Final Environmental Assessment

Issuance of an Endangered Species Act Section 10(a)(1)(A) Enhancement Permit to the California Department of Fish and Wildlife for the Operation of the Fall Creek Coho Salmon Hatchery Program

Prepared by the

NOAA's National Marine Fisheries Service, West Coast Region

July 2023

Title of Environmental Review:	Environmental Assessment for the Fall Creek Coho Salmon Hatchery Program
Evolutionary Significant Unit:	Southern Oregon Northern California Coast (SONCC)
Lead Agency and Official:	Jennifer Quan, Regional Administrator National Marine Fisheries Service, West Coast Region 501 West Ocean Boulevard, Suite 4200 Long Beach, California 90802
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Location of Proposed Activities:	Klamath River Watershed in Northern California

Activity Considered: National Marine Fisheries Service proposes to issue an Endangered Species Act section 10(a)(1)(A) enhancement permit for the operation of the Fall Creek coho salmon Hatchery Program according to the hatchery genetic management plan submitted by California Department of Fish and Wildlife.

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ACRONYM LIST

CA HSRG	California Hatchery Scientific Review Group
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
DPS	Distinct Population Segment
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FCH	Fall Creek Hatchery
HGMP	Hatchery Genetic Management Plan
HSRG	Hatchery Scientific Review Group
HOR	Hatchery-Origin
IGH	Iron Gate Hatchery
KRRC	Klamath River Renewal Corporation
NCRWQCB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
pHOS	Proportion of Natural Spawning Population Consisting of Hatchery Origin Fish
PNI	Proportionate Natural Influence
pNOB	Proportion of Hatchery Broodstock Consisting of Natural Origin Fish
SONCC	Southern Oregon Northern California Coast
USFWS	United States Fish and Wildlife Service

1 INTRODUCTION

The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) is the lead agency responsible for administering the Federal Endangered Species Act (ESA) (16 U.S.C. 1531 *et seq.*) as it relates to listed salmon and steelhead. Actions that may affect listed species are reviewed by NMFS under section 7 and section 10 of the ESA, or under section 4(d), which can be used to limit the application of take prohibitions described in section 9 of the ESA.

The California Department of Fish and Wildlife (CDFW) provided NMFS with a section 10(a)(1)(A) enhancement permit application and hatchery genetic management plan (HGMP) for the Fall Creek Hatchery (FCH) Coho Salmon Program (Program) (CDFW 2022a). The HGMP provides a framework for the breeding, rearing, releasing, and associated monitoring and evaluation activities that will occur in streams of the Klamath River watershed known to support populations of the federally threatened Southern Oregon Northern California Coast (SONCC) coho salmon Evolutionarily Significant Unit (ESU).

NMFS seeks to consider, through National Environmental Policy Act (NEPA) analysis, how its pending actions may affect the natural and physical environment and the relationship of people with that environment. The NEPA analysis provides an opportunity to consider, for example, how the action may affect conservation of non-listed species and socioeconomic objectives that seek to balance conservation with the use of affected resources.

On February 1, 2023 CDFW submitted an ESA enhancement permit application and associated HGMP for the Program to NMFS. If NMFS determines that the application meets all applicable criteria, NMFS will issue the ESA section 10(a)(1)(A) enhancement permit to the CDFW for operation of the Program as described in the HGMP (CDFW 2022a) and summarized in section 1.1 below.

This Environmental Assessment (EA) is being prepared using the 2020 Council on Environmental Quality (CEQ) NEPA Regulations as modified by the Phase I, 2022 revisions. The effective date of the 2022 revisions was May 20, 2022, and reviews begun after this date are required to apply the 2020 regulations as modified by the Phase I revisions unless there is a clear and fundamental conflict with an applicable statute. This EA began on July 26, 2023 and accordingly proceeds under the 2020 regulations as modified by the Phase I revisions.

1.1 Description of the Proposed Action

CDFW is applying for an Endangered Species Act (ESA) Section 10(a)(1)(A) permit for the FCH coho salmon program. The ESA Section 10(a)(1)(A) application incorporates an HGMP developed by CDFW. NMFS will use the information in the HGMP to determine whether to issue an ESA section 10(a)(1)(A) permit to CDFW.

1.1.1 Overview of HGMP

The HGMP is an update to the 2014 version developed for the coho salmon hatchery program at Iron Gate Hatchery (IGH) (CDFW and PacifiCorp 2014). It was anticipated that the 2014 HGMP would cover hatchery operations until mainstem Klamath River dams of the Klamath Hydroelectric Project were removed (Federal Energy Regulatory Commission Project Nos. 14803-001 and 2082-063). Dam removal is expected to occur in 2024 (NMFS 2021). By that time, the existing IGH facility will cease operations and an updated hatchery will be constructed at Fall Creek located approximately sever river miles upstream of the old hatchery facility. To ensure that hatchery operations continue without interruption in the year of dam removal, FCH will have to be operational in the months prior to dam removal (2023). Hatchery operations will be paid for by PacifiCorp for eight years following dam removal. CDFW will operate the hatchery.

The Program will culture coho salmon of the Upper Klamath Population Unit. This unit is part of the SONCC ESU that is listed as Threatened under ESA. The HGMP incorporates principles of hatchery operations developed by the Hatchery Scientific Review Groups (HSRGs) of the Columbia River and California.

The primary purpose of the Program is to protect the genetic resources of the Upper Klamath Population Unit and reduce extinction risks prior to and after the removal of the four Klamath River dams for eight years. The purpose would be achieved by integrating natural origin (NOR) adults into broodstock and using a genetically based spawning matrix to reduce inbreeding. The NOR fish required to integrate the program will be obtained from Bogus Creek, the IGH auxiliary fish ladder, Fall Creek (e.g., via seine or dip net) and fish volitionally entering FCH as described in the broodstock collection document (CDFW 2022b), and the Terms and Conditions of NMFS' Biological Opinion for the Surrender and Decommissioning of the Lower Klamath Hydroelectric Project (NMFS 2021).

The secondary purpose of the Program is to provide adult coho salmon that could disperse to newly accessible habitat (~76 miles) made available from dam removal (DOI and CDFG 2012). The potential dispersal of Program adult coho salmon results from fish straying to tributaries other than Fall Creek and by releasing adult coho salmon surplus to broodstock needs back to the mainstem Klamath River near Fall Creek.

Hatchery origin (HOR) adult fish not needed for broodstock may also be released directly to Bogus Creek. This stream will be used as one of the four locations to collect NOR adults needed for broodstock as a weir/trap is already in place. Because NOR fish will be collected and removed from this stream to integrate the Program, it may be necessary to release some hatchery adults back to the stream to maintain a continuing supply of readily accessible NORs and/or increase the genetic diversity of this subpopulation. The Program will remove no more than 50% of the naturally produced adults returning to Bogus Creek each year for broodstock. Therefore,

Bogus Creek will be managed to achieve a pHOS[1] of <0.5 upstream of the weir when adult run size allows.

The proportion of the broodstock consisting of NOR adults (pNOB) will be as large as possible – but not less than 10% - given the following four limitations:

1. Yearling smolt production will not exceed 75,000 fish.
2. No more than 50% of the NOR adults encountered at the Bogus Creek weir/trap may be removed each year for broodstock.
3. The number of fish spawned each year will be based on the results of the genetically based spawning matrix. Fish will only be mated (spawned) if resulting genetic relatedness coefficient (Rxy) is 0.10 or less.
4. NOR and HOR adults may be collected directly from Fall Creek for use as broodstock if approved by the CDFW and NMFS, accounting for recommendations by a hatchery technical team representative of Klamath Basin fisheries managers.

HOR adult coho salmon surplus to broodstock may also be released to the mainstem Klamath River near Fall Creek. NOR adults rejected by the spawning matrix for broodstock use would be released close to where they were collected.

Additionally, surplus HOR adults could be released to the Shasta River based on recommendations by the hatchery technical team, with approval of CDFW and NMFS. The details of supplementation of hatchery adults into the Shasta River, including the number of fish and location of release, would require additional clarification and permitting before a supplementation program would be implemented.

The number of surplus fish released each year to any location will be determined by a hatchery technical team based on:

- Results of genetic analysis;
- Management objectives for Bogus Creek;
- Management objectives for the Shasta River.

Program monitoring and evaluation (M&E) will consist of the following activities:

- In-hatchery fish production and survival by life stage, disease prevalence, treatment, and water quality monitoring of influent, rearing vessels, and effluent.
- Genetic sampling of coho salmon adults for the spawning matrix.
- Proportion of NOR and HOR fish used for spawning.
- Calculate PNI (proportionate natural influence) for Coho salmon spawners in Bogus Creek.
- Average smolt to adult survival rate calculated annually.
- Average release size, with variation, annually.

[1] Proportion of the natural spawning population consisting of hatchery origin fish.

- Quantifying juvenile coho salmon production in Bogus Creek. Genetic samples will also be collected from a portion of the juveniles captured each year.
- Adult monitoring and broodstock removal at the Bogus Creek weir/trap. Genetic samples will be taken from all coho salmon released upstream of the weir or considered for broodstock.

Additionally, fish behavior at the new fish ladder at Fall Creek will be monitored for three-years. Such monitoring is needed to confirm that coho salmon entering Fall Creek can successfully migrate to, enter, and pass through the ladder.

Operation of the Program as described is expected to continue the progress made in culture practices and outcomes with the implementation of the 2014 HGMP. The Program has been successful at increasing survival rates by life stage which results in a decrease in the number of coho salmon adults taken for broodstock. The Program has also increased the proportionate natural influence (PNI) of the population from 0.19 (pre-2014) to 0.50. The higher the PNI value the more the natural environment drives the local adaptation (i.e., fitness) of the population which is expected to result in increased survival, abundance, and productivity over time.

1.2 Purpose and Need for Action

The purpose of the action is for NMFS to approve the ESA permit application and issue an ESA section 10(a)(1)(A) enhancement permit to CDFW for the operation of the coho salmon Program as described in the HGMP. The need for the action is to ensure that the propagation of hatchery-origin (HOR) SONCC coho salmon will not reduce the likelihood of the survival and recovery for NOR SONCC salmon.

1.3 Project Area

The Project Area is the geographic area where the Program would take place. This includes the location of activities described in the HGMP and associated production facilities (Figure 1).

Program coho salmon will be spawned, incubated, reared, and released at FCH located at Fall Creek, California. The fish will be released directly from the hatchery and will migrate from this point through the Klamath River and into the Pacific Ocean. Resultant adult coho salmon produced by the Program juveniles will return to FCH and may also stray into major Klamath River tributaries.

