Draft Environmental Assessment

Issuance of an Endangered Species Act Section 10(a)(1)(A) Enhancement Permit to the National Marine Fisheries Service Southwest Fisheries Science Center Fisheries Ecology Division for the Operation of the Southern Coho Salmon Captive Broodstock Program

Photo: Morgan Bond, SWFSC

Prepared By:
NOAA's National Marine Fisheries Service
West Coast Region
December 04, 2023

COVER SHEET

Title of Environmental Review:	Draft Environmental Assessment for the Southern Coho Salmon Captive Broodstock Program
Evolutionary Significant Unit:	California Central Coast coho salmon
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Location of Proposed Activities:	Coastal streams of the Santa Cruz Mountains in San Mateo and Santa Cruz counties, 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 Southern Coho Salmon Captive Broodstock Program according to the hatchery genetic management plan submitted by the National Marine Fisheries Service Southwest Fisheries Science Center.

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LIST OF ACRONYMS AND ABBREVIATIONS

CCC	Central California Coast
CCRWQCB	Central Coast Regional Water Quality Control Board
CDFW	California Department of Fish and Wildlife
CESA	California Endangered Species Act
DCFH	Don Clausen Fish Hatchery
DPS	Distinct Population Segment
EA	Environmental Assessment
ESA	Endangered Species Act
ESU	Evolutionary Significant Unit
FED	Fisheries Ecology Division (NOAA SWFSC)
FRGP	Fisheries Restoration Grants Program
HGMP	Hatchery Genetic Management Plan
HOR	Hatchery-Origin
KFH	Kingfisher Flat (Genetic Conservation) Hatchery
L/sec	Liters per second
MBSTP	Monterey Bay Salmon Trout Project
MMPA	Marine Mammal Protection Act
NAHC	Native American Heritage Commission
NCRWQCB	North Coast Regional Water Quality Control Board
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOR	Natural-Origin Fish
NPDES	National Pollutant Discharge Elimination System
PHOS	Proportion of natural spawning population consisting of Hatchery fish
PNI	Proportionate Natural Influence
PNOB	Proportion of Broodstock Consisting of NOR fish
RRCSCBP	Russian River Coho Salmon Captive Broodstock Program
SCMDS	Santa Cruz Mountains Diversity Stratum
SCSCBP	Southern Coho Salmon Captive Broodstock Program
SWFSC	Southwest Fisheries Science Center
SWRCB	State Water Resources Control Board
UCSC	University of California at Santa Cruz
USACE	United States Army Corps of Engineers

1 INTRODUCTION

The National Oceanic and Atmospheric Administration's (NOAA's) 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 is used to limit the application of take prohibitions described in section 9.

In September 2018, NOAA's Southwest Fisheries Science Center (SWFSC) Fisheries Ecology Division (FED) shared with NMFS a preliminary draft of the hatchery genetic management plan for the Southern Coho Salmon Captive Broodstock Program (program). At this time, NMFS anticipated the HGMP would be finalized and submitted with an ESA section 10(a)(1)(A) enhancement permit application for the program. NMFS proceeded with its review of the program. However, completion of the HGMP and section 10(a)(1)(A) enhancement permit application was delayed due to several factors, including funding/staffing availability, exceptional drought conditions, and the aftermath of the 2020 CZU Lightning Complex Fire in the Santa Cruz Mountains (coupled with continued drought in 2021-2022).

On February 16, 2023, FED submitted a section 10(a)(1)(A) enhancement permit application and HGMP to NMFS for the program. The HGMP provides a framework for the breeding, rearing, releasing, and associated monitoring and evaluation activities that will occur in coastal streams of Santa Cruz and San Mateo counties known to support populations of the federally endangered Central California Coast (CCC) coho salmon (*Oncorhynchus kisutch*) Evolutionary Significant Unit (ESU) and the federally threatened CCC steelhead (*O. mykiss*) Distinct Population Segment (DPS).

NMFS seeks to consider, through a National Environmental Policy Act (NEPA) analysis, how its pending action 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 the conservation of other listed species, non-listed species, and the socioeconomic objectives that seek to balance conservation with the use of affected resources and other legal and policy mandates. If NMFS determines that the application meets all applicable criteria, NMFS will issue the ESA section 10(a)(1)(A) enhancement permit to FED for operation of the program as described in the HGMP (Appendix A).

This EA is being prepared using the 1978 Council of Environmental Quality (CEQ) NEPA Regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations can be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020. Since the review of this proposed program began on November 20, 2018, the agency has decided to proceed under the 1978 regulations.

1.1 Description of the Proposed Action

FED proposes to operate a genetically managed hatchery program for the restoration of depleted or lost populations of CCC coho salmon in the Santa Cruz Mountain Diversity Stratum (SCMDS). The program will operate as an integrated recovery type hatchery as defined by the

California (CAHSRG 2012) and Columbia River Hatchery Scientific Review Group (CRHSRG 2014)[1]. The intent of an integrated program is to create conditions wherein the natural environment drives the adaptation and fitness of a composite population of fish that spawns both in a hatchery and in the wild (i.e., naturally).

The program currently uses both natural-origin (NOR) and captive broodstock as well as the release of juvenile and adult fish to prevent regional extirpation, conserve population genetics, and to maintain a breeding population of CCC coho salmon south of San Francisco. Broodstock for the program are usually collected in SCMDS streams. A small number of outbreeders are used annually to increase genetic diversity. The outbreeders are sourced from the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP) operated at Don Clausen Fish Hatchery (DCFH) in Sonoma County and include NOR fish from the Russian River (Sonoma County) and Lagunitas-Olema Creek (Marin County).

The program releases CCC coho salmon annually into SCMDS streams. Hatchery programs contribute to the recovery of listed salmonid populations by maintaining or increasing the abundance and genetic diversity of the naturally spawning population until it is self-sustaining. The HGMP outlines a four-phased approach for the Program that details a hatchery management strategy from a population preservation phase (Phase 1) to full recovery in SCMDS (Phase 4). Established regional monitoring will provide data to evaluate the program's status and effects to ESA-listed species, and inform the decision making-body, a technical oversight committee (TOC), on program progress.

NMFS is reviewing the ESA section 10(a)(1)(A) permit application submitted by FED to evaluate whether the application meets applicable criteria specified in section 10(a)(1)(A) of the ESA and NMFS' implementing regulations. Under the proposed action, NMFS will determine if the HGMP meets the criteria of the ESA, and if it meets these requirements, NMFS will issue an ESA section 10(a)(1)(A) enhancement permit. Additionally, NMFS is reviewing the effects of the program under section 7 of the ESA to determine whether issuance of the enhancement permit is likely to jeopardize the continued existence of CCC coho salmon or CCC steelhead, or result in destruction or adverse modification of any critical habitat.

The following enhancement activities, as described in the HGMP, have the potential to affect CCC coho salmon and/or CCC steelhead:

- Transport of collected broodstock including NOR and hatchery-origin (HOR) adults and NOR juveniles,
- Mating/spawning of adult fish,
- Egg incubation and juvenile captive rearing,
- Marking of HOR juveniles,
- Egg, fry, parr, advanced parr, yearling (smolt) and adult broodstock releases to streams

[1] The HSRGs provide a definition for an integrated program, but not recovery. The HGMP templates states: An artificial propagation project primarily designed to aid in the recovery, conservation or reintroduction of particular natural population(s), and fish produced are intended to spawn in the wild or be genetically integrated with the targeted natural population(s). Sometimes referred to as "supplementation."

1.2 Purpose and Need for Action

Issuance of an ESA section 10(a)(1)(A) enhancement permit is a Federal action subject to analysis for potential environmental impacts under NEPA. NMFS proposes to issue the ESA section 10(a)(1)(A) enhancement permit to FED, in order to operate the broodstock program. The purpose of the proposed action/preferred alternative is to carry out section 10(a)(1)(A), which allows for the authorization of actions to enhance the propagation or survival of listed species, here the CCC coho salmon ESU.

Coho salmon have been in decline in California for decades (Brown et al. 1994; Weitkamp et al. 1995; CDFG 2004; Spence et al. 2011; Williams et al. 2016), and populations are especially imperiled in the SCMDS at the southern end of their range (NMFS 2012; Williams et al. 2016; Spence 2022). Therefore, the proposed action is needed to conserve CCC coho salmon, which are in danger of extinction, pursuant to Congress' directive to conserve listed species.

1.3 Project Area

The project, or program, area includes the location of activities described in the HGMP including the three facilities and nine streams where CCC coho salmon are to be: (1) collected; (2) spawned, incubated, and reared; and (3) acclimated or released (Figure 1).

The three facilities used for the program are the Monterey Bay Salmon and Trout Project's (MBSTP) Kingfisher Flat Genetic Conservation Fish Hatchery (KFH), the FED laboratory facility (FED Lab), and U.S. Army Corps of Engineers' (Corps) DCFH facility (Figure 1).

KFH is located along Big Creek, a tributary to Scott Creek in northern Santa Cruz County, California. KFH is the primary facility for coho salmon spawning, egg incubation, and juvenile/adult rearing. All three facilities are expected to be utilized for rearing captive broodstock. In the case of a catastrophic event, the three facilities serve as a redundancy for the captive broodstock population, while also increasing total program rearing capacity.

