Refer to NMFS No: WCRO-2023-02811

November 18, 2024

Nathan Wiese
U.S. Fish and Wildlife Service
Lower Snake River Compensation Plan Coordinator
1387 S Vinnell Way, Suite 343
Boise, ID 83709

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Tucannon Spring Chinook Hatchery Salmon Alternative Release Strategy (Lower Columbia River release at Kalama Falls Fish Hatchery

Dear Mr. Weise:

Thank you for your July 22, 2022, letter requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Tucannon Spring Chinook Hatchery Salmon Alternative Release Strategy (Lower Columbia River release at Kalama Falls Fish Hatchery).

This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA and implementing regulations at 50 CFR 402. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action.

The enclosed biological opinion is based on our review of the U.S. Fish and Wildlife's proposed project and describes NMFS' analysis of potential effects on threatened Lower Columbia River Chinook salmon (*Oncorhynchus tshawytscha*), and their designated critical habitat in accordance with section 7 of the ESA. In the enclosed biological opinion, NMFS concludes the project is not likely to jeopardize the continued existence of Lower Columbia River Chinook salmon; nor is it likely to adversely modify critical habitat. However, NMFS anticipates that take of Lover Columbia River Chinook salmon may occur. Therefore, an incidental take statement is included with the enclosed opinion that includes terms and conditions that apply to this project and must be complied with in order for the Fish and Wildlife Service to be exempt from the prohibitions of section 9 of the ESA for any take that may occur as a consequence of the action described in this Opinion.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would not adversely affect the EFH of Chinook salmon. We have included the results of that review in Section 3 of this document.

Please contact Brett Farman of the Sustainable Fisheries Division in our Portland office at 503-231-6222 or brett.farman@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Ryan J. Wulff
Assistant Regional Administrator for Sustainable Fisheries

Enclosure

cc: Rod Engle (USFWS)
Greg Burak (USFWS)
Eric Kinne (WDFW)
Chis Donley (WDFW)
Becky Johnson (NPT)
Jen Krajcik (CTUIR)

bcc: CHRON File (pdf)
Division File copy

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

Tucannon Spring Chinook Hatchery Salmon Alternative Release Strategy
(Lower Columbia River release at Kalama Falls Fish Hatchery)

NMFS Consultation Number: WCRO-2023-02811

Action Agency: U.S. Fish and Wildlife (USFWS) through the Lower Snake River Compensation Plan (LSRCP)

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Lower Columbia River Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	No	No

Fishery Management Plan That Describes EFH in the Project Area	Does the Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	No	No

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

Issued By: ______________________________
FOR Jennifer Quan
Regional Administrator

Date: November 18, 2024

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1. INTRODUCTION

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

The long-term decline in the overall abundance of Tucannon River spring Chinook has generated a multitude of efforts to stop and reverse the decline by fishery managers and scientists within the Snake River basin. Efforts to improve freshwater habitat, improve hatchery rearing and release strategies, implement a captive brood program, and a myriad of other small program modifications have not resulted in measurable changes to the overall abundance of spring Chinook in the Tucannon River.

The Proposed Action—the Kalama releases of Tucannon River Chinook salmon—was developed to help improve fish survival compared to the historic poor returns of both natural and hatchery fish back to the Tucannon River so that both the natural population and program can be maintained. The operation of the original and underlying Tucannon Chinook Endemic hatchery program (collection, rearing, and release of Chinook salmon) will not change, and has already been covered under a prior opinion NMFS (2016)—thus that action and its effects are in the environmental baseline of this Opinion. This new program being evaluated here is a temporary safety net strategy to release a portion of the Tucannon production in a different location—the lower Kalama River—to try to improve return survival by collecting fish much further downstream. These releases at this downstream location would not otherwise affect or change the operations of the Tucannon Chinook Endemic hatchery program, and so would not change the effects of the program previously considered in NMFS (2016).

NMFS is consulting, pursuant to 50 CFR 223.203, on a proposal to release fish from the Tucannon River Endemic Chinook salmon program into the lower Kalama River. The recent limited number of adult returns to the Tucannon River and the Tucannon River hatchery means that almost no natural spawning has occurred upstream of the Tucannon Fish Hatchery weir in the past five years. In addition, the fish that return to the Tucannon River often experience high mortality in the river because of poor water quality. In some years, all fish returning to the Tucannon River are collected and held to reduce pre-spawn mortality before being returned to the river to spawn naturally. Poor returns and poor survival have made it increasingly difficult to maintain the program with diminishing numbers of adults available for spawning both in the wild and in the hatchery.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered

Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600. Because the action does not include construction or changes to any physical infrastructure we concluded that there are no adverse effects on EFH. Our analysis reaching this conclusion is documented in Section 3.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within 2 weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). A complete record of this consultation is on file at the NMFS Portland office.

1.2. Consultation History

A biological opinion was issued in June 24, 2016, on the effects of the Tucannon Hatchery Chinook Endemic program (NMFS 2016). This program is a continuing program, and that opinion remains in effect. As described below in Section 2.4, we consider that program and its opinion to be in the environmental baseline of this consultation. Because of a need to improve survival of fish released from this program and to increase their return numbers, it was determined that a subset of fish from this program would be released as smolts in the Kalama River, in the Lower Columbia River. This additional release is the sole topic of this opinion, and is summarized here and detailed below.

The 2016 ESA Section 7 consultation for the Tucannon Hatchery Chinook Endemic program (NMFS 2016) evaluated the effects of the hatchery program. The Tucannon Hatchery Chinook Endemic program is funded by the U.S. Fish and Wildlife Service (USFWS) through the Lower Snake River Compensation Plan (LSRCP) and operated by the Washington Department of Fish and Wildlife with support from the Nez Perce Tribe (NPT) and Confederated Tribes of the Umatilla Indian Reservation (CTUIR). Through the Tucannon Hatchery Chinook Endemic program, the comanagers rear and release Snake River spring/summer Chinook salmon into the Tucannon River. The hatchery program also includes infrastructure and monitoring which was considered and covered in the formal consultation and associated incidental take statement (ITS) (NMFS 2016).

Though the Tucannon Hatchery Chinook Endemic program has continued to operate as described in the original Hatchery Genetic Management Plan (HGMP) and consistent with the existing Biological Opinion, survival and return of fish from the program has been well below expectations, and made it difficult to

maintain a hatchery program while also allowing fish to spawn naturally in the wild. Many of the Tucannon fish (wild and hatchery) ascend Lower Granite Dam (two mainstem dams upstream from the mouth of the Tucannon River) beyond the Tucannon River or otherwise fail to return to the Tucannon River, where they can be captured to support the program. In recent years, returns have been so low that comanagers questioned whether removing fish to continue to attempt to provide a survival advantage with the
hatchery program was strategically better than allowing the few returning fish to spawn. The hatchery program is primary action available to increase abundance of the stock and avoid extirpation.

When fish were collected, fishery managers would transport and hold all or most of the returning adults at Lyons Ferry Hatchery (LFH) to safeguard against pre-spawn mortality because of poor water quality and high temperatures in the Tucannon River. Little or no natural spawning has occurred within the Tucannon River since 2019. The comanagers were concerned that multiple years of such low returns greatly increased the risk of extinction. While there have been occasional exceptions, natural returns of spring Chinook in the Tucannon River in recent years have usually been below an abundance that would maintain the population without intervention, increasing the risk of extinction.

Past and ongoing efforts to improve freshwater habitat, improve hatchery rearing and release strategies, implement a captive brood program, and near-constant adjustment of the program has not resulted in changes to the overall abundance of spring Chinook in the Tucannon River.

In an effort to increase smolt-to-adult return (SAR) and capture more returning adults, WDFW proposed releasing Tucannon Chinook salmon in the Lower Columbia River, well downstream of the Tucannon River, with the expectation that SAR would be better. Based on prior experience operating a similar program with fall Chinook salmon from the Kalama Falls Hatchery, WDFW proposed Kalama Falls Hatchery as a release location.

NMFS staff met and discussed the proposal with WDFW several times during the summer and fall of 2022. At that time, draft written proposals were shared for comment. After a few iterations of editing and responding to questions about the proposed action, WDFW provided a final HGMP for the Kalama releases of Tucannon River Chinook salmon on March 16, 2023—what we are calling here the “Kalama Release Program.” Consultation was initiated at that time. The proposed action evaluated here is the USFWS funding of the Kalama Release Program as described in the HGMP, which serves as the basis for this opinion’s analysis.

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

1.2.1. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (see 50 CFR 402.02).

Need for the Proposed Action

The Tucannon Chinook salmon adult returns have been at critically low levels (typically less than 150 adults annually) over the last 5 years (2019-2023). Many of the returning adults have been prioritized for broodstock in an attempt to maximize the number of juveniles that would be produced from the low number of returning adults. In addition, many of the returns have been strays from other areas, and juvenile survival through Lower Monumental Dam, the first mainstem dam encountered, has been low (about 50 percent) in recent years.

While the hatchery can help maintain the population in the short-term, efforts to improve freshwater habitat, improve hatchery rearing and release strategies, implement a captive brood program, and a myriad of other small modifications to the program have not resulted in measurable changes to the overall abundance of spring Chinook in the Tucannon River.

Within the Snake River Spring/Summer Chinook Salmon ESU, one of the major population group (MPG) designations is the Lower Snake, which consists of only two populations (Asotin Creek and the Tucannon River). Asotin Creek is considered functionally extirpated, leaving the Tucannon River the only population in the MPG, which substantially increases the risk of losing this MPG.

The comanagers have determined that immediate intervention is needed to reduce the risk of a catastrophic loss of the Tucannon River population. Increasing the number of fish available for natural spawning in the Tucannon River is the ultimate goal of this program.

Proposed Action Summary

The USFWS, through the Lower Snake River Compensation Plan (LSRCP), is proposing to fund a temporary intervention program (Kalama releases of Tucannon River Chinook salmon) that would take up to half, but no more than 100,000 smolts, of the existing 250,000 Tucannon Hatchery Chinook salmon Endemic program and release them downstream at the Kalama Falls Fish Hatchery (KFFH). The proposal is to release 50% of the total Tucannon Hatchery Chinook salmon Endemic program production, to a maximum release of 100,000 smolts, at KFFH. Transfer of juveniles to KFFH would occur in the fall to provide 3-5 months of acclimation at KFFH before release. All juveniles transferred downstream to KFFH will be considered part of the Kalama releases of Tucannon River Chinook salmon.

All Tucannon spring Chinook taken to KFFH will be 100% uniquely marked with a right maxillary clip to distinguish them from Kalama River Chinook Salmon when they return as adults in addition to the codded wire which all Tucannon spring Chinook juveniles in the program receive. None of the fish are adipose-fin clipped, which makes the combination of tags unique to the Tucannon Chinook released at KFFH. The selection of the maxillary clip mark is based on its clear visibility on a returning adult as these fish need to be quickly identified during sorting and during ongoing monitoring of the proposed action in the form of spawning ground surveys. A summary of production is provided in Table 1, below.

Table 1. Proposed annual release protocols from the Kalama releases of Tucannon River Chinook salmon and from the Proposed Action of releasing fish from Kalama Falls. AD=adipose fin clip; CWT = coded-wire tag; PIT = passive integrated transponder tag. LFH=Lyons Ferry Lyons Ferry Fish Hatchery; TFH=Tucannon Fish Hatchery; KFFH=Kalama Falls Fish Hatchery.

Program	Life Stage, Size and Number	Marking and Tagging[1]	Rearing Location	Acclimation Site; Duration	Release Location	Release Time
Kalama releases of Tucannon River Chinook salmon	Up to 100,000; 10-15 fish per pound*	No AD; 100% CWT; 100% right maxillary Clip	LFH/KFFH	KFFH; 3-5 months	KFFH	Late March-Early April

* The proposal is to release 50% of the total Tucannon production at KFFH, though the total number will be capped at 100,000 smolts.

The proposed action will initiate with adult collection in 2024 and continue for 12 years (approximately 3 full generations). The program will be monitored closely throughout operation to determine whether the Kalama releases provide a survival improvement that might maintain the program. Prior to the 12-year expiration in 2036, the program will be evaluated to determine if the program is succeeding. Based on the review, the program will either be terminated or modified and re-submitted for consultation depending on the success of supplementing the Tucannon population.

Initially, all broodstock will be collected in the Tucannon River. Broodstock collection at the Tucannon fish ladder and trap will occur as already described and covered under the initial consultation on the Tucannon Chinook salmon program (Section 10 Permit #18024) NMFS 2016. Fish collected at the trap for broodstock are (and will continue to be) transported to Lyons Ferry Hatchery for holding, spawning, incubation, and rearing through the pre-smolt stage (typically October/November each year). Smolts not released at Kalama will also continue to be released in the Tucannon River according to Section 10 Permit #18024.

After the first couple years of releases, some adults are expected to return to the Kalama River and broodstock will begin to be collected at the Kalama Falls Fish Hatchery and incorporated into the Tucannon broodstock. Adults collected at the Kalama trap will not be kept separate from brood collected from the Tucannon trap, and will be integrated into the program using the standard mating protocols for the Tucannon Endemic Chinook program. This strategy is intended to reduce the risk of localizing a stock to the Kalama River, and maintain the existing mating protocols consistent with preserving the Tucannon Endemic Chinook broodstock.

Tucannon-origin fish returning to the Kalama River, identified via the right maxillary clip, would be trapped at KFFH, sorted, and transported back to LFH for holding. Adults could then be used for broodstock if needed, or outplanted into the Tucannon River. Based on moderate smolt-to-adult survival from spring Chinook released from KFFH, we expect that around 500 adults could return on average to contribute to rebuilding efforts in the Tucannon River.

The KFFH adult trap operates 365 days/year, 24 hours, 7 days a week. Fish volitionally enter the trap via a step and pool ladder at KFFH. Adults are transferred from the trap via overhead brail into a 1,500-gallon tanker truck and moved to the sorting pond. See KFFH species-specific hatchery program HGMPs and the NOAA Biological Opinion {NMFS, 2007 #4344;NMFS, 2017 #8326} for further details of trap operations. The collection of Tucannon returns at the KFFH adult trap will occur concurrently with Kalama collections, and will not alter the operation of the trap in any way. Tucannon River returns will simply be identified and held separately during normal collection and sorting.

In the first few years of program implementation, the number of smolts released annually at KFFH is expected to be between 30,000-50,000 smolts, based on low broodstock collections expected at the Tucannon River trap as well as limited space at KFFH. If the program is successful in increasing survival, co-managers will try to increase the number of smolts to the 100,000 cap depending on funding and rearing space. During all phases of implementation, the program will monitor and assess risk to Lower Columbia River populations through straying into and potential spawning with Lower Columbia River populations.