1.4 Public Involvement

Although public comment was not requested specific to the EA, substantial effort was made to include public involvement related to the HGMP. On July 12, 2022 CDFW released a draft HGMP for comment from partners including NMFS, Tribal partners, United States Fish and Wildlife Service (USFWS), PacifiCorp, and Oregon Department of Fish and Wildlife (ODFW), Klamath River Renewal Corporation, and the City of Yreka. Comments were requested by August 19, 2022. Between August 19, 2022 and February 1, 2022 CDFW and NMFS coordinated to amend the draft HGMP as needed in response to comments by partners. On

February 1, 2023 CDFW submitted a final FCH coho salmon program HGMP to NMFS as an attachment to an application for an ESA Section 10(a)(1)(A) permit for scientific research and enhancement activities associated with implementation of the final draft FCH coho salmon program HGMP. The final draft HGMP submitted on February 1, 2023 is dated December 2022. On March 27, 2023, NMFS announced receipt of the permit application in the Federal Register. This notice advised the public that the permit application and associated HGMP were open for a 30 day public comment period, which closed on April 26, 2023. No public comments were received during this public comment period.

2 ALTERNATIVES

2.1 Alternatives Analyzed in Detail

Two alternatives are considered in this EA:

- Alternative 1: Do Not Issue the Section 10(a)(1)(A) Permit; Do not Approve the HGMP (No Action);
- Alternative 2: Issue the Section 10(a)(1)(A) Permit with Conditions and Approve the HGMP (Proposed Action).

In 2014, NMFS completed a Biological Opinion for the implementation of the coho salmon program at IGH (NMFS 2014). Coho salmon production at IGH is being transferred to the new facility at Fall Creek. The target number of hatchery fish (75,000) to be released each year remains unchanged and effects to listed species will be similar as well.

The Program is a requirement of the Klamath River Hydroelectric Settlement Agreement (KHSA 2010, Amended 2016). The settlement calls for the decommissioning and removal of Lower Klamath River dams. The KHSA requires PacifiCorp, the previous owner of the Lower Klamath River Hydroelectric Project, to maintain funding for hatchery production for eight years following the removal of project.

NMFS completed a Biological Opinion for the surrender and decommissioning of the Lower Klamath Hydroelectric Project (FERC No. 14803-001) in 2021 (NMFS 2021). The Biological Opinion included an analysis of Fall Creek Hatchery construction effects to listed species and their habitat but did not address hatchery operation effects to coho salmon.

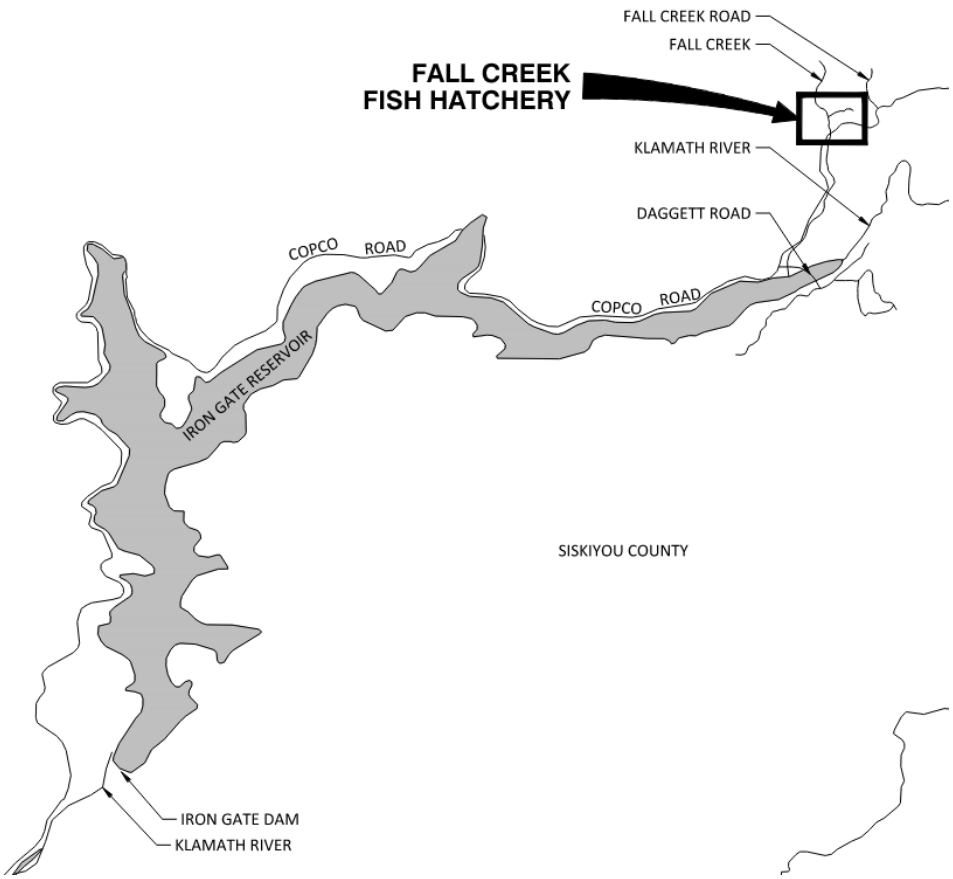


Figure 1. Fall Creek Hatchery Vicinity and Site Map. Reproduced from Amended Application for Surrender of License for Major Project and Removal of Project Works – Appendix F.

2.1.1 Alternative 1: Do Not Issue the Section 10(a)(1)(A) Permit (No Action)

Under this alternative, NMFS concludes that the submitted permit application fails to meet the criteria necessary to issue an ESA section 10(a)(1)(A) permit, and NMFS would not issue the ESA section 10(a)(1)(A) permit to CDFW. Because the HGMP would not be approved, the hatchery actions proposed by CDFW for coho salmon would not have ESA authorization or exemptions as described in the ESA. For this EA, NMFS treats Alternative 1 (No Action) as resulting in the termination of the coho salmon Program until a new permit application is submitted, and the applicants are granted an ESA section 10(a)(1)(A) permit.

For analysis purposes, the EA also assumes that failure to issue the Permit would not result in the termination of the fall Chinook salmon hatchery program at FCH. This hatchery program, as well as all facilities required for its operation, would continue for at least eight years consistent with existing agreements.

2.1.2 Alternative 2: Issue the Section 10(a)(1)(A) Permit with Conditions (Proposed Action)

The Proposed Action is to issue a permit under section 10(a)(1)(A) of the ESA to CDFW, for a period of eight years authorizing the hatchery production and release of up to 75,000 HOR coho salmon yearling juveniles and some resulting adult production into the Klamath River.

3 AFFECTED ENVIRONMENT

3.1 Introduction

The affected environment in this analysis is defined as that portion of the physical and biological environment that may be affected by the implementation of the alternatives described in Section 2. The affected environment includes riverine habitat accessible to anadromous coho salmon extending from Spencer Creek (downstream of Keno Dam, California) to the mouth of the Klamath River (Oregon), its estuary and the Pacific Ocean (Figure 2).

This chapter describes the existing baseline conditions for the following resources that may be affected by the two alternatives considered in this EA:

- Water Resources (Section 3.2),
- Salmon and Steelhead (Section 3.3),
- Other Fish Species (Section 3.4),
- Wildlife (Section 3.5),
- Cultural Resources (Section 3.6).

The proposed action is not expected to have effects on other resources (i.e., geologic resources, air quality, noise and visual resources, vegetation, and species of wildlife other than those addressed), therefore those resources are not specifically addressed in this analysis.

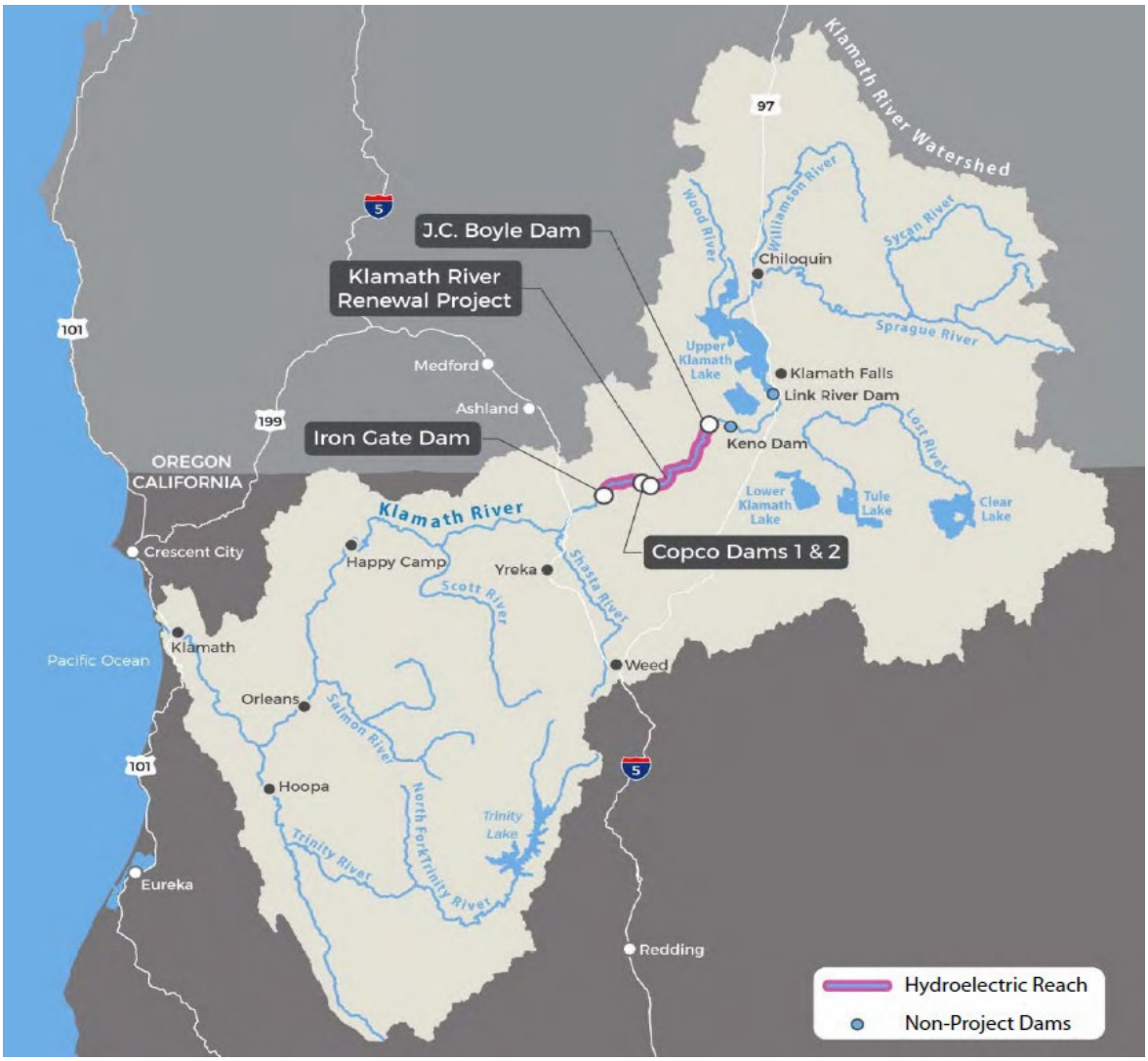


Figure 2. Klamath River watershed and facilities locations (Reproduced from FERC 2021).

