			0.0%	5.4%
2005	6.1%			0.0%	5.2%
2006	9.8%			0.0%	8.6%

Year	Bogus Creek FW ER	Scott River FW ER	Shasta River FW ER	Freshwater Creek FW ER	Trinity River FW ER
2007	2.4%	2.4%	2.4%	0.0%	3.4%
2008	10.2%	10.2%	10.2%	0.0%	14.4%
2009	8.9%	8.9%	8.9%	0.0%	13.0%
2010	7.2%	7.2%	7.2%	0.0%	13.6%
2011	6.7%	6.7%	6.7%	0.0%	8.3%
2012	5.7%	5.7%	5.7%	0.0%	6.0%
2013	10.5%	10.5%	10.5%	0.0%	13.1%
2014	3.5%	3.5%	3.5%	0.0%	8.5%
2015	8.7%	8.7%	8.7%	0.0%	14.2%
2016	5.4%	5.4%	5.4%	0.0%	7.0%
2017	0.3%	0.3%	0.3%	0.0%	0.3%
2018[1]	6.7%	6.7%	6.7%	0.0%	44.6%
2019	3.9%	3.9%	3.9%	0.0%	11.9%
total average	6.3%	6.2%	6.2%	0.0%	10.7%
10-yr	5.9%	5.9%	5.9%	0.0%	12.8%
5-yr	5.0%	5.0%	5.0%	0.0%	15.6%

[1] The 2018 exploitation rate for the Trinity River was considered an outlier due to a very small number of program marks applied at Willow Creek Weir, and corresponding high uncertainty (PFMC 2021).

Adding the current consultation standard of 13 percent ER in Council salmon fisheries on SONCC coho salmon to the values calculated in Table 13 for freshwater fisheries provides the total ERs that the populations in the ESU could have experienced if SONCC coho salmon were exploited to the maximum extent allowable in the ocean[7]. While this scenario is unlikely, as explained above, this exercise allows us to examine the potential total ERs SONCC coho salmon could have experienced in the past (Table 14).

Table 15. Total ERs estimated for SONCC coho salmon population by adding a fixed maximum Council area salmon fishery limit of 13 percent to observed annual postseason freshwater ERs.

[7] The ocean is a mixed stock fishery where populations are comingled such that encounters of coho from any single population is random and assumed to occur proportionally to their abundance. Therefore, ocean harvest based on ER management is assumed to contact individual populations equally at the same rate.

Year	Bogus Creek FW ER + 13%	Scott River FW ER + 13%	Shasta River FW ER + 13%	Freshwater Creek FW ER +13%	Trinity River FW ER + 13%
1997				13.0%	20.1%
1998				13.0%	20.0%
1999				13.0%	25.0%
2000				13.0%	22.6%
2001				13.0%	29.0%
2002				13.0%	28.5%
2003				13.0%	15.0%
2004	18.4%			13.0%	18.4%
2005	19.1%			13.0%	18.2%
2006	22.8%			13.0%	21.6%
2007	15.4%	15.4%	15.4%	13.0%	16.4%
2008	23.2%	23.2%	23.2%	13.0%	27.4%
2009	21.9%	21.9%	21.9%	13.0%	26.0%
2010	20.2%	20.2%	20.2%	13.0%	26.6%
2011	19.7%	19.7%	19.7%	13.0%	21.3%
2012	18.7%	18.7%	18.7%	13.0%	19.0%
2013	23.5%	23.5%	23.5%	13.0%	26.1%
2014	16.5%	16.5%	16.5%	13.0%	21.5%
2015	21.7%	21.7%	21.7%	13.0%	27.2%
2016	18.4%	18.4%	18.4%	13.0%	20.0%
2017	13.3%	13.3%	13.3%	13.0%	13.3%
2018	19.7%	19.7%	19.7%	13.0%	57.6%
2019	16.9%	16.9%	16.9%	13.0%	24.9%
total average	19.3%	19.2%	19.2%	13.0%	23.7%
10-yr	18.9%	18.9%	18.9%	13.0%	25.8%
5-yr	18.0%	18.0%	18.0%	13.0%	28.6%

Adding post season freshwater fishery ERs to the current SONCC coho salmon consultation standard limit of 13 percent in Council salmon fisheries results in average total ERs ranging from 19.2 percent (on the Scott or Shasta rivers populations units), to 23.7 percent total in the Trinity River population, with the Bogus population unit percent in between with a total of 19.3 (Table 15). The Freshwater Creek population unit stays at a static 13.0 percent ER, since there are no freshwater fisheries in the creek, i.e., a freshwater ER of 0% (Table 14). Subtracting the proposed HCR limits (16 percent on Trinity populations and 15 percent on the rest of the populations) from the values in Table 14 allows us to calculate the difference in annual ER between the status quo and the proposed limits of the new HCRs (Table 15) and to assess the risks to viability under the current consultation standard compared with the proposed action.

Table 16. Difference between total ERs estimated for SONCC coho salmon population by adding the maximum Council area salmon fishery limit of 13 percent added to observed annual postseason freshwater ERs, and the Council's 2022 proposed HCR for SONCC coho salmon (proposed limit in parentheticals)[1].

Year	Bogus Creek FW ER (15%)	Scott River FW ER (15%)	Shasta River FW ER (15%)	Freshwater Creek FW ER (15%)	Trinity River FW ER (16%)
1997				2.0%	-4.1%
1998				2.0%	-4.0%
1999				2.0%	-9.0%
2000				2.0%	-6.6%
2001				2.0%	-13.0%
2002				2.0%	-12.5%
2003				2.0%	1.0%
2004	-3.4%			2.0%	-2.4%
2005	-4.1%			2.0%	-2.2%
2006	-7.8%			2.0%	-5.6%
2007	-0.4%	-0.4%	-0.4%	2.0%	-0.4%
2008	-8.2%	-8.2%	-8.2%	2.0%	-11.4%
2009	-6.9%	-6.9%	-6.9%	2.0%	-10.0%
2010	-5.2%	-5.2%	-5.2%	2.0%	-10.6%
2011	-4.7%	-4.7%	-4.7%	2.0%	-5.3%
2012	-3.7%	-3.7%	-3.7%	2.0%	-3.0%
2013	-8.5%	-8.5%	-8.5%	2.0%	-10.1%
2014	-1.5%	-1.5%	-1.5%	2.0%	-5.5%
2015	-6.7%	-6.7%	-6.7%	2.0%	-11.2%
2016	-3.4%	-3.4%	-3.4%	2.0%	-4.0%
2017	1.7%	1.7%	1.7%	2.0%	2.7%
2018	-4.7%	-4.7%	-4.7%	2.0%	-41.6%
2019	-1.9%	-1.9%	-1.9%	2.0%	-8.9%
total average	-4.3%	-4.2%	-4.2%	2.0%	-7.7%
10-yr	-3.9%	-3.9%	-3.9%	2.0%	-9.8%
5-yr	-3.0%	-3.0%	-3.0%	2.0%	-12.6%