Monitoring of program effectiveness is also part of the proposed action, and includes:

- Survival monitoring for adult returns
- Spawning ground surveys in both Tucannon River and Kalama River
- Genetic sampling (parental-based tagging) at adult collection facilities and on spawning grounds
- Evaluation of overall success of increasing broodstock returns and contributions to the Tucannon population

Ongoing monitoring associated with the Tucannon Endemic program will also continue as described and covered in the prior consultation. Such monitoring is in the environmental baseline of this consultation.

We considered, under the ESA, whether the proposed action would cause any other activities that may have an impact on listed species, and determined that it would not.

Under the MSA, "federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a federal agency (see 50 CFR 600.910).

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 Incidental Take Statement (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 of critical habitat for Lower Columbia River Chinook Salmon uses the term primary constituent elements (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 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 physical or biological features that are essential for the conservation of the species.

Table 2. Species Listing Information.

Species	ESU or DPS	Original Listing	Revised Listing	Current Classification
Chinook Salmon (*O. tshawytscha*)	Lower Columbia River Chinook Salmon	**FR Notice:** 64 FR 14308 **Date:** 3/24/1999 **Classification:** Threatened	**FR Notice:** 70 FR 37159 **Date:** 6/28/2005 **Re-classification:** Threatened	Threatened

"Species" Definition: The ESA of 1973, as amended, 16 U.S.C. 1531 *et seq.* defines "species" to include any "distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature." To identify DPSs of salmon species, NMFS follows the "Policy on Applying the Definition of Species under the ESA to Pacific Salmon" (56 FR 58612, November 20, 1991). Under this policy, a group of Pacific salmon is considered a DPS and hence a "species" under the ESA if it represents an evolutionarily significant unit (ESU) of the biological species. The group must satisfy two criteria to be considered an ESU:
(1) It must be substantially reproductively isolated from other con-specific population units.
(2) It must represent an important component in the evolutionary legacy of the species.

Physical or biological features essential for Lower Columbia Chinook salmon are listed below. These are often similar among listed salmon and steelhead; specific differences can be found in the critical habitat designation for each species.

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
(2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;

(3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;

(4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;

(5) Near-shore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels;

(6) Offshore marine areas with water-quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

For salmon and steelhead, NMFS categorized watersheds as high, medium, or low in terms of the conservation value that the watersheds provide to each listed species they support within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5). To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (i.e., spawning gravels, wood and water condition, side channels), the relationship of the specific geographic area being examined compared to other areas within the species' range, and the significance to the species of the population occupying that area (NMFS 2005a). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential because of factors such as limited availability (e.g., one of a very few spawning areas), a unique contribution to the population it served (e.g., for a population at the extreme end of geographic distribution), or the fact that it serves another important role besides providing habitat (e.g., obligate area for migration to upstream spawning areas).

2.2.1. Status of Listed Species

For Pacific salmon and steelhead, NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: abundance, productivity, spatial structure, and diversity (McElhany et al. 2000). These "viable salmonid population" (VSP) criteria therefore encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These parameters or attributes are substantially influenced by habitat and other environmental conditions.

“Abundance” refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment.

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

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

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

In describing the range-wide status of listed species, we rely on viability assessments and criteria in TRT documents and recovery plans, when available, that describe VSP parameters at the population, major population group (MPG), and species scales (i.e., salmon ESUs). For species with multiple populations, once the biological status of a species’ populations and MPGs have been determined, NMFS assesses the status of the entire species. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as meta-populations (McElhany et al. 2000).

2.2.2. Lower Columbia River Chinook Salmon ESU

On March 24, 1999, NMFS listed the LCR Chinook Salmon ESU as a threatened species (64 FR 14308). The threatened status was reaffirmed on April 14, 2014. Critical Habitat for LCR Chinook salmon was designated on September 2, 2005 (70 FR 52706).

The Lower Columbia River Chinook Salmon ESU includes all naturally spawned Chinook salmon originating from the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls. Not included in this ESU are: (1) Spring-run Chinook salmon originating from the Clackamas River; (2) fall-run Chinook salmon originating from Upper Columbia River bright hatchery stocks, that spawn in the mainstem Columbia River below Bonneville Dam, and in other tributaries upstream from the Sandy River to the Hood and White Salmon Rivers; (3) spring-run Chinook salmon originating from the Round Butte Hatchery (Deschutes River, Oregon) and spawning in the Hood River; (4) spring-run Chinook salmon originating from the Carson National Fish Hatchery and spawning in the Wind River; and (5) naturally spawned Chinook salmon originating from the Rogue River Fall Chinook Program. This ESU includes Chinook salmon from 19 artificial propagation programs (70 FR 37159, June 28, 2005; 85 FR 81822, December 17, 2020).

Within the geographic range of this ESU, 27 hatchery Chinook salmon programs are currently operational. Fourteen of these hatchery programs are included in the ESU, while the Mitchell Act-funded remaining 13 programs are excluded {Jones, 2015 #7628}. Willamette River Chinook salmon are listed within the Willamette River Chinook Salmon ESU, and may occupy some of the same space within the mainstem Lower Columbia River, but they are not included in the LCR Chinook Salmon ESU. Genetic resources that represent the ecological and genetic diversity of a species can reside in a hatchery program. "Hatchery programs with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU are considered part of the ESU and will be included in any listing of the ESU" {NMFS, 2005 #3183}. For a detailed description of how NMFS evaluates and determines whether to include hatchery fish in an ESU or DPS {NMFS, 2005 #3183}.

The ESU spans three distinct ecological regions: Coastal, Cascade, and Gorge (Figure 1). Myers {Myers, 2006 #3016} identified distinct life-histories (run and spawn timing) within ecological regions in this ESU as MPGs. In total, 32 historical demographically-independent populations (DIPs) were identified in the LCR Chinook Salmon ESU: 9 spring-run populations, 21 fall-run populations, and 2 late-fall run populations. The populations were organized into 6 MPGs based on run timing and ecological region.

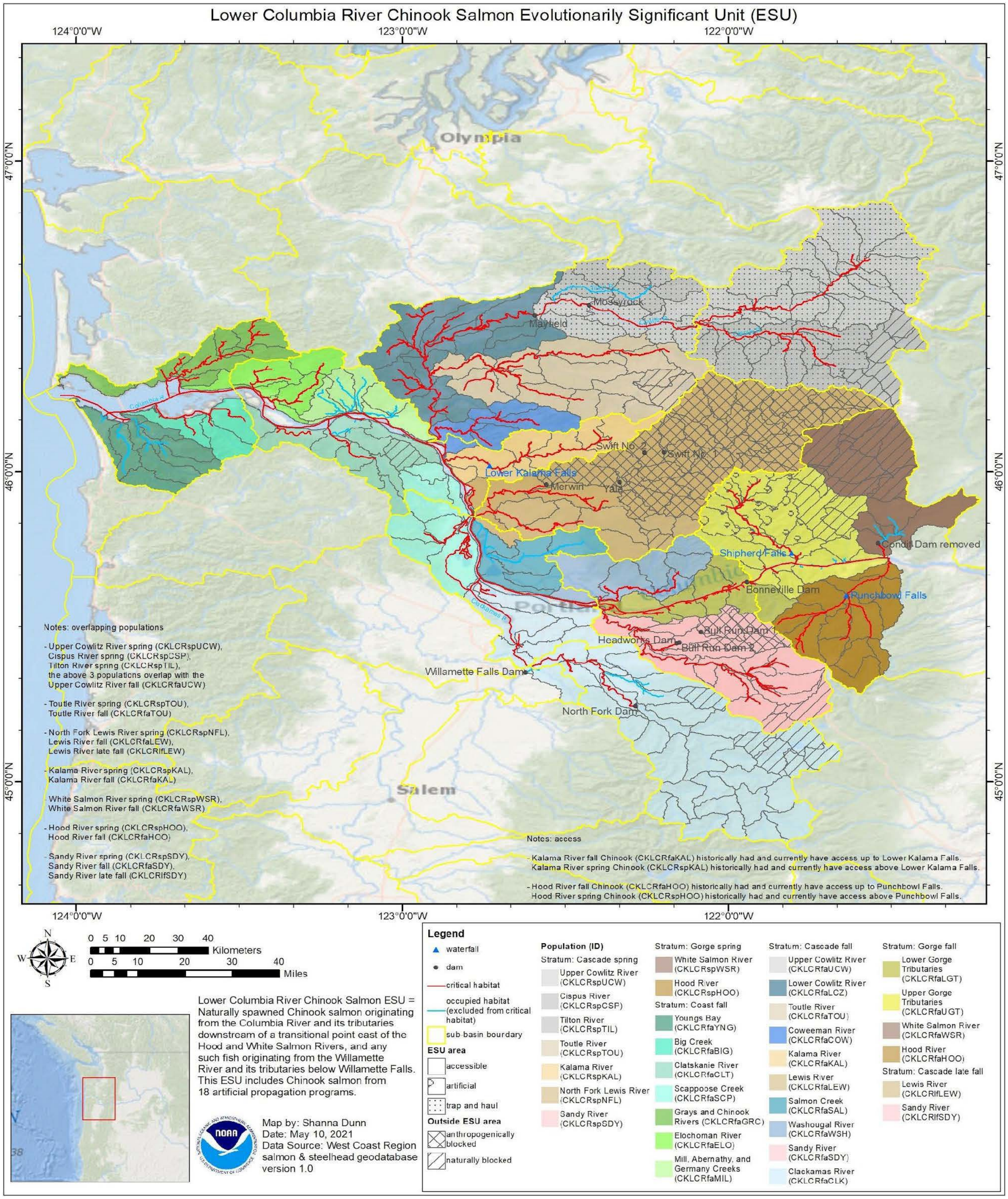
Lower Columbia River Chinook Salmon Evolutionarily Significant Unit (ESU)
124°0'0"W
123°0'0"W
122°0'0"W
47°0'0"N
46°0'0"N
45°0'0"N
Olympia
Salem
Portland
Mossyrock
Mayfield
Swift No. 2
Swift No. 1
Lower Kalama Falls
Merwin
Yale
Condit Dam removed
Shipherd Falls
Bonneville Dam
Punchbowl Falls
Bull Run Dam 1
Headworks Dam
Bull Run Dam 2
Willamette Falls Dam
North Fork Dam
Notes: overlapping populations
- Upper Cowlitz River spring (CKLCRspUCW), Cispus River spring (CKLCRspCSP), Tilton River spring (CKLCRspTIL), the above 3 populations overlap with the Upper Cowlitz River fall (CKLCRfaUCW)
- Toutle River spring (CKLCRspTOU), Toutle River fall (CKLCRfaTOU)
- North Fork Lewis River spring (CKLCRspNFL), Lewis River fall (CKLCRfaLEW), Lewis River late fall (CKLCRlfLEW)
- Kalama River spring (CKLCRspKAL), Kalama River fall (CKLCRfaKAL)
- White Salmon River spring (CKLCRspWSR), White Salmon River fall (CKLCRfaWSR)
- Hood River spring (CKLCRspHOO), Hood River fall (CKLCRfaHOO)
- Sandy River spring (CKLCRspSDY), Sandy River fall (CKLCRfaSDY), Sandy River late fall (CKLCRlfSDY)
Notes: access
- Kalama River fall Chinook (CKLCRfaKAL) historically had and currently have access up to Lower Kalama Falls. Kalama River spring Chinook (CKLCRspKAL) historically had and currently have access above Lower Kalama Falls.
- Hood River fall Chinook (CKLCRfaHOO) historically had and currently have access up to Punchbowl Falls. Hood River spring Chinook (CKLCRspHOO) historically had and currently have access above Punchbowl Falls.
N
S
E
W
0 5 10 20 30 40 Kilometers
0 5 10 20 30 40 Miles
Lower Columbia River Chinook Salmon ESU = Naturally spawned Chinook salmon originating from the Columbia River and its tributaries downstream of a transitional point east of the Hood and White Salmon Rivers, and any such fish originating from the Willamette River and its tributaries below Willamette Falls. This ESU includes Chinook salmon from 18 artificial propagation programs.
Map by: Shanna Dunn
Date: May 10, 2021
Data Source: West Coast Region salmon & steelhead geodatabase version 1.0
Legend
waterfall
dam
critical habitat
occupied habitat (excluded from critical habitat)
sub-basin bourdary
ESU area
accessible
artificial
trap and haul
Outside ESU area
anthropogenically blocked
naturally blocked
Population (ID)
Stratum: Cascade spring
Upper Cowlitz River (CKLCRspUCW)
Cispus River (CKLCRspCSP)
Tilton River (CKLCRspTIL)
Toutle River (CKLCRspTOU)
Kalama River (CKLCRspKAL)
North Fork Lewis River (CKLCRspNFL)
Sandy River (CKLCRspSDY)
Stratum: Gorge spring
White Salmon River (CKLCRspWSR)
Hood River (CKLCRspHOO)
Stratum: Coast fall
Youngs Bay (CKLCRfaYNG)
Big Creek (CKLCRfaBIG)
Clatskanie River (CKLCRfaCLT)
Scappoose Creek (CKLCRfaSCP)
Grays and Chinook Rivers (CKLCRfaGRC)
Elochoman River (CKLCRfaELO)
Mill, Abernathy, and Germany Creeks (CKLCRfaMIL)
Stratum: Cascade fall
Upper Cowlitz River (CKLCRfaUCW)
Lower Cowlitz River (CKLCRfaLCZ)
Toutle River (CKLCRfaTOU)
Coweeman River (CKLCRfaCOW)
Kalama River (CKLCRfaKAL)
Lewis River (CKLCRfaLEW)
Salmon Creek (CKLCRfaSAL)
Washougal River (CKLCRfaWSH)
Sandy River (CKLCRfaSDY)
Clackamas River (CKLCRfaCLK)
Stratum: Gorge fall
Lower Gorge Tributaries (CKLCRfaLGT)
Upper Gorge Tributaries (CKLCRfaUGT)
White Salmon River (CKLCRfaWSR)
Hood River (CKLCRfaHOO)
Stratum: Cascade late fall
Lewis River (CKLCRlfLEW)
Sandy River (CKLCRlfSDY)

Figure 1. LCR Chinook Salmon ESU population structure.

Figure 1 generally shows the accessible and historically accessible areas for the Lower Columbia River Chinook Salmon ESU. The area displayed is consistent with the regulatory description of the composition of the Lower Columbia River Chinook salmon found at 50 CFR17.11, 223.102, and 224.102. Actions outside the boundaries shown can affect this ESU. Therefore, these boundaries do not delimit the entire area that could warrant consideration in recovery planning or determining if an action may affect this ESU for the purposes of the ESA.