3.2 Water Resources

The Program has the potential to affect the water resources of the Klamath River in both Oregon and California. The water resources most affected will be Fall Creek, a small tributary in California, where the hatchery is located. This stream flows into the Klamath River and therefore water resources of this river may also be affected by the Program.

3.2.1 Water Quantity

The hatchery utilizes 10 cfs of primarily spring-water from Fall Creek. The water is routed through the hatchery and returned to Fall Creek with minimal loss in flow volume due to either evaporation or leakage.

3.2.2 Water Quality

The temperature of the water used for the rearing of coho salmon at FCH ranges from approximately 43°F to 54.5 °F that have been found ideal for the culture of salmonids (Figure 3). Water oxygen levels are at or near saturation.

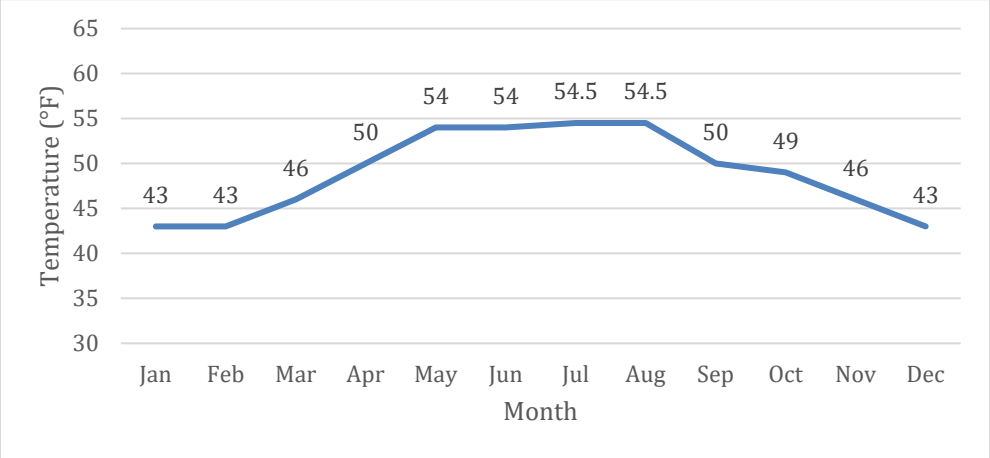


Figure 3. Fall Creek monthly stream temperatures in degrees Fahrenheit.

Settling ponds are used to ensure that hatchery effluent complies with the standards shown in Table 1. Compliance with the standards is monitored by sampling the facility effluent two times per month, with results submitted in a monthly report to the North Coast Regional Water Quality Control Board (NCRWQCB).

Table 1. Effluent limits of various water quality parameters at FCH National Pollutant Discharge Elimination System (NPDES) program required by the NCRWQCB.

Parameter	Effluent Limit (Daily Maximum)
Total Suspended Solids	15 mg/l
Total Settleable Solids	0.2 ml/l/hr.
pH	within 0.5 of receiving waters
Salinity (chloride)	250 mg/l
Temperature	no measurable change to receiving water
Turbidity	no increase > 20% of background
DO	> 7.0 mg/l
Flow – Warm Springs	15.5 million gallons/day

3.3 Fish Resources

A description of the biological resources of the project area are described below.

3.3.1 Salmon and Steelhead

The Klamath River supports populations of steelhead, Chinook salmon (spring and fall run) and coho salmon. Only coho salmon are listed under ESA.

3.3.2 Southern Oregon Northern California Coast (SONCC) Coho Salmon

Coho salmon (*Oncorhynchus kisutch*) to be propagated at FCH are part of the SONCC Evolutionary Significant Unit (ESU). The SONCC ESU includes all coho salmon populations from Cape Blanco, Oregon to Punta Gorda, California. On May 6, 1997, the NationalMarine Fisheries Service (NMFS) published the final rule establishing a threatened status for coho salmon in the SONCC ESU (62 Fed. Reg.24588). At the time of this listing determination, NMFS excluded hatchery stocks from the listing because artificially produced coho salmon were considered non-essential for recovery of the listed species. NMFS subsequently proposed status review updates for 26 listed ESUs. Thereafter, on June 28, 2005, NMFS promulgated final listing determinations for 16 salmon ESUs, including the SONCC ESU (70 Fed. Reg. 37159). The SONCC listing included coho salmon produced at IGH, Trinity River Hatchery (TRH) and Cole M. Rivers Hatchery (CRH) as part of the ESU.

The California Fish and Game Commission also listed coho salmon as a threatened species pursuant to the California Endangered Species Act within the California portion of the SONCC coho salmon ESU on March 30, 2005.

Coho salmon adults return to spawn at age three after spending 18 months in the ocean, but some sexually-mature males (jacks) return after one summer in the ocean. Age-four adults are less common in waters south of British Columbia. Adult coho salmon in general enter fresh water to

spawn from September through January. Data collected at the Bogus Creek weir showed that adult coho salmon entered the stream in late October, peaked in November/December, with the last fish observed in January (Knechtle and Giudice 2021). This run-timing is like that observed for coho salmon at IGH.

The egg incubation period (November through April) is inversely related to water temperature, but the embryos usually hatch after eight to twelve weeks. The fry emerges from the gravel between March and July, with peak emergence occurring from March to May, depending on when the eggs were fertilized andthe water temperature during development (Shapovalov and Taft 1954).

After one year in freshwater, wild coho salmon yearling smolts begin migrating downstream to the ocean in late-March or early April. Because hatchery fish are released at this time, they may compete with wild fish for food and space.

There are nine coho salmon population units in the Klamath River. The population type and status of each unit, regarding extinction risk, is shown in Table 2 and range from moderate to high. The location of each population unit is provided in Figure 4.

Table 2. SONCC coho salmon ESU populations of the Klamath River and their predicted risk of extinction based on spawner density (NMFS 2014b).

Stratum	Population	Estimated Extinction Risk	Population Type*
Interior Klamath	Middle Klamath River	Moderate	Non-Core 1
	Upper Klamath River	High	Core
	Shasta River	High	Core
	Scott River	Moderate	Core
	Salmon River	High	Non-Core 1
Interior Trinity	Lower Trinity River	High	Core
	South Fork Trinity River	High	Core
	Upper Trinity River	Moderate	Core
Central Coastal Basin	Lower Klamath River	High	Core

*Core populations are independent populations that are likely to respond to recovery actions and achieve low extinction risk. Non-Core 1 may achieve a moderate risk of extinction.

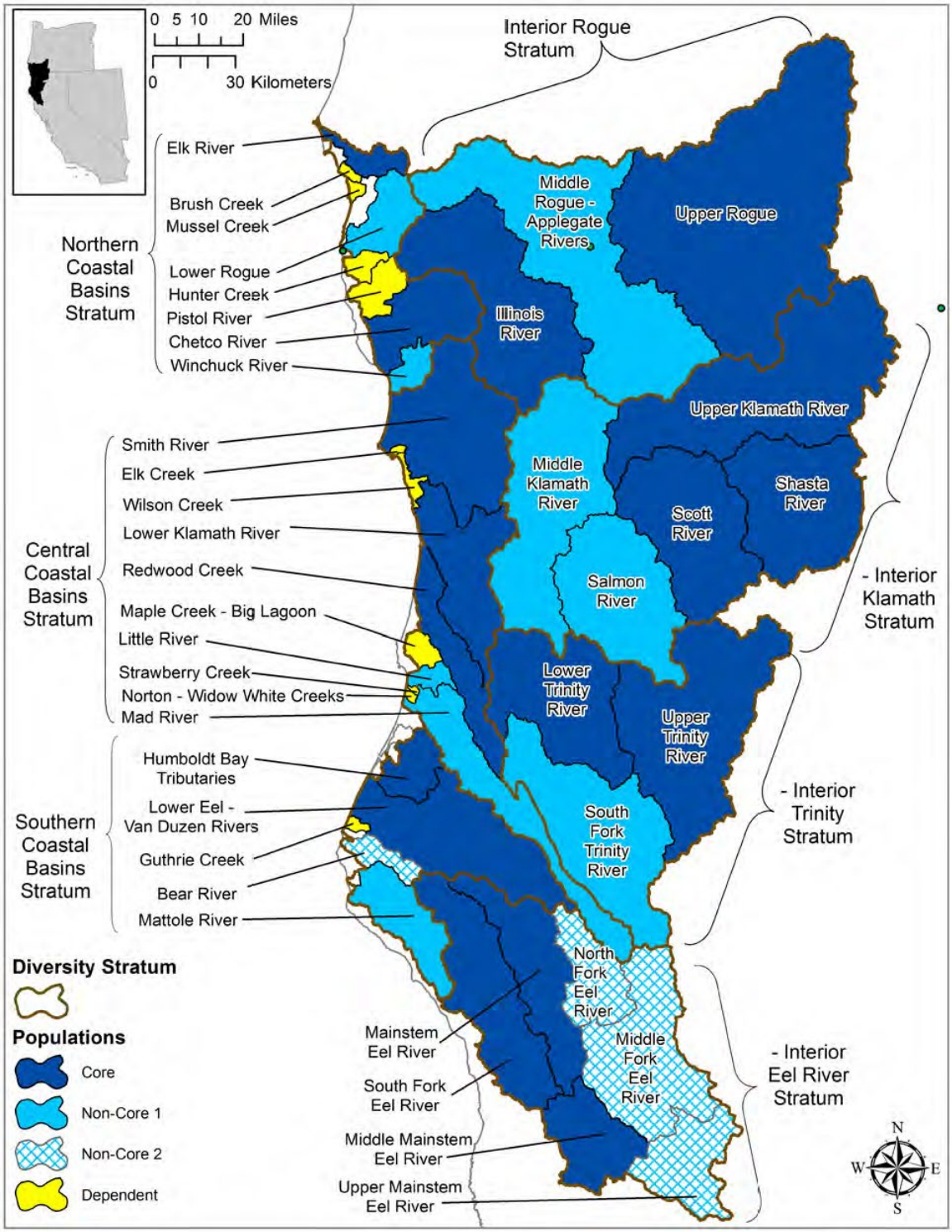


Figure 4. Core, non-core, and dependent populations within diversity strata of the SONCC coho salmon ESU. (NMFS 2014b).

The Program has the potential to affect the nine coho salmon population units of the Klamath River. Because FCH is in the Upper Klamath Population Unit, potential Program effects are greatest for this unit and least for the Lower Klamath and Trinity River population units.

A brief description of coho salmon abundance in each population unit is provided below.

3.3.2.1 Upper Klamath Population Unit

If a spawning population of coho salmon is too small, the survival and production of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Williams et al. (2008) determined at least 425 coho salmon must spawn in the Upper Klamath Population Unit each year to avoid such effects of extremely low population sizes (depensation threshold). The low-risk spawner threshold for the population is 8,500 spawners. However, about 43 percent of the available IP kilometers that define the Upper Klamath Population Unit occur upstream of Iron Gate Dam in areas that are not currently accessible to anadromous fish but will be after dam removal.