The HGMP proposes to collect, rear and release CCC coho salmon in up to nine regional streams within Santa Cruz and San Mateo counties (Figure 2). The HGMP and current operations prioritize fish collections and releases on Scott, Waddell, San Vicente, and Pescadero creeks due to the presence of naturally produced coho salmon and fish trapping and monitoring infrastructure. Pescadero Creek is one of two independent populations within the SCMDS, with the other being the San Lorenzo River (Spence et al. 2008). Fish collection and releases in San Gregorio Creek, Gazos Creek, the San Lorenzo River, Soquel Creek, and Aptos Creek will be opportunistic during the first 10 years of the program and are limited until adult coho salmon abundance increases in the priority streams.

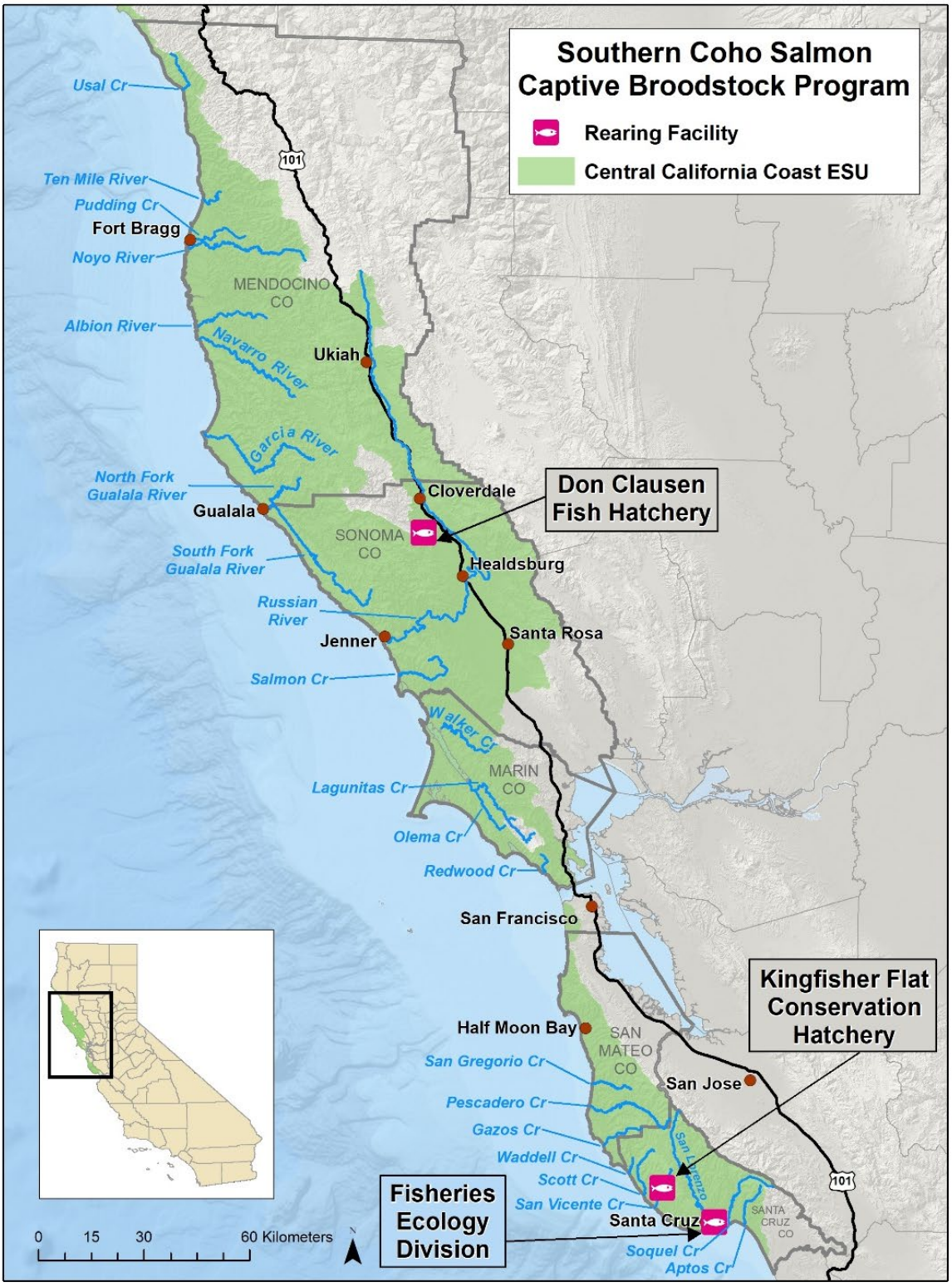

Figure 1. Boundary map of the Central California Coast coho salmon evolutionarily significant unit (ESU) and the locations of three rearing facilities of the Southern Coho Salmon Captive Broodstock Program. Map modified from CDFW and Corps (2017).

Figure 2. Location map of coho salmon recovery watersheds within the Santa Cruz Mountains Diversity Stratum. Except for Laguna Creek (recognized as a supplemental watershed rather than a recovery watershed), the program targets all watersheds in the diversity stratum.

2 ALTERNATIVES

2.1 Alternatives Analyzed in Detail

Two alternatives were analyzed in detail: No Action Alternative (Alternative 1) and the Proposed Alternative (Alternative 2).

2.2 Alternative 1 (No Action Alternative): Do Not Issue the Section 10(a)(1)(A) Permit, do not Approve the HGMP

Under this alternative, NMFS would determine that the submitted application fails to meet the criteria necessary to issue an ESA section 10(a)(1)(A) enhancement permit to FED, and NMFS would not approve the HGMP as submitted. Because the HGMP would not be approved, the hatchery actions proposed by FED would not have ESA authorization or exemptions and therefore liable for take under Section 9 of the ESA. NMFS treats Alternative 1 as resulting in the termination of the ongoing SCSCBP, where coho salmon production would cease until a new permit application and HGMP are submitted and the applicants are granted an ESA section 10(a)(1)(A) enhancement permit.

2.3 Alternative 2 (Proposed Action): Issue the Section 10(a)(1)(A) Permit with Conditions and Approve the HGMP

Under this alternative, NMFS would issue a permit under section 10(a)(1)(A) of the ESA to FED for a period of ten years that authorizes hatchery production and release of up to 380 captive broodstock coho salmon adults and up to 170,000 combined eggs, fry, parr, advanced parr, and yearling coho salmon annually as described in the HGMP (Table 1). The number of coho salmon released by life stage is designed to achieve the adult downlisting criteria for SCMDS streams (NMFS 2012). The streams are prioritized into three groups for receiving adult and juvenile releases of hatchery production (Table 1). Group 1 streams are the highest priority locations for coho salmon releases.

2.4 Alternatives Considered but Not Analyzed in Detail

The HGMP considered the following alternative for implementation:

- Elimination of Captive Broodstock Element; Increase Juvenile Rearing Space and Juvenile Production

This alternative was rejected because the termination of the captive broodstock element eliminates a safety net for protecting the remaining genetic resources of CCC coho salmon in the SCMDS. Having a source of genetic material (fish) in the hatchery protects the population from adverse environmental effects (e.g., drought, flooding, fire and poor ocean survival), which, in addition to anthropogenic factors, have driven coho salmon to near extinction. Therefore, NMFS expects the elimination of the captive broodstock element would greatly impair the persistence and recovery of CCC coho salmon populations within the Santa Cruz Mountains, and the recovery of the ESU. Because this alternative was analyzed and rejected in the HGMP, it was not further analyzed in this EA.

Table 1. Annual maximum number of program egg, fry, parr, advanced parr, smolt and captive brood adults released by stream and group. Priority of egg and fish releases is to Group 1 streams. Total number of coho salmon released in a year (all life stages and locations) will not exceed 170,380*.

Stream Priority Group	Stream	Population Status	Naturally Produced Coho Salmon Present	Adult Abundance Downlisting Criteria	Maximum Release Number by Life Stage					
					Early Life Stages		Juveniles			Captive Brood
					Eggs	Fry	Parr	Advanced Parr	Smolts	
1	Scott Creek	Dependent	Yes	255	100,000	100,000	70,000	35,000	35,000 to 70,000	240
	Waddell Creek	Dependent	Yes	157	100,000	100,000	70,000	29,600	11,822	157
	San Vicente Creek	Dependent	Yes	53	100,000	79,819	53,213	9,977	3,991	53
	Pescadero Creek	Independent	No	1,150	100,000	100,000	70,000	35,000	35,000	240
2	Gazos Creek	Dependent	No	140	100,000	100,000	70,000	26,355	10,542	140
	San Lorenzo River	Independent	No	1,900	100,000	100,000	70,000	35,000	35,000	240
	San Gregorio Creek	Dependent	No	682	100,000	100,000	70,000	35,000	35,000	240
3	Soquel Creek	Dependent	No	561	100,000	100,000	70,000	35,000	35,000	240
	Aptos Creek	Dependent	No	466	100,000	100,000	70,000	35,000	35,000	240

**Note*: These release assumptions are based on achieving the in-hatchery survival performance metrics by life stage. If survival is lower than the metrics, then the release of more adults may be necessary. The juvenile numbers would not change, but the number of captive broodstock adults that would be available for release would be higher, or up to a maximum of 380.

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 implementation of the alternatives described in Section 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
- Salmon and Steelhead
- Other Fish Species
- Wildlife
- Cultural Resources

The proposed action is expected to have no, or extremely minor, effects on other resources such as 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.

3.2 Water Resources

The water resources potentially affected by the operations at KFH are those within Big Creek and Berry Creek (Scott Creek Watershed). The hatchery sits along Big Creek at approximately 1.5 river kilometers (rkm) upstream from the confluence with Scott Creek. Big Creek provides most of the water utilized by KFH. Berry Creek is a non-fish bearing tributary of Big Creek and serves as a primary source of water for egg incubation at KFH. KFH water diversion infrastructure is already in operation and no new permanent facilities will be built under the proposed action. Substantial changes or effects to water resources associated with the KFH facility are not anticipated.