[1] Negative values in Table 16 indicate that fisheries in that year would have exceeded the limits allowed in Table 15 (the rate limits required under the proposed action) and would need to reduce by the amount depicted to stay within the limit. The positive values in Table 16 during 2017 mean that fisheries could have expanded in that year specifically under the proposed action, as the ER across the populations was under

either the 15 or 16 percent limits proposed

The difference in the values between Table 14 and Table 15, calculated here in Table 16, allows us to evaluate the potential change in risk from the status quo consultation standard versus the proposed action. A negative sign in Table 16 indicates the proposed action would restrict fisheries more than the status quo, whereas a positive sign indicates the proposed action would be less restrictive and allow fisheries to increase their ER on that population unit (Table 16 indicates only the Freshwater Creek population unit is under this scenario). Table 16 indicates that managing under the exploitation rates in the proposed action would have reduced the average total ER historically for Bogus, Scott, Shasta, and Trinity populations units by 4.3, 4.2, 4.2, and 7.7 percent, respectively. Given there is no freshwater exploitation on the Freshwater Creek population unit, the status quo consultation standard is more restrictive here, and the proposed action would allow for a static 2.0 percent ER increase on the population unit. That potential increase likely would occur in freshwater given the constraints on other population units illustrated by Table 16. As indicated at the start of this exercise, estimates of freshwater ERs for the Rogue population unit were not available and therefore we must infer from these other population units what is likely to occur for the Rogue population unit. While future efforts to annually collect this information in the Rogue River will be undertaken, for our analysis in evaluating impacts for the Freshwater Creek and Rogue population units, we assume that the ocean fishery maximizes the available ER, meaning ocean fisheries would utilize 100 percent of the limit. Therefore, we expect the proposed action would have a similar effect to that of Freshwater Creek on the Rogue population unit, which by allowing a 15 ER limit, would enable fisheries to slightly increase their ER on the Rogue population unit and that would likely occur within the freshwater terminal area for the Rogue population unit. However, the record demonstrates in Section 2.2.2 (Table 10) that Council salmon fisheries often achieved post season estimates of final ocean ERs much lower than 13 percent.

The magnitudes of viability risk and escapement estimates associated with the HCRs in the proposed action of 15 and 16 percent ER are summarized in Table 13 while Figure 8 below depicts these risk profiles graphically. Figure 8 graphically depicts the extinction risk probabilities we discussed above associated with the exploitation rate limits under the proposed action of 15 and 16 percent as indicated by the dashed vertical blue and purple lines. The intersection of the vertical lines with each population unit curve indicates the extinction risk probabilities associated with those ERs that we first examined in this section. Next, by depicting the low end and high end of average annual total ERs that the population units would have been subject to under the status quo (averages in Table 15) (the solid vertical blue and purple lines) we can visually see the difference between extinction risk associated with the proposed action at the short-term (20 year) and the status quo PFMC (2021d). The reduction in ER of just over 19 percent for the status quo to 15 percent for the Bogus, Scott and Shasta aggregates would reduce the extinction risk probability. The same can be seen for the Trinity River population aggregate in Figure 8 by examining the purple vertical line's movement compared to the purple dashed vertical line, which is the reduction in risk from a total ER average of 23.7 estimated under status quo to 16 percent under the proposed action. For the Freshwater Creek population unit, simply because it does not experience freshwater ERs, changing from a potential 13 ocean-only percent ER limit to a 15 percent total ER limit is a simple increase in risk associated with an additional two percent increase in ER. We infer the same effect here for the Rogue River population aggregate.

These differences from the status quo in ERs amount to the following changes in risk for the population units: a reduction of risk by 4 percent to the Bogus Creek, a reduction of risk by 27 percent to the Scott, no change in risk for the Shasta, an increase in risk by 27 percent to Freshwater Creek, and a reduction of risk by 21 percent to the Trinity River population unit.

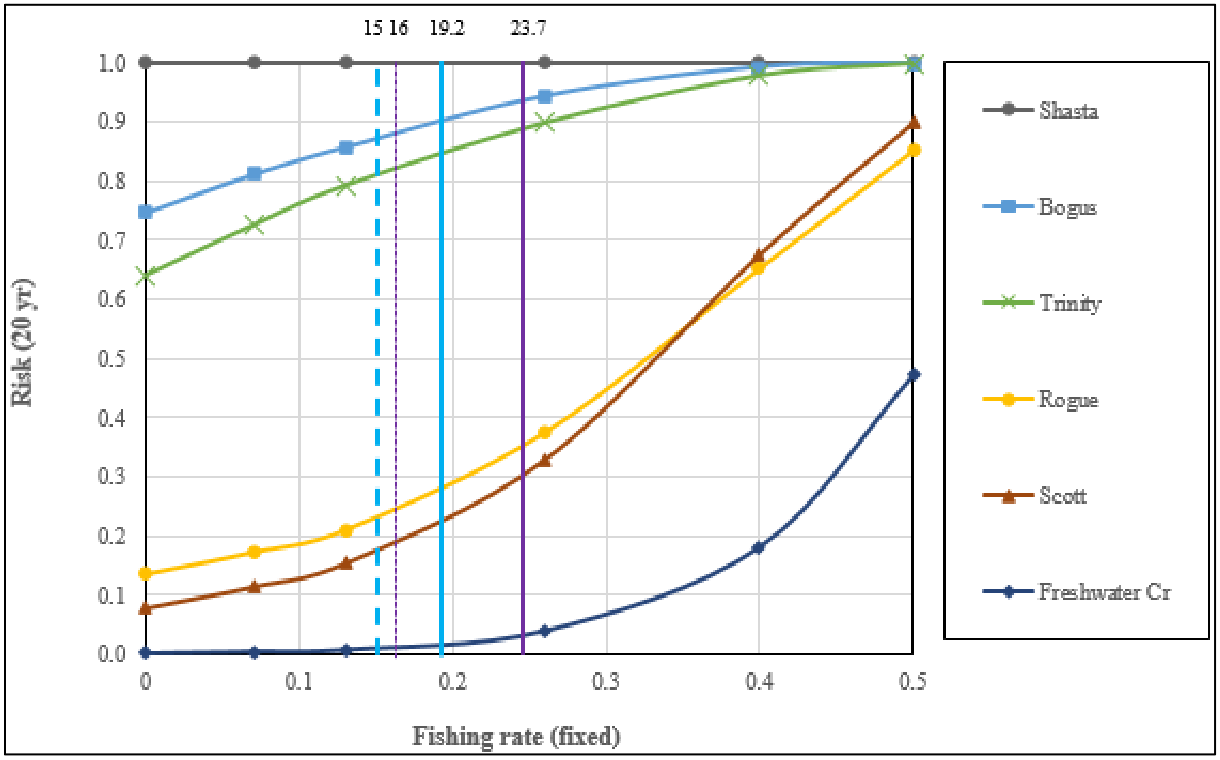

Figure 8. Modeled effects of fixed exploitation rates on risk over 20 years of falling below critical wild population abundance thresholds with dashed lines representing the proposed HCRs while solid lines represent a constant 13 percent ocean ER plus the observed annual historical freshwater ERs (reproduced from PFMC (2021d)).

While this examination and comparison has provided context for how the associated extinction risk probabilities to each population unit change with the proposed action, it is also useful to compare changes in expected escapement. Again, since the proposed action would establish total ER limits, and since we do not have Rogue River population unit freshwater ER components to add in, we therefore exclude it from this discussion.

Using the associated total average ERs we calculated in Table 15 we can convert these average ERs into escapements. Average total ERs for the Bogus, Scott, Shasta, Freshwater, and Trinity population units under the current consultation standard were approximately 19, 19, 19, 13 and 24 percent, respectively. These long-term average ER rates amount to escapements for the Bogus, Scott, Shasta, Freshwater, and Trinity population units respectively of 50, 560, 0, 380 and

590. This is at or below the CRT for both the Bogus and Shasta rivers populations (see above for each respective CRT value, or Table 4). The Scott River population unit at a 19 percent total average ER is above its CRT value, but would lose on average, 20 percent of its annual spawning escapement. The Freshwater Creek population unit at status quo expects to achieve an annual spawning escapement of 380, which is more than double its CRT value. The Trinity River population unit at an average ER is also above its CRT value, but would lose 50 percent of its annual spawning escapement on average.