IGH has a goal of releasing 75,000 yearling coho salmon each year. The fish are released directly from the hatchery into the Klamath River within the Upper Klamath River Population Unit. This production is shifted to FCH under the HGMP.

Fish counts from the video counting station on Bogus Creek, returns to the Iron Gate Hatchery, and various tributary spawner surveys provide some indication of the current population size. Adult abundance data collected from 2015 to 2020 for coho salmon in Upper Klamath Population Unit tributaries showed that run-size varied from 170 to 455 fish. The number of coho salmon returning to Iron Gate Hatchery varied from 72 to 663 adult (Figure 5) (PacifiCorp 2021).

Coho salmon escapement to Bogus Creek since 2004 has been highly variable and averaged 134 adults (Figure 6).

3.3.2.2 Shasta River

The estimated number of NOR adult coho salmon returning to the Shasta River averaged 70 fish from 2007 to 2020 (Giudice and Knechtle 2021) (Figure 7).

If a spawning population is too small, the production and survival of eggs or offspring may suffer because it may be difficult for spawners to find mates, or predation pressure may be too great. This situation accelerates a decline toward extinction. Two out of three Shasta River coho salmon brood years have abnormally low abundance levels, indicating reduced population size and productivity that may have recently resulted in their extirpation.

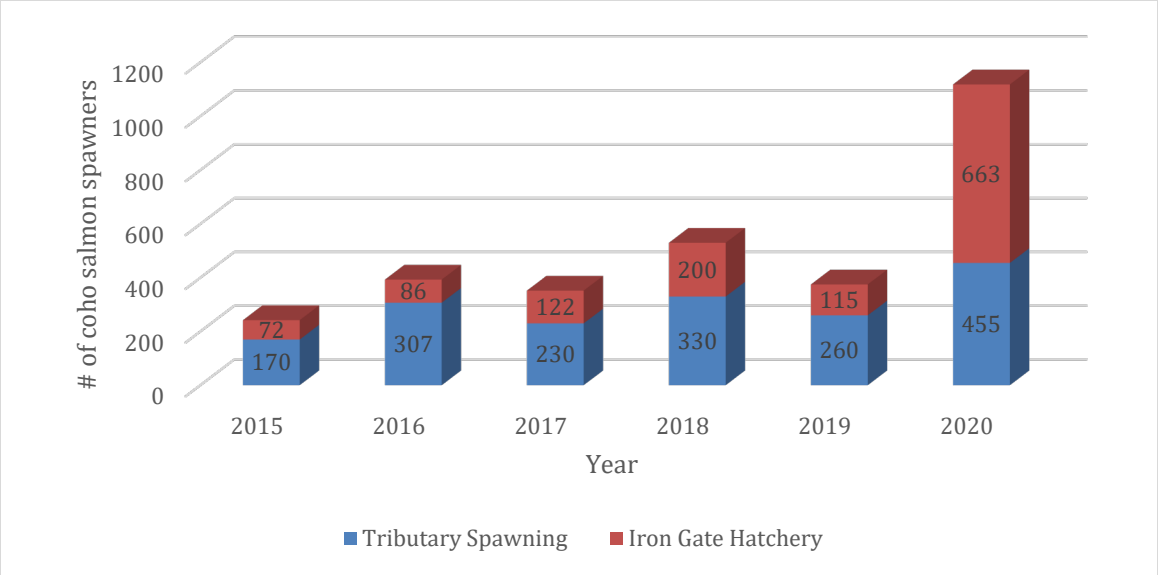


Figure 5. The number adult coho salmon spawning in tributaries of the Upper Klamath Population Unit and returns to Iron Gate Hatchery (2015-2020). Source: PacifiCorp 2021.

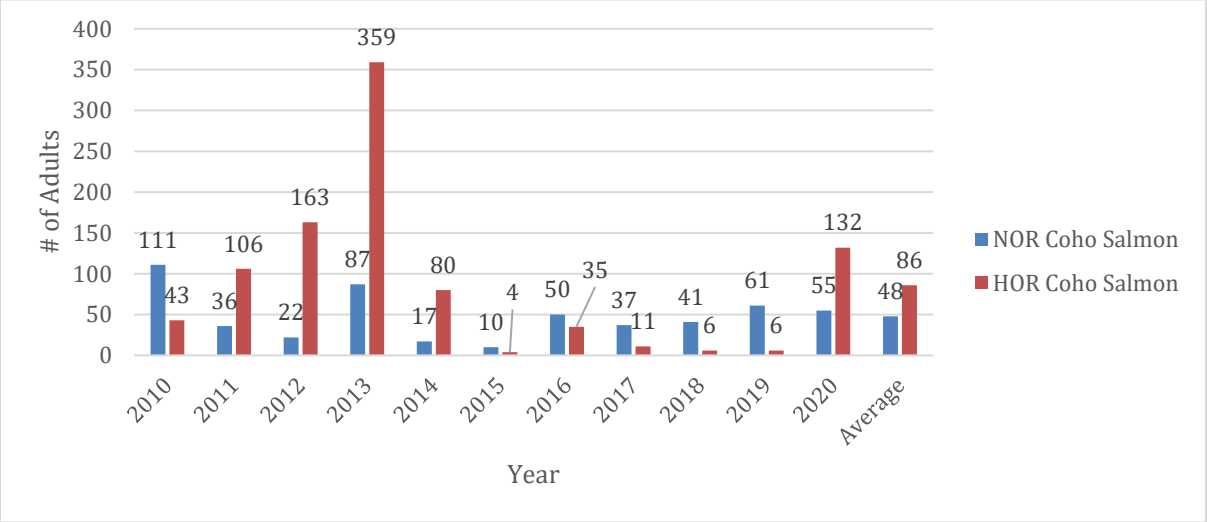
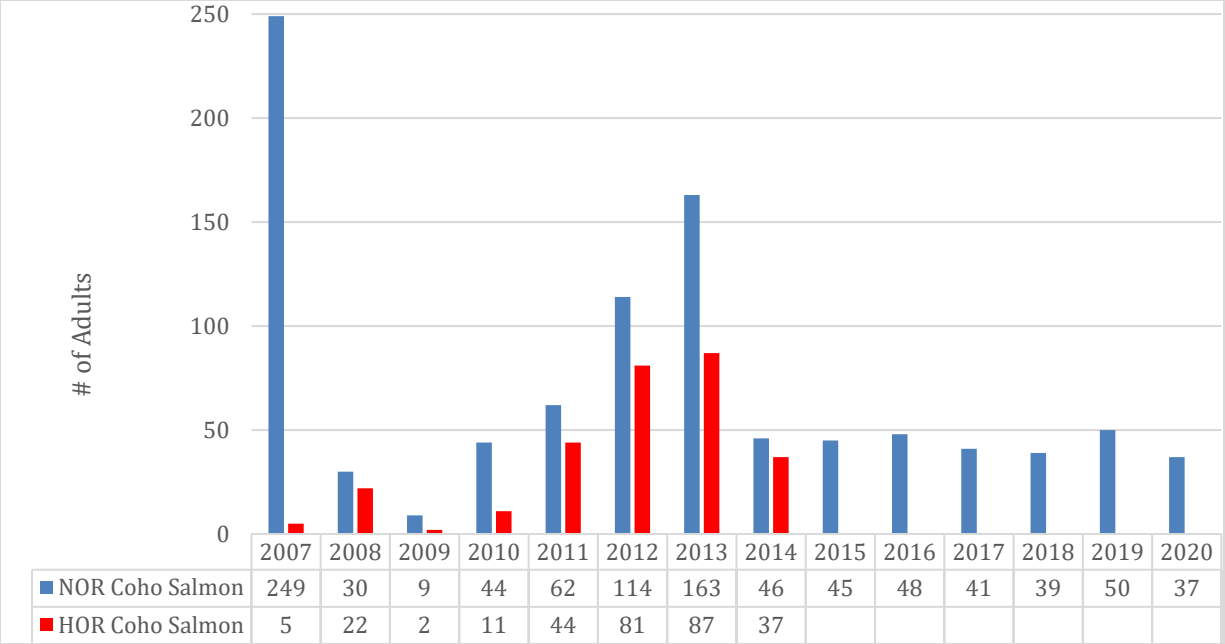


Figure 6. The estimated number of adult NOR and HOR coho salmon spawning in Bogus Creek from 2010 to 2020.



	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
NOR Coho Salmon	249	30	9	44	62	114	163	46	45	48	41	39	50	37
HOR Coho Salmon	5	22	2	11	44	81	87	37						

Figure 7. The estimated number of adult NOR and HOR coho salmon spawning in the Shasta River for return years 2007 to 2020. Data not available on HOR abundance for 2015 to 2020.

Williams et al. (2008) determined that at least 531 salmon must spawn in the Shasta River each year to avoid effects of extremely low population size. Adult spawning surveys and fish counting weir information started in 1934 are conducted by the CDFW. Recent weir counts indicate that adult spawning coho salmon number between 0-400 for most years. These brood year population estimates are low and have not trended upward over time. Therefore, the Shasta River coho salmon population is at high risk of extinction given the unstable and low population size and presumed negative population growth rate.

3.3.2.3 Scott River

In the Scott River, adult coho abundance has ranged from 63 to 2,752 and averaged 726 fish from 2007 to 2020. Approximately 1% of the coho salmon spawning in Scott Creek were of hatchery origin (i.e., IGH origin) (Knechtle and Giudice 2021a).

Williams et al. (2008) determined at least 441 coho salmon must spawn in the Scott River each year to avoid such effects of extremely low population sizes. From 2007 to 2020 the 441 fish spawner goal has only been achieved in six years.

3.3.2.4 Middle Klamath River

There is little new data available on the Middle Klamath River population since the submittal of the 2014 HGMP (NMFS 2019, Biological Opinion). NMFS (2019) concluded that although this population spatial distribution appears to be good, many of the tributaries are used for non-natal rearing and too little is known to determine extinction risk (NMFS 2021). NMFS (2021) assumed that adult coho salmon abundance is likely less than 1,500 fish.

3.3.2.5 Trinity River (Lower, Upper, and South Fork)

Because program coho salmon are rarely found in the Trinity River, NOR and HOR coho salmon consist almost exclusively of Trinity River origin adults. Since 2011, an average of 1,090 NOR coho salmon have returned to the Trinity River. However, in the last few years fewer than 225 NOR adults have returned to the system. In contrast, coho salmon HOR returns to the Trinity River has averaged 8,166 fish, or 87% of the total coho salmon returns to the basin (CDFW 2021).

3.3.2.6 Lower Klamath River

Program coho salmon adults are not expected to stray into tributaries of the lower Klamath Population Unit. Information on adult abundance is sparse for this population unit. Juvenile sampling in McGarvey Creek indicated that juvenile coho salmon abundance was low (up to 3,000 age-1+ smolts) (Antonetti et al. 2017). This population unit has a high risk of extinction.