Updated Biological Risk Summary

Overall, there has been modest change since the last review of the biological status of Chinook salmon populations in the Lower Columbia River ESU (Ford 2022), although some populations did exhibit marked improvements. Increases in abundance were noted in about half of the fall-run populations and 75% of the spring-run population for which data were available. Decreases in hatchery contribution were also noted for several populations. Relative to baseline VSP levels identified in the Recovery Plan {NMFS, 2013 #3306}. there has been an overall improvement in the status of a number of fall-run populations, although most are still far from the recovery plan goals.

The biological status relative to the recovery goals show that of the 32 DIPs in this ESU, 7 of 32 populations are at or near the recovery viability goals set in the recovery plan {NMFS, 2013 #3306}. The 7 DIPs included: 1 spring-run, 5 fall-run, and 1 late-fall-run DIP. Furthermore, 6 of the 7 DIPs were located in the Cascade Strata, with most of the populations in the Coastal and Gorge Strata doing rather poorly. Most of the remaining populations still require substantial improvements in abundance to reach their viability goals. The estimated proportion of hatchery-origin spawners was well in excess of the limits set in the recovery plan for many of the primary populations {NMFS, 2013 #3306}. Of greater concern was the large number of DIPs (10) that either had no abundance information (presumed near zero) or exist at very low abundances. All of the Coastal and Gorge MPG fall-run populations (except the Lower Gorge DIP) likely fell within the high to very-high risk categories. Similarly, with the exception of the Sandy River spring-run DIP, all of the spring-run DIPs in the Cascade and Gorge MPGs are at high to very high risk categories, with a number of populations at or near zero, while others may only persist through hatchery supplementation. The Cascade fall-run MPG contains a number of populations above or near their recovery goals, while the Cascade late-fall MPG may be near viability although, there is some uncertainty in the abundance estimates for the Sandy-River late-fall DIP.

Improved fall-run status reflects both changes in biological status and improved monitoring. Spring-run Chinook populations in this ESU are generally unchanged; most of the populations are at a high or very high risk due to low abundances and the high proportion of hatchery-origin fish spawning naturally. In contrast, the spring-run Chinook salmon DIP in the Sandy River has a 5-year average of 3,359, nearly double the previous five-year average. This appears to be due, in part, to the removal of Marmot Dam (eliminating migration delays and passage injuries) and the diversion dam on the Little Sandy River (restoring access and flow to historical habitat). Elsewhere in the ESU, many of the spring-run populations rely upon passage programs at high head dams and downstream juvenile collection efficiencies are still too low to maintain self-sustaining natural runs. Limited numbers of naturally-produced spring run fish return to the Cowlitz and Cispus Rivers (no spring-run fish are transported into the Tilton River Basin), and the status of spring-run Chinook salmon in the Toutle River Basin remains unclear. The removal of Condit Dam on the White Salmon River has provided an opportunity for the reestablishment of naturally-spawning fall and spring-run populations with volitional access to historical spawning grounds. The status of spring-run Chinook salmon in the Hood River is unclear; with the removal of Powerdale Dam, there is minimal monitoring in the basin and the abundance and genetic composition of returning spring-run Chinook salmon is unknown. It remains to be determined if any native spring-run Chinook salmon remain, or if they have been supplanted by Deschutes River (Middle Columbia River Spring Run Chinook Salmon ESU).

Many of the populations in this ESU remain at high risk, with low natural-origin abundance levels. Hatchery contributions remain high for a number of populations, and it is likely that many returning unmarked adults are the progeny of hatchery-origin parents, especially where large hatchery programs operate. While overall hatchery production has been reduced slightly, hatchery-produced fish still represent a majority of fish returning to the ESU. The continued release of out-of-ESU stocks, including Upriver Bright fall run, Rogue River (SAB) fall run, Upper Willamette River spring run, Carson Hatchery spring run, and Deschutes River spring run, remains a concern. Harvest rates are a potential concern, especially for low abundance tule fall-run populations. There have been a number of notable efforts to restore migratory access to areas upstream of dams, until efforts to improve juvenile passage systems bear fruition, it is unlikely that there will be significant improvements in the status of many spring-run populations. Alternatively, dam removals (Condit Dam, Marmot Dam, and Powerdale Dam) not only improve/provide access but allow the restoration of hydrological processes that may improve downstream habitat conditions. Continued land development and habitat degradation in combination with the potential effects of climate change may present a continuing strong negative influence into the foreseeable future. Finally, although many of the populations in this ESU are at high risk, it is important to note the poor ocean and freshwater conditions existed during the 2015-2019 period and despite these conditions the status of a number of populations improved, some remarkably so (Grays River, Lower Cowlitz River, and Kalama River fall runs). Overall, we conclude that the viability of the Lower Columbia River Chinook Salmon ESU has increased somewhat since the last 5-year review, although the ESU remains at moderate risk of extinction {Ford, 2022 #8327}.

Within the Cascade MPGs, of the 17 Chinook populations, 6 are at less than 10 percent of target abundance and 6 are exceeding their full target abundance. Throughout the range of the LCR Chinook Salmon ESU channel complexity, side channel and floodplain connectivity, water quality and quantity, and riparian cover remain in poor condition. There is need for habitat restoration or protection throughout the range of these species. Additional habitat protection and restoration actions are necessary to bring this ESU to viable status.

LCR Chinook salmon include three distinct life-history components: spring-run Chinook salmon, tule fall-run Chinook salmon, and late fall-run Chinook salmon {Ford, 2022 #8327}. These different components are subject to different in-river fisheries because of differences in river entry timing but share similar ocean distributions.

- Harvest of fall-run Chinook salmon between 2015 and 2019 has seen a modest increase from the decreasing trend observed from 2005 through 2012 of 30 and 40 percent harvest rates on the ESU {TAC, 2017 #9225}{TAC, 2018 #9226}{TAC, 2019 #9227}{TAC, 2020 #9228}. As part of this approach, NMFS adopted in its biological opinion an assessment of the performance of the ABM matrix every three years as a check on projected results and any changes in key presumptions. The latest performance review for Chinook salmon was completed in 2019 {NMFS, 2019 #8886} concluding new escapement information gathered over the last four or five years shows no substantive changes in abundance or hatchery fractions that are inconsistent with previous trends, and when more data points allow for a more comprehensive review, the estimates of exploitation rates from fishery models should be compared to independent exploitation rate estimates derived from coded-wire tag groups.
- Harvest of late fall-run Chinook salmon also dropped to 20 to 25 percent in the mid-1990s but has been increasing since. In the period from 2015 to 2019, harvest rates of late fall-run Chinook salmon increased, equivalent to the harvest rates between 1985 and 1990 {TAC, 2017 #9225}{TAC, 2018 #9226}{TAC, 2019 #9227}{TAC, 2020 #9228}. These rates for late fall-run Chinook salmon (North Fork Lewis and Sandy populations) are now based on the escapement of natural-origin fish, ensuring that there are sufficient numbers of adults on the spawning grounds.

Cascade MPG

There are ten populations in the Cascade MPG. Of these, only the Coweeman and East Fork Lewis are considered genetic legacy populations. The baseline persistence probability of all of these populations is very low. These determinations were generally based on assessments of status at the time of listing. Lower Cowlitz, Kalama, Clackamas, and Sandy populations are targeted for medium persistence probability and Toutle, Coweeman, Lewis, and Washougal populations are targeted for high-plus persistence probability in the recovery scenario. The target persistence probability for the other two populations is very low: Salmon Creek, a population within a highly urbanized subbasin with limited habitat recovery potential, and Upper Cowlitz, a population with reintroduction of spring Chinook salmon as the main recovery effort (NMFS 2013b).

Total escapements to the Coweeman and East Fork Lewis remain below their recovery abundance targets of 900 and 1,500 (Ford 2022). The historical contribution of hatchery spawners to the Coweeman and East Fork Lewis populations is relatively low compared to that of other populations because the remaining populations are substantially affected by hatchery strays (Beamesderfer et al. 2011). The Kalama, Washougal, Toutle, and Lower Cowlitz populations are all associated with important in-basin hatchery production and are subject to large numbers of hatchery strays (Beamesderfer et al. 2011).

The Coweeman and Lewis populations do not have in-basin hatchery programs and are generally subject to less straying. Broodstock management practices for hatcheries are being revised to reduce the effects of hatchery-origin fish straying. Weirs are being operated on the Kalama River to assist with brood stock management, and on the Coweeman and Washougal Rivers to further assess and control hatchery straying in each system. These are examples of actions the states have taken as part of a comprehensive program of hatchery reform to address the effects of hatcheries. The nature and scale of the reform actions were described in more detail in Frazier (2011) and Stahl (2011).

Cascade Late Fall MPG

There are two late fall, “bright” Chinook salmon populations in the LCR Chinook ESU in the Sandy and Lewis Rivers. Both populations are in the Cascade MPG. The baseline persistence probability of the Lewis and Sandy populations are very high and high, respectively; both populations are targeted for very high persistence probability under the recovery scenario. The Sandy River population is outside of the action area of this consultation.

The Lewis River population is the principal indicator stock for management within the Cascade Late Fall MPG. It is a natural-origin population with little or no hatchery influence. The escapement goal, based on estimates of maximum sustained yield (MSY), is 5,700. The escapement has averaged 9,000 over the last ten years and has generally exceeded the goal by a wide margin since at least 1980. Escapement was below goal from 2006 through 2008 (Table 3). The shortfall is consistent with a pattern of low escapements for other far-north migrating stocks in the region and can likely be attributed to poor ocean conditions. Escapement improved in 2009 and has been well above goal since (Table 3). NMFS (2013b) identifies an abundance target under the recovery scenario of 7,300, which is 1,600 more fish than the currently managed for escapement goal. The recovery target abundance is estimated from population viability simulations and is assessed as a median abundance over any successive 12-year period. The median escapement over the last 12 years is 8,750, therefore exceeding the abundance objective (Table 3). Escapement to the Lewis River is expected to vary from year-to-year as it has in the past, but generally remain high relative to the population’s escapement objectives, which suggests that the population is near capacity (NWFSC 2016).

Table 3. Annual escapement of LCR Chinook natural-origin salmon populations from 2013-2023 in the Lewis River.

Year	*Escapement*		*Year*	*Escapement*
2012	*8,143*		*2018*	*4,671*
2013	*17,022*		*2019*	*11,568*
2014	*20,489*		*2020*	*25,664*
2015	*18,635*		*2021*	*12,675*
2016	*9,311*		*2022*	*6,847*
2017	*7,149*		*2023*	*7,628*

[1] Online at: https://fortress.wa.gov/dfw/score/score/species/population_details.jsp?stockId=1620 * Date Accessed: 10/03/2024

2.2.3. Status of Critical Habitat

This section of the opinion examines the range-wide status of designated critical habitat for Lower Columbia River Chinook salmon. NMFS has reviewed the status of critical habitat affected by the proposed action. The action area (defined in Section 2.3, Action Area), contains critical habitat designated for Lower Columbia River Chinook salmon, and includes the stream channels within designated stream reaches and a lateral extent, as defined by the ordinary high-water line (33 CFR 319.11).

We review the status of designated critical habitat affected by the proposed action by examining the condition and trends of essential physical and biological features throughout the range of the action area. Examining these physical and biological features is important because these features support one or more of the species' life stages (e.g., sites with conditions that support spawning, rearing, migration, and foraging) and are essential to the conservation of the listed species.

For salmon and steelhead, NMFS categorized watersheds as high, medium, or low in terms of the conservation value that the watersheds provide to each listed species they support[1] within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5). To determine the conservation value of each watershed to species viability, NMFS' critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (i.e., spawning gravels, wood and water condition,

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[1] The conservation value of a site depends upon: "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" (NMFS 2005b).

side channels), the relationship of the specific geographic area being examined compared to other areas within the species' range, and the significance to the species of the population occupying that area {NMFS, 2005 #3183}. Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential because of factors such as limited availability (e.g., one of a very few spawning areas), a unique contribution to the population it served (e.g., for a population at the extreme end of geographic distribution), or the fact that it serves another important role besides providing habitat (e.g., obligate area for migration to upstream spawning areas).

A summary of the status of critical habitat for Lower Columbia River Chinook salmon is included in Table 4 below.

Table 4. Critical habitat, designation date, federal register citation, and status summary for critical habitat Lower Columbia River Chinook salmon.

Species	**Designation Date and Federal Register Number**	**Critical Habitat Summary**
09/02/2005 70 FR 52630	09/02/2005 70 FR 52630	Critical habitat encompasses 10 subbasins in Oregon and Washington containing 47 occupied watersheds, as well as the lower Columbia River rearing/migration corridor. Most HUC5 watersheds with PBFs for salmon are in fair-to-poor or fair-to-good condition {NMFS, 2005 #3183}. However, most of these watersheds have some, or high potential for improvement. We rated conservation value of HUC5 watersheds as high for 30.

Land management activities have severely degraded stream habitat conditions in most Lower Columbia River subbasins. Logging, agriculture, urbanization, and gravel mining in the Cascade and Coast Ranges have contributed to increased erosion and sediment loads throughout the Lower Columbia River {NMFS, 2016 #3346}. Therefore, the watersheds in the action area have potential for improvement.

On the mainstem of the Columbia River, hydropower projects have significantly degraded salmon and steelhead habitats. The series of dams and reservoirs that make up the Federal Columbia River Power System (FCRPS) block an estimated 12 million cubic yards of debris and sediment that would otherwise naturally flow down the Columbia River and replenish shorelines along the Washington and Oregon coasts. The Columbia River estuary has lost a significant amount of the tidal marsh and tidal swamp habitats that are critical to juvenile salmon and steelhead, particularly small or ocean-type species, as a result of the FCRPS modifications to these mainstem river processes. Furthermore, habitat and food-web changes within the estuary, and other factors affecting salmon population structure and life histories, have altered the estuary's capacity to support juvenile salmon {NMFS, 2016 #3346}.

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 includes the entire Kalama River basin where Tucannon River Chinook salmon will be released as juveniles and return as adults. In addition, also includes the Cowlitz River basin and Lewis River basin because some adults are likely to stray into these basins when they return from the ocean. The action area also includes the mainstem Columbia River from the mouth up to the confluence of the Lewis River, where Tucannon Chinook may migrate on their way to and from the Kalama River release location.