Comparing these escapement values to the effects of the proposed action we reported earlier indicates that most populations would likely receive increased escapement as a result of implementing the proposed action as compared with the current consultation standard. Under a 15 percent ER limit, the Bogus Creek population unit escapement would increase from a 50 to a 60 fish annual escapement expectation (a positive increase of 14 percent), and exceed its CRT. The Scott River population unit under the same scenario would change from an expected escapement of 560 to 590 fish annual escapement expectation (positive increase of 16 percent). The Shasta River population unit would be unchanged. The Trinity River population aggregate receives the largest change, even though it would experience a higher total ER at 16 percent, instead of averaging an annual escapement of 590 fish it would increase to 790 fish annual escapement expectation (positive increase of 34 percent). The Freshwater Creek population unit could experience a decreased annual spawning escapement of 10 fish (a negative decrease of three percent) if fisheries were implemented in the freshwater terminal area. We infer that the Rogue River population unit would likely experience similar effects to that of the Freshwater Creek population unit.

In summary the overall effects of implementing the proposed action described in Section 1.3 by diversity strata under the 15 percent ER limit are:

- *Interior Klamath, Interior Trinity*
    - Viability risks represented by Bogus Creek, Shasta and Scott rivers population units of: Bogus Creek 87 percent, Shasta River 100 percent, Scott River 17 percent.
    - These viability risks when compared to a zero fishing scenario result in the following changes: increased risk to Bogus Creek by 12.4 percent, no change to the Shasta River population unit, and increased risk to Scott River by 9.1 percent. These increased risk effects are low.
    - The effects to escapement are compared with a zero fishing scenario, resulting in the following reduced percentage of each population's annual projected escapement (with the number of fish these changes represent from Table 13 in parenthesis): Bogus Creek -14 percent (10 fish), Shasta River -100 percent (10 fish), and Scott River -16 percent (110 fish). These reduced escapements are low.
    - Reduced average total ER from status quo for Bogus, Shasta, and Scott rivers population units of: 4.3, 4.2, 4.2 percent respectively. These reduced ERs are low.
    - Increased average annual escapement compared with status quo for Bogus, Shasta, and Scott rivers population units of (with the number of fish these changes represent from Table 13 in parenthesis): Bogus Creek +20 percent (10 fish), Shasta River no change, and Scott River +5 percent (30 fish). These increased average annual escapements are low.

- *Northern Coastal Basin, Interior Rogue, and Southern Coastal*
  - o Viability risks represented by Rogue River aggregate of 23 percent and Freshwater Creek of one percent.
  - o These viability risks when compared to a zero fishing scenario result in the following changes: increased risk to Rogue River by 9.9 percent and Freshwater Creek by 1.1 percent. These increased risk effects are low.
  - o The effects to escapement are compared with a zero fishing scenario, resulting in the following reduced percentage of each population's annual projected escapement (with the number of fish these changes represent from Table 13 in parenthesis): Rogue River aggregate -14 percent (780 fish), and Freshwater Creek -16 percent (70 fish). These reduced escapements are low.
  - o Increased average total ER from status quo for both Rogue River and Freshwater Creek by 2.0 ER. These increased risk effects are low.
  - o Decreased average annual escapement compared with status quo for Rogue River and Freshwater Creek population units of (with the number of fish these changes represent from Table 13 in parenthesis): Rogue River -two percent (110 fish), and Freshwater Creek –three percent (10 fish). These reduced escapements are low.

- *Southern Coastal Basin and Interior Eel*
  - o Information available for the remaining Southern Coastal Basin and Interior Eel strata, was insufficient to conduct the same risk assessment analysis that was done for other strata in the ESU. In order to be conservative, we assume the proposed action may have a similar effect on both of them as it does to the Interior Klamath or Interior Trinity strata.

The overall effects of implementing the proposed action described in Section 1.3 by diversity strata under the 16 percent ER limit are:

- *Interior Klamath, Interior Trinity (only diversity strata affected)*
  - o Viability risks represented by Trinity River aggregate are 82 percent.
  - o These viability risks when compared to a zero fishing scenario result in an increased risk of 18.6 percent. These increased risk effects are moderate.
  - o The effects to escapement when compared with a zero fishing scenario, result in the following reduced percentage of each population's annual projected escapement (with the number of fish these changes represent from Table 13 in parenthesis): Trinity River aggregate -34 percent (400 fish). These reduced escapements are moderate.
  - o Decreased average total ER from status quo for Trinity River aggregate by 7.7 ER. These decreased risk effects are low.
  - o Increased average annual escapement compared with status quo for Trinity River aggregate population unit of (with the number of fish these changes represent from Table 13 in parenthesis) +34 percent (200 fish). These increased escapements are moderate.

2.5.2. Effects on Critical Habitat

The effects of harvest activities from the proposed action on critical habitat PCEs would occur from boats in the EEZ, as the Council does not manage or regulate fishing in state or inland waters. The PCEs NMFS has determined the PCES that are essential for the conservation of SONCC coho are: freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, estuarine areas, nearshore marine areas, and offshore marine areas. The fishing gear used in the EEZ include hook-and-line and we cannot detect any disturbance to critical habitat in the EEZ from these activities. Removing adults in the ocean that would otherwise return to inland spawning areas, Council area harvest could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas. These effects are likely to be minor, and in some cases (as demonstrated in Section 2.5.1) such as the Bogus Creek, Shasta, and Trinity rivers population units, the proposed action would actually increase the annual expected spawning escapement from status quo conditions, thereby increasing the nutrient input slightly.

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).

Future tribal, state, and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives and fishing permits. Activities in the action area are primarily those conducted under state, tribal or federal government management. We expect these to include coastal and inland freshwater regulatory fishery actions that would adhere to ERs described in the Council's proposed HCRs. These actions may also include changes in ocean policy and increases and decreases in the types of activities currently seen in the action area, including changes in the types of fishing activities, resource extraction, and designation of marine protected areas, any of which could impact listed species or their habitat.

Inland areas will include non-Federal habitat and hydropower actions supported by state, and local agencies; tribes; environmental organizations; and private communities. Projects supported by these entities focus on improving general habitat and ecosystem function or species-specific conservation objectives. In Section 2.4.3 we reviewed types of these projects that have gone through ESA consultation. These projects address the protection of adequately functioning habitat, and the restoration of degraded fish habitat, including improvements to instream flows, water quality, fish passage and access, pollution reduction, and watershed or floodplain conditions that affect downstream habitat. These projects also support probable hydropower and irrigation improvement efforts that are likely to continue to improve fish survival through hydropower and water diversion systems. Significant actions and programs contributing to these benefits include growth management programs (planning and regulation); a variety of stream and riparian habitat projects; watershed planning and implementation; acquisition of water rights for instream purposes and sensitive areas; instream flow rules; stormwater and discharge regulation; hydraulic project permitting; and increased spill and bypass operations at hydropower facilities. NMFS determined that many of these actions would have positive effects on the viability (abundance, productivity, spatial structure, and/or diversity) of listed SONCC coho salmon populations and the functioning of PCEs in designated critical habitat. These activities are likely to have beneficial cumulative effects that will significantly improve conditions for coho salmon. While these activities occur outside the EEZ, and therefore outside the area where the Council has jurisdiction, but they still occur in the action area and would positively affect the future status of SONCC coho salmon. Government actions are subject to political, legislative and fiscal uncertainties. These realities, added to geographic scope of the action area which encompasses several government entities exercising various authorities, and the changing economies of the region, make any analysis of cumulative effects difficult and, speculative. Although state, tribal and local governments have developed plans and initiatives to benefit listed fish, they must be applied and sustained in a comprehensive way before NMFS can consider them “reasonably foreseeable” in its analysis of cumulative effects. However, for the purpose of this analysis, NMFS assumes that effects of future tribal, state or private activities in the action area will have a neutral or positive effect for the duration of this opinion.