3.3.2.7 Harvest of Coho Salmon

In January of 2022, the Pacific Fishery Management Council (PFMC) set a total fishery (marine and freshwater) exploitation limit of 15% for SONCC coho salmon populations (See PFMC Website for fishing regulations (pcouncil.org)).

Historical estimates of the harvest of Program coho salmon are not available. However, PFMC calculated exploitation rates for Bogus Creek coho salmon in ocean fisheries, Yurok Tribal fisheries, and Klamath River recreational fisheries (Figure 8) based partially upon Program coho salmon recoveries (recovery of left-maxillary clipped fish). The total exploitation rate for all fisheries combined from 2010 to 2019 averaged 11.4%.

3.3.3 Upper Klamath -Trinity River and Northern California Coastal Chinook Salmon and Southern Oregon and Northern California Coastal ESUs

Klamath Chinook salmon consist of both fall and spring-run Chinook. Chinook salmon inhabiting habitat upstream of the Klamath River and Trinity River confluence are considered part of the Upper Klamath – Trinity Rivers Chinook salmon ESU. The fall-run component found below the confluence with the Trinity River belong to the Southern Oregon and Northern California Coastal ESUs. Neither population is listed under ESA.

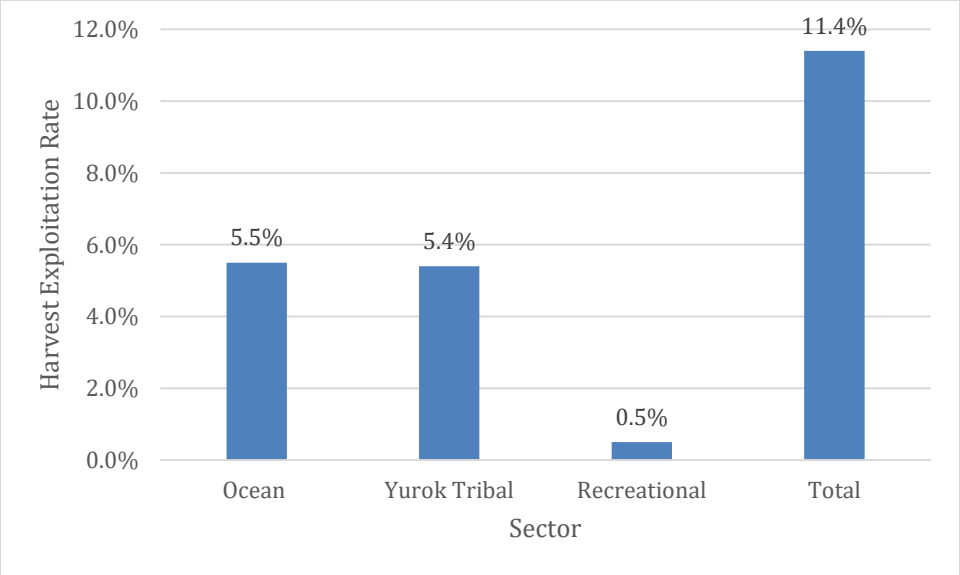


Figure 8. Harvest exploitation rates (percent) for Bogus Creek coho salmon in ocean and freshwater fisheries (2010 to 2019) (PMFC 2021).

Chinook salmon populations can be found in the Trinity River, Salmon River, Shasta River, Scott River, in the mainstem Klamath River and other smaller tributaries (e.g., Bogus Creek). Spring-run Chinook salmon are limited to the Trinity River (primarily hatchery fish) and Salmon River (mostly wild fish). With the removal of the mainstem Klamath River dams, Chinook salmon are expected to extend their range into the upper Klamath River basin upstream of Iron Gate Dam and possibly upstream of Keno Dam.

The total in-river adult fall Chinook run from 2012 to 2021 has ranged from 47,000 to 317,000 and averaged 111,000 fish (2022 Fall Chinook Megatable[2]). From 2012 to 2020, spring Chinook total run size has ranged from 6,400 to 35,000 and averaged 13,000 fish (2022 Spring Chinook Megatable). The adult numbers include both natural and hatchery-origin fish.

Hatchery spring and fall Chinook salmon are produced at the Trinity River Hatchery (TRH). Only fall Chinook are produced at IGH. The TRH program releases 2.9 million fall Chinook salmon and 1.4 million spring Chinook salmon each year. In contrast, IGH has historically released approximately 6.0 million fall Chinook salmon.

With removal of the Klamath River Dams, IGH fall Chinook salmon production will be moved to FCH. The hatchery will release 3.25 million fall Chinook salmon (NMFS 2021).

[2] 2022 fall Chinook and Spring Chinook Megatables can be found at https://nrm.dfg.ca.gov/documents/ContextDocs.aspx?cat=KlamathTrinity

3.3.3.1 Chinook Harvest

The number of fall Chinook salmon and spring Chinook salmon harvested in Klamath River tribal and recreational fisheries has ranged from 4,000 to 25,000 for the period 2017 to 2021 (2022 Megatables).

3.3.4 Klamath Mountains Province DPS- Steelhead

All steelhead in the Klamath River Basin are part of the Klamath Mountains province DPS. This DPS is not ESA-listed.

Historically, the Klamath River supported large runs of fall, summer, and to a lesser extent, winter steelhead. Additionally, there continues to be a large resident steelhead (rainbow trout) population present in the basin.

Steelhead can be found in most of the major tributaries below IGD. Steelhead adult abundance in the Shasta River has ranged from less than 50 to more than 300 from 2005 to 2020 (Giudice and Knechtle 2021). Steelhead adult abundance in the Scott River has averaged 258 fish and ranged from 8 to 917 from 2007 to 2020 (Knechtle and Giudice 2021b). Over this same time, natural steelhead returns to the Trinity River has ranged from about 2,000 to 9,000 (CDFW 2021).

Historically, up to 200,000 hatchery steelhead were produced at IGH, but steelhead have not been produced since 2012 due to a lack of adults returning to IGH. Hatchery steelhead (~ 450,000 yearlings) are produced at the TRH, located on the Trinity River. It is estimated that anywhere from a few thousand to tens of thousands have returned to the river since 2004. A large number of these hatchery fish spawn naturally in the system.

3.3.4.1 Steelhead Harvest

The number of hatchery steelhead harvested in recreational fisheries in the Klamath River from 2015 to 2019 has ranged from 1,000 to 3,000 fish (California Natural Resources Agency 2021). Most of this harvest occurs in the Trinity River.

3.4 Other Fish Species

3.4.1 Southern DPS Eulachon

The Southern DPS of Pacific eulachon (*Thaleichthys pacificus*) was listed as a threatened species in 2010 (75 FR 13012). This DPS encompasses all populations in the states of Washington, Oregon, and California, and extends from the Skeena River in British Columbia (inclusive) south to the Mad River in northern California (inclusive). The DPS is divided into four subareas: Klamath River, Columbia River, Fraser River, and British Columbia coastal rivers south of the Nass River. In 2011, NMFS published a final rule designating critical habitat for Southern DPS eulachon that includes as critical habitat the lowest 10.7 river miles of the Klamath River, from the Klamath River mouth to the Klamath River confluence with Omogar Creek; however, critical habitat does not include any Tribal lands of the Yurok Tribe or the Resighini Rancheria (76 FR 65324).

According to the University of California web site:

Eulachon are anadromous and spend most of their lives in the ocean and return back to coastal freshwater streams to spawn and die. Most eulachon live 3 years though some fish are repeat spawners and live to age 5. When eulachon first hatch, the larvae are washed downstream towards the sea, and they do not become free swimming juveniles until they have reached a total length of 50-80 mm. In the ocean eulachon live and feed in both shallow and deep-water areas, focusing their diet on copepods, euphausid shrimp, and other crustaceans. Most eulachon reach sexual maturity after 3 years and enter their natal streams between December and May (Moyle 2002).

Historically, large numbers of eulachon were found in the lower Klamath River (Moyle 2002). However, since the 1970's population numbers have been low but have fluctuated over the decades. In 2017, the NMFS developed a recovery plan for the species in which they listed the level of threat severity for each eulachon subpopulation (NMFS 2017). For the Klamath River subpopulation climate change impacts on ocean conditions was classified as greatest (high) threat to the species. NMFS did not identify the artificial production of salmon as a threat to the continued existence of eulachon in any of the subpopulations.

NMFS (2006) reported that eulachon may be an occasional prey item for coho salmon and other fish and wildlife species.

3.4.2 Southern Distinct Population Segment Green Sturgeon

Two DPSs of North American green sturgeon (*Acipenser medirostris*) have been identified; a Northern DPS and a Southern DPS. While individuals from the two DPSs are visually indistinguishable and have significant geographical overlap, current information indicates that they do not interbreed or utilize the same natal streams. The Southern DPS of North American green sturgeon (*Acipenser medirostris*) was listed as threatened in 2006 (71 FR 17757). This DPS includes all spawning populations south of the Eel River, encompassing coastal or Central Valley populations and with the only known spawning population in the Sacramento and Feather Rivers. In 2009, NMFS published a final rule designating critical habitat for Southern DPS green sturgeon that does not include any portion of the Klamath River Basin as critical habitat (74 FR 52300). The coastal marine areas around the Klamath River estuary are designated by NMFS as critical habitat for Southern DPS green sturgeon.

Green sturgeon of the Klamath River belong to the northern DPS. This DPS is not federally listed but has been designated by NMFS as a species of special concern. This species enters the Klamath River between March and July to spawn. Green sturgeons are not thought to ascend the Klamath River above Ishi Pishi Falls at River Mile (RM) 66 (Benson et. al. 2005). Juveniles spend 1 to 3 years in freshwater prior to migrating to the Klamath River estuary and then to the ocean. Green sturgeon may spend up to 13 years in the ocean before returning to spawn.

Green sturgeon are opportunistic predators that consume invertebrates such as shrimp and crab. Larger adults will eat fish that are injured or dead and thus easily captured.

3.4.3 Pacific Lamprey

Pacific Lamprey (*Lampetra tridentata)* are found in the Klamath River. However, their current abundance and distribution in the Klamath River is not known with certainty. Pacific Lamprey juveniles are captured in small numbers in traps operated in the Klamath River (David et al., 2016). This species is not ESA-listed.

Pacific Lamprey are anadromous and die after spawning. They can enter the Klamath River in any month to spawn. This species is a predator of coho salmon and other salmonid species but adults do not feed when in freshwater. Juveniles can remain in freshwater for years before migrating to the ocean.

3.5 Wildlife

3.5.1 Southern Resident Killer Whale

The Southern Resident killer whale DPS (Southern Residents) was listed as endangered under the ESA on November 18, 2005 (70 FR 69903).

In 2014, NMFS (2014) concluded that the IGH coho salmon program may affect but not adversely affect Southern Resident killer whale DPS as the program would have no effect on Chinook salmon the primary prey item for the species. Since the FCH program is a continuation of the coho salmon production raised historically at IGH, and production levels are unchanged from past production levels, no effects are expected to this species. Therefore, Sothern Resident killer whale DPS will not be considered further in this EA. The effects of changes to Chinook salmon production on Southern Residents associated with the change from IGH to FCH are analyzed in NMFS's biological opinion on dam removal (NMFS 2021).