The effects of the Proposed Action on Southern Resident Killer Whales (SRKW) was not considered, because there will be no change in the targeted total production of Chinook salmon for the Kalama releases of Tucannon River Chinook salmon. The action only changes the release and collection locations to increase survival back to the program, and therefore there no measurable change in prey species availability is expected. While the intent of lower Columbia River releases is to increase survival to adulthood, and thus survival in the ocean, the increase in survival is expected to result in only a few hundred extra adults. While this is a meaningful change in broodstock availability for the program, when considering releases throughout the Columbia River basin, the small contribution of a few hundred adults in the Pacific Ocean is unlikely to make any difference in prey availability for SRKW.

2.4. Environmental Baseline

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

2.4.1. Habitat and Hydropower

Habitat

A discussion of the baseline condition of habitat and hydropower throughout the Columbia River Basin occurs in our Biological Opinion on the Mitchell Act Hatchery programs (NMFS 2017b). Here we summarize some of the key impacts on salmon habitat, primarily in the Lower Columbia River Basin because it encompasses the Action Area for this Opinion; the mainstem Columbia River from the mouth up to the Lewis River. While harmful land-use practices continue in some areas, many land management activities, including forestry practices, now have fewer impacts on salmonid habitat due to raised awareness and less invasive techniques. For example, timber harvest on public land has declined drastically since the 1980s and current harvest techniques (e.g., the use of mechanical harvesters and forwarders) and silvicultural prescriptions (i.e., thinning and cleaning) require little, if any, road construction and produce much less sediment.

Specifically, for LCR salmonid populations affected, impacts on tributary habitat result from the widespread development and other land use activities have disrupted watershed processes, reduced water quality, and diminished habitat quantity, quality, and complexity in most of the LCR subbasins. Past and/or current land use or water management activities have adversely affected stream and side channel structure, riparian conditions, floodplain function, sediment conditions, and water quality and quantity, as well as the watershed processes that create and maintain properly functioning conditions for salmon and steelhead (LCFRB 2010b; 2010a; ODFW 2010; NMFS 2014). Oregon's recovery plan for the LCR ESA-listed species contains a detailed description of the factors affecting habitat quantity and quality in the Columbia River Basin (ODFW 2010). ODFW (2010) also identified increased fine sediments in the spawning grounds from forest and rural roads, and from glacially influence water transfers between basins. Also identified as limiting factors affecting the physical habitat quality include past activities, such as stream cleaning, straightening and channelization, diking, wetland filling, and lack of larger wood recruitment, which resulted in the loss of habitat diversity for all three listed species in the basin.

Hydropower

Anywhere hydropower exists, some general effects occur, though those effects vary depending on the hydropower system. Though the Action Area is well below the mainstem Columbia River dams, some of these general effects from hydropower systems on biotic and abiotic factors related to flow and temperature may impact fish migrating in the mainstem Columbia River. The impacts in the action area may include, but are not limited to:

- Water quantity (i.e., flow) and seasonal timing (water quantity and velocity and safe passage in the migration corridor; cover/shelter, food/prey, riparian vegetation, and space associated with the connectivity of the estuarine floodplain);
- Temperature in the reaches below the large mainstem storage projects (water quality and safe passage in the migration corridor)
- Sediment transport and turbidity (water quality and safe passage in the migration corridor)
- Total dissolved gas (water quality and safe passage in the migration corridor)
- Food webs, including both predators and prey (food/prey and safe passage in the migration corridor)

Furthermore, the altered habitats in project reservoirs reduce smolt migration rates and create more favorable habitat conditions for fish predators (NMFS 2017b). The favorable habitat may increase abundance of these predators, both above and below the project reservoirs. Mainstem dams and reservoirs can also affect water quality by influencing temperature due to storage, diversions, and irrigation return flows, reducing turbidity, increasing total dissolved gas, and contributing toxic contaminants. All of these impacts affect the migration of adults and juveniles in the mainstem Columbia River.

2.4.2. Climate Change

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest.

These changes will not be spatially homogeneous across the Pacific Northwest. Major ecological realignments are already occurring in response to climate change (IPCC 2022). Long-term trends in warming have continued at global, national and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 (IPCC 2021).

The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC 2021). Globally, 2014-2021 were all in the top 10 warmest years on record both on land and in the ocean (2021 was the 6th warmest)(NOAA NCEI 2022). Events such as the 2013-2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC 2022). These two factors are often examined in isolation, but likely have interacting effects on ecosystem function.

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

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

Climate change effects on salmon and steelhead
In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species.

Changing freshwater temperatures are also likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact inter-gravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier et al. 2019). Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence.

For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (Fitzgerald et al. 2020; Crozier et al. 2021). Rising river temperatures increase the energetic cost of migration and the risk of *en route* or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Keefer et al. 2018; Barnett et al. 2020).

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al. 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Kilduff et al. 2015; Dorner et al. 2018). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger et al. 2018). Other Pacific salmon species (Stachura et al. 2014) and Atlantic salmon (Olmos et al. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

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

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historical levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin.

In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater et al. 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al. 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al. (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al. 2019; Munsch et al. 2022).

While all habitats used by Pacific salmon will be affected, the impacts and certainty of the change vary by habitat type. Some effects (e.g., increasing temperature) affect salmon at all life stages in all habitats, while others are habitat specific, such as stream flow variation in freshwater, sea level rise in estuaries, and upwelling in the ocean. How climate change will affect each stock or population of salmon also varies widely depending on the level or extent of change and the rate of change and the unique life history characteristics of different natural populations (Crozier et al. 2008). For example, a few weeks difference in migration timing can have large differences in the thermal regime experienced by migrating fish (Martins et al. 2011).

In the Status of Listed Species, Section 2.2.1 identified local-scale climate effects as a limiting factor for the majority of the species. Given this Proposed Action (Section 1.2.1) and Action area (Section 2.3), we may expect direct climate change effects of increased water temperature on fish physiology, temperature-induced changes to stream flow patterns, and alterations to freshwater food webs.

Within the tributaries of the Lower Columbia River, reduced snowpack and earlier run-off may have some of these effects on a small scale locally, and dam operations to control changing run-off patterns may occur in the mainstem Columbia River. The effects are likely to be more prominent outside of the action area, as fish migrate to and from the action area through warmer rivers.

As discussed in NMFS (2022) LCR Chinook are at risk for summer stream temperature increases. If spring-run Chinook adults or yearling juveniles are restricted to lower river reaches due to lower flows, summer temperatures might become a limiting factor. There is also risk for hydrologic regime shift, indicating that reduced snowmelt and higher winter flows may affect these fish in some areas. To access headwater areas, spring-run Chinook rely upon high flows from snowmelt during April-June; thus, a reduced spring freshet might require earlier migration. The timing of river entry for the spring run is triggered by a rising thermograph {Keefer, 2008 #5915}.

2.4.3. Hatcheries

Included in the Environmental Baseline are the ongoing effects of hatchery programs or facilities that have undergone ESA consultation. Within the Lower Columbia, all programs have undergone a recent

ESA review, and are thus part of the baseline. A more comprehensive discussion of hatchery programs in the Columbia Basin can be found in our opinion on Mitchell Act funded programs {NMFS, 2017 #8326}[2]. In summary, because most programs are ongoing, the effects of each are reflected in the most recent status of the species, (Ford 2022) and were summarized in Section 2.2.1 of this Opinion. In the past, hatcheries have been used to compensate for factors that limit anadromous salmonid viability (e.g., harvest, human development) by maintaining fishable returns of adult salmon and steelhead. A new role for hatcheries emerged during the 1980s and 1990s as a tool to conserve the genetic resources of depressed natural populations and to reduce short-term extinction risk (e.g., Snake River sockeye salmon). Hatchery programs also can be used to help improve viability by supplementing natural population abundance and expanding spatial distribution. However, the long-term benefits and risks of hatchery supplementation are still being studied. Therefore, fixing the factors limiting viability is essential for long-term viability.

2.4.4. Harvest

Harvest on the DPSs and ESUs considered here occur primarily in the mainstem Columbia River (NMFS 2018).

LCR Chinook salmon include three distinct life-history components: spring-run Chinook salmon, tule fall-run Chinook salmon, and late fall-run Chinook salmon (Ford 2022). These different components are subject to different in-river fisheries because of differences in river entry timing but share similar ocean distributions.

Harvest of fall-run Chinook salmon between 2015 and 2019 has seen a modest increase from the decreasing trend observed from 2005 through 2012 of 30 and 40 percent harvest rates on the ESU{TAC, 2017 #9225}{TAC, 2018 #9226}{TAC, 2019 #9227}{TAC, 2020 #9228}. As part of this approach, NMFS adopted in its biological opinion an assessment of the performance of the ABM matrix every three years as a check on projected results and any changes in key presumptions. The latest performance review for Chinook salmon was completed in 2019 {NMFS, 2019 #8886} concluding new escapement information gathered over the last four or five years shows no substantive changes in abundance or hatchery fractions that are inconsistent with previous trends, and when more data points allow for a more comprehensive review, the estimates of exploitation rates from fishery models should be compared to independent exploitation rate estimates derived from coded-wire tag groups.

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[2] NMFS has reinitiated this 2017 Mitchell Act Opinion and expects to finalize an updated consultation by the end of 2024. Although this 2017 version has been reinitiated, the discussion of the hatchery programs in the 2017 document is still relevant and important background to understand the Environmental Baseline.

Harvest of late fall-run Chinook salmon also dropped to 20 to 25 percent in the mid-1990s but has been increasing since. In the period from 2015 to 2019, harvest rates of late fall-run Chinook salmon increased, equivalent to the harvest rates between 1985 and 1990 {TAC, 2017 #9225}{TAC, 2018 #9226}{TAC, 2019 #9227}{TAC, 2020 #9228}. These rates for late fall-run Chinook salmon (North Fork Lewis and Sandy populations) are now based on the escapement of natural-origin fish, ensuring that there are sufficient numbers of adults on the spawning grounds.

Current legal fisheries in the Columbia River subbasins are highly regulated to limit negative impacts on Chinook salmon and steelhead. Selective gear rules, catch and release, selective timing closures and low catch limits are designed to protect adult and juvenile salmonids.

Existing Permits for Research, Monitoring, and Evaluation and Artificial Propagation in the Basin
There are a variety of section 10 permits and 4(d) authorizations currently in place to allow the operators to assess natural-origin juvenile abundance, productivity and migration timing through the use of screw traps and electrofishing and to conduct spawning ground/redd surveys for estimating escapement to individual populations.

In addition, there is separate ESA coverage for Chinook salmon and steelhead captured and handled at the Kalama Falls Hatchery, and so these activities are also included in the baseline. The expected take from each of the RM&E activities was previously analyzed by NMFS in the Biological Opinions associated with these 4(d) authorizations and Section 10 permits {NMFS, 2013 #3249}{NMFS, 2017 #8326}. None of these analyses resulted in jeopardy, and the overall effects from RM&E activities have both beneficial and negative effects.

Other Restoration Actions
Congress established the Pacific Coastal Salmon Recovery Fund (PCSRF) to help protect and recover salmon and steelhead populations and their habitats {NMFS, 2020 #7606}. The states of Washington, Oregon, California, Idaho, and Alaska, and the Pacific Coastal and Columbia River Tribes receive PCSRF appropriations from NMFS each year. The fund supplements existing state, tribal, and local programs to foster development of federal-state-tribal-local partnerships in salmon and steelhead recovery. The PCSRF has made substantial progress in achieving program goals, as indicated in annual Reports to Congress, workshops, and independent reviews.

Information relevant to the Environmental Baseline is also discussed in the Federal Columbia River Power System Biological Opinion {NMFS, 2020 #7606}, which provides an analysis of the effects of past and ongoing human and natural factors on the current status of the species, their habitats and ecosystems, within the entire Columbia River Basin.

Within the action area, there are no specific restoration actions that are relevant for consideration for this proposed action.

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. 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 402.02).

This section describes the effects of the Proposed Action, independent of the Environmental Baseline and Cumulative Effects. The methodology and best scientific information NMFS follows for analyzing hatchery effects and analysis of the Proposed Action itself follows in Section 2.5.1, below.

The effects of the Proposed Action, the status of ESA-protected species and designated critical habitat, the Environmental Baseline, and the Cumulative Effects are considered together later in this document to determine whether the Proposed Action is likely to appreciably reduce the likelihood of survival and recovery of Lower Columbia River Chinook salmon or result in the destruction or adverse modification of their designated critical habitat.

2.5.1. Factors That Are Considered When Analyzing Hatchery Effects

NMFS has substantial experience with hatchery programs and has developed and published a series of guidance documents for designing and evaluating hatchery programs following best available science (Hard et al. 1992; McElhany et al. 2000; NMFS 2004; 2005b; Jones Jr. 2006; NFMS 2008; NMFS 2011). For Pacific salmon, NMFS evaluates extinction processes and effects of the Proposed Action beginning at the population scale (McElhany et al. 2000). NMFS defines population performance measures in terms of natural-origin fish and four key parameters or attributes; abundance, productivity, spatial structure, and diversity and then relates effects of the Proposed Action at the population scale to the MPG level and ultimately to the survival and recovery of an entire ESU or DPS.

Because of the potential for circumventing the high rates of early mortality typically experienced in the wild, artificial propagation may be useful in the recovery of listed salmon species. However, artificial propagation entails risks as well as opportunities for salmon conservation (Hard et al. 1992). A Proposed Action is analyzed for effects, positive and negative, on the attributes that define population viability: abundance, productivity, spatial structure, and diversity. The effects of a hatchery program on the status of an ESU or steelhead DPS and designated critical habitat "will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery fish within the ESU affect each of the attributes" (70 FR 37215, June 28, 2005). The presence of hatchery fish within the ESU can positively affect the overall status of the ESU by increasing the number of natural spawners, by serving as a source population for repopulating unoccupied habitat and increasing spatial distribution, and by conserving genetic resources. Conversely, a hatchery program managed without adequate consideration can affect a listing determination by reducing adaptive genetic diversity of the ESU, and by reducing the reproductive fitness and productivity of the ESU.

As discussed above (section 1.1), the Tucannon River population has been critically low in recent years. The proposed action is expected to reduce or even avoid the risk of extinction for this population and MPG, since it is the only extant population in the MPG. The proposed action reduces the risk of demographic extinction by both preserving the genetic lineage of Chinook salmon in the Tucannon River, and increasing abundance to support natural spawning in the Tucannon River. Both of these are positive effects of hatchery intervention, and could be critical in avoiding loss of the population completely.

NMFS' analysis of hatchery Proposed Actions is in terms of effects it would be expected to have on ESA-listed species and on designated critical habitat, based on the best scientific information available. This allows for quantification (wherever possible) of the effects of the six factors of hatchery operation on each listed species at the population level (in Section 2.5.1), which in turn allows the combination of all such effects with other effects accruing to the species to determine the likelihood of the proposed action posing jeopardy to the species as a whole or adversely modifying its critical habitat.