Future tribal, state, and local government actions in the action area of the types described above are not likely to have an effect on climate change. However, if climate change reduces ocean productivity or seeding levels, it may require tribes, states, and local governments to consider actions to mitigate climate change 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.

First, in our review of the status of SONCC coho salmon we account for how climate change is expected to impact the ESU during all stages of their complex life cycle, described in Section 2.2.1. In addition to the effects of rising temperatures, other effects include alterations in stream flow patterns in freshwater and changes to food webs in freshwater, estuarine and marine habitats. There is high certainty that predicted physical and chemical changes will occur across the SONCC Coho Salmon ESU. However, the ability to predict bio-ecological changes to fish or food webs in response to these physical/chemical changes is extremely limited, particularly to different populations or among diversity strata, leading to considerable uncertainty. As we continue to deal with a changing climate, management actions may help further alleviate some of these potential adverse effects (e.g., hatcheries serving as a genetic reserve for natural populations).

Next, our understanding of the status of SONCC coho salmon has improved recently as a result of information assembled by the Council's Workgroup (PFMC 2021d). Recall the ESU is divided into seven diversity strata comprising 40 populations (Figure 1, Table 4) (NMFS 2014). The RA (PFMC 2021d) indicates available status information by diversity stratum is still very limited. The information is scarcest for the Interior Eel and Southern Coastal Basin strata, whereas population estimates exist for the Northern Coastal Basin, Central Coastal Basin, Interior Rogue, Interior Klamath, and Interior Trinity strata (Table 6). The distribution of SONCC coho salmon across the seven strata is reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which SONCC coho salmon are now absent (Williams et al. 2011, 2016). The ESU includes more robust populations (e.g., Scott River), but also smaller, less productive populations. Small and/or unproductive population units (e.g., Shasta River) are at high risk even without fishing as the number of spawners in these populations is already very low. None of the seven diversity strata appear to currently support a single viable population as defined by the viability criteria. However, from our review of all available data sources all diversity strata are currently occupied.

Section 2.2.2 indicates that the ESU's status has continued to decline over the last ten years (Figure 4), and that adult returns of naturally produced coho salmon within each diversity strata have been highly variable (represented by information from population units in parentheses): Northern Coastal and Interior Rogue (Rogue River), Southern Coastal (Freshwater Creek), Interior Trinity (Trinity River), Interior Klamath (Bogus Creek, Shasta and Scott rivers) (Table 6). Although long-term data for many populations are scarce, the available monitoring data indicate that some populations, such as those in the Interior Trinity strata (Trinity River), were still recently experiencing relatively high levels of hatchery origin fish on the spawning grounds (Table 8) that continue to affect VSP criteria in a negative manner (NMFS 2014). The RA noted that as with the previous viability assessment, the lack of increasing abundance trends across the ESU for most populations with adequate data are of concern and should be considered in the context of the relatively poor ocean, freshwater, and climate conditions experienced over the past 10 to 15 years as water year 2015 stands out as the warmest year on record, while water year 2018 is the second warmest year on record for California (PFMC 2021d). Newer information compiled for the RA (PFMC 2021d) since Williams et al. (2016) and taking into account information in the recovery plan indicates the ESU remains at moderate to high demographic risk. The information in the RA represents the best scientific information available for SONCC coho salmon.

The environmental baseline provides context for a broad range of past and present actions and activities that have affected SONCC coho salmon in the action area and contributed to their current status. These include harvest, hatchery, and habitat actions. Harvest mortality in fisheries has been reduced substantially in response to evolving conservation concerns (Figure 7, Table 10, and Table 11). The estimated ocean ER has been low and relatively stable since the early

1990s (average = 5.4 percent for years 1994–2019), which contrasts sharply with the much higher rates estimated for the 1980s and early 1990s. The recent 10 year average for all freshwater fisheries is similar to the long-term average (Table 11). In addition, actions taken in more recent years have reduced negative effects actions related to hatchery and habitat management previously posed on the ESU, which we review below.

Hatcheries were identified as a key limiting factor for SONCC coho salmon by the recovery plan (NMFS 2014). Recent baseline improvements, specifically within the Klamath and Trinity rivers, have begun to address this key limiting factor in Core populations (Table 7, Table 8). A HVTFD proposal to begin rearing coho salmon eyed eggs at the HVTH was approved by NMFS in 2022 (NMFS 2022) which would reseed Trinity River tributaries within the HVT reservation boundary with coho salmon to provide a harvest benefit while minimizing ecological and genetic impacts to SONCC coho salmon. With so few naturally spawning coho salmon returning to the lower Trinity River, the hatchery is expected to be beneficial to the Interior Trinity River diversity stratum in the short-term by increasing abundance and spatial structure. Productivity and diversity are also expected to increase in the short-term. Additionally, in the same stratum in 2020 NMFS approved the Trinity River coho salmon HGMP (U.S. Department of the Interior and CDFW 2017; NMFS 2020a). We expect the largest reduction from hatchery limiting effects and risk to come from this approved HGMP in the Interior Trinity River stratum. Our review of hatchery actions which NMFS has exempted from the take prohibition under its ESA 4(d) rule have improved the environmental baseline, which will result in increased productivity, capacity, diversity, fitness, and abundance of naturally produced coho salmon into the future, specifically in the Upper Trinity River coho salmon population (NMFS 2020a). We expect these increases to VSP criteria will begin to accrue over the next decade. Reductions in hatchery production and other reforms specifically designed to reduce the effects of straying are also consistent with the hatchery provisions of the recovery plan in particular and overall recovery strategy in general (NMFS 2014).

Habitat was also identified as a key limiting factor in the recovery plan (NMFS 2014). As discussed in Section 2.4.4 (Environmental Baseline, Habitat Actions), actions NMFS has evaluated and for which it has provided exemptions from the take prohibition under the ESA are expected to reduce limiting factor effects on habitat. Relative to status changes expected from developments in habitat improvement, in 2020, NMFS evaluated and provided exemptions from the take prohibition under the ESA for multiple restoration projects to be completed in the Trinity River Basin by Reclamation's TRRP (NMFS 2020b). The purpose of the TRRP is to mitigate impacts of the Trinity River Division of the CVP on anadromous fish populations in the Trinity River (U.S. Department of the Interior 2000). TRRP's ongoing restoration activities are designed to increase in-river salmon and steelhead production by reestablishing habitat forming processes and complex instream habitat for salmonids. In fiscal year 2020 Reclamation provided funding of $12.2 million to the TRRP (Trinity River Restoration Program 2021), allowing us to be certain that these activities will continue to occur for some time. The implementation of the TRRP is expected to have an overall long-term positive effect on salmonid habitat in the Trinity River (NMFS 2020b). Restored habitat resulting from restoration projects should improve adult spawning success, juvenile survival, and smolt outmigration, which will in turn lead to improved abundance, productivity, spatial structure, and diversity within each affected coho salmon population (NMFS 2020b). As individual population viability improves, the viability of the diversity strata and ESU will improve as well. While these activities have been ongoing, and are not solely focused on coho salmon restoration, they will still benefit coho salmon and will continue to do so into the future. While these efforts are reasonably certain to continue to occur, funding levels may vary on an annual basis. Completion of habitat restoration projects, as reviewed in Section 2.4.4, has occurred annually, albeit at sporadic intervals and scale, rather than consistent, evenly measured out intervals and scale. This pattern is likely due to funding variances and the time it takes to complete projects. The frequency, level of commitment, and interest in completing these projects indicates this pattern will continue.