3.5.2 Other Wildlife Species

Other wildlife species found in the project area that could affect, or be affected by the program include, but are not limited to, the bald eagle, osprey, kingfisher, cormorant, merganser, heron, river otter, marine mammals (sea lions etc.) and black bear. These species use salmon as a food source.

3.6 Cultural Resources

Salmon represents an important cultural resource to many Native American tribes. It is a core symbol of tribal identity, individual identity, and the ability of many Native American cultures to endure (NMFS 2005). The survival and well-being of salmon is seen as inextricably linked to the survival and well-being of Native American people and the cultures of the tribes.

There are six - federally recognized tribes in the Klamath River:

- The Quartz Valley Indian Community includes a federal reservation of Klamath, Karuk, and Shasta Indians in northwestern California near the community of Fort Jones. Siskiyou County, California.

- The Karuk Tribe, which is today one of the largest tribes in California, has a small land base, with most of the Karuk Tribe living in Humboldt and Siskiyou counties, California, and in southern Oregon.
- The Yurok Indian Reservation includes lands located 1 mile on either side of the Klamath River from the mouth at the Pacific Ocean upstream 22 miles, extending through Del Norte and Humboldt counties, California.
- The Hoopa Valley Indian Reservation is located along the Trinity River in northeast Humboldt County, California.
- The Resighini Rancheria is a federal reservation of Karuk Indians in Del Norte County, California. The reservation spans the mouth of the Klamath River.
- The Klamath Tribes consists of three native American tribes with lands located in the Upper Klamath River basin (upstream of Iron Gate Dam).

4 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

- This chapter describes the analysis of the direct and indirect environmental effects associated with the alternatives on the five resource categories. The effects on resources from other general factors (e.g., climate change, development, habitat restoration, hatchery production, and fisheries) are described in Chapter 5, Cumulative Effects. The relative degree of effect(s) is described using the following terms:

  - No Effect: No beneficial or adverse effect.
  - Undetectable: The effects would not be detectable.
  - Negligible: Beneficial or adverse effects would be at the lower levels of detection.
  - Low: Beneficial or adverse effects would be slight.
  - Moderate: Beneficial or adverse effects would be measurable with low statistical power.[3]
  - High: Beneficial or adverse effects would be measurable with high statistical power.[4]

The duration of the effect is described using two terms:

- Short-term: The effect would be for less than 8-years.
- Long-term: The effect would be for 8-years or more.

[3] Low statistical power means that a monitoring program designed to measure the effect would have a small chance of detecting a true effect as the results can be heavily influence by random or systematic error.

[4] High statistical power means that results from a monitoring program designed to measure the effect are likely valid.

The 8-year time frame was chosen for distinguishing duration periods as this is the length of time the permit would be in force.

A summary of the degree of effects by resource area is provided for each alternative in Table 3. The rationale for each effect classification is provided by resource area below.

4.2 Alternative 1 (No Action): Short- and Long-Term Effects

Under Alternative 1 (No Action) NMFS would determine the submitted permit application fails to meet the criteria necessary to issue an ESA section 10(a)(1)(A) permit and the permit would therefore not be issued. For the purposes of this analysis, this alternative would not allow for continued operation of the coho salmon hatchery program until a new permit application was submitted and approved. The beneficial or adverse effects that may occur to the affected environment are discussed below.

4.2.1 Water Resources

4.2.1.1 Water Quantity

Under Alternative 1 (No Action), water from Fall Creek would no longer be used to produce coho salmon. Because the use of water for the hatchery is non-consumptive this direct effect to water quantity would be negligible beneficial over the short-term.

4.2.1.2 Water Quality

Under Alternative 1 (No Action), the characteristics of water discharge from FCH is not likely to change. The elimination of the Program would reduce the total amount of pollutants produced at FCH. However, the discharge from FCH is regulated by the NPDES guidance that is designed to protect the water quality and aquatic resources of the stream (Table 1). Additionally, the fall Chinook salmon program and associated pollutants would continue. Therefore, the direct effect on water quality from the implementation of this alternative is expected to be negligible beneficial.

Table 3. Summary of effects on resources under each of the two alternatives.

Resource	Metric	Type of Effect	Alternative 1 (No Action)		Alternative 2 (Proposed Action)	
			Degree of Effect	Effect Duration	Degree of Effect	Effect Duration
water resources	quantity	direct	negligible beneficial	short-term	negligible adverse	short-term
	quality	direct	negligible beneficial	short-term	negligible adverse	short-term
coho salmon	overall	direct	moderate adverse	short-term	moderate beneficial	short-term
	population	direct	high adverse	short-term	moderate beneficial	short-term
	genetic	direct	high beneficial	long-term	moderate adverse	long-term
	ecological	direct	low beneficial	short-term	negligible adverse	short-term
Chinook salmon	overall	indirect	negligible beneficial	short-term	negligible adverse	short-term
	population	indirect	negligible beneficial	short-term	negligible adverse	short-term
	genetic	not applicable	not applicable	not applicable	not applicable	not applicable
	ecological	indirect	negligible beneficial	short-term	negligible adverse	short-term
steelhead	overall	indirect	undetectable	short-term	undetectable	short-term
	population	indirect	undetectable	short-term	undetectable	short-term
	genetic	not applicable	not applicable	not applicable	not applicable	not applicable
	ecological	indirect	undetectable	short-term	undetectable	short-term
eulachon	ecological	indirect	undetectable	short-term	undetectable	short-term
Pacific lamprey	ecological	indirect	undetectable	short-term	negligible beneficial	short-term
green sturgeon	ecological	indirect	undetectable	short-term	negligible beneficial	short-term
wildlife	ecological	indirect	undetectable	short-term	negligible beneficial	short-term
cultural resources	all aspects	indirect	moderate adverse	short-term	moderate beneficial	short-term
fisheries harvest	all aspects	direct	negligible adverse	short-term	low beneficial	short-term

4.2.2 Salmon and Steelhead

If NMFS determines to not issue an ESA section 10(a)(1)(A) permit to CDFW to maintain coho salmon hatchery production, Program operations would cease until a new permit application is submitted, and the applicants granted an ESA section 10(a)(1)(A) permit. Without the Program, all potential beneficial or adverse effects of the Program on salmon and steelhead, as discussed below, would be eliminated, or reduced long-term (e.g., genetic direct effects to natural origin coho salmon).

4.2.2.1 SONCC Coho Salmon

Population Effects

The discontinuation of hatchery coho salmon production under Alternative 1 (No Action) would have direct short-term highly adverse effects to the Upper Klamath Population Unit. Coho salmon abundance in this unit is low, and because of this lack of abundance their extinction risk is rated as high (Table 2). Program fish provide a reserve of Upper Klamath Population Unit coho salmon genetics in case naturally produced fish are no longer sustainable in the natural environment or are extirpated due to random causes such as drought.

Additionally, Program fish are expected to be a significant source of coho salmon that repopulate stream habitat made available to salmonids with the removal of the Klamath River Dams. The loss of these fish could have highly adverse effects on the success of the reintroduction effort and the time required to achieve coho salmon population goals for this habitat is likely to take longer.

A large percentage of coho salmon spawning naturally in the Shasta River are strays from the Program. These strays are currently supporting coho salmon production in this population unit. Without the input of HOR spawners, Shasta River coho salmon could become extirpated from this river. The Shasta River Population Unit would therefore experience short-term high adverse effects from the termination of the Program.

Genetic Effects

The termination of the Program under Alternative 1 (No Action) would eliminate any adverse effects to coho salmon population genetics from HOR adults spawning naturally with NOR adults in the Klamath River and result in an increase in population fitness (HSRG 2004a, HSRG 2014, CA HSRG 2012). Therefore, the elimination of these direct adverse effects to genetics would result in long-term high beneficial effects to coho salmon.

Ecological Effects

Ecological effects (indirect) of the Program to coho salmon occur primarily through the mechanisms of competition, predation, and disease. Competition between HOR and NOR coho salmon for limited resources may occur when large numbers of hatchery fish are released into the natural environment. The released fish may also prey on natural origin fish resulting in a decrease in natural production. Both hatchery operations and fish releases may increase disease risk to naturally produced coho salmon that could also reduce natural fish abundance.

Hatchery coho salmon from the Program will no longer be released to the Klamath River in Alternative 1 (No Action). This action will eliminate all competition, predation, and disease effects the Program may have on naturally produced fish. The level of ecological effect to coho salmon from Alternative 1 (No Action) is considered short-term low beneficial.

Hatchery Operations

Because FCH will continue to produce 3.25 million fall Chinook salmon juveniles each year, Program termination will only have negligible beneficial hatchery operational effects to coho salmon as all hatchery facilities will remain in place. The benefit is derived from the negligible improvements in water quality resulting from the elimination of hatchery effluent associated with the Program.

4.2.2.2 Upper Klamath -Trinity River and Northern California Coastal Chinook Salmon

Population Effects

Alternative 1 (No Action) would have short-term negligible beneficial effects to Klamath River fall and spring-run Chinook salmon populations. Although Program fish may prey on Chinook fry and subyearlings, the number of fish released (75,000) likely has little effect on total Chinook salmon abundance as evidenced by the results of PCDRISK modeling that indicates that mortality on this species from hatchery coho salmon was less than 0.1% (CDFW and PacifiCorp 2014). This level of mortality is too low to substantially affect total Chinook abundance in the basin.

Ecological Effects

Coho salmon may prey on and compete with Chinook salmon for food and space. The termination of the Program would eliminate these ecological indirect effects and result in negligible beneficial effects to Chinook salmon. These benefits are negligible because the size of the Program is small compared to the size of the Chinook salmon population in the Klamath River.

Hatchery Operations

Negligible beneficial effects as described for coho salmon would occur to Chinook with the implementation of Alternative 1 (No Action).

4.2.3 Klamath Mountains Province DPS – Steelhead

Population Effects

The implementation of Alternative 1 (No Action) would have indirect short-term undetectable effects on Klamath River steelhead. The few Program fish spawning naturally likely produce a small number of juveniles that may be used as a food source by steelhead (Naman 2008). Termination of the Program under Alternative 1 (No Action) would eliminate this food source but would be insufficient to have a measurable (undetectable) effect on steelhead population abundance.

Ecological Effects

There may be short-term undetectable ecological effects to steelhead under Alternative 1 (No Action). Hatchery coho salmon may compete with steelhead for food and space (habitat). The termination of the Program would eliminate this competition.

Hatchery Effects

Negligible beneficial effects as described for coho salmon would occur to steelhead with the implementation of Alternative 1 (No Action).