When evaluating the effects of hatchery programs in general, NMFS applies best available scientific information, identifies the types of circumstances and conditions that are unique to individual hatchery programs, then analyzes the range in effects for a specific hatchery program. Information about program operations that NMFS needs to analyze the effects of a hatchery program on ESA-listed species is included in the HGMP provided by the comanagers. Our analysis of a hatchery program Proposed Action addresses six factors:

1. The hatchery program does or does not remove fish from the natural population and use them for hatchery broodstock
2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities
3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas, the migration corridor, estuary, and ocean
4. Research, monitoring, and evaluation (RM&E) that exist because of the hatchery program

5. Operation, maintenance, and construction of hatchery facilities that exist because of the hatchery program
6. Fisheries that would not exist but for the hatchery program, including terminal fisheries intended to reduce the escapement of hatchery-origin fish to spawning grounds

Special considerations for this proposed action

In most cases, NMFS would be looking at an action that includes all aspects of a hatchery program; however, in this case, the hatchery program has existing coverage, and the action under consideration is limited to a change in the release and collection location for some of the production, which does not change the overall management of the program as a whole (i.e., broodstock numbers, broodstock origin, production targets, etc.). As a result, many of the factors that we would typically address when evaluating an entire hatchery program have already been discussed and covered under a previous Biological Opinion and Incidental Take Statement (NMFS 2016). The effects of much of the existing hatchery and its operations (which include collection, release, and adult returns), are already in the baseline in the Tucannon River and Lower Snake River, and are not further considered here as an effect of this action. The effects of the underlying program, will however be discussed and taken into account in our Integration and Synthesis, Section 2.8, below, since that action and consultation is considered part of the baseline.

For our analysis here, NMFS will identify what components of each factor are already covered by the existing Tucannon Hatchery Chinook Endemic program Biological Opinion (NMFS 2016), and limits the discussion to effects of this action that are being evaluated in this Biological Opinion. For sake of clarity, we will walk through all six factors, even though many are not affected by this proposed action.

Framework for evaluation

NMFS analysis of hatchery actions assigns an effect category for each of the six factors (negative, negligible, or positive/beneficial) on population viability. The effect category assigned is based on: (1) an analysis of each factor weighed against the affected population(s) current risk level for abundance, productivity, spatial structure, and diversity; (2) the role or importance of the affected natural population(s) in salmon ESU or steelhead DPS recovery; (3) the target viability for the affected natural population(s) and; (4) the Environmental Baseline, including the factors currently limiting population viability.

Factor 1. The hatchery program does or does not remove fish from the natural population and use them for hatchery broodstock

This factor considers the risk to a natural population from the removal of natural-origin fish for hatchery broodstock. The level of effect for this factor ranges from neutral or negligible to negative.

A primary consideration in analyzing and assigning effects for broodstock collection is the origin and number of fish collected. The analysis considers whether broodstock are of local origin and the biological pros and cons of using ESA-listed fish (natural or hatchery-origin) for hatchery broodstock. It considers the maximum number of fish proposed for collection and the proportion of the donor population used to provide hatchery broodstock. Using a large proportion of a natural population to supply hatchery broodstock (often referred to as "mining") can reduce population abundance and spatial structure. Also considered here is whether the program "backfills" with fish from outside the local or immediate area.

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All removal of Tucannon spring Chinook from the natural environment for artificial production.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- None

The action does not include any additional broodstock removal. The number and origin of fish collected for broodstock does not change, and only the location of collection changes.

Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities

NMFS also analyzes the effects of hatchery fish and the progeny of naturally spawning hatchery fish on the ESU, as well as the effects of possibly encountering and being handled at collection facilities. The level of effect for this factor ranges from positive to negative.

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, or in the Biological Opinion for the Kalama River Falls Hatchery {NMFS, 2017 #3379} and thus part of the environmental baseline.

- All interactions between natural- and hatchery-origin chinook salmon in the Tucannon River basin.

- Encounters with, and handling at, adult collection facilities in the Tucannon River and Lyons Ferry Hatchery
- Encounters with and handling at adult collection facilities at Kalama Falls Hatchery, including Lower Columbia River Chinook and steelhead.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- Interactions between natural- and hatchery-origin Chinook salmon in the Lower Columbia River Basin.
- Effects of potential breeding between the Tucannon River adults that do not recruit to the Kalama collection facility and spawn with the Lower Columbia River ESU.

Effects On Diversity

NMFS generally views genetic effects of hatchery programs as detrimental because artificial breeding and rearing is likely to result in some degree of genetic change and fitness reduction in hatchery fish and their progeny, particularly if they interbreed with fish from natural populations.

While the Tucannon River broodstock are intended to be integrated with the Tucannon River natural-origin population, the Tucannon adults returning to the Lower Columbia River are not intended to interact or spawn with any of the populations in the Lower Columbia River.

NMFS considers three major areas of genetic effects of hatchery programs: (1) within-population diversity; (2) outbreeding effects; and (3) hatchery-induced selection. In this case, these effects are viewed as risks because any Tucannon Chinook salmon that spawn in the Lower Columbia River would be considered an out-of-ESU influence. So, the impact would be more similar to the influence of fish straying out of their basin, rather than a managed integration of hatchery and natural fish within a single population or ESU. Below, we analyze the effects of the proposed hatchery program in each of the three river basins in the Lower Columbia River: the Kalama, Cowlitz, and Lewis River basins.

Within-Population Diversity

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All genetic diversity and effective population size impacts within the Tucannon River population.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- None

The effects of hatchery influence on the Tucannon River chinook salmon population will remain the same, as brood selection, spawning, and mating protocols are not being changed.

Outbreeding Effects On Diversity

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All outbreeding effects on genetic diversity within the Tucannon River population.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- All outbreeding effects on genetic diversity within the Lower Columbia River
  - The action may introduce Tucannon River chinook salmon into the Lower Columbia River, where they are not intended to spawn.
  - Tucannon River spring chinook salmon spawning in the Lower Columbia River are akin to out-of-ESU strays, which could introduce genes from the Snake River ESU into the Lower Columbia River ESU.

Outbreeding Effects Considered

Though the program managers intend to minimize outbreeding effects by limiting release sizes, and monitoring for escapement into the surrounding areas, it is likely that some Tucannon River Chinook salmon will stray into these areas, and could interbreed with local populations. Therefore, it is necessary to look at how outbreeding could affect a population at risk, and the degree to which the proposed action might impose that risk.

Outbreeding effects are caused by gene flow from outside populations, and occur naturally among salmon and steelhead populations, a process referred to as straying (Quinn 1993; 1997). Natural straying can serve a valuable function in preserving diversity that would otherwise be lost through genetic drift and in re-colonizing vacant habitat. However, straying can be considered a risk when it occurs at unnatural levels or from unnatural sources.

Because Tucannon Chinook may return to, and attempt to spawn in, the Lower Columbia River at higher rates than would be expected if they were not released in the Kalama River, and they are not of the local populations, unnatural levels of gene flow into Lower Columbia River populations could pose a risk.

Gene flow from other populations can have two effects:

1. It can increase genetic diversity (e.g., Ayllon et al. 2006) (which can be a benefit in small populations) but it can also alter established allele frequencies (and co-adapted gene complexes) and reduce the population's level of adaptation, a phenomenon called outbreeding depression (Edmands 2007; McClelland and Naish 2007). In general, the greater the geographic separation between the source or origin of hatchery fish and the recipient natural population, the greater the genetic difference between the two populations (ICTRT 2007), and the greater potential for outbreeding depression.
2. Unusual rates of straying into other populations within or beyond the population's MPG or ESU or a steelhead DPS can have an homogenizing effect, decreasing intra-population genetic variability (e.g.,Vasemagi et al. 2005), and increasing risk to population diversity, one of the four attributes measured to determine population viability. Reduction of within-population and among-population diversity can reduce adaptive potential.

The long-term genetic effects of hatchery fish spawning naturally over many generations become problematic when pHOS approaches and exceeds five percent, particularly when pNOB (the proportion of the broodstock that is of natural origin) equals 0 (HSRG 2009). NMFS uses this five-percent threshold to indicate when impacts might result in adverse impacts, particularly when sustained over time.

The proportion of outside fish among natural spawners (in this case, Tucannon Chinook salmon in the Lower Columbia River) can be used as a surrogate measure of gene flow. Unique fish clips and tags can be used to identify and quantify the number of Tucannon Chinook salmon during broodstock collection and spawning ground surveys in the basin. These numbers can be used to approximate the number and proportion of Tucannon Chinook salmon that were available to spawn in the tributaries of the Lower Columbia River. However, appropriate cautions and qualifications should be considered when using this proportion to analyze genetic effects, as the proportion alone does not consider spawning success. While spawning success may be inferred through inspection of carcasses to show evidence of spawning through tail erosion or presence or absence of gametes in the body cavity, and may improve precision, it is somewhat subjective, and does not imply viability of eggs in the gravel.

Not all Tucannon River Chinook would be expected to spawn successfully with local natural-origin Chinook, and thus gene flow rates would be expected to be lower than the proportion of adults in the system. Therefore, caution must also be taken in assuming that strays (in this case strays of Tucannon River Chinook salmon) contribute genetically in proportion to their abundance in the Lower Columbia River. Several studies demonstrate little genetic impact from straying despite a considerable presence of strays in the spawning population (Saisa et al. 2003; Blankenship et al. 2007). The causative factors for poorer breeding success of strays are likely similar to those identified as responsible for reduced productivity of hatchery-origin fish in general, e.g., differences in run and spawn timing, spawning in less productive habitats, and reduced survival of their progeny (Reisenbichler and McIntyre 1977; Leider et al. 1990; McLean et al. 2004; Williamson et al. 2010).

There may not be an exact correlation of gene flow based on the census proportion of Tucannon River fish in the Lower Columbia River, because it does not alone provide the information on actual success of spawning, and thus the gene flow into the populations. The census proportion still serves as a surrogate that is more easily monitored without making assumptions about spawning success, and would indicated a maximum gene flow impact because not all of those counted would spawn successfully.

To evaluate the impact on the natural populations in the Lower Columbia River, NMFS must determine the number of Tucannon River spring Chinook that may return to the area, and compare that with the abundance of each population that may be impacted. These estimates are based on smolt-to-adult return (SAR) predictions for various release numbers, and then adjusted by the proportion of those that may stray into areas in which they are not intended.

The HGMP included estimates of how many Tucannon River chinook salmon may return to the Lower Columbia River (Table 4). The estimates were based on a range of smolt-to-adult (SAR) return scenarios that are likely to cover a realistic range from lowest to highest.

Table 5. Range of smolt to adult return (SAR) predictions and rationale.

Prediction category	SAR Used	Rationale
Pessimistic (P)	0.2%	The current SAR of Tucannon spring Chinook Salmon returning to the Tucannon, and likely the worst-case scenario
Moderate (M)	0.5%	Prior modeling of CWT data from returning lower Columbia River spring Chinook Salmon showed this as moderate
Optimistic (O)	1.0%	Prior modeling of CWT data from returning lower Columbia River spring Chinook Salmon showed this is the upper bound

Based on the SAR predictions provided, and the expected release numbers in the proposed action, the number of total fish returning from the Kalama releases of Tucannon River Chinook salmon to each of the three populations in the Lower Columbia River (Cowlitz, Lewis, and Kalama Rivers) can be calculated. Table 6 below shows the predicted returns of Tucannon Chinook salmon from Kalama releases from various release levels based on a range of SARs.

Table 6. Total predicted returns of Tucannon Chinook salmon from Kalama releases to Kalama Falls Fish Hatchery. Predictions are categorized as pessimistic (Pess), moderate (Mod), or optimistic (Opt).

	Expected Smolt Release Number								
Number of Smolts Released	**30,000**			**50,000**			**100,000**		
Scenario	Pess	Mod	Opt	Pess	Mod	Opt	Pess	Mod	Opt
Assumed SAR	0.2%	0.5%	1.00%	0.2%	0.5%	1.00%	0.2%	0.5%	1.00%
Total Expected Adult Returns to Kalama	**60**	**150**	**300**	**100**	**250**	**500**	**200**	**500**	**1000**
Age 3	15	37	74	25	62	124	49	124	247
Age 4	42	106	212	71	177	353	141	353	706
Age 5	3	7	14	5	12	24	10	24	48
Expected Captured at Kalama Weir	48	120	240	80	200	400	160	400	800

The HGMP also included estimates of the proportions of Tucannon River Chinook salmon that may escape into areas of the Lower Columbia River. The estimates were based on historical releases of Chinook salmon from the Kalama Hatchery.

Table 7. Predictions of Tucannon River Chinook salmon from Kalama releases that remain uncollected upon return to the Lower Columbia River.

Adult Stray Area	Percent*
Straying Within Kalama River Basin	
Below weir – not captured	12%
Above weir – passed above weir	0%
Total Straying Outside Kalama River Basin*	6.20%
Straying into Cowlitz	0.20%
Straying into Lewis	5.60%
Straying Other	0.30%

*Estimates of straying outside of the Kalama River basin were based on CWT recoveries from Kalama River Basin spring Chinook releases from 1989-2015 (pooled averages). Estimates are considered conservative because fish that were called "strays" included captures from fisheries, and it's unknown if these fish might have returned to the Kalama River Basin. Removal of fishery recoveries reduces the average stray rate to about ½ of what's provided in the table.

Using these numbers, NMFS can estimate the total number of fish that may return to the basin and either stay in the lower Kalama River (below the weir) or stray into adjacent rivers like the Cowlitz and Lewis Rivers. Table 7 shows the numbers of fish that would be predicted to return to each area.

Table 8. Predicted number of Tucannon River Chinook salmon from Kalama releases predicted to stray from the program into the Lower Columbia River. Predictions are categorized as pessimistic (Pess), moderate (Mod), or optimistic (Opt).

	Expected Smolt Release Number								
Number of Smolts Released	**30,000**			**50,000**			**100,000**		
Scenario	Pess	Mod	Opt	Pess	Mod	Opt	Pess	Mod	Opt
Number of Returns to Lower Kalama – not captured	12	30	60	20	50	100	40	100	200
Strays by basin									
Cowlitz	1*	1*	1	1*	1	1	1*	1	2

Lewis	3	8	17	6	14	28	11	28	56
Other Basins	1*	1*	1	1*	1	2	1	2	3
Total Strays (all basins)	4	9	19	6	16	31	12	31	62

*Indicates a value less than 1, but rounded up to one fish for the purpose of evaluating the impact of the potential for an adult to be present because the calculated value is above zero.