Additionally related to habit improvements, since the 2016 status review, the John D. Dingell Jr. Conservation, Management, and Recreation Act (Public Law 116-9; 133 Stat. 580) added miles to various National Wild and Scenic Rivers systems (https://www.rivers.gov/rivers/elk.php) that provide protection for various SONCC coho salmon populations across the Northern Coastal Basin and Interior Rogue strata.

Summarizing changes to the environmental baseline, we expect that the VSP factors described in Section 2.2 will improve into the future due to the positive changes due to the implementation of HGMPs and habitat restoration actions in key watersheds within the ESU (NMFS 2020a). However, productivity and diversity are likely to remain poor for those populations that experience low abundances due to possible depensation effects until the anticipated benefits of these actions are realized.

The ER limits under the proposed action account for all harvest mortality in ocean and freshwater salmon fisheries. Council salmon fisheries would therefore be managed subject to the total ER limit while accounting for and coordinating with state and tribal fishery impacts. Therefore, the conclusions in this opinion focus on the overall effects of implementing the total ERs described in Section 1.3, in Council salmon fisheries as well as state and tribal managed fisheries. The proposed action will result in a reduction in natural origin spawners by an average of 15 percent compared to no harvest, except for the populations in the Trinity River aggregate which will experience an average reduction of 16 percent. Year-specific exploitation rates will vary, but are expected to be below these limits. The Workgroup's RA helps quantify the relative extinction risk these ER limits pose to six indicator population units representing five of the seven diversity strata (PFMC 2021d). These are the same strata we have data sets for in our review of the ESUs status. For the reasons discussed in the Section 2.5.1, NMFS evaluated the relative risk to each of the representative population units in the ESU based on a 20 year time horizon. Here it is useful to recall that the risk metric we adopted for our analysis from the RA is the probability of a population falling below a defined CRT in three consecutive years any time during the 20-year period (as this is the span of a single generation of coho salmon). We can then evaluate the risk to the ESU by examining the collective risk across the population units representative of the strata that comprise the ESU. Recall, because the proposed action is a maximum rate of allowable fishing impacts based on the forecasted annual abundance projected encounters of hatchery fish representing the ESU, it is not possible for us to know exactly how many fish will be impacted by the proposed action either on an annual basis or over the course of the implementation of the proposed action. Therefore, NMFS used estimates of fishery exploitation in this consultation as a proxy for assessing effects of the proposed action on the SONCC Coho Salmon ESU.

The effects of implementing the proposed action result in low to moderate increases in risk to the representative populations when compared to no fishing. For the populations under the 15 percent ER limit, viability risk by population unit is: Bogus Creek 87 percent, Shasta River 100 percent, Rogue River aggregate 23 percent, Scott River 17 percent, and Freshwater Creek one percent (Table 13). These viability risks when compared to a zero fishing scenario for each population unit change by: increased risk to Bogus Creek by 12.4 percent, to Rogue River by 9.9 percent, Scott River by 9.1 percent, Freshwater Creek by 1.1 percent, and no change to the Shasta River population unit which is already at very high risk without fishing (Table 13). The effects to escapement when compared with a zero fishing scenario result in the following changed percentage of each population's annual projected escapement: Bogus Creek decreases by 14 percent (10 fish), Shasta River decreases by 100 percent (10 fish), Rogue River aggregate decreases by 14 percent (780 fish), Scott River decreases by 16 percent (110 fish), and Freshwater Creek decreases by 16 percent (70 fish)(for the values these changes represent in escapement values see Table 13). Under a proposed 16 percent ER limit, the viability risk to the Trinity population unit is 82 percent or an increase in risk of 18.6 percent from a no fishing scenario, which reduces its annual projected escapement by 34 percent (400 fish)(Table 13).

Contextualizing these effects of the proposed action relative to current management is useful in determining change in risk to the survival and recovery of the ESU under the proposed action. As discussed above in Section 2.5.1, the analysis indicates a reduction in viability risk under the proposed action when compared to status quo management. When taking freshwater exploitation rates into account, total ERs under the status quo averaged 4.2 to 7.7 percent higher (long term average difference from Table 16) than the ERs under the proposed action for the Bogus Creek, Scott, Shasta, and Trinity rivers population units. Effectively, by adopting an ER that is inclusive of ocean and freshwater mortality at the described 15 and 16 percent limits, the viability risk under the proposed action is reduced for many of the population units when compared with the status quo by reducing the total ER they are exposed to by an average of 4.2 to 7.7 percent (Table 16) (i.e., under status quo conditions, the viability risk to the Trinity population unit is 100 percent in Table 13 (at a 24 percent ER, as calculated in Table 15), under the proposed action, it is 83 percent in Table 13, representing a reduction in risk of 17 percent). These reductions in extinction risk probabilities also result in increases in annual expected spawning escapements for these same populations. The positive changes in escapement (see Table 13, with increased numbers here in parenthesis) from status quo across the population units are: Bogus Creek +14 percent (10 additional fish), Shasta River unchanged, Trinity River aggregate +34 percent (200 additional fish), and Scott River +16 percent (30 additional fish). These positive effects occur to the weakest populations, as explained above.

The Rogue River aggregate population unit did not have past freshwater ER data available for us to compare the proposed ER limit of 15 percent with status quo. Given that the Freshwater Creek unit is the only other population unit in the same situation we use effects to it to infer our expectation for the Rogue River population unit. As explained above, since no freshwater exploitation currently occurs on the Freshwater Creek population unit the proposed action would allow for a static two percent ER increase on the population unit if freshwater fisheries were to occur in the future. We expect the proposed action would have a similar effect to that of Freshwater Creek on the Rogue population unit. However, as shown in Section 2.2.2 (Table 10) post season estimates of final ERs in Council salmon fisheries are much lower than 13 percent so additional increase in risk to either of these populations should freshwater fishery increase will likely be low to moderate.

In summary, the proposed action decreases risk when compared to the status quo on the weakest population units but increases risk on the more robust population units, the Freshwater and Rogue River. However, for these two population units while risk increases it still remains less than 10 percent change in risk from a zero fishing scenario (Figure 8, Table 13). The analysis also indicates that projected annual spawning escapements would increase over time except for the Freshwater Creek and Rogue River population units. Managing fishery impacts holistically, across the entire ESU, also provides greater certainty in total ER than managing these impacts for separate fisheries with limited coordination.

It is important to put the effects of the proposed actions in the context of the status of the populations across the ESU, their roles in recovery of the ESU, and the effects of reform and recovery related activities. For the population units with available data, each represents either a Core or Non-Core 1 population, meaning they are essential to the recovery of the ESU (Table 4). These populations are representative of five of the seven strata in the ESU. This provides us a representative view across diversity strata across the ESU on the effects of the proposed action. The data set includes more robust population units (Scott, Rogue, Freshwater Creek), but also smaller, less productive populations. Small and/or unproductive population units (e.g., Shasta, Bogus and Trinity) are at high risk even without fishing as the number of spawners in these populations is already very low. Whether or not these severely depleted populations can persist over the long term is largely dependent on factors other than fishing. More productive population units, such as Freshwater Creek, are not particularly sensitive to low rates of exploitation. This is a classic example of a *de minimis* fishery (PFMC 2021d) where low exploitation rates do not impact enough fish to produce a significant influence on long term viability. Population units of intermediate size and/or productivity (Rogue and Scott) are intermediate in their response.

Interior Klamath, Interior Trinity

The diversity strata represented by smaller and less productive population units are the Interior Trinity (Trinity River) and Interior Klamath (Bogus Creek, Shasta and Scott rivers). Since they are at higher risk, in general a proposed action that decreased risk relative to the status quo would be beneficial to these strata in particular. Our analysis indicates risk does decrease for the smallest populations when compared to the status quo. Both the Bogus Creek and Shasta River populations, which are populations so small that their ability to remain above their respective CRT is very low, receive a positive effect to VSP factors when compared to status quo.