4.2.4 Other Fish Species

Beneficial and adverse effects to species other than salmonids under Alternative 1 (No Action) is presented in this section of the EA. Hatchery operational effects on each species is classified as undetectable due to a slight (unmeasurable) increase in the quality of the hatchery effluent from Program termination. Because hatchery structures will remain in place to support fall Chinook production there would be no change in facility effects to any of these species with implementation of Alternative 1 (No Action).

4.2.4.1 Southern DPS Eulachon

Little data is available on the interactions that may occur between coho salmon and eulachon. It is likely that coho salmon do prey on adult and possibly juvenile eulachon in the marine and freshwater environments where they overlap in distribution. However, data to support this assumption is lacking (NMFS 2021). Therefore, this indirect effect (if it occurs) is considered undetectable.

4.2.4.2 Green Sturgeon

Program termination in Alternative 1 (No Action) could result in the decrease in the food base for green sturgeon. Hatchery coho salmon adults and juveniles may die during their migrations. Green sturgeon could consume the carcasses of these fish. The termination of the Program would eliminate this food source and result in undetectable short-term effects to green sturgeon.

4.2.4.3 Pacific Lamprey

Because Pacific Lamprey may prey on adult Coho produced by the Program, Alternative 1 (No Action) would result in an undetectable effect to this species by reducing its food base. However, Pacific lamprey also prey on adult Chinook salmon which is more abundant than coho salmon in the Klamath River. The total in-river adult fall Chinook run from 2012 to 2021 has ranged from 47,000 to 317,000 and averaged 111,000 fish[5] (2022 Fall Chinook Megatable). From 2012 to 2020, spring Chinook total run size has ranged from 6,400 to 35,000 and averaged 13,000 fish (2022 Spring Chinook Megatable). In contrast, the Program produces less than 1,000 adult coho salmon each year.

[5] 2022 fall Chinook and Spring Chinook Megatables can be found at https://nrm.dfg.ca.gov/documents/ContextDocs.aspx?cat=KlamathTrinity

4.2.5 Wildlife

Wildlife found in the action area that are predators of salmon adults, fry, and juvenile will likely experience some adverse effect if the program ceases. These adverse effects are expected to occur to each of these species in the action area, but the indirect effect will be undetectable over the short-term.

4.2.6 Cultural Resources

Under Alternative 1 (No Action), CDFW would not be issued a permit for the program as proposed, resulting in a decrease in total coho salmon production in the Klamath River. A decrease in adult coho salmon production could reduce the number of fish available to meet tribal cultural needs. Over the short-term, the degree of effect is expected to be moderate adverse as a small number of Program coho salmon are caught in Tribal fisheries (Figure 8).

4.2.7 Harvest

The termination of the Program under Alternative 1 (No Action) would result in negligible adverse effect on the recreational fishing opportunity for salmonids in the Klamath River. There is no directed recreational harvest on Program fish or NOR coho salmon. Because adult coho salmon return to the Klamath River later in the fall than fall-run Chinook, and earlier than spring-run Chinook, recreational harvest levels on Chinook would not be significantly affected by Program termination.

4.3 Alternative 2 (Proposed Action): Short- and Long-Term Effects

Under Alternative 2 (Proposed Action), NMFS would determine that the submitted permit application meets the criteria necessary to issue an ESA section 10(a)(1)(A) enhancement permit and would ultimately issue permit to CDFW for a period of eight years. For analysis purposes, this alternative would result in the hatchery production of SONCC coho salmon as described in the submitted HGMP (CDFW 2022a).

4.3.1 Water Resources

4.3.1.1 Water Quantity

Under Alternative 2 (Proposed Action), the potential direct effects to water quantity is likely minor (negligible adverse). Water used for adult holding, egg incubation and juvenile rearing is non-consumptive and is returned directly to Fall Creek.

4.3.1.2 Water Quality

Negligible adverse direct short-term effects to the water quality of Fall Creek are expected under Alternative 2 (Proposed Action). The hatchery would continue to operate consistent with the NPDES permit designed to protect water quality (Table 1). Compliance with permit conditions will be monitored through effluent sampling two times a month and the following parameters measured: total suspended and settleable solids, pH, salinity, temperature, turbidity, and dissolved oxygen. Corrective actions will be taken by hatchery staff if maximum allowed values of any parameters were observed.

4.3.2 Salmon and Steelhead

4.3.2.1 SONCC Coho Salmon

If NMFS issues an ESA section 10(a)(1)(A) permit for the Program as submitted under Alternative 2 (Proposed Action), high beneficial effects to SONCC coho salmon are likely to occur for the reasons discussed below.

Population Effects

Alternative 2 (Proposed Action) is expected to provide direct high beneficial short-term effects to the Upper Klamath Population Unit. The data in Figure 5 and Figure 6 show that the program produces many hundreds of adult coho salmon that return to the hatchery and contribute to natural production in Bogus Creek. The number of NOR adult coho salmon required for broodstock is less than 100 fish, thus the Program produces a net increase in adult coho salmon.

Program adult coho salmon may also fail to return to the hatchery and instead spawn naturally in the Shasta River. Because of extremely low NOR coho salmon abundance in this stream, Program fish spawning naturally in the Shasta River increase population abundance and reduce extinction risk for this population.

Additionally, HOR coho salmon surplus to broodstock needs will be released back to the Klamath River to spawn naturally in historically productive habitat made available with the removal of Klamath River Dams. Offspring of these naturally spawning HOR coho salmon will likely result in an increase in NOR juvenile and adult production.

Genetic Effects

Under Alternative 2 (Proposed Action) the Program will have long-term direct moderate adverse effects on the genetics of coho salmon. These effects occur because of HOR coho salmon spawning naturally with NOR coho salmon and hatchery broodstock practices discussed below.

The Program will function as an *integrated recovery program*. An integrated recovery program is defined as an artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of natural salmon population(s), and the fish produced are intended to spawn in the wild or be genetically integrated with the targeted natural population(s) (in this case the Upper Klamath River Population). Performance standards for the program are based on those developed for an integrated type of program as defined by HSRG (2004b, 2014). Program integration is achieved by incorporating NOR adults into broodstock.

HOR coho salmon spawning naturally can interbreed with NOR adults. This breeding can in turn reduce the genetic fitness of resulting offspring and the productivity and abundance of the NOR component of the population (HSRG 2014). The severity of the effect is estimated by calculating the proportionate natural influence value (PNI) for the Program.

PNI is calculated as follows:

PNI = pNOB/ (pNOB + pHOS)

Wherein:

pHOS = the proportion of the natural spawning population consisting of HOR adults, and

pNOB = the proportion of the hatchery spawned population consisting of NOR adults.

PNI values > 0.50 indicate that the genetic fitness of the composite population (HOR + NOR) is being driven by the natural environment, values < 0.50 by the hatchery environment. A fully fit natural population has no hatchery influence and therefore has a PNI of 1.0. Such a population exhibits the highest level of productivity and abundance possible for the environmental conditions present in the stream. The HSRG (2014) recommends that for biologically important populations (e.g., ESA listed coho salmon) that PNI should be >0.67.

Program PNI has averaged 0.50 from 2014 to 2020 (Figure 9). This level of PNI is expected to be achieved or exceeded over the short-term. Because PNI is < 1.0, the Program will continue to have moderate long-term adverse effects to coho salmon genetics.[6]

To reduce genetic effects of artificial breeding to the natural population, a genetic spawning matrix will be used to reduce inbreeding that may cause a decrease in population productivity, diversity, and abundance.

[6] The effect is considered long-term as it will take decades to reverse any hatchery effects after program termination.

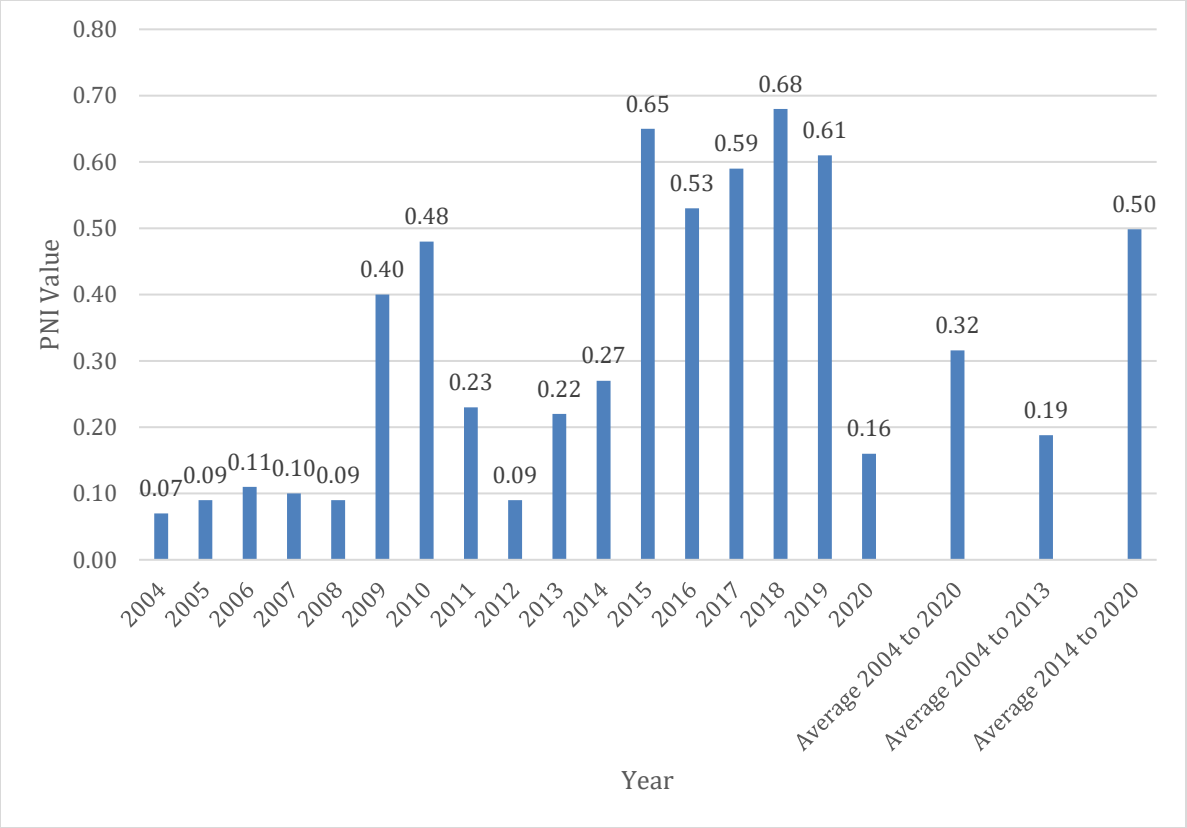


Figure 9. PNI values for coho salmon from 2004 to 2020.

4.3.2.2 Upper Klamath -Trinity River and Northern California Coastal Chinook Salmon

Population Effects

Alternative 2 (Proposed Action) would have indirect short-term negligible adverse effects to Klamath River fall and spring-run Chinook salmon population abundance. Program fish may prey on Chinook salmon fry and subyearlings, however, the number of fish released (75,000) will likely have little effect on the Chinook salmon runs as evidenced by the results of PCDRISK modeling that indicates that total mortality on this species from hatchery coho salmon was less than 0.1% (CDFW and PacifiCorp 2014).