These predicted stray numbers can then be used to determine the proportion of Tucannon fish that may be contributing to the Lower Columbia River populations. These predicted proportions are shown in Table 8, Table 9, and Table 10.

Table 9. Proportion of Tucannon Chinook salmon from Kalama releases in the Cowlitz River population. Predictions are categorized as pessimistic (Pess), moderate (Mod), or optimistic (Opt).

	Expected Smolt Release Number								
Number of Smolts Released	**30,000**			**50,000**			**100,000**		
Scenario	Pess	Mod	Opt	Pess	Mod	Opt	Pess	Mod	Opt
Number of Returns to Cowlitz River	1*	1*	1	1*	1	1	1*	1	2
Proportion of Tucannon in the Cowlitz spring Chinook population*	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%

Table 10. Tucannon Chinook salmon from Kalama releases represented in the Lewis River spring Chinook population. Predictions are categorized as pessimistic (Pess), moderate (Mod), or optimistic (Opt).

	Expected Smolt Release Number

Number of Smolts Released	30,000			50,000			100,000		
Scenario	Pess	Mod	Opt	Pess	Mod	Opt	Pess	Mod	Opt
Number of Returns to Lewis River	3	8	17	6	14	28	11	28	56
Proportion of Tucannon in the Lewis River spring Chinook population*	0.10%	0.30%	0.70%	0.30%	0.60%	1.20%	0.50%	1.20%	**2.40%**

*Values over 2% are bolded for emphasis

Table 11. Proportion of Tucannon Chinook salmon from Kalama releases in the Kalama River population. Predictions are categorized as pessimistic (Pess), moderate (Mod), or optimistic (Opt).

	Expected Smolt Release Number								
Number of Smolts Released	**30,000**			**50,000**			**100,000**		
Scenario	Pess	Mod	Opt	Pess	Mod	Opt	Pess	Mod	Opt
Number of Tucannon returns that remain in Lower Kalama (not collected)	12	30	60	20	50	100	40	100	200
Proportion of Tucannon in the Kalama River spring	0.6%	1.4%	**2.9%***	1.0%	**2.4%***	**4.8%***	1.9%	**4.8%***	**9.5%***

Chinook population*									

*****Values over 2% are bolded for emphasis

Under most scenarios, the rates of potential contribution of Tucannon River fish in Cowlitz and Lewis River populations are very low (< 2.5 percent) and introduce a very small risk to the Lower Columbia River ESUs through gene flow. Within the Kalama River, however, the risk is slightly higher under certain scenarios.

If SARs are close to the optimistic projections (1.0%), even smaller releases start to pose more of a risk (>2.5%). At moderate SAR projections (0.5%), the risk also increases to around 2.5% when release sizes exceed 50,000. At the maximum release size (100,000 smolts), even the pessimistic SAR predictions (0.1%) start to potentially contribute more than 2% to the available spawning population, and introduce the possibility of genetic risk.

Summary of effects

Cowlitz River

In the Cowlitz River, even at the maximum release level, and the highest possible (optimistic) estimated SAR level, the Tucannon River Chinook releases would return only 2 adults in a population that averages close to 10,000 spawners. At this level, even if both returning adults were successful at spawning in the basin, their contribution would contribute only 0.02 percent to the population. In more realistic conditions (lower production and lower SAR), it is likely that none of the Tucannon Chinook adults would return to the Cowlitz River, and, even if they did, they may not spawn successfully. Therefore, the risk of outbreeding effects is extremely low, and is unlikely to reach a level that would cause a measurable impact.

Lewis River

In the Lewis River, the smaller average adult abundance (around 2,300 adults) and slightly higher expected stray contribution rate results in the potential for a very low outbreeding effect potential within the Lewis River population at optimistic SAR assumptions at the higher release levels. The contribution of Tucannon Chinook adults into the Lewis River would only be expected to exceed 2 percent in years that releases were high, and SARs were also high. While the HSRG suggested a threshold for out-of-population risk tolerance (stray rate) could be up to five percent {HSRG, 2009 #1946}, a lower threshold seems suitable for an out-of-ESU influence that occurs through management.

It is worth noting that this level of risk is only realized when the Lewis River has only an average return year, while at the same time the Tucannon Chinook experience an optimistic return. Though it is possible for this to occur, it is more likely that a high SAR for Tucannon River Chinook would correspond with a high SAR for the Lewis River, as both populations would experience similar conditions that lead to the improved SAR. This risk also assumes that all returning Tucannon Chinook salmon would spawn successfully, which is also unlikely. Therefore, NMFS expects that, on the whole, outbreeding effects would generally contribute less than one percent to the Lewis River population, as it is not likely that all returning Tucannon Chinook salmon would spawn successfully in the Lewis River, even if releases are high and SARs are higher than for the Lewis River population. Therefore, the risk of outbreeding effects is typically low, and is unlikely to reach a level that would cause a measurable impact in most years; however, monitoring will be important to confirm this.

Kalama River

In the Kalama River, however, the risk is slightly higher for outbreeding effects for three reasons. First, because Tucannon River Chinook salmon will be released within the Kalama River, Chinook released there are expected to return directly to the Kalama River. Second, the Kalama River population is small enough that returns from the Tucannon River releases could spawn successfully and contribute to the population genetically. Finally, because some fish may not return all the way to the weir where they can be removed, they may remain in the Kalama River and interact with the native Kalama River population, while also not being directly detected for monitoring.

Similar to the Cowlitz River population, it is worth noting that this level of risk is high only when the Kalama River has only an average return year at the same time that the Tucannon Chinook experience an optimistic return. Though it is possible for this to occur, it is more likely that a high SAR for Tucannon River Chinook would correspond with a high SAR for the Kalama River, as both populations would experience similar conditions that lead to the improved SAR. This risk also assumes that all returning Tucannon Chinook salmon would spawn successfully, which is also unlikely because of pre-spawn mortality, mate selection, and spawning site preferences that may slightly differ from natural-origin Chinook salmon. Therefore, NMFS expects that, on the whole, outbreeding effects would generally contribute less than three percent to the Kalama River population, as it is not likely that all returning Tucannon Chinook salmon would spawn successfully in the Kalama River, even if releases are high and SARs are higher than for the Kalama River population. Therefore, the risk of outbreeding effects is low in most years, and would only reach a level that would cause a measurable impact in years when Tucannon Chinook returns to the Kalama are high, and returns of natural-origin Kalama River Chinook are average to low, which is unlikely to occur. Monitoring will be critical to measure this, and to adjust program implementation to ensure the impact remains low.

As discussed above, the long-term genetic effects of hatchery fish spawning naturally over many generations become problematic if the influence continues unchecked. With each generation, the outside genes can be introduced from both returning adults from progeny that had outside genetic influence already as well as from the ongoing influence from program fish continuing the contribution annually. Thus ongoing, influence may increase the genetic influence over long periods of time. Likewise, reducing or eliminating the influence to either a smaller magnitude (fewer spawners contributing) or by reducing the time of supplementation, the impact can be reduced, and can subside over time if ongoing supplementation is eliminated.

As with any Chinook hatchery adaptive management plan, there is the potential for lag time between discovering a trend, adjusting the program, and seeing results from program adjustments because of the lifecycle of Chinook taking three years or longer. By the nature of the program relying on adult return numbers to collect broodstock, the trend to releasing the maximum allowable number of fish in the Kalama River will occur slowly, and each year, data gathered will improve predictions of returns to the Lower Columbia basin. This is expected to result in slow trends over time, which would reduce the likelihood of a much larger impact than anticipated happening unexpectedly.

Therefore, even though there will be lag time between the release of juveniles and the return of the adults, the program starting small, increasing slowly (due to limited broodstock availability), and monitoring trends along the way, NMFS expects that program management can still adjust to successfully meet targets, particularly as data is collected and helps refine future forecasts.

Hatchery-induced selection

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All broodstock selection and mating protocols for all Tucannon spring chinook salmon used in the program.
- All domestication risk effects within the Tucannon population.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- None
    - The action does not include any additional broodstock spawning or mating protocols. The number and origin of fish collected for broodstock does not change, nor does the mating protocol.
    - Any Tucannon chinook salmon adults returning to collection facilities, both Tucannon River trap and Kalama River trap are genetically the same, and their use in the program is guided by existing mating protocols.

Ecological Effects

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All effects from competition for spawning sites and redd superimposition within the Tucannon River and Asotin Creek related to spring Chinook from the natural environment competing for suitable spawning sites with adults returning from the artificial production program.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- All effects from competition for spawning sites and redd superimposition in the Lower Columbia River.
    - Adult chinook from the releases of Tucannon spring chinook salmon from the Kalama Falls Hatchery that either stray into surrounding areas, or fail to recruit to the weir for collection, could potentially spawn with spring Chinook salmon in the Lower Columbia River populations.

NMFS considers several ecological effects for this factor, including effects from competition for spawning sites and redd superimposition, contributions to marine derived nutrients, and the removal of fine sediments from spawning gravels by naturally spawning fish. It is important to consider both the co-occurrence of returns from the Kalama releases of Tucannon River Chinook salmon and Lower Columbia River Chinook salmon as well as their run and spawning timing to determine the extent of the risk that they will spawn together.

Table 12. Population run and spawn timing of Tucannon River spring Chinook salmon and populations of the Lower Columbia River.

Population	Run Timing	Peak Arrival Time	Peak Spawning
Tucannon River Spring Chinook Salmon*	Start - Early June End – Late September	Mid-June	Mid-September
Kalama River Spring Chinook Salmon	Start - Early June End – Late September	Mid-June	Early September
Cowlitz River Spring Chinook Salmon	Start - Early June End – Late September	Mid-June	Mid-September
Lewis River Spring Chinook Salmon	Start - Early June End – Late	Mid-June	Mid-September

	September		

*Based on returns to the Tucannon River. Return timing of Tucannon River spring chinook to the Kalama River will be monitored, but is currently unknown.

Based on almost complete overlap of expected arrival and spawn timing, there is a possibility of spawning site competition or redd superimposition with hatchery-origin Tucannon River chinook salmon in the Lower Columbia River. It is therefore possible that hatchery-origin Tucannon River Chinook salmon could compete with natural-origin spring Chinook salmon in the Lower Columbia River for spawning sites. The physical characteristics (like flow, temperature, and substrate) of the Tucannon River system may be different from the Lower Columbia River tributaries, which could impact the run timing and site selection of Tucannon fish in the Lower Columbia. However, because the expected timing overlaps and interactions are all between populations of spring Chinook salmon, the spawning site selections are likely to be similar.

The proposed hatchery releases in the Kalama River could increase the total number of Tucannon River hatchery-origin spawners in the Lower Columbia River slightly. Because the proportion of Tucannon chinook salmon returning to the Lower Columbia River tributaries and not removed by weirs is expected to be low (below 3% in the Lewis and Cowlitz, and below 10% in the Kalama), spawning competition is not expected to pose a threat to the populations' ability to find suitable spawning sites.

Adult Collection Facility Effects

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All removal of Tucannon Spring Chinook from the natural environment for artificial production.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- None
    - The collection of Tucannon River spring chinook salmon at the Kalama Falls Hatchery does not change operation of the ladder and trap, and will therefore not impact any additional species.
    - Delays of Tucannon spring chinook salmon in the Kalama River basin is not relevant because those fish are not intended to migrate beyond the weir. Any delay at the weir would not be considered an impact on the Tucannon Chinook salmon population, because Tucannon Chinook salmon would be considered strays above the weir. Because Tucannon Chinook salmon are not desired as spawners in the basin, the delay would not be considered a negative impact.

- All ladder and trap operations at Kalama Falls Hatchery are covered under {NMFS, 2017 #8326}.

Factor 3. Hatchery-origin fish and the progeny of naturally spawning hatchery-origin fish in juvenile rearing areas and migratory corridors.
NMFS also analyzes the potential for competition and predation when the progeny of naturally spawning hatchery fish and hatchery releases share juvenile rearing areas and migratory corridors. This factor can have effects on the productivity VSP parameter (Section 2.2.2) of the natural population. The effect of this factor ranges from negligible to negative.

Hatchery release competition and predation effects
Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.
- All competition and predation effects of hatchery-origin Tucannon Spring within the Tucannon River and Asotin Creek.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.
- All competition and predation effects of hatchery-origin Tucannon Spring chinook salmon releases within the Lower Columbia River basin, specifically the Kalama River.

NMFS expects that hatchery production on the scale proposed in this action (no more than 100,000 smolts) considered in this opinion would have a negligible effect on the survival and recovery of the Lower Columbia River Chinook Salmon ESU. Recent hatchery production in the Lower Columbia River is shown in Table 13 below.

Table 13. Spring Chinook hatchery releases from Cowlitz, Kalama, and Lewis facilities in 2010-2020.

	Cowlitz		**Kalama**		**Lewis**	
Year	**Goal**	**Plant**	**Goal**	**Plant**	**Goal**	**Plant**
2010	1,262,539	1,280,347	500,000	352,924	1,050,000	1,110,755
2011	1,260,226	1,076,945	500,000	501,556	1,050,000	1,057,833
2012	942,369	881,337	500,000	559,575	1,350,000	1,410,270
2013	1,464,849	1,601,472	500,000	521,462	1,250,000	1,286,170
2014	1,797,115	2,051,598	500,000	515,038	1,675,000	1,516,940
2015	1,793,529	1,958,471	500,000	549,558	1,925,000	1,814,469

2016	1,793,529	1,874,482	500,000	481,624	1,250,000	717,742
2017	1,741,899	1,852,960	500,000	533,954	1,250,000	402,224
2018	1,741,899	1,844,162	500,000	509,425	1,250,000	710,708
2019	1,741,899	2,011,018	500,000	509,909	1,350,000	2,294,425
2020	1,741,899	1,968,336	500,000	479,961	1,350,000	1,760,485

Within the Kalama River, Tucannon River smolt releases may contribute up to 28% of all smolt releases in years where Kalama releases are at their lowest, and comanagers are able to release the maximum targeted 100,000 smolts for the program. Because the smolts are released at a stage when they are ready to outmigrate, they are not expected to compete with natural-origin fish, which are also outmigrating, for long periods of time. Once they are below the mouth of the Kalama River, they would make up no more than six percent of all fish released just from these programs if all Lower Columbia River programs produce the lowest number represented in the table, and Tucannon releases are at the maximum 100,000 smolts. In most years, the contribution would be less than three percent.