The water resources potentially affected by the operations at the FED Lab are those from the Pacific Ocean, as seawater is drawn into the FED Lab. The FED Lab is already in operation and no new permanent facilities will be built under the proposed action.

At DCFH, the water resources potentially affected by the operations that occur at this facility are those within Dry Creek (Lake Sonoma), a tributary to the Russian River. DCFH is located immediately downstream of Warm Springs Dam/Lake Sonoma and is fed water directly from Lake Sonoma. This facility is the home of the Russian River Coho Salmon Captive Broodstock Program. No new permanent facilities will be built under this Proposed Action.

3.2.1 Water Quantity

The water supply for the SCSCBP is obtained from water sources that are associated with its specific facility.

3.2.2 Kingfisher Flat Hatchery

Surface water for the hatchery is obtained from two nearby sources - Big Creek and Berry Creek.

Big Creek - Water is diverted from Big Creek via a small retention dam built by California Department of Fish and Wildlife (CDFW) in 1927 and renovated by MBSTP in 1982. Diverted water is routed through a 20.3-centimeter (cm) PVC underground mainline to the hatchery. Maximum water flow rate is 92 liters per second (L/sec) and average late summer (base) flows are approximately 35 L/sec. However, low flows can approach 13 L/sec during drought conditions. An emergency backup line is used during critical low flows and provides water from Big Creek at a rate of approximately 8 L/sec. Additional emergency backup water is provided by a 9.5 L/sec sump pump placed in the stream. The intake on Big Creek is screened to prevent entrainment/impingement of fish and other wildlife. During periods of low stream flow, hatchery water is managed (via a designated spillway at the retention dam) to ensure freshwater habitats downstream of the dam receive adequate water and remain suitable for salmonid rearing.

Berry Creek - Surface water (19 L/sec) is diverted from Berry Creek through a screened inlet structure where water is passed through a sediment removal canister and then continues underground via a 10.2-centimeter (cm) PVC mainline to a 757 L storage tank on the hatchery grounds. Water is then gravity fed via a plastic pipeline to the hatchery.

Water from both sources is used for egg incubation and fish rearing and is returned back to Big Creek through multiple points adjacent to the hatchery. Outfall structures are elevated above the creek to prevent aquatic organisms from accessing and entering effluent conveyance systems and hatchery rearing tanks. Each hatchery rearing container is screened prior to its outfall to prevent fish from escaping, and likewise to prevent the entry of exogenous animals into the rearing container.

3.2.3 Fisheries Ecology Division

At the FED Lab, yearling and adult broodstock are reared in seawater. Seawater is pumped (59-95 L/sec) from the Pacific Ocean seaward of the Long Marine Laboratory at the University of California at Santa Cruz (UCSC) from the subtidal zone at rates depending on usage needs. The FED Lab and the Long Marine Laboratory share a common seawater intake and primary filtration system. Water is discharged back to the Pacific Ocean through several screened discharge pipes in the rocky subtidal zone. No listed or sensitive species are known to occur in the areas of intake or discharge.

3.2.4 Don Clausen Fish Hatchery

Surface water (up to 60 cfs, 1,699 L/sec) to operate DCFH is obtained from the stilling basin of Warm Springs Dam (Lake Sonoma). Water used for fish production at the hatchery is returned immediately to Dry Creek below the dam, where it eventually flows into the Russian River (NMFS 2020).

3.2.5 Water Quality

3.2.6 Kingfisher Flat Hatchery:

This facility is exempt from the National Pollutant Discharge Elimination System (NPDES) permit by the Central Coast Regional Water Quality Control Board due to the size of the facility (i.e., density and number of animals maintained), and the fact that no chemical effluent is released. Under the exemption, the only materials that may be discharged to the creek are fish food and feces as the potential adverse ecological effects from these products are considered negligible.

3.2.7 Fisheries Ecology Division Laboratory:

The FED Lab operates under NPDES general permit No. CAG993003, Order No. R3–2008–0059 issued to the University of California at Santa Cruz (UCSC), Long Marine Laboratory. Seawater used for rearing is pumped back to the ocean.

3.2.8 Don Clausen Fish Hatchery:

Discharged water from the DCFH is regulated by a NPDES Permit No. CA0024350, I.D. No. 1B84034050N issued by the North Coast Regional Water Quality Control Board (NCRWQCB). Discharge standards were established for the DCFH by the NCRWQCB based on designated beneficial uses for the subject waters, and include standards for turbidity, suspended sediment concentrations, temperature, and dissolved oxygen (NMFS 2008). Apart from infrequent periods of low dissolved oxygen in some years, DCFH has been in continuous compliance with its NPDES permit requirements.

3.3 Salmon and Steelhead

3.3.1 Central California Coast (CCC) Coho Salmon

The CCC coho salmon ESU, currently listed as endangered, was initially listed as threatened on October 31, 1996 (61 FR 56138). On June 28, 2005 (70 FR 37160), the species was reclassified as an endangered species in response to severe population declines (Brown et al. 1994; Adams et al. 1999). The ESU includes genetically managed coho salmon produced at KFH as part of the SCSCBP. Critical Habitat for CCC coho salmon was designated on May 5, 1999 (64 FR 24049). The action area is in the southern portion of the species range and their designated critical habitat.

The CCC coho salmon ESU ranges from Punta Gorda in southern coastal Humboldt County, California, south to Aptos Creek in Santa Cruz County, California. In addition, the ESU includes coho salmon from the following artificial propagation programs: the RRCSCBP[2], and the Southern Coho Salmon Captive Broodstock Program[3]. A total of 75 watersheds (populations) in the CCC ESU historically supported coho salmon and these populations have been grouped into

[2] Formerly referred to as the Don Clausen Fish Hatchery Captive Broodstock Program.
[3] Formerly referred to as the Scott Creek/King Fisher Flats Conservation Program and the Scott Creek Captive Broodstock Program.

five diversity strata (i.e., geographically distinct areas with similar environmental conditions) for recovery planning (Bjorkstedt et al. 2005; NMFS 2012). The action area for this program is located within the Santa Cruz Mountains Diversity Stratum (SCMDS), the southern-most stratum for the species.

All populations in the CCC coho salmon ESU are currently doing poorly due to range constriction, fragmentation, and loss of genetic diversity (Williams et al. 2016; NMFS 2016a, 2016b). Coho salmon are especially imperiled within the SCMDS as populations have been functionally extirpated from nearly all historical watersheds. Within the SCMDS, coho salmon have rarely been observed in watersheds in any appreciable numbers other than Scott Creek. Nevertheless, the Scott Creek population has experienced substantial declines and few NOR adults have returned to the basin since 2006.

With a predominant three-year life cycle, coho salmon typically exhibit three distinct brood lineages. At the inception of the SCSCBP in 2002, the Scott Creek source population had already been reduced to a single dominant broodline with very small numbers of breeding individuals, while the two adjacent broodlines were severely depressed. Although NMFS, CDFW, and other program partners had originally anticipated terminating the SCSCBP in 2009, continued operation was deemed necessary to prevent extirpation of coho salmon south of San Francisco. Field surveys indicated that returns of natural-origin adult coho salmon to Scott Creek, once the regional stronghold that supported all three broodlines, had declined to critical levels (Figure 3).

Consequently, the population is presently at high risk of extirpation through demographic and genetic processes. The small effective population size (number of breeders) combined with low encounter rates between potential mates in the natural environment has resulted in a substantial loss of genetic variation in the population and the SCMDS. Moreover, the near elimination of brood lineages, coupled with the relatively inflexible three-year life history of coho salmon in California, increases the likelihood of extirpation since there is minimal gene flow among brood lineages and little chance of demographic rescue. The reduction, or extirpation, of native populations to an unsustainably small number of family groups necessitates continued production of coho salmon through captive breeding as a means of preserving the remaining genetic lineage and reducing the likelihood of regional extirpation. The CCC Coho Salmon Recovery Plan explicitly recognizes that domain-scale recovery will not be possible without sustained, high-volume broodstock production coupled with strategic reintroductions and effectiveness monitoring (NMFS 2012).

Natural-origin CCC coho salmon production in SCMDS streams is concentrated in Scott Creek, Waddell Creek, San Vincente Creek and Pescadero Creek (Appendix A). However, except for Scott Creek, little information is available on CCC coho salmon abundance and productivity of other SCMDS streams.