Ecological Effects

Program coho salmon juveniles may compete with Chinook salmon for food and space. However, the indirect effect of competition is negligible adverse because Program size is small compared to the size of the Chinook population in the Klamath River which consists of thousands of adults and 100,000's of juveniles.

Hatchery Effects

Negligible adverse effects of hatchery operations as described for coho salmon would occur to Chinook (primarily fall Chinook) with the implementation of Alternative 1 (No Action).

4.3.3 Klamath Mountains Province DPS – Steelhead

Population Effects

The implementation of Alternative 2 (Proposed Action) would have short-term negligible adverse effects to Klamath River steelhead population abundance. Although coho salmon may prey on juvenile steelhead, the number of hatchery coho salmon released is relatively small (75,000). Additionally, Program fish are to be released near the mouth of Fall Creek where they will then enter the mainstem Klamath River and migrate to the ocean. Few Program juvenile fish are expected to enter tributaries and thus any effects to steelhead subpopulations inhabiting these streams would be minor.

Ecological Effects

There may be indirect short-term undetectable ecological effect to steelhead under Alternative 2 (Proposed Action). Hatchery coho salmon may compete with steelhead for food and space (habitat) and as noted previously prey on juvenile steelhead. This competition will likely only occur in Fall Creek and the mainstem Klamath River and not in the large tributaries such as the Shasta River, Scott River, Salmon River and Trinity River. Thus, Program fish would likely only affect a small portion of the total Klamath River steelhead population.

Hatchery Effects

Negligible adverse effects of hatchery operations as described for coho salmon would occur to steelhead with the implementation of Alternative 2 (Proposed Action).

4.3.4 Other Fish Species

Beneficial and adverse effects to species other than salmonids is presented in this section of the EA for Alternative 2 (Proposed Action). Hatchery operational effects on each species is classified as undetectable due to a slight (unmeasurable) decrease in the quality of the hatchery effluent from Program termination. Because hatchery structures will remain in place to support fall Chinook production there would be no change in facility effects to any of these species with implementation of Alternative 1 as well (No Action).

4.3.4.1 Southern DPS Eulachons

The 2014 Biological Opinion for the IGH HGMP (NMFS 2014) concluded that eulachon may be impacted by hatchery fish through competition for food and possibly through predation. However, because little data is available on either of these factors NMFS believed such effects are unlikely to occur and considered discountable. Regardless, the effect if it existed would be undetectable.

4.3.4.2 Green Sturgeon

Under Alternative 2 (Proposed Action), the Program would continue to produce juvenile and adult coho salmon that may increase food abundance for green sturgeon. Both adult and juvenile coho salmon may die during their migration and their carcasses consumed by this species. Because of the small number of juveniles and adults produced by the Program it is highly

unlikely that any effect (beneficial or adverse) would be detectable. Therefore, the degree of effect is considered undetectable over the short-term.

4.3.4.3 Pacific Lamprey

Because Pacific Lamprey may prey on adult Coho produced by the Program, Alternative 2 (Proposed Action) would result in a short-term negligible benefit to this species by increasing its food base.

4.3.5 Wildlife

Wildlife found in the action area that are predators of salmon adults, fry, and juvenile will experience negligible beneficial indirect effects from Program production of 75,000 juveniles and upwards of 1,000 adult coho salmon.

4.3.6 Cultural Resources

Under Alternative 2 (Proposed Action), Tribal fishers would continue to catch Program coho salmon in Klamath River freshwater fisheries (Figure 8). The degree of effect is considered moderate beneficial.

4.3.7 Harvest

The Program under Alternative 2 (Proposed Action) would result in low beneficial effect on the recreational fishing opportunity for salmonids in the Klamath River. There is no directed recreational harvest on Program fish or NOR coho salmon. However, the data in Figure 8 indicate that small numbers of Program fish are harvested incidentally in recreational fisheries.

5 Cumulative Effects

This cumulative effect section addresses the incremental effects that past, present, and reasonably foreseeable future actions have on the affected environment. Cumulative effects are defined as the impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Actions by federal, non-federal agencies, and private parties are considered in this section.

5.1 Land Use/Management Activities

In the NMFS 2021 Biological Opinion for the Decommissioning of Lower Klamath Dams (NMFS 2021) analyzed the effects past and future timber management activities, water withdrawals, use of roads, wildfire, agriculture, mining, urbanization, and other land use activities would have on the physical and biological resources of the Klamath River Basin. In general, NMFS concluded that an increase in these activities would result in negative effects on the biological resources of the basin, while a decrease in activities may result in positive benefits.

The change in these activities in the action area over the next 8-years is expected to be minor, if at all. Therefore, over the 8-year term of the Permit land use/management activities will have undetectable effects on the coho salmon hatchery program (i.e., Alternative 2 Proposed Action).

The elimination of the program under Alternative 1 (No Action) would result in a substantial decrease in coho salmon abundance in the basin. This decrease in abundance could result in a change in this species ESA listing status from threatened to endangered. This would likely result in more severe restrictions on land use/management activities in the action area. This is especially true for activities such as water withdrawals, agriculture and timber harvest in streams that support coho salmon production.

However, the effects of Program termination could be offset by the associated action of dam removal (described below). The removal of the four lower Klamath River dams could improve the quantity and quality of coho salmon habitat in the basin. Thus, the loss of Program hatchery production could be replaced by an increase in wild coho salmon production.

5.2 Decommissioning (Removal) of Lower Klamath River Dams

The Klamath River Renewal Corporation (KRRC) will be removing four mainstem Klamath River dams (Iron Gate, Copco 1, Copco 2, and J.C. Boyle) in 2023/2024. This will include the complete removal of the dams, power generation facilities, water intake structures, canals, pipelines, ancillary buildings, and dam foundations. The Proposed action also includes the restoration of the areas formerly inundated by reservoirs, reconnecting tributary streams to the mainstem, stabilizing lands disturbed by the dam facilities, closing IGH, and upgrading and temporarily operating FCH (NMFS 2021).

Dam removal is expected to increase salmon habitat[7], improve water quality, reestablish sediment transport, and restore a more natural flow regime in the mainstem Klamath River downstream of JC Boyle Dam (NMFS 2021). These outcomes are expected to have high beneficial long-term effects to all species of salmon (including coho salmon produced by the Program) and other native resident fish species inhabiting this portion of the affected environment.

The actual dam removal process is expected to have moderate short-term adverse effects to both wild and hatchery coho salmon. The effect results primarily from the high suspended sediment concentrations that will occur as reservoirs are drained to remove dam structures (NMFS 2021). Program juveniles and adult may be exposed to these higher suspended sediment levels as they migrate to and from the ocean for a period of two years. NMFS (2021) estimated that mortality rates on migrating coho salmon smolts could be as high as 20% for 10% of the spring outmigration period.

The resulting improvement after two years in habitat quality and quantity from dam removal is expected to increase the survival of Program coho salmon juveniles which should lead to an increase (moderate beneficial) in adult production under Alternative 2 (Proposed Action).

The coho salmon program under Alternative 2 (Proposed Action) would also provide adults that could recolonize new habitat made available by the removal of the dams. This in turn would

[7] 76 miles for Coho Salmon, over 300 miles for Chinook, lamprey, and steelhead (DOI and CDFG 2012).

increase wild coho salmon abundance and possibly speed up the recolonization process compared to Alternative 1 (No Action) where it's assumed Program coho salmon production is eliminated.

5.3 Bureau of Reclamation's Klamath Project

The United States Bureau of Reclamation (Reclamation) operates a water management project to supply irrigation water for agriculture uses upstream of the action area in the Upper Klamath River Basin. The operation of this project affects river flow quantity and water quality in the action area. Reclamation operations are expected to continue over the long-term and also to change over time in response to changing environmental and policy conditions (Reclamation 2021a and 2021b).

The effects this water management project has on the physical and biological resources of the Klamath River has been evaluated by both the NMFS and United States Fish and Wildlife Service (NMFS and USFWS 2013, USFWS 2019 and NMFS 2019). These documents should be consulted for more detail on the type and degree of severity project operations may have on the affected environment.

The NMFS Biological Opinion for the Klamath Project (NMFS 2019) concluded:

> *.. the proposed action is expected to not decrease the conservation value of migratory corridors for coho salmon in the action area during the period of effects of the proposed action and is likely to result in some long-term beneficial effects to migratory corridors from the proposed restoration activities.*

The beneficial effect to the migratory corridor would be low beneficial to Program coho salmon that utilize the mainstem Klamath River (i.e., the migration corridor) to migrate to and from the ocean to the hatchery.

Under Alternative 2 (Proposed Action), the Program would have no additional effects on Klamath Project operations.

The elimination of the program under Alternative 1 (No Action) would result in a substantial decrease in coho salmon abundance in the basin. This decrease in abundance could result in a change in this species ESA listing status from threatened to endangered. A change in listing status could result in a change in Klamath Project operations such as the timing, magnitude and quality of the water used to mee instream flow requirements. The degree of effect would likely be highly adverse.

Again, the effects of Program elimination on future Klamath Project operations could be offset by the increase in wild coho salmon production expected from the removal of the four mainstem dams. An increase in natural production could be sufficient to prevent the fish being listed as endangered under ESA.

5.4 Climate Change

The NMFS 2021 Biological Opinion for the Decommissioning of Lower Klamath Dams stated that climate change would have a substantial effect on Klamath River aquatic habitat (NMFS 2021). Based on the best available information, the earth's climate is warming and this could significantly affect ocean and freshwater habitat conditions and adversely affect species survival. Under climate change, freshwater and sea temperatures are expected to warm, droughts and flooding to become more frequent which then may cause an increase in wildfire severity and frequency. The 2021 Biological Opinion should be consulted for more detail on climate change effects to Klamath River resources.

Increasing stream and marine temperatures from climate change is likely to reduce the long-term survival rate and abundance of wild and Program produced coho salmon under Alternative 2 (Proposed Action). However, over the 8-year term of the Permit, any effects of climate change to Program coho salmon would be undetectable.

The Program under Alternative 2 (Proposed Action) would have no effect on climate change.

6 AGENCIES AND PERSONS CONSULTED

6.1 Public and Private entities

The following entities were consulted during development of the HGMP:

- Tribes
    - Klamath
    - Karuk
    - Yurok
    - Hoopa
- United States Fish and Wildlife Service
- California Department of Fish and Wildlife
- Oregon Department of Fish and Wildlife
- Klamath River Renewal Corporation
- City of Yreka
- PacifiCorp

6.2 National Marine Fisheries Service Individuals

NMFS staff and contractors that developed the EA are:

- Kevin Malone (NMFS Contractor – Saltwater Inc.)
- Jeff Abrams (NMFS)
- Elif Wilkins (NMFS)
- Jim Simondet (NMFS)

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