Regarding changes in risk when compared to no-fishing, the increased viability risk to Bogus Creek population is 12.4 percent and average escapement is above its CRT in the 20 year modeled simulation under a 15 percent ER limit. As part of the Interior Klamath strata, for the Shasta River population there is no change in risk between a no-fishing fishing scenario and effects from the proposed action. The population is at very high risk regardless. The remaining two populations, the Scott and Trinity rivers units, experience the largest effect in this diversity strata from the proposed action, where we respectively expect a decrease in escapement of 16 percent (110 fish) and 34 percent (400 fish) compared to no-fishing. The effects from the proposed action still allow the Scott River, also a part of the Interior Klamath strata, to consistently remain above its CRT compared to a zero fishing scenario. Therefore, under the proposed action the increase in viability risk to this population is low (i.e., < a 10 percent change in risk from a zero fishing scenario), and compared to status quo conditions the Scott River would expect to experience an annual increase of 5 percent (30 fish) in escapement.

The Trinity River population unit is subject to a 16 percent ER limit and therefore at 18.6 percent change in risk relative to a zero fishing scenario. It represents the Interior Trinity strata, which benefits from a reduction in risk when the effects of the proposed action are compared with the status quo by an average reduction of 7.7 percent (Table 16). The analysis indicates the population unit would consistently be above its aggregated CRT and that annual escapement under the proposed action would be 34 percent (200 spawners) higher than under the status quo. While the change in risk from a zero fishing scenario is the largest among all the population units in our analysis, it is balanced with the population unit being above its aggregated CRT and by positive improvements in hatchery and habitat actions to address the largest threats identified in the recovery plan as described in the environmental baseline above.

Northern Coastal Basin, Interior Rogue, and Southern Coastal
The proposed action is expected to increase risks to the Northern Coastal and Interior Rogue and Southern Coastal strata compared to no fishing. Absent other population specific estimates we assume that the Rogue River and Freshwater Creek population units for which we have data are representative of these strata. These population units are two of the most abundant and productive population units for which we have data. These strata are less exposed to threats limiting recovery (e.g., hatcheries) than other strata in the ESU (Table 7). Our analysis of the effects of the action indicate that under a 15 percent ER limit both population units remain consistently above their CRTs. This indicates the increase in viability risk is low, i.e., less than a 10 percent change in risk from a zero fishing scenario (Table 13).

Southern Coastal Basin and Interior Eel
Information available for the remaining Southern Coastal Basin and Interior Eel strata, was insufficient to conduct the same risk assessment analysis that was done for other strata in the ESU. In order to be conservative, we assume the proposed action may have a similar effect on both of them as it does to the Interior Klamath or Interior Trinity strata. From the available information described in the status section, these populations are similarly very small and unproductive, and experience no freshwater fishing mortality. As described above, we therefore assume ocean fisheries would affect all populations equally. Given these assumptions and available information on the populations, is it reasonable to assume that the Shasta population unit would likely represent populations in these strata. However, we know they’ve not experienced the same level of key limiting factors associated with potential hatchery effects as either the Interior Klamath or Interior Trinity strata (Table 7), so even at inferred low abundance levels, we expect they may experience the same or slightly lower levels of risk than either the Interior Klamath or Interior Trinity strata.

Overall ESU
We have reviewed the effects of the action, which increase risk to viability compared to no fishing, but is relatively low for most populations. Where risk is higher (e.g., Rogue and

Freshwater Creek population units) the populations are more robust and the baseline and cumulative effects include improvements in habitat and hatchery practices (notably in the Trinity River population unit). We conclude the proposed action should not impede the long-term survival of any of the diversity strata in the SONCC coho ESU, and therefore of the ESU itself.

Our determination in this opinion is made in the context of a comprehensive recovery strategy that has been articulated through recovery planning, and is described in NMFS' SONCC coho salmon recovery plan (NMFS 2014) and the continuing development of new information over the last several years. The outlook for recovery given our review of the environmental baseline affecting the ESU is more optimistic at this time. While the status of the ESU indicates it is at moderate to high demographic risk, actions are in place to address primary threats for population units affected by the proposed actions. Improved hatchery practices should reduce the adverse effects of those programs. A new supplementation program is anticipated to reseed coho in areas previous occupied in the Trinity Basin (NMFS 2020a) (Table 7, Table 8) These actions are anticipated to improve productivity, abundance spatial structure and diversity. Actions are also being taken to address degraded habitat conditions through multiple restoration projects using appropriated funding for the Trinity and Klamath rivers. Increased wilderness area designations for multiple populations in other strata will retain habitat protections into the future. There is certainty that previously degraded or inaccessible habitats are being restored and aligned with hydropower and water diversion requirements, therefore ensuring benefits will continue to accrue into the future. While these reductions in key limiting factors is certain to occur, these positive developments will accrue slowly over time. The proposed action further reduces risk to the ESU on all strata from status quo conditions for all but the Northern Coastal and Interior Rogue (Rogue River) and Southern Coastal diversity strata and our analysis indicates that the overall risk to the representative populations in these strata remains low. Relative to the effects of the action on the current status and long term prospects for recovery for the ESU at this time, the effects of the proposed action on viability risk are low across all the diversity strata at the 15 percent limit. The 16 percent limit does moderately increase the viability risk compared to zero fishing for the Interior Klamath, Interior Trinity strata but the improvements to the environmental baseline provides a stabilizing effect to these strata, as represented by the Trinity River aggregate population unit. Therefore, the effects on viability risk from the proposed action across the diversity strata using the representative populations units when compared to no fishing are low, with only a few strata exposed to moderate risk where conditions for population VSP criteria are certain to improve. Therefore the proposed action will not appreciably reduce the ability of the ESU as a whole to recover. We have considered the effects of the proposed action together with the status of the species, the improving conditions in the environmental baseline, the cumulative effects. We acknowledge the effects of climate change are likely to adversely affect the status and environmental baseline of the ESU and there is uncertainty in the level of effects. However, we do not believe this alters our conclusions that the proposed action is not likely to reduce appreciably the likelihood of both survival and recovery of SONCC Coho Salmon ESU.

Regarding critical habitat, the proposed action would effect it by removing adults in the ocean that would otherwise return to inland spawning areas. This could affect water quality and forage for juveniles by decreasing the return of marine derived nutrients to spawning and rearing areas. These effects are likely to be a small negative effect and in some cases (as demonstrated in

Section 2.5.1) the proposed action would actually increase the annual expected spawning escapement from status quo conditions, thereby increasing the nutrient input slightly leading to positive effects on critical habitat. Therefore, as Section 2.5.2 analyzes, the proposed action will not result in the destruction or adverse modification of any of the essential features of designated critical habitat for the SONCC Coho Salmon ESU.

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 the SONCC Coho Salmon ESU 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 ITS.

2.9.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur. The proposed action of authorizing ocean salmon fisheries pursuant to the FMP, promulgation of regulations implementing the FMP, and the ER HCRs under the proposed action designed to protect SONCC coho salmon is likely to result in incidental take of this ESA-listed ESU.