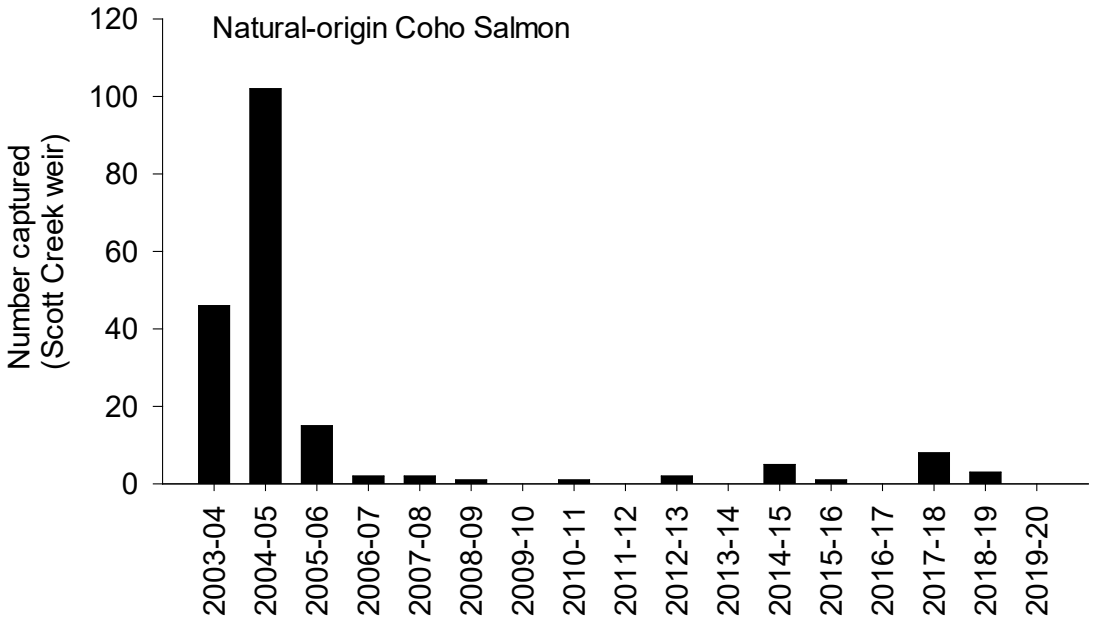

Figure 3. Time series of adult natural-origin coho salmon intercepted at the Scott Creek weir (Santa Cruz County, California) for return winters 2003–2004 through 2019–2020. Data are weir captures only and thus represent minimum estimates. Source: Kiernan et al. 2022.

Under current conditions, the SCSCBP releases less than 40,000 juveniles (fry, parr, smolt) annually into SCMDS streams, and in most years, releases do not exceed 25,000 total juveniles. Also, variable numbers of sexually mature adults (N = <200) have been released in two of the Program streams—Scott Creek and neighboring San Vicente Creek (Appendix A).

3.3.2 Central California Coast (CCC) Steelhead

The CCC steelhead (*Oncorhynchus mykiss*) Distinct Population Segment (DPS) was listed as a federally threatened species on August 18, 1997 (62 FR 43937). Following a status review on January 6, 2005, NMFS issued a final determination that CCC steelhead remain a threatened species as previously listed (71 FR 834). The CCC steelhead DPS includes all naturally spawned populations of steelhead (and their progeny) in streams from the Russian River to Aptos Creek, and the drainages of San Francisco and San Pablo Bays. CCC steelhead are present in all watersheds targeted for coho salmon reintroduction in the SCMDS. Since there is substantial life-history overlap between CCC coho salmon and CCC steelhead, there is potential for direct and indirect ecological interactions to occur between the species. The action area occurs within critical habitat for CCC steelhead, which was designated on September 2, 2005 (70 FR 52488).

Scarce abundance data makes it extraordinarily difficult to definitively ascertain the status of the DPS. However, within the action area steelhead still appear to occur in most watersheds. While data availability for this DPS remains poor (Williams et al. 2016), there is little new evidence to suggest that the extinction risk for this DPS has changed appreciably in either direction since the last status review (NMFS 2016c).

As was the case for CCC coho salmon, data on adult CCC steelhead abundance in the SCMDS comes primarily from Scott Creek (Figure 4). Juvenile CCC steelhead abundance for Gazos Creek, Waddell Creek and Scott Creek indicate that the number of fish per 100 feet of stream ranges from about 10 to 64 fish (Figure 5).

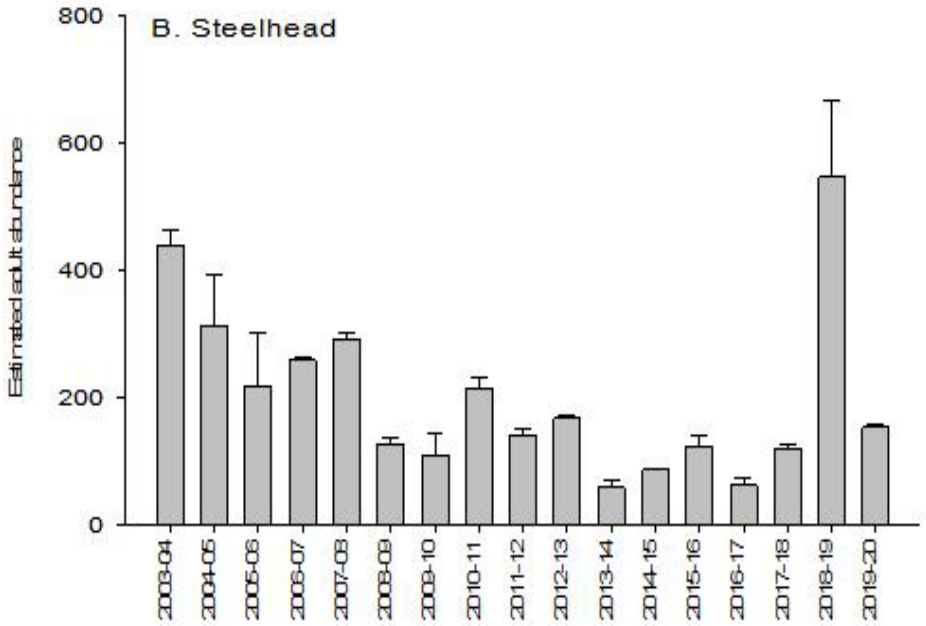

Figure 4. Time series of adult steelhead escapement to Scott Creek, spawn winters 2003–2004 through 2019–2020. Point estimates are derived from mark-recapture sampling and error bars represent +1 standard error. Source: Kiernan et al. 2022.

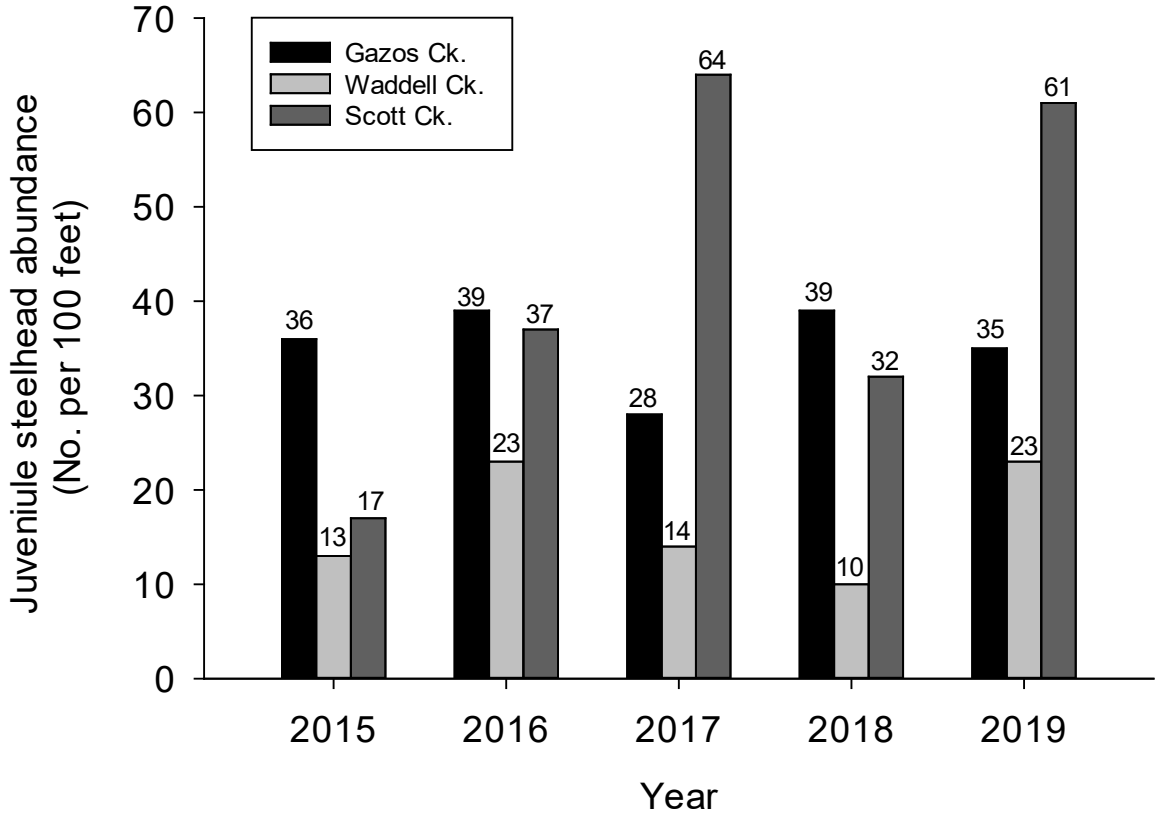

Figure 5. Steelhead juvenile abundance (individuals per 100 linear feet of stream) derived from summer-fall electrofishing surveys of Gazos Creek, Waddell Creek, and Scott Creek (2015–2019). Source: J. Smith, SJSU.

3.4 Other Fish Species

Various fish species in the action area have a relationship with salmon as competitors, prey, or predators (Table 2). Many fish species in the action area compete for food and space with salmon; as juveniles they may act as prey for salmon and as adults they may act as predators. Fish species known to occur in the action area that may prey on or compete with coho salmon include: brown bullhead (*Ictalurus nebulosus*), bluegill (*Lepomis macrochirus*), Monterey roach (*Hesperoleucus venustus subditus*), coastrange sculpin (*Cottus aleuticus*), green sunfish (*Lepomis cyanellus*), golden shiner (*Notemigonus crysoleucas*), Pacific lamprey (*Entosphenus tridentatus*), prickly sculpin (*Cottus asper*), Sacramento sucker (*Catostomus occidentalis*), speckled dace (*Rhinichthys osculus*), and striped bass (*Morone saxatilis*).