Because the total releases in the Columbia River basin will not change because of the new release location, the only increase of fish migrating out will be due to increased survival from the release lower in the basin. The small contribution of fish added to the overall production in the Lower Columbia River would be difficult to measure in context of total fish in the estuary. Additionally, these fish are released as smolts, and would be expected to pass quickly through the estuary, with very few taking up residence for any period of time, Therefore, NMFS does not anticipate additional impacts from predation on Chinook salmon due to size similarity with wild fish. Therefore, the impact from the release of Tucannon River fish in the Kalama is not expected to increase competition and predation impacts in a meaningful way.

Naturally-produced progeny competition

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All juvenile competition between hatchery- and natural-origin Tucannon Spring Chinook in the Tucannon River and Asotin Creek.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- All juvenile competition between progeny of hatchery-origin Tucannon Spring Chinook in the Lower Columbia River.

NMFS has reviewed the literature for new and emerging scientific information over the role and the consequences of density-dependent interactions in estuarine and marine areas. While there is evidence of density-dependent effects such as predation on salmon survival, available information does not support a meaningful causal link to a particular category of hatchery program.

Strong density dependence has been observed in small systems for Snake River spring/summer Chinook salmon populations {ISAB, 2015 #2073}, which also indicates that improvements in tributary habitat capacity or productivity, if targeted at limiting life stages and limiting factors, would likely improve overall population abundance and productivity. The role or contribution of hatchery fish in density-dependent interactions affecting salmon and steelhead growth and survival in the mainstem Columbia River, the Columbia River estuary, and the Pacific Ocean is not yet well understood (NMFS 2017b). NMFS will support new research to discern and to measure the frequency, the intensity, and the resulting effect of density-dependent interactions between hatchery and natural-origin fish. In the meantime, NMFS will monitor emerging science and information and will consider that re-initiation of Section 7 consultation is required in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

A review by the Independent Scientific Advisory Board (ISAB) identified uncertainty about the aggregate carrying capacity for juvenile salmonids as the highest priority for research, management, and restoration activities in the basin (ISAB 2011); "It is important to recognize that the concept of carrying capacity is based on specified conditions which might vary temporarily (seasonally) or be impacted by climate change and shifts in ocean regimes. Some of this information is being collected, but general access to data remains problematic."

Offspring of naturally spawning hatchery-origin adults will likely emerge at the same time, be exposed to the same conditions, and compete for the same resources as, and therefore there is no reason to expect these progeny will behave differently from, the offspring of natural-origin parents exposed to the same environment. Therefore, the only expected effect of this added production is a density-dependent response of decreasing growth and potential exceedance of habitat capacity. Population status trends monitored through life cycle modeling may suggest this response and will be measured into the future.

A very low proportion of hatchery-origin adults from this program are expected to spawn successfully and produce offspring. Therefore, competition impacts from the resulting offspring are expected to be small. There is overall at most a slight negative effect from these actions.

Disease

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All disease impacts of Tucannon spring Chinook reared at Tucannon River Hatchery.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- Any added risk of disease impacts of Tucannon spring Chinook reared at Kalama Falls Hatchery

The risk of pathogen transmission to natural-origin salmon and steelhead is negligible for rearing Tucannon River Chinook salmon at Kalama Falls Hatchery because of pre-transport disease testing protocols and low-density rearing. Adults spawned for the Tucannon River program are screened for disease at spawning, and culled from production in the event the risk of passing disease to progeny is high. In addition, prior to transport of juvenile Tucannon River spring chinook salmon, a health examination is performed and fish will not be transported if they are diseased.

Existing hatchery production at Kalama Falls Fish Hatchery is already covered {NMFS, 2017 #8326}, and not an effect of this proposed action. The program will only move fish to KFFH that have been cleared by a health examination, and there are no unique pathogens from the Tucannon that would be introduced to KFFH that are not endemic to the area already. Therefore, the risk of pathogen transmission is very low, and there are no known non-native pathogens that may be transmitted to ESA-listed natural-origin fish from moving fish from the Tucannon Fish Hatchery to KFFH.

Factor 4. Research, monitoring, and evaluation that exists because of the hatchery program

NMFS analyses the incidental effects of the proposed research, monitoring, and evaluation (RM&E) on listed species. This factor can also affect the productivity VSP parameter (section 2.2.1) of the natural population.

The monitoring and evaluation activities directly related to the proposed hatchery programs are part of a larger effort to determine the overall status of the Lower Columbia River ESUs and DPSs. Additional monitoring for the Kalama releases of Tucannon River Chinook salmon is limited to spawning ground surveys and carcass collection, which do not introduce any additional impact.

Therefore, the effects from research, monitoring, and evaluation on Lower Columbia River Chinook salmon are negligible.

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All research, monitoring, and evaluation of Tucannon Spring Chinook in the Tucannon River and Asotin Creek.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- None
    - The action does not include any additional trapping or tagging of fish in the wild.
    - Spawning ground surveys and carcass collections are already done to monitor species status, and will not increase because of the proposed action.

Factor 5. Construction, operation, and maintenance of facilities that exist because of the hatchery programs

The construction/installation, operation, and maintenance of hatchery facilities can alter fish behavior and can injure or kill eggs, juveniles and adults. It can also degrade habitat function and reduce or block access to spawning and rearing habitats altogether. The proposed action does not include any new infrastructure. All hatchery facilities, including water use, water intakes, weirs, and ladders already exist, and no changes, upgrades, or additional maintenance will occur as part of or as a result of the proposed action.

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All facilities in the Tucannon River and Asotin Creek for artificial production or research and monitoring.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- None
    - All hatchery facilities, including water intakes, weirs, and ladders already exist, and no changes, upgrades, or additional maintenance will occur as part of or as a result of the proposed action.
    - Water use at Kalama Falls Hatchery will not change.

Factor 6. Fisheries that exist because of the hatchery program

There are two aspects of fisheries that are potentially relevant to NMFS' analysis of hatchery program effects. One is where fisheries exist because of the Proposed Action (i.e., the fishery is explicitly supported by and dependent upon the hatchery) and listed natural-origin species are inadvertently and incidentally taken in those fisheries. These fisheries would have negative effects on the *abundance* VSP parameter of the affected populations (Section 2.2.1). The other is when fisheries are used as a tool to prevent the hatchery fish associated with the Proposed Action, including hatchery-origin fish included in an ESA-listed salmon ESU or steelhead DPS, from spawning naturally. The effects of such fisheries can range from positive to negative, but here, as described below, the proposed action would not contribute to fisheries in such a way as to modify the management or effects of such fisheries.

Effects of the Tucannon Hatchery Chinook Endemic program that were analyzed and covered in NMFS 2016, and thus part of the environmental baseline.

- All fishery-related impacts from the Tucannon River chinook salmon program.

Effects caused by this proposed action: the Kalama releases of Tucannon River Chinook salmon.

- The minor increase of adult returns based on the slightly increased survival of the part of the Tucannon River chinook salmon program released at Kalama Falls Hatchery.
    - The proposed action is not intended to provide any fish for harvest.
    - Increases of adults returning is only limited to the small increase in survival from the shorter migration distance.

The release of Tucannon River chinook salmon at Kalama Falls is strictly to increase adult survival back to a collection point, and not intended to support any additional harvest. Additionally, the overall production for the Tucannon River chinook salmon program will not change. Only the release location for a portion of the releases is being changed. The slight increase in survival based on releases from the Kalama Falls Hatchery will only amount to a maximum of a few hundred additional Tucannon Chinook salmon that return to the Kalama with a slightly higher survival rate. The increase of a few hundred adults will not change any existing harvest protocols or change run forecasts enough to modify fishery implementation.

2.6. Effects of the Action on Critical Habitat

For this action, the PBFs for Lower Columbia Chinook salmon that could be affected would be:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;

(2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage supporting juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;

(3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;

While analyzing the impacts to Lower Columbia River Chinook salmon, habitat features were also considered (see section 2.5.1). The Proposed Action does not include any new construction, water withdrawals, or any modifications to collections facility structures or operations. Specifically:

- No new construction of any kind is proposed.
- Hatchery facilities already exist, and no changes in operations that would affect water quantity or quality will occur.
- No new or additional trapping will occur that could delay migration.
- Hatchery smolt releases are not expected to affect, in any measurable way, natural-origin smolts rearing in the Kalama River because:
    - Smolts will be released when they are ready to migrate, limiting competition for food and habitat.
    - The relative proportion of smolts released is small in comparison to the number of outmigrants in the basin, limiting competition for food and habitat.
    - Smolts will have health exams prior to transfer to the Kalama Falls Hatchery as well as prior to release, which reduces the potential for exposure to any pathogens.
- The overall releases for the Tucannon Chinook salmon program will not change, and will not increase the interactions overall in the tributaries of the Lower Columbia River Basin that would impact availability of suitable rearing space and food availability.
- The proposed hatchery program would have negligible effects on ESA-listed fish in the migration corridor, estuary, and Pacific Ocean. Migration-ready smolts from the Kalama releases are likely to migrate to the ocean quickly, where resources and space are generally not limiting.
- Adult Tucannon Chinook salmon returning to the Lower Columbia River may compete for spawning habitat, though the impact is expected to be low because they will be proportionally small amongst the populations (generally less than 5 percent), and spawning habitat is not a critical limiting factor(Ford 2022). The program will also be closely monitored, and modified or terminated after 12 years depending on results.

It is possible that a few additional salmon carcasses would be contributed in the Lower Columbia River from fish that do not recruit back to the Kalama Falls Hatchery to be collected. Salmon carcasses provide a direct food source for juvenile salmonids and other fish, aquatic invertebrates, and terrestrial animals, and their decomposition supplies nutrients that may increase primary and secondary production. These marine-derived nutrients can increase the growth and survival of the ESA-listed species by increasing forage species (i.e., aquatic and terrestrial insects), aquatic vegetation, and riparian vegetation, to name a few. Though the few fish that may contribute are unlikely to make a measurable difference, this effect would be slightly positive.

As a result, freshwater spawning, rearing, and migration PBFs are not expected to be diminished. Therefore, NMFS concludes that the Proposed Action of releasing Tucannon River Chinook salmon in the Kalama River will have a negligible negative effect on PBFs in the Action Area, though there may be a small positive impact from nutrient enhancement from additional carcasses in the Lower Columbia River.

2.7. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the Action Area of the federal action subject to consultation (50 CFR 402.02). Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.4.2).

For the purpose of this analysis, the Action Area is that part of the Lower Columbia River Basin described in Section 2.3. To the extent ongoing activities have occurred in the past and are currently occurring, their effects are included in the environmental baseline (whether they are federal, state, tribal, or private). To the extent those same activities are reasonably certain to occur in the future (and are tribal, state, or private), their future effects are included in the cumulative effects analysis. This is the case even if the ongoing, tribal, state, or private activities may become the subject of section 10(a)(1)(B) incidental take permits in the future. The effects of such activities are treated as cumulative effects unless and until an opinion has been issued.

State, tribal, and local governments have developed plans and initiatives to benefit listed species and these plans must be implemented and sustained in a comprehensive manner for NMFS to consider them "reasonably foreseeable" in its analysis of cumulative effects. The Federally approved draft Recovery Plan for Lower Columbia River Chinook Salmon (LCFRB 2010a) is such a plan and it describes, in detail, the on-going and proposed Federal, state, tribal, and local government actions that are targeted to reduce known threats to ESA-listed salmon and steelhead in the Snake River Basin. NMFS released this document for public comment on October 27, 2016 through February 9, 2017. It is acknowledged, however, that such future state, tribal, and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives, and land use and other types of permits and that government actions are subject to political, legislative and fiscal uncertainties. A full discussion of cumulative effects can also be found in the Columbia River System Biological Opinion {NMFS, 2020

#7606} and the Mitchell Act Biological Opinion (NMFS 2017a), many of which are relevant to this Action Area. It should be noted that the actions in the FCRPS Biological Opinion—the operation of the Columbia River Federal Hydropower system—and the Mitchell Act biological opinion—the funding of Columbia River hatchery programs—are included in the baseline for this opinion as discussed above.

We note here that the Mitchell Act Opinion is undergoing reinitiation and is expected to be completed by the end of 2024. The 2017 Mitchell Act Opinion was originally scheduled to cover the distribution by NMFS of Mitchell Act funds through 2025. The hatchery programs analyzed in that opinion are predominantly state and tribal hatchery programs, however, and are expected to continue indefinitely. Therefore, the programs from that opinion, and their effects, are included here as cumulative effects.

2.8. 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.

In assessing the overall risk of the Proposed Action on each species, NMFS considers the risks of each factor discussed in Section 2.4.2., above, in combination, considering their potential additive effects with each other and with other actions in the area (environmental baseline and cumulative effects). This combination serves to translate the positive and negative effects posed by the Proposed Action into a determination as to whether the Proposed Action as a whole would appreciable reduce the likelihood of survival and recovery of the listed species and their designated critical habitat.

Lower Columbia River Chinook salmon

Best available information indicates that Lower Columbia River Chinook Salmon ESU is at high risk and remains at threatened status. Risks to this ESU are primarily from climate change and increasing stream temperatures as well as incidental harvest impacts during mainstem fisheries {Ford, 2022 #8327}. Hatchery effects continue to present some risks to the persistence of the LCR Chinook salmon ESU, but the risk has decreased slightly in recent years because of changes in management {Ford, 2022 #8327}.

Because the Tucannon Chinook salmon releases in the Kalama River are all intended to be collected and removed from the natural environment when they return as adults, the risk is less than a traditional hatchery that integrates fish into the natural population intentionally, which may pose more genetic risk. Because this program is only being operated for three generations (12 years), the risk is also limited in time, and less likely to be an ongoing risk. Because the initial contribution of Tucannon River Chinook spawning in the wild will be low, combined with overall survival from smolt to adult being less than two percent per year, any ongoing genetic influence after program cessation will diminish quickly. Genetic change and fitness reduction resulting from outbreeding depression depends partly on the duration of hatchery program operation (i.e., the number of generations that fish are propagated by the program). The number of years the exposure takes place increases the risk that outside genes may be passed along from generation to generation, and be represented in more individuals within the population, which can continue to pass along outside traits. When the exposure stops, the natural population returns to being the dominant gene influence, and, if outside genes have not been incorporated at high levels in a large proportion of individuals, the risk diminishes over time.

While there is some risk that Tucannon River Chinook released from the Kalama Falls hatchery would compete with the natural-origin Chinook salmon for space and habitat (juvenile and adult), that risk is small, and the primary risk would be from Tucannon Chinook salmon spawning successfully in the populations of the Lower Columbia River.