NMFS anticipates incidental take of ESA-listed SONCC coho salmon to occur each year in Council salmon fisheries. Under the proposed action, Council salmon fisheries will be constrained to total ER HCRs for SONCC coho of (1) 16.0 percent for the Trinity population unit (Upper Trinity River, Lower Trinity River, South Fork Trinity River); and, (2) 15.0 percent for each of the remaining individual populations within the ESU as represented by the Rogue River, the Scott River, the Shasta River, Freshwater Creek and Bogus Creek. Hatchery coho salmon containing CWTs released within the Rogue and Klamath Rivers are used to represent SONCC coho salmon ocean distributions in the coho salmon FRAM. These ERs account for landed and non-landed mortality of adult SONCC coho salmon encountered in the Council fisheries. These ER limits account for all ocean and inland sources of fishery mortality on age-3 adult SONCC coho salmon, including landed and non-landed mortality. Because the annual ER will account for the catch in ocean salmon fisheries as well as catch in state and tribal fisheries, the actual ER, and therefore level of incidental take of SONCC coho, in the ocean salmon fisheries will be less than 15 percent or 16 percent. Coho salmon-directed fisheries and coho salmon retention in Chinook salmon-directed fisheries off of California will continue to be prohibited.

The ER for SONCC coho salmon will be estimated on an annual basis through the Council's preseason planning process and will also be confirmed post-season. During the preseason process, the Council will develop the annual management measures for the ocean salmon fisheries to not exceed the HCRs under the proposed action. Because annual abundance of SONCC coho salmon cannot be determined or estimated, we cannot quantify or directly measure the expected incidental take from the proposed action in numbers of fish. Therefore, we use the ERs, derived from representative hatchery fish, as a surrogate for the amount of expected incidental take from the proposed action. ERs are a valid take surrogate because they are directly related to the number of fish expected to be taken by the proposed action and can be monitored and assessed, therefore serving as a meaningful reinitiation trigger.

NMFS expects during its annual salmon preseason planning process, the Council will plan ocean salmon fisheries using the coho FRAM so that, when combined with state marine and freshwater ERs, the preseason projected total ER does not exceed the applicable HCR. The in-river ER population unit-specific ER inputs will be determined using projections provided by co-managing agencies. Postseason ERs for SONCC coho salmon will be estimated for each year once available postseason harvest and abundance estimates become available

Fisheries are planned preseason and managed consistent with the HCR limits. The distribution of harvest between ocean and in-river fisheries may vary from year-to-year so long as the total ER does not exceed the year specific total. Management error is such that it is reasonable to expect that postseason estimates of the ER could be either above or below the preseason limit. Our analysis accounted for management error that is inherent in fishery management. However, we expect that the deviations will be unbiased and on average consistent with the specified HCRs. Therefore the extent of take is exceeded if either (1) post season estimates of the total ERs exceed a HCR limit in two out of any three year period by five percentage points or more in each year, or (2) the total annual post-season ER exceeds the applicable HCR limit by any amount in three years within a 10 year period.

2.9.2. Effect of the Take

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

2.9.3. Reasonable and Prudent Measures

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

NMFS concludes that the following reasonable and prudent measures are necessary and appropriate to minimize the impacts to listed species from fisheries considered in this biological opinion:

1. NMFS, in cooperation with the Council, shall ensure in-season management actions taken during the course of fisheries must be consistent with the harvest objectives and other management measures established in accordance with the salmon FMP that were subject to review with this biological opinion.
2. NMFS, in cooperation with the Council, shall ensure harvest impacts on listed species are monitored on an annual basis using the best available measures. Although NMFS is the Federal agency responsible for ensuring that this reasonable and prudent measure is carried out, it is the states, tribes, Council, and U.S. Fish and Wildlife Service (USFWS) that conduct monitoring and reporting of catch and other data necessary to complete the analyses of impacts.
3. NMFS shall ensure that the Council provide reports to NMFS annually that document that the pre-season planning for annual salmon management measures includes managing the fisheries to the applicable SONCC coho salmon total ER HCR and that document the estimates of the total ER on SONCC coho on a post season basis.

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

   NMFS shall confer with the affected states and tribes, and the Council to account for the catch of the Council salmon fisheries throughout the season. If it becomes apparent inseason that the fisheries have changed in any way such that estimates of exploitation rates may exceed those specified in the Incidental Take Statement, then NMFS, in consultation with the Council, and states and tribes, shall take additional management measures to reduce the anticipated catch as needed to ensure the fisheries do not exceed the take surrogates.

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

2a. NMFS, in cooperation with the affected states and tribes, and the Council, shall monitor the implementation of the FMP, including the annual salmon management measures, to ensure that catch in the salmon fisheries is within the applicable HCR for SONCC coho. The purpose of the monitoring is to ensure full implementation of, and compliance with, management actions specified to control the Council fisheries. Catch monitoring programs must be stratified by gear, time, and management area.

2b. NMFS, in cooperation with the affected states and tribes, the Council, and USFWS, as appropriate, shall support efforts to ensure that surveys of spawning population data used as part of the risk analysis continues to be collected.

2c. NMFS, in cooperation with the affected states and tribes, the Council, as appropriate, shall support efforts to ensure that fisheries are sampled for stock composition, including the collection of coded-wire-tags (CWTs) in all applicable fisheries contributing to total ERs and other biological information, to allow for a thorough representative and statistically valid annual post-season analysis of fishery impacts on the SONCC Coho Salmon ESU, as appropriate.

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

3a. NMFS in collaboration with the Council, and affected states and tribes, shall generate a report on the work required to investigate whether the methods used to forecast ocean fishery exploitation rates for both hatchery and naturally produced SONCC coho salmon could be improved upon. This investigation should initially be focused on analyses that can be conducted using existing data. The investigation should also identify whether new methods could improve the forecasts of marine exploitation rates on SONCC coho salmon if additional data were available (e.g. genetic stock identification or CWT's and adipose fin clips on all hatchery fish), and present its report and findings to the Council at the September 2022 Council meeting. An evaluation of the work required to assess the potential bias in preseason versus postseason exploitation rates should be included in the report.

3b. NMFS, in cooperation with the affected states and tribes and the PFMC, as appropriate, must ensure that post-season total ERs for SONCC coho salmon are estimated and reported each year once postseason harvest and abundance estimates become available for all fisheries contributing to each total ER, which shall include ERs for the past 10 years. A postseason summary of the previous year's Council salmon fisheries shall be reported annually prior to the Council's March meeting.

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).

1. NMFS, in collaboration with the Council, states and tribes, should investigate forecasting methods for SONCC coho population or population aggregates as more data become available (e.g., use of hatchery proxies for forecasting), decisions are made about production (e.g., Trinity River Hatchery), or the effects of Klamath dam removal become known.
2. NMFS, in collaboration with the Council, states, and tribes, should continue to improve the quality of information gathered on marine survival and ocean rearing and migration patterns to improve the understanding of the utilization and importance of these areas to listed Pacific salmon.
3. NMFS, in collaboration with the Council, states and tribes should continue to investigate increases in monitoring including expansion of spawning ground surveys to aid the co-managers' ability to assess impacts to wild SONCC coho salmon, reducing some of the uncertainty reflected in the risk assessment.

Alternative methods used to generate preseason projections of freshwater impacts could be developed using methods that vary in complexity. Such methods should be documented, to the extent practicable, and agreed to among co-managers.

2.11. Reinitiation of Consultation

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."

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

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

This analysis is based, in part, on the EFH assessment provided by the NMFS and descriptions of EFH for Pacific coast groundfish (PFMC 2020), coastal pelagic species (PFMC 2021a), Pacific coast salmon (PFMC 2021b); and highly migratory species (PFMC 2018) contained in the fishery management plans developed by the Council and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

For this EFH consultation, the proposed action and action area (Figure 5) are described in detail above in Sections 1.3 and 2.3. The action area is the Pacific Coast EEZ (Figure 5), which is directly affected by the federal action, and the coastal and inland waters of the states of Washington, Oregon, and California. The estuarine and offshore marine waters are designated EFH for various life stages of Pacific Coast salmon, Pacific Coast groundfish, coastal pelagic species, and highly migratory species managed by the Council.