While specific habitat preferences vary greatly across species, the geographic range, or distribution, of many of the native species overlaps with coho salmon in the action area, thus many of these species may be affected by current and future program operations. Several of the fish species have been introduced to regional streams (Table 2); their distributions are limited to a few basins with most only occurring in the San Lorenzo River watershed.

The tidewater goby (*Eucyclogobius newberryi*) is a small native species that resides in estuarine environments and is listed as endangered under the ESA (59 FR 5494, February 4, 1994) with Critical Habitat designated on February 6, 2013 (78 FR 8745). Tidewater Goby are administered under the ESA by the United States Fish and Wildlife Service (USFWS).

3.5 Wildlife

The action area supports a variety of birds, mammals, amphibians, and invertebrates that may eat coho salmon, compete with coho salmon for food and space, and/or scavenge on coho salmon (throughout their different life stages) (Table 3). Predators of salmon include many bird species, amphibians, and marine and terrestrial mammals. Examples of avian predators of coho salmon in the action area include blue heron *(Ardea herodias),* double-chested cormorant *(Phalacrocorax auritus)*, and the western gull *(Larus occidentalis).*

Avian predation is a concern in the region. A recent empirical study by Frechette et al. (2012) demonstrated that avian predators can take up to 4.6% of out-migrating coho salmon and steelhead from the Scott, Waddell, and San Vicente Creek watersheds, annually. In addition to avian predators, marine mammals such as harbor seals *(Phoca vitulina),* northern elephant seals (*Mirounga angustirostris),* and California sea lions (*Zalophus californanus*) are present in the region and may represent substantial natural sources of predation on multiple coho salmon life stages.

Other wildlife species compete with salmon and steelhead for food and/or habitat. Adult coho salmon currently produced by the program are a food source for various wildlife species, which transport nutrients from the ocean (marine derived nutrients) into the terrestrial ecosystem through nutrient cycling. Another species that might provide benefits to the Program is the American beaver *(Castor canadensis)*, which can create slow-moving, and complex freshwater habitat utilized by juvenile coho salmon. However, the distribution of American beaver within the action area appears limited to the Pescadero Creek watershed (and its presence in this watershed remains unclear).

Table 2. Fish species, status, habitats utilized, and anticipated interactions with coho salmon in the action area

Species (N=Native; I=Introduced)	Listing Status (Federal and State)	Habitat Type	Type of Interaction with Salmon
Monterey Roach (N)	Species of Moderate concern (State)	Found in lower gradient riverine habitats. Can occupy large pools as well as shallow water areas.	● Potential prey item for juvenile salmon ● May compete with salmon for food
Pacific Lamprey (N)	Species of Moderate Concern (State)	Associated with migratory and rearing habitat in the various coastal streams of the Santa Cruz Mountain Diversity Stratum. Young use backwater and other low velocity habitats.	● Predator of salmon eggs and fry ● Potential prey item for juvenile salmon ● May compete with salmon for food and space. ● May benefit from carcasses of hatchery-origin fish
Sacramento Sucker (N)	None	Utilize lower gradient rivers and warm water	● Potential predator of salmon eggs and fry ● Potential prey item for salmon ● May compete with salmon for food and space
Sculpins Coastrange Sculpin (N) Prickly Sculpin (N) Staghorn Sculpin (N)	None	Coastrange Sculpin and Prickly Sculpin are associated freshwater habitats in coastal streams. Staghorn Sculpin are found in estuarine and marine habitats.	● Predator of salmon eggs and fry ● May compete with salmon for food and space. ● May benefit from carcasses of hatchery-origin fish
Speckled Dace (N)	None	Utilize well oxygenated streams with deep cover or overhead vegetation and woody debris.	● Potential predator of salmon eggs, fry, and juveniles ● May compete with juvenile salmon for space and food

Species (N=Native; I=Introduced)	Listing Status (Federal and State)	Habitat Type	Type of Interaction with Salmon
Threespine Stickleback (N)	None	Utilize slow moving waters with emerging vegetation	● May compete with juvenile salmon for food and space. ● Potential prey item for salmon ● May benefit from carcasses of hatchery- origin fish
Tidewater Goby (N)	Endangered (Federal)	Utilize shallow, slow moving, estuarine habitats	● Potential prey item for salmon ● May compete with juvenile salmon for food and space
Bluegill (I)	None	Utilize lower gradient rivers and warmer water habitats	● Potential predator of juvenile salmon
Brown Bullhead (I)	None	Utilize lower gradient rivers	● Predator of salmon eggs and fry
Golden Shiner (I)	None	Utilize slow moving streams with dense aquatic vegetation.	● May compete with salmon for food and space
Green Sunfish (I)	None	Utilize lower gradient rivers and warmer water habitats	● Potential predator of salmon eggs, fry, and juveniles
Striped Bass (I)	None	Utilize lower gradient rivers and warmer water habitats	● Potential predator of juvenile salmon

Sources: NOAA's species webpage. Available at https://www.fisheries.noaa.gov/find-species; California Department of Fish and Wildlife Fish Species of Special Concern. Available at https://www.wildlife.ca.gov/Conservation/SSC/Fishes; University of California, Division of Agriculture and Natural Resources California Fish Website. Available at https;//calfishapp.wfcb.ucdavis.edu

Table 3. Status and habitat of native wildlife in the action area with indirect or direct relationships with hatchery-origin salmon.

Species	Listing Status (Federal and State)	Habitat Type	Type of Interaction with Salmon
California red-legged frog	Threatened (Federal) Species of special concern (State)	Freshwater	● Potential predator of salmon eggs and fry ● Potential prey item for juvenile salmon
Pacific giant salamander	Species of special concern (State)	Freshwater	● Potential prey item for juvenile salmon
western pond turtle	Species of special concern (State)	Freshwater	● Potential predator of salmon eggs and fry ● May compete with salmon for food and space
ducks, geese, and swans	None	Freshwater, Marine, Estuary	● Potential predator of salmon eggs and fry
gulls and terns	None	Freshwater, Marine, Estuary	● Potential predator of juvenile salmon ● Potential scavenger of adult salmon carcasses
great egret	Special animal (State)	Freshwater, Estuary	● Potential predator of juvenile salmon
great blue heron	Special animal (State)	Estuary	● Potential predator of juvenile salmon
double-crested cormorant	Special animal (State)	Freshwater, Marine, Estuary	● Potential predator of juvenile salmon ● Potential scavenger of adult salmon carcasses

Species	Listing Status (Federal and State)	Habitat Type	Type of Interaction with Salmon
osprey	Special animal (State)	Freshwater, Estuary	● Potential predator of juvenile salmon ● Potential scavenger of adult salmon carcasses
raccoon	None	Freshwater, Estuary	● Potential predator of salmon eggs, fry, and juveniles ● Potential scavenger of adult salmon carcasses
harbor seal northern elephant seal	MMPA (Federal)	Marine, Estuary	● Potential predator of salmon eggs, fry, and juvenile and adult salmon
California sea lion Stellar sea lion	MMPA (Federal)	Marine, Estuary	● Potential predator of salmon eggs, fry and juvenile and adult Potential predator of salmon eggs, fry, and juveniles

Endangered Species Act (ESA), California Endangered Species Act (CESA), California Department of Fish and Wildlife (CDFW), and Marine Mammal Protection Act (MMPA).

Sources: https://www.fisheries.noaa.gov/find-species; California Department of Fish and Wildlife, California Natural Diversity Database, Special Animal List, April 2018. Available at https://www.wildlife.ca.gov/Data/CNDDB

3.6 Cultural Resources

Effects on cultural resources typically occur when a proposed action disrupts or destroys cultural artifacts, disrupts cultural use of natural resources, or when it would disrupt cultural practices. Hatchery programs have the potential to affect cultural resources if there is construction, expansion or transportation at the hatchery facilities that disrupts or destroys cultural artifacts, or if the hatchery programs affect the ability of indigenous people to use salmon and steelhead in their cultural practices.

Salmon represent an important cultural resource to many indigenous people or tribes. It is a core symbol of tribal identity, individual identity, and the ability of many indigenous cultures to endure. The survival and well-being of salmon is seen as inextricably linked to the survival and well-being of indigenous people and the cultures of many tribes.

In addition, tribal assets are legal interests in property held in trust by the United States for tribes or individuals. The U.S. Secretary of the Interior, acting as the trustee, holds tribal assets, which may either be on or off tribal reservations. The United States, and thus Federal agencies, have a trust responsibility to protect and maintain these rights reserved by or granted to tribes or individuals by treaties, statutes, and executive orders. (NMFS 2005)[4] . The natural or physical environment of a tribe may include resources reserved by treaty or lands held in trust; native species (e.g., salmon and steelhead); sites of special cultural, religious, or archaeological importance, such as sites protected under the National Historic Preservation Act or the Native American Graves Protection and Repatriation Act; and other areas reserved for hunting, fishing, and gathering. Fishing is considered a tribal trust asset because treaties with the United States government on the West Coast guaranteed tribes party to those treaties the right to fish.