In general, the effects of releasing Tucannon River Chinook salmon into the Kalama River are expected to be low for the following reasons:

- Competition between Tucannon smolts released and natural-origin smolts will be reduced by releasing fish when they are ready to migrate, so that they leave the tributaries quickly.
- Competition between Tucannon adults and natural-origin adults will be limited by collection of most adults at the Kalama Falls Fish Hatchery. The remaining adults that are not collected, comprise a small percentage of the total adults in the system, and are not expected to reduce spawning habitat availability in the basin or reduce natural-origin adults' ability to find and use suitable spawning habitat (section 2.5.1).
- The program will use existing facilities that are already being used for another Chinook salmon program, and will not expand the operation physically or operationally. Thus, all effects of the facilities are considered part of the baseline and not an effect of this action.

While there is some risk of genetic outbreeding effects from Tucannon River Chinook spawning in the Lower Columbia River, those impacts are expected to be low for the following reasons:

- Measurable genetic impacts are expected to be limited to the Kalama River basin, and those impacts are expected to be low because:

- The release levels are not expected to reach the maximum allowed (100,000 smolts) for several years because of limited broodstock, which will reduce adult returns of Tucannon Chinook to the Kalama River. Section 2.5.1, above, analyzes effects under the scenario that releases reach the maximum targeted number (100,000); however, in years with lower release numbers, fewer fish would be expected to return, and thus a smaller impact would occur.
- Years with high returns of adult Tucannon River Chinook salmon are expected to be related to generally good ocean conditions, and would be returning to areas that are also affected by those good conditions. Thus, if the Tucannon River Chinook program returns more adults in a given year, the Kalama Chinook population would also be expected to return more adults, and, proportionally, the impact of Tucannon River Chinook spawning would be lower than the maximum impacts discussed above because they assume high Tucannon returns combined with static local returns.
- Monitoring and program adaptive management will facilitate appropriate action to keep impacts from reaching a level of concern when releases approach the maximum of 100,000 smolts into the Kalama River.

Because of the low abundance and poor returns of Tucannon Chinook, the release of Tucannon Chinook in the Kalama River will likely lead to improved survival, which will be a positive for the population. There is also a higher likelihood of preserving the unique genetics of the Tucannon River Chinook population through the increase in abundance.

After taking into account the current depressed viability status of the species, the Environmental Baseline, the effects of the proposed hatchery programs, and cumulative effects, NMFS concludes that the Proposed Action is not likely to appreciably reduce the likelihood of survival and recovery of the Lower Columbia River Chinook Salmon ESU. Though there are adverse effects of artificial propagation, including genetic outbreeding impacts, and competition, the magnitude of these effects as a result of the release of Tucannon River Chinook into the Kalama River is relatively small. Furthermore, these effects are monitored and programs can be adaptively managed to minimize these effects. If the program is successful, the increased abundance of Tucannon spring Chinook salmon may improve the survival opportunities for the Lower Snake River MPG.

Critical Habitat

The proposed action does not include any additional hatchery infrastructure, construction, or changes in current operations. The impact on the spawning, rearing, and migration PBFs will be negligible, and will not appreciably diminish the capability of the critical habitat to satisfy the essential requirements of the species.

Climate change may have some effects on critical habitat as discussed in Section 2.4.2. With continued losses in snowpack and increasing water temperatures, it is possible that increases in the density and residence time of fish using cold water refugia could result in increases in ecological interactions between hatchery and natural-origin fish of all life stages. However, the continued restoration of habitat may alleviate some of this potential pressure for suitable rearing and spawning habitat.

The release of Tucannon River Chinook in the Kalama River is not expected to exacerbate any effects from climate change within the Lower Columbia River. This is primarily because the program is not intended to provide adults for spawning in the Lower Columbia River; neither smolts or adults are expected to provide many fish that will use the habitat year-round, and will not contribute enough fish that could otherwise further limit availability for natural-origin Chinook in the basin.

After reviewing the Proposed Action and conducting the effects analysis, NMFS has determined that the Proposed Action will not impair PBFs designated as essential for spawning, rearing, juvenile migration, and adult migration for Lower Columbia River Chinook salmon.

2.9. Conclusion

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the Proposed Action, including effects of the Proposed Action that are likely to persist following expiration of the Proposed Action, and cumulative effects, it is NMFS' biological opinion that the Proposed Action is not likely to jeopardize the continued existence of the Lower Columbia River Chinook Salmon ESU, or destroy or adversely modify its designated critical habitat.

2.10. 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.

2.10.1. Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities

Chinook Salmon

As described in Section 2.5, above, effects of hatchery fish on the genetics of natural-origin fish can occur through outbreeding depression. There may be further take caused by ecological interactions between hatchery- and natural-origin adults; specifically, spawning site competition and redd superimposition. These genetic and ecological effects cannot be directly measured because it is not possible to observe gene flow or interbreeding or other physical interactions between hatchery and natural fish in a reliable way.

Within the Lower Columbia River, NMFS expects that genetic impacts that could lead to take from Tucannon River Chinook spawning with natural-origin Chinook, will occur primarily in the Lewis and Kalama Rivers. Though some Tucannon Chinook may also return to the Cowlitz River, they are expected to contribute such a small percentage to the population overall, that impacts are not expected.

For all forms of take described above, including both genetic and ecological effects, NMFS will rely on a combination of two surrogate measures of incidental take that both represent gene flow from the Tucannon Chinook population into the local natural-origin Chinook populations. The first will be an estimate (based on run projections, trapping, and spawning ground surveys) of the proportion of Tucannon Chinook salmon within each of the populations each spawning season based on run predictions. The second will be a refined estimate of the proportion that may have actually contributed to spawning in the area. The first will provide an estimate based on run projections to determine if stray rates are approaching a level of concern, and may allow for some in-season management options. The second will be used to give a refined estimate, based on spawning ground surveys and final run numbers of whether the Tucannon Chinook present in the river system actually contributed to the natural-origin population, because not all would be expected to spawn successfully and actually contribute genes to the local population.

The surrogates will be described as follows:

- First, a maximum proportion of three (3) percent of Tucannon River Chinook as part of the total number of Chinook abundance calculated in each of the lower Columbia River populations (Kalama, Cowlitz, and Lewis) in any spawning season. This will represent the theoretical maximum contribution of gene flow from the Tucannon Chinook population into the natural-origin population in the area, and can be estimated in relative real-time as the season progresses.
- Second, a maximum estimated spawning contribution to each local population (Kalama, Cowlitz, and Lewis) of 2.5 percent by Tucannon Chinook based on spawning surveys and/or genetic sampling showing evidence of successful spawning (spawned out carcasses). This further refines the previous surrogate by estimating the actual gene flow into the affected population annually.

These two take surrogates will serve as effective reinitiation triggers because they are quantifiable, and are easily monitored by program managers. We expect program managers to estimate and monitor the rate of straying, and thus the potential risk of genetic contribution, as the season progresses as well as confirm after the season whether the impact of concern (outbreeding depression) is consistent with the population estimates from earlier in the season. Because the surrogates will be evaluated during and after each season, timely reinitiation would be possible if the values were to be exceeded.

These Kalama, Cowlitz, and Lewis River populations represent the “primary” and “contributing” populations needed for viability of the ESUs leading to delisting; therefore, if the estimated stray and spawning contribution rate is below the surrogate targets above, this indicates that the take through genetic introgression is not more than we anticipated. If estimated spawning contribution rates are above these targets, comanagers will need to make adjustments accordingly to reduce the rates below the limits identified above.

While these metrics do not directly measure the gene flow leading to outbreeding depression, a higher proportion of Tucannon Chinook spawners in the environment is expected to increase the potential for Tucannon Chinook to negatively influence the natural-origin population through addition of out-of-ESU gene flow. Therefore, the take surrogate is rationally connected to the take expected to occur. Moreover, this can be effectively measured and monitored for the purposes of tracking the program’s performance.

Additionally, these take surrogates will help limit any take resulting from redd superimposition or competition for habitat or spawning sites because the proportion of Tucannon Chinook salmon adults in each system will be kept low enough to minimize interactions at the individual or population scale.

2.10.2. 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 Lower Columbia River Chinook ESU or destruction or adverse modification of its critical habitat.

2.10.3. 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 incidental take. The USFWS through the LSRCP, in cooperation with WDFW, shall:

1. Ensure sufficient funding is allocated during budget decision processes to provide consistent and dependable operation, maintenance, and monitoring and evaluation of the Kalama releases of the Tucannon Chinook salmon hatchery program and adult collection facilities required to monitor and manage adult returns to minimize impacts.

2. Minimize the effects of the Kalama releases of the Tucannon Chinook salmon hatchery programs on ESA-listed natural-origin salmon and steelhead in the Lower Columbia River and its tributaries.

3. Provide NMFS with annual reports describing the implementation and monitoring on the impacts and expected incidental take on listed species in the action area.

2.10.4. 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 USFWS, through the LSRCP 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:
    a. The USFWS through the LSRCP and in coordination with WDFW shall ensure that funding is allocated during budget planning process are sufficient to implement the monitoring and evaluation activities outlined below:
        i. Unique tagging of Tucannon Chinook salmon released in the Kalama River.

    ii. Continued operation of the Kalama Falls Hatchery barrier and trap, which is already being used for collecting Kalama River broodstock, at maximum efficiencies possible throughout the adult return period to capture and remove as many Tucannon Chinook salmon adult returns to the Kalama River.
    iii. Maintaining spawning ground surveys to identify Tucannon Chinook salmon strays into Lower Columbia River tributaries (Lewis, Cowlitz, and Kalama Rivers) sufficient to estimate genetic contribution to Lower Columbia River Chinook salmon populations using the surrogates above.

2. The following terms and conditions implement reasonable and prudent measure 2:
    a. In order to minimize the negative effects of ecological interactions between hatchery- and natural-origin juvenile fish in the Lower Columbia River and its tributaries, the program operators shall ensure juvenile Tucannon Chinook salmon that are transferred to and released from Kalama Falls Hatchery are in good health.
    b. Juvenile salmon shall be transferred, reared, and released using the best management practices described in the Integrated Hatchery Operations Team 1995 Report and the WDFW Anadromous Salmon and Steelhead Policy to produce healthy smolts ready to make the transition to saltwater.
    c. The program operators shall ensure that transfers comply with the Washington state guidance for Aquaculture Disease Control for fish transfers to ensure that any fish transferred from Tucannon River to the Kalama River are free of disease prior to transport.

3. The following terms and conditions implement reasonable and prudent measure 3:
    a. The applicants shall provide reports to SFD annually for implementation of the Kalama releases of Tucannon River Chinook salmon program and associated RM&E activities. All reports and required notifications are to be submitted electronically to the NMFS, West Coast Region, Sustainable Fisheries Division, Anadromous Hatcheries South Branch. The current point of contact for document submission is Brett Farman (brett.farman@noaa.gov, 503-231-6222).
    b. An annual RM&E report(s) is submitted by applicants no later than March 31st of the year following releases and associated RM&E (e.g., release/RM&E in year 2024, report due March 2025) that will include:
        i. The number, dates, size, health condition, and markings of Tucannon Chinook salmon smolts released into the Kalama River.
        ii. The number of Tucannon Chinook salmon adults trapped in the lower Columbia River tributaries (Kalama, Cowlitz, and Lewis) by location with their respective

proportion to the natural population in each tributary, as well as the disposition of those adults.

iii. The number of Tucannon Chinook salmon observed, collected, or sampled during spawning ground surveys in tributaries of the Lower Columbia River to include:
    1. Observations about spawning condition of female carcasses (pre-spawn or post-spawn).
    2. Number and proportion of Tucannon Chinook salmon carcasses observed in each reach or location relative to total carcasses in that reach or location.

iv. Any other information that may indicate the spawning success of Tucannon Chinook salmon in the tributaries of the Lower Columbia (for example, proximity to redds, or tail condition indicating redd construction, if available).

v. Any problems that may have arisen during hatchery activities.

vi. Any unforeseen effects on ESA-listed fish.

2.11. 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).

Because the effects of this action will be closely monitored, the action is limited to 12 years (three generations), and ongoing implementation will be informed by monitoring results, NMFS has not identified any additional conservation recommendations for this Proposed Action.

2.12. Reinitiation of Consultation

This concludes formal consultation for the Tucannon Chinook salmon releases in the Kalama River.

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 Pacific Coast salmon (PFMC 2003) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

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)].

The Proposed Action is the implementation of a spring Chinook salmon hatchery programs in Washington for conservation of the Tucannon Chinook salmon population, as described in Section 1.3. The Action Area includes habitat described as EFH for Chinook and coho salmon (PFMC 2003) within the Columbia River Basin.

It is still reasonable to consider EFH impacts as described by (PFMC 2014). As laid out there, the freshwater EFH for Chinook and coho salmon has five habitat areas of particular concern (HAPCs): (1) complex channels and floodplain habitat; (2) thermal refugia; (3) spawning habitat; (4) estuaries; and (5) marine and estuarine submerged aquatic vegetation. NMFS does not believe any HAPC will be affected by the Proposed Action.

3.2. Adverse Effects on Essential Fish Habitat

The Proposed Action has negligible, if any, effects on the major components of EFH. Hatchery programs have been in operation for years and do not include any construction or change any habitat features in the Lower Columbia River. There will be no change to (1) complex channels and floodplain habitat; (2) thermal refugia; (3) spawning habitat; (4) estuaries; and (5) marine and estuarine submerged aquatic vegetation.

The PFMC (2014) recognized concerns regarding the “genetic and ecological interactions of hatchery and wild fish… [which have] been identified as risk factors for wild populations.” The biological opinion describes in considerable detail the impacts the hatchery programs might have on natural populations of Chinook salmon. However, these impacts will occur on a very small scale because of the small size of the program, and adult management objectives described in the Proposed Action (see section 2.5.1). Coho salmon will not be impacted genetically from the release of Chinook salmon.

Ecological effects of juvenile and adult hatchery-origin fish on natural-origin fish are discussed in Section 2.5. Hatchery fish returning to the Lower Columbia River are expected to be managed to minimize Tucannon Chinook spawning naturally in the Lower Columbia River.

For the reasons summarized above, NMFS determines that the proposed action would not adversely affect EFH. This concludes the EFH consultation.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS has no conservation recommendations specifically for Chinook and coho salmon EFH applicable to this proposed action.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, USFWS must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation.

Because no EFH Conservation Recommendations were identified, no reporting of the number of recommendations adopted is required.

3.5. Supplemental Consultation

The USFWS 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 the USFWS. Other interested users could include WDFW, NPT, and CTUIR. Individual copies of this opinion were provided to the USFWS, WDFW, NPT, and CTUIR. 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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