Pursuant to the MSA, the Council has designated EFH for six coastal pelagic species (PFMC 2021a), over 90 species of groundfish (PFMC 2020), 11 highly migratory species (PFMC 2018), and three species of federally-managed Pacific salmon: Chinook salmon (*O. tshawytscha*), coho salmon (*O. kisutch*), and Puget Sound pink salmon (*O. gorbuscha*) (PFMC 2014b; 2021b). The Council does not manage the fisheries for chum salmon (*O. keta*) or steelhead (*O. mykiss*). Therefore, EFH has not been designated for these species.

EFH for coastal pelagic species includes all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline where sea surface temperatures range between 10° C to 26° C (PFMC 2021a). The southern boundary is the United States-Mexico maritime boundary. The northern boundary is more dynamic, and is defined as the position of the 10°C isotherm, which varies seasonally and annually. The EFH designation for all species of krill extends the length of the West Coast from the shoreline to the 1,000 fm isobath and to a depth of 400 meters. A more detailed description and identification of EFH for coastal pelagic species is found in Appendix D of Amendment 8 to the Coastal Pelagic Species Fishery Management Plan (PFMC 1998).

EFH for groundfish includes all waters, substrates and associated biological communities from the mean higher high water line, or the upriver extent of saltwater intrusion in river mouths, seaward to the 3,500 m depth contour plus specified areas of interest such as seamounts (in depths greater than 3,500m). Additionally EFH for groundfish includes any areas designated as Habitat Areas of Particular Concern (HAPCs) not already identified by the previous criteria (PFMC 2020). A more detailed description and identification of EFH for groundfish is found in the most recent Pacific Coast Groundfish Fishery Management Plan (PFMC 2020).

EFH for highly migratory species ranges from vertical habitat within the upper ocean water column, from the surface to depths generally not exceeding 200 m, to vertical habitat within the mid-depth ocean water column (from depths between 200 and 1000 m). These range from coastal waters primarily over the continental shelf, generally over bottom depths equal to or less than 183 m to the open sea, beyond continental and insular shelves. For a more detailed description of EFH for each highly migratory species, see the most recent Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species (PFMC 2018).

Marine EFH for Chinook, coho and Puget Sound pink salmon in Washington, Oregon, and California includes all estuarine, nearshore and marine waters within the western boundary of the EEZ, 200 miles offshore. Freshwater EFH for Pacific salmon includes all those streams, lakes, ponds, wetlands, and other water bodies currently, or historically accessible to salmon in Washington, Oregon, Idaho, and California, except areas upstream of certain impassable man-made barriers, and longstanding, naturally-impassable barriers (i.e., natural waterfalls in existence for several hundred years). A more detailed description and identification of EFH for salmon is found in Appendix A to Amendment 18 to the Pacific Coast Salmon Plan (PFMC 2014b). Assessment of potential adverse effects to these species' EFH from the proposed action is based, in part, on this information.

The harvest-related activity of the proposed action considered in this consultation involves boats using hook-and-line gear. The use of hook-and-line gear affects the water column rather than estuarine and near shore substrate or deeper water, offshore habitats.

3.2. Adverse Effects on Essential Fish Habitat

The Council assessed the effects of fishing on salmon EFH, mostly in freshwater, and provided recommended conservation measures in Appendix A to Amendment 18 of the Pacific Coast Salmon Plan (PFMC 2014b). The Council identified five types of impact on EFH: 1) gear effects; 2) harvest of prey species by commercial fisheries; 3) removal of salmon carcasses; 4) redd or juvenile fish disturbance; and 5) fishing vessel operation on habitat.

Harvest related activities described in this opinion for intercepted salmon are accounted for explicitly in the ESA analyses regarding harvest related mortality. Changes to overall salmon fishing activities have decreased over the last decade. Therefore, any gear related effects have also been reduced over this time frame. Derelict gear effects occur in fishing activities managed under all four Pacific Coast FMPs, as well as recreational and commercial fishing activities not managed by the Council. However, the action considered in this opinion does not include commercial trawl nets, gillnets, long lines, purse seines, crab and lobster pots or recreational pots. These types of gear losses are those most commonly associated as having an effect on EFH. Hook-and-line gear is not placed into this category, and so long as the action continues to authorize fisheries using hook-and-line regulations, gear effects will not be present on EFH.

Prey species can be considered a component of EFH (NMFS 2010b). However, the action considered in this opinion is promulgation of fisheries targeting adult salmon, which are not considered prey for any of the remaining species managed under the other three Pacific coast FMPs. Furthermore, the salmon fisheries considered in this opinion have not documented interception of prey species for the adult species managed under the other three FMPs either.

The Council addresses the third type of possible EFH impact, the removal of salmon carcasses, by continuing to manage for maximum sustainable spawner escapement and implementation of management measures to prevent overfishing. The use of proper spawner escapement levels ensures Council Fisheries are returning a consistent level of marine-derived nutrients back to freshwater areas.

Fishing vessel operation will occur in the EEZ as a result of the action. Vessels can adversely affect EFH by affecting physical or chemical mechanisms. Physical effects can include physical contact with spawning gravel and redds (freshwater streams) and propeller wash in eelgrass beds (estuaries). Derelict, sunk, or abandoned vessels can cause physical damage to essentially any bottom habitat the vessel comes into contact with (PFMC 2011). Vessels operate in the EEZ as a result of implementing fisheries governed by any of the four FMPs, and for other non-fishing related activities. All of these operations provide potential for physical damage to any bottom habitat.

As discussed above the use of hook-and-line gear in the fisheries promulgated through the action in Section 1.3 of this opinion does not contribute to a decline in the values of estuarine and near shore substrate or deeper water, offshore habitats through gear effects. As adult salmon are not known prey species to the other species in the remaining three FMPs, prey removal is also not considered to have a discernable impact on EFH. Additionally the bounds of the action area are outside the bounds of freshwater EFH, therefore redd or juvenile fish disturbance will not result from the action in this opinion. Fishing vessel operation as a result of the action may result in physical damage to marine EFH. Generally fishing effort has fluctuated in recent years, with the exception of 2020 where it was lower than usual, but has remained much lower than the 1979-1990 average (PFMC 2021c). Both commercial and recreational fishing vessels fish for Chinook and coho salmon and the effort solely attributable to the action considered in this opinion is unknown. However, based on the gear type used and the total fishing effort, the effect on essential habitat features of the affected species from the action discussed in this biological opinion will be minimal, certainly not enough to contribute to a decline in the values of the habitat.

It is NMFS opinion that current Council actions address EFH protection, and no discernible adverse effects on EFH for species managed under the Coastal Pelagic Species Fishery Management Plan (PFMC 2021a), the Pacific Coast Groundfish Management Plan (PFMC 2020), the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species (PFMC 2018), and the Pacific Coast Salmon Plan (PFMC 2021b) will result from the proposed action considered in this biological opinion.

3.3. Essential Fish Habitat Conservation Recommendations

Pursuant to Section 305(b)(4)(A) of the MSA, NMFS is required to provide EFH conservation recommendations to Federal agencies regarding actions which may adversely affect EFH. However, because NMFS concludes that sufficient measures addressing possible EFH impact, as described above, have been made and adopted for the Council Fisheries and the proposed fisheries will not adversely affect the EFH, no additional conservation recommendations beyond those identified and already adopted are needed.

3.4. Statutory Response Requirement

Because there are no conservation recommendations, there are no statutory response requirements.

3.5. Supplemental Consultation

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are NOAA's NMFS, the Council, and its associated participating entities. Individual copies of this opinion were provided to the Council via electronic mail. 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.

4.2. Integrity

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

4.3. Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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