No new construction is planned, and transportation routes use existing roadways which avoids sites of special cultural, religious, or archaeological importance. The endangered status of CCC coho salmon, and the take prohibitions[5] associated with this listing, supersede any permissions that may exist otherwise allowing take of this species as a cultural resource. SCSCBP activities involve the collection of adult and juvenile coho salmon, and the spawning, rearing and release of fish into SCMDS streams. Therefore, program activities are reasonably likely to potentially affect cultural use and practices that utilize this natural resource. NMFS contacted the Bureau of Indian Affairs on September 17, 2018, in reference to tribal interest in the action area. The Bureau of Indian Affairs informed NMFS that there are no federally recognized tribes within the action area of the SCMDS. However, there is one federally recognized tribe that has land adjacent to DCFH where some of the program fish are reared. The Dry Creek Rancheria Band of Pomo has federally recognized land that is located adjacent to the DCFH facility (NMFS 2020). This tribe was contacted for the development of an EA for the issuance of an enhancement permit for the Russian River Coho Salmon Captive Broodstock Program, which described and evaluated the environmental impacts of rearing coho salmon at the DCFH.

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[4] For more information on Sovereign Relations, please visit the NMFS, West Coast Region website at: https://www.fisheries.noaa.gov/west-coast/partners/sovereign-relations-west-coast.

[5] Take of coho salmon is prohibited pursuant to section 4(d) and section 9 of the ESA (61 FR 56138).

In May 2023, NMFS obtained a list from the Native American Heritage Commission (NAHC) of Native American tribes culturally affiliated with the program area, and who may have knowledge of cultural resources within the program area. Pursuant to 36 CFR § 800.4(a)(4), on June 21, 2023, NMFS sent letters offering consultation to the Association of Ramaytush Ohlone, Amah Mutsun Tribal Band, Amah Mutsun Tribal Band of San Juan Bautista, Costanoan Ohlone Rumsen-Mutsen Tribe, Indian Canyon Mutsun Band of Costanoan, Muwekma Ohlone Indian Tribe of the San Francisco Bay Area, Wuksache Indian Tribe/Eshom Valley Band, and the Costanoan Rumsen Carmel Tribe and requested their assistance to identify sites of religious or cultural significance in the program area that may be affected by the program. No responses were received. This outreach is also intended to ensure compliance with the American Indian Religious Freedom Act (1978) and Consultation and Coordination with Indian Tribal Governments (Executive Order 13175 [2000]).

4 ENVIRONMENTAL CONSEQUENCES

4.1 Introduction

The goal of this EA is to determine if any of the alternatives' effects are likely to be significant (NOAA 2009). The significance of the effect is determined by the degree to which the actions adversely or beneficially effect the affected environment's resources. To evaluate each alternative's potential environmental consequences on the affected environment, actions and effects must be placed in context of the Affected Environment, and an estimation of the probability of occurrence, magnitude or intensity and duration of the effect or intensity must be made. The relative degree of effects 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, but detectable
- Moderate: Beneficial or adverse effects would be measurable with low statistical power[6]
- High: Beneficial or adverse effects would be measurable with high statistical power[7]

This chapter provides the scientific and analytic basis for comparing the two alternatives. Each alternative is compared, where appropriate, to the effects the hatchery program had on environmental resources prior to 2020 (Appendix A). It includes a discussion of the probable consequences of the two proposed alternatives on environmental resources. The proposed action potentially can affect the physical or biological resources within the action area. The following is an analysis of the potential environmental consequences on the major components of the environment based on the current affected environment conditions described in Section 3

[6] 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.

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

(Affected Environment), above, organized by the alternatives considered in Section 2 (Alternatives Including the Proposed Action). Differences between the No-Action and Proposed Action alternatives are primarily related to incremental biological improvements due to full implementation of the HGMP over the next ten years.

A summary of effects by resource area is provided in Table 4. The rationale for each effect classification is provided in subsequent sections of this EA.

Table 4. Summary of effects on resources under each Alternative

Resource	Metric	Alternative 1 (No Action)	Alternative 2 (Proposed Action)
Water Resources	Quantity	No Effect	Negligible Adverse
	Quality	No Effect	Negligible Adverse
CCC Coho Salmon	Overall	High Adverse	High Beneficial
	Population	High Adverse	High Beneficial
	Ecological	Negligible Beneficial	Low Adverse
CCC Steelhead	Overall	Negligible Adverse	Low Beneficial
	Population	Negligible Adverse	Low Beneficial
	Ecological	Negligible Beneficial	Low Beneficial
Other Fish Species	Competing with Salmon	Negligible Beneficial	Negligible Adverse
	Predators of Salmon	Negligible Adverse	Negligible Beneficial
Wildlife	Predators of Salmon	Negligible Adverse	Negligible Beneficial
	Potential Prey Item	Negligible Beneficial	Negligible Adverse
Cultural Resources	All Aspects	No Effect	Negligible Beneficial

4.2 Alternative 1 (No Action)

Under the No Action Alternative, NMFS would not approve the application and HGMP as submitted after determining the submitted permit application and HGMP fail to meet the criteria necessary to issue an ESA section 10(a)(1)(A) enhancement permit. For the purposes of this analysis, this alternative would not allow for continued operation of the Program.

4.2.1 Water Resources

4.2.1.1 Water Quantity

Under Alternative 1 (No Action), the use of water for hatchery operations at KFH would not occur and therefore there would be no effect to water resources of Big Creek or Berry Creek.

Similarly, effects to waters diverted from the Pacific Ocean to operate facilities at the FED Lab would not occur, nor would any additional waters used from Lake Sonoma in the Russian River drainage be used to maintain Program fish at DCFH.

4.2.1.2 Water Quality

Under Alternative 1 (No Action), there would be no discharge from hatchery operations at KFH and therefore any effects from discharges to receiving waters, as occurs in Alternative 2 (Proposed Action) in Big Creek would be avoided. Similarly, there would be no discharge of waters to the Pacific Ocean from the FED Lab, or any added discharge related to the rearing of Program fish to Dry Creek in the Russian River basin.

4.2.2 Salmon and Steelhead

As described in Section 2.1 under Alternative 1 (No Action), if NMFS determines to not issue an ESA section 10(a)(1)(A) permit to FED to maintain the SCSCBP, Program operations would cease until a new permit application and HGMP are submitted, and the applicants are granted an ESA section 10(a)(1)(A) enhancement permit. Without the SCSCBP, all potential beneficial or adverse effects of the Program on biological resources would be eliminated.

4.2.2.1 Central California Coast Coho Salmon

If FED is not issued an ESA section 10(a)(1)(A) enhancement permit as described under Alternative 1 (No Action), it is anticipated high adverse effects to the CCC coho salmon ESU are reasonably likely to occur because of the discontinuation of hatchery production by the Program.

Population Effects

Hatchery production currently contributes to the overall abundance, population growth rate (productivity), population spatial structure and diversity of SCMDS CCC coho salmon. These four metrics form the viable salmon population (VSP) parameters used to define population status (McElhaney et al. 2000). The elimination of the program is expected to result in a decrease in all four VSP parameters resulting in a large decrease in population viability. Thus, the effect of this alternative on population viability is expected to be high adverse.

Ecological Effects

Ecological effects of the Program on CCC coho salmon occur through the mechanisms of competition, predation, and disease. Competition between hatchery-origin and natural-origin 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 CCC coho salmon that can also reduce natural fish abundance.

Without the Program, as stated under Alternative 1 (No Action), hatchery-origin adult and juvenile CCC coho salmon will no longer be released to SCMDS streams. This in turn will reduce competition and predation risk to natural-origin CCC coho salmon, which is likely to result in a negligible beneficial effect as supported by the PCD-Risk modeling analysis provided in the HGMP (Appendix A). This modeling analysis showed that ecological effects to naturally produced CCC coho salmon from hatchery production was quite low (values of <3 out of possible maximum score of 100) over a range of hatchery release numbers, stream temperatures and the amount of time hatchery fish spend in the stream (Table 5).

In summary, while the elimination of the Program results in negligible beneficial effects on coho salmon, this benefit is diminished by the high adverse effect to population viability. Therefore, NMFS expects the adoption of Alternative 1 (No Action) would result in high adverse effects to the CCC coho salmon ESU including jeopardizing species recovery (NMFS 2012).

Table 5. PCD Risk results for natural-origin (NOR) coho salmon fry and smolts by hatchery-origin (HOR) residence time in the stream and stream temperature. The maximum PCD Risk value possible is 100.0 which results in complete loss of NOR fish.

7-Day Residence Time									
Temperature (°C)	Fry Release (HOR Coho Salmon)								
	N = 1,000			*N* = 2,000			*N* = 4,000		
	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
10	0.1	0.2	0.4	0.2	0.5	0.7	0.6	1.0	1.3
12	0.1	0.2	0.4	0.2	0.5	0.8	0.6	1.0	1.4
14	0.1	0.3	0.5	0.2	0.5	0.7	0.6	1.0	1.4
16	0.1	0.2	0.4	0.3	0.5	0.8	0.7	1.0	1.4
Temperature (°C)	Smolt (HOR Coho Salmon)								
	N = 1,000			*N* = 2,000			*N* = 4,000		
	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
10	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3
12	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3
14	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.4	0.4
16	0.1	0.1	0.1	0.2	0.2	0.2	0.4	0.4	0.5
14-Day Residence Time									
Temperature (°C)	*N* = 4,000 (HOR Coho Salmon)								
	Fry Release			Smolt Release					
	Min	Ave	Max	Min	Ave	Max			
16	1.3	1.9	2.6	0.8	0.9	0.9			

4.2.2.2 Central California Coast Steelhead

If FED is not issued an ESA section 10(a)(1)(A) enhancement permit as described under Alternative 1 (No Action), it is anticipated that CCC steelhead will face negligible adverse effects. These negligible adverse effects will stem from the localized loss of coho salmon as prey (eggs and fry), as well as the minor impacts on the food chain from the reduced marine derived nutrient loads provided by more abundant adult coho salmon carcasses in the stream channel.

Population

These negligible adverse effects will be realized through decreased abundance of CCC coho salmon eggs, fry, and juveniles in program streams, which steelhead may use as a food source. If operations cease under Alternative 1 (No Action), these life stages of coho salmon will no longer be raised, or released, as part of the program and therefore CCC steelhead are expected to face negligible adverse effects to their salmon-based food sources, which constitute only a minor portion of the overall CCC steelhead diet. In addition, there would be a reduction of marine

derived nutrients from adult coho salmon carcasses (returns or artificially placed from the hatchery), which would have some minor effect on the food chain.

Ecological

Similar to natural-origin CCC coho salmon, under Alternative 1 (No Action), it is likely juvenile CCC steelhead would experience negligible beneficial effects from the decreased abundance of juvenile coho salmon due to decreased competition for resources (i.e., food and habitat), and reduced predation. This would only occur in watersheds within the SCMDS where coho salmon are present because of releases by the program, otherwise there would be no effect for SCMDS watersheds where coho salmon are extirpated. There would also be negligible adverse effects related to the loss of marine-derived nutrients from adult salmon carcasses and eggs produced from these adult coho salmon during spawning.

4.2.3 Other Fish Species

If CCC coho salmon hatchery production were to cease, as described under Alternative 1 (No Action), those species identified in 2 as a "predator of salmon eggs, fry, juveniles and adults", and/or those identified as benefiting from "fish carcasses from hatchery-released fish" are reasonably expected to experience negligible adverse effects under Alternative 1 (No Action).

Conversely, it is also possible that fish identified in Table 2 as "competing with salmonids for food and space" may experience negligible beneficial effects due to increased availability of resources (i.e., food and habitat) from decreased competition with salmon and steelhead.

The effects to these other species are considered negligible based on the size of the hatchery program that is eliminated and the geographic scale it operates over (multiple basins).

4.2.4 Wildlife

Like the description above concerning "other fish species" wildlife species that are potential predators of coho salmon eggs, fry, juveniles, and adults in the action area have likely benefited to some degree from the ongoing efforts of the Program and may experience negligible adverse effects with Program termination under Alternative 1 (No Action).

Under this alternative it is possible that species identified in Table 3 that may be a "potential prey item of salmon" may experience negligible beneficial effects from the elimination of predation by hatchery-origin coho salmon. This includes the California red-legged frog (*Rana draytonii*), a species listed as threatened under the Federal ESA.

4.2.5 Cultural Resources

The Program utilizes existing facilities and roadways for transportation which already avoid culturally important artifacts. Under Alternative 1 (No Action), FED would not be issued a permit for the SCSCBP as proposed, resulting in adverse effects to salmonid populations, and would reasonably be expected to increase the extinction risk of the CCC coho salmon ESU (as described in section 3.3.1). Though salmon represent an important cultural resource to many Native American tribes, the take prohibitions currently supersede any permissions that allow take

of this species as a cultural resource at this time; thus, there is no effect to tribal assets under Alternative 1 (No Action).

4.3 Alternative 2 (Proposed Action)

Under this alternative (Proposed Action), NMFS would approve the submitted application and HGMP and issue the section 10(a)(1)(A) enhancement permit to FED for a period of ten years after determining that the application sufficiently meets the issuance criteria . The issued ESA section 10(a)(1)(A) enhancement permit would grant FED and other entities operating under the permit permission for the take of the ESA-listed species associated with the proposed hatchery program, including the production of CCC coho salmon (Appendix A). Operation of the program would include implementation of risk aversion measures to minimize the likelihood for adverse genetic and ecological effects, effects to water resources, listed species, and other wildlife as described in the HGMP.

4.3.1 Water Resources

4.3.1.1 Water Quantity

Under Alternative 2 (Proposed Action), the potential effects to water quantity is not expected to have a significant effect on hydrologic conditions and resources at the three program facilities.

At KFH, water for hatchery operations is managed with a designated spillway at a retention dam to ensure freshwater habitats downstream of the dam receive adequate water and always remain viable for salmonids. Because the water utilized to operate the KFH is continuously discharged back into the stream, and no appreciable consumption of water occurs, any effects associated with water quantity to operate these systems will be negligible adverse.

At the FED Lab, seawater is pumped directly from the Pacific Ocean. The limited amount of water used to fill and maintain holding tanks at the FED Lab is negligible and would have no effects on supply.

Water used to rear Program fish at DCFH is obtained from the stilling basin of Warm Springs Dam (Russian River basin). Water used for fish production at the DCFH is returned to Dry Creek, where it eventually flows into the Russian River. The amount of water used for continued rearing of Program fish would be negligible (adverse), particularly when compared to the amount water available in Lake Sonoma (used to store and release water into Dry Creek for downstream uses), and the amount used to maintain ongoing DCFH program CCC coho salmon and steelhead hatchery programs.

4.3.1.2 Water Quality

No significant effects on water quality are expected under Alternative 2 (Proposed Action). Under this alternative water discharged from KFH is released into Big Creek and would contribute minor amounts of nutrient and organic matter (food and feces) to the creek due to KFH operations. However, this is not expected to result in significant effects to nutrients or algal growth in Big Creek or Scott Creek, which is consistent with past observations since 2002. Because of its small size and the lack of chemical discharge to streams, the Central Coast

Regional Water Quality Control Board (CCRWQCB) has exempted KFH from obtaining an NPDES permit. At both the FED Lab and DCFH facilities, water quality is closely monitored and treated to comply with existing NPDES permits issued by the CCRWQCB and NCRWQCB, respectively.

Therefore, Alternative 2 (Proposed Action) is expected to result in negligible adverse effects to water quality within the action area.

4.3.2 Salmon and Steelhead

4.3.2.1 CCC Coho Salmon

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

Population Effects

Program releases of various life stages of hatchery-origin CCC coho salmon are expected to result in improvements in each of the four VSP parameters, abundance, population growth rate (productivity), spatial structure and diversity. The expected increase in adult CCC coho salmon abundance from Program fish releases is shown by life stage and stream in Table 7.

Over the 10-year term of the HGMP, benefits to CCC coho salmon will occur primarily in Stream Priority Group 1 that consists of Scott Creek, Waddell Creek, San Vicente Creek and Pescadero Creek. This occurs because the Program has insufficient production capacity to release fish into all nine streams of the SCMDS simultaneously.

The streams selected for inclusion in Stream Priority Group 1 were selected because they either currently have some natural CCC coho salmon production, and/or have existing infrastructure that supports collection of adults for program broodstock and/or population monitoring (e.g., Scott Creek). Additionally, Pescadero Creek is included in Group 1 because it is classified by NMFS as an independent population, and therefore has sufficient juvenile carrying capacity to support large releases of program fish without resulting in significant density-dependent effects to naturally produced CCC coho salmon because few are present in this basin. Therefore, the effects to CCC coho salmon from Alternative 2 (Proposed Action) is classified as highly beneficial.

Program produced adult CCC coho salmon will assist in the attainment of the NMFS adult downlisting criteria for Stream Priority Group 1 (Table 6). The attainment of this criterion in a stream will increase population viability and therefore reduce extinction risk for CCC coho salmon (McElhaney et al., 2000).

Hatchery broodstock practices may result in an increase in inbreeding and genetic drift (random loss of alleles). Inbreeding occurs when related individuals are mated. This results in the lowering of the population's ability to survive and reproduce over time, a phenomenon called inbreeding depression. To reduce inbreeding depression, the program uses a genetically based spawning matrix for selecting mates. This approach reduces relatedness among spawn pairs compared to random mating (Figure 6). However, because of low adult abundance at the

population scale, an insufficient number of broodstock are available to eliminate inbreeding completely. This can be seen by the number of pairs (yellow bars) in Figure 6 that exceed the do-not-mate threshold value established by geneticists for the program. When this occurs, the related fish are not released to the natural environment.

Additionally, to reduce inbreeding and improve population genetic variability the program may import CCC coho salmon from other basins (e.g., Lagunitas Creek) for use as program broodstock (i.e., outbreeders). The Lagunitas-Olema Creek population is in Marin County immediately north of San Francisco, and is the nearest, persistent population to the north within the ESU. The collection of NOR juvenile coho salmon from Lagunitas-Olema Creek, or from the next northern population (Russian River) is conducted by staff from the Corps or CDFW under ESA section 10(a)(1)(A) enhancement permit 21501 issued for the RRCSCBP. The purpose of these collections is to improve genetic diversity within the Russian River population. Surplus captive broodstock fish from these two populations are then made available to the SCSCBP for outbreeding and genetic diversity enrichment.

The use of the spawning matrix and importation of broodstock from other basins is expected to improve (high beneficial) the genetic variability of CCC coho salmon above that which would be obtained naturally given current adult abundance levels. The extremely low abundance of natural-origin CCC coho salmon in SCMDS streams makes it highly likely that genetic variability will continue to decline without the program.

HOR adult and NOR juvenile and adult coho salmon needed for broodstock may be collected by the program or other parties working at SCMDS streams. For example, coho salmon from Scott Creek used as broodstock will be collected by FED under ESA section 10(a)(1)(A) research permit 17292-3R. The FED uses a weir to monitor CCC coho salmon and CCC steelhead adult and juvenile production in Scott Creek as part of long-running Life Cycle Monitoring Station. In addition, FED conducts other monitoring activities in adjacent watersheds, including San Vicente Creek and has an established network of PIT-tag antennas in various program streams. The effects of weir operations (i.e., fish capture and handling) or other fisheries collections by FED are covered under their research permit. The enhancement permit for the program would authorize the transport of coho salmon captured during these monitoring activities for use as broodstock to program facilities, and for their subsequent captive rearing and spawning. Because mortality associated with fish transport is expected to be less than 2%, the effect to CCC coho salmon is considered low adverse (Appendix A).

The program may also collect HOR or NOR adult coho salmon for use as broodstock from other SCMDS using seines on an ad hoc basis. This is considered ad hoc due to the low abundance and unpredictable nature of where adult coho salmon may occur and be detected prior to spawning in the wild.

The removal of NOR adult and juvenile CCC coho salmon from SCMDS streams has the potential to reduce natural production in the streams where they are collected. However, the overall effect to the CCC coho salmon population will be highly beneficial as the program increases total population size through the production of hatchery-origin fish. For Phase 1 and

Table 6. Expected adult production from the maximum release of eggs, fry, parr, advanced parr, yearlings and captive brood adults by stream and Stream Priority Group.

Stream Priority Group	Stream	Population Status	Naturally Produced Coho Salmon Present	Adult Abundance Downlisting Criteria	Expected Adult Production by Life Stage					
					Early Life Stages		Juveniles			Captive Brood
					Eggs	Fry	Parr	Advanced Parr	Smolts	
1	Scott Creek	Dependent	Yes	255	33	66	70	186	465–930	240
	Waddell Creek	Dependent	Yes	157	33	66	70	157	157	157
	San Vicente Creek	Dependent	Yes	53	33	53	53	53	53	53
	Pescadero Creek	Independent	No	1,150	33	66	70	186	465	240
2	Gazos Creek	Dependent	No	140	33	66	70	140	140	140
	San Lorenzo River	Independent	No	1,900	33	66	70	186	465	240
	San Gregorio Creek	Dependent	No	682	33	66	70	186	465	240
3	Soquel Creek	Dependent	No	561	33	66	70	186	465	240
	Aptos Creek	Dependent	No	466	33	66	70	186	465	240

* Independent populations historically are believed to have had a high probability of persistence over a 100-year period, with or without immigrants from adjacent populations, while dependent populations require such immigrants.

**Adult downlisting criterion for each stream is based on the total kilometers of intrinsic potential habitat (IPkm) present.

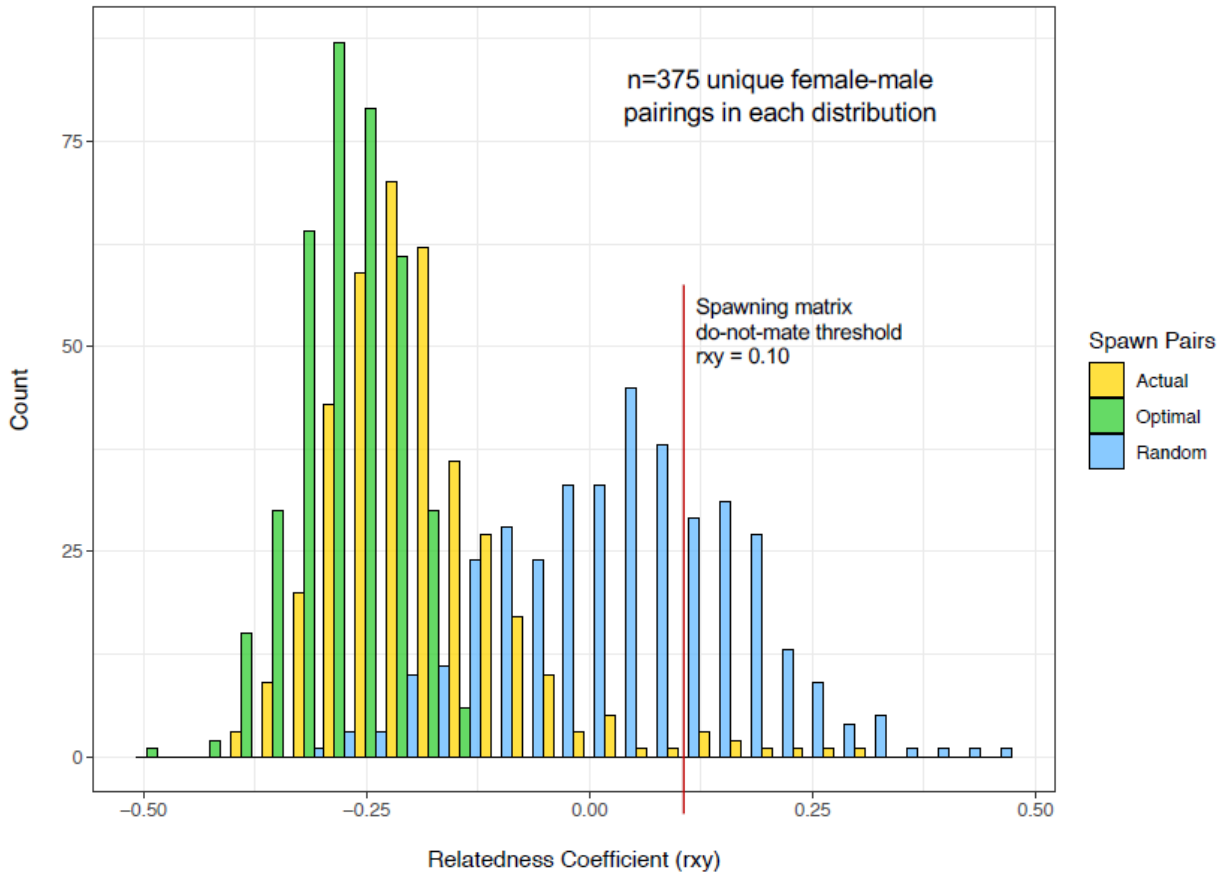

Figure 6. Distributions of the relatedness coefficient for three categories of spawn pairs: actual (fish spawned at KFH); optimal (top mate choices in the spawning matrix); and random (mates chosen using a random number generator), for the 2019–2020 spawn season. Vertical orange bar denotes the do-not-mate (r_{xy} > 0.1, currently 0.125) threshold in the spawning matrix.

Phase 2, the program will take a maximum of 75 NOR adults to produce approximately 465 HOR adults (Appendix A). Up to 600 natural-origin juveniles may be collected each year by the program (or by others under permit 17292-3R) and used to create the captive broodstock for the program. Fish may be captured using traps, seines and or backpack electroshocking gear. The effects of this monitoring on other species such as CCC steelhead (also a focus of the research monitoring) has been evaluated for the issuance of the section 10(a)(1)(A) research permit.

Ecological Effects

The ecological effects the program has on CCC coho salmon occur through the mechanisms of competition, predation, and disease. Competition between hatchery-origin and natural-origin coho salmon for limiting 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 can also reduce natural fish abundance. The effect to CCC coho salmon is classified as low adverse.

If NMFS issues an ESA section 10(a)(1)(A) permit for the SCSCBP, as stated under Alternative 2 (Proposed Action), there will be a potential increase in the abundance of hatchery-origin coho salmon that are found in program streams. However, the program intends to primarily release yearling smolts near the mouths of these streams. Fry, parr and advanced parr releases will be prioritized to streams where CCC coho salmon abundance is extremely low, or extirpated. Combined, these actions will minimize the competition and predation risks program fish pose to natural CCC coho salmon populations in each stream.

Hatchery fish production may increase disease risk in streams where fish are reared (via hatchery effluent) or released. Program rearing activities follow disease and prevention guidelines developed by the CDFW Fish Health Laboratory (Appendix A). Prior to fish being released, or transferred between facilities, a sample of 60 fish are sacrificed and sampled for disease screening by CDFW pathologists. Fish are not released until they receive health certification from the pathologists.

NMFS concludes that the ecological effects of the program pose a low adverse effect to CCC coho salmon of the SCMDS. This conclusion is supported by the PCD-Risk modeling analysis provided in the HGMP (Appendix A). This modeling analysis showed that ecological effects to naturally produced coho salmon from releases of HOR fish was quite low (values of <3 out of possible maximum score of 100) over a range of hatchery release numbers, stream temperatures and the amount of time hatchery fish are likely to spend in each release stream (Table 5 and Table 7).

In summary, due to the extremely precarious condition of coho salmon populations in the SCMDS, NMFS has determined (NMFS 2012) that the restoration of extirpated populations and the enhancement of few extant populations of CCC coho salmon in the SCMDS will require continued implementation of a genetically managed hatchery program. Any minor species-specific benefits from eliminating the release of hatchery-origin fish, are far outweighed by the larger benefits of implementing the program. As such, NMFS considers adoption of Alternative 2 (Proposed Action) to result in high beneficial effects to the CCC coho salmon ESU.

4.3.2.2 CCC Steelhead

It is reasonably likely that the CCC steelhead population will face a mixture of beneficial and adverse effects if FED is issued an ESA section 10(a)(1)(A) enhancement permit and the SCSCBP is implemented as described under Alternative 2 (Proposed Action). Low beneficial effects to CCC steelhead will be realized by progressively increasing the abundance of CCC coho salmon fry and juveniles to program streams, and through the addition of marine-derived nutrients to the freshwater environment. In time, it is expected that the program will lead to increased natural-origin production in the SCMDS, which in turn will result in more eggs, fry and marine-derived nutrients. Under current program operations, the SCSCBP releases less than 50,000 juveniles (fry to smolt) into program streams. As proposed, the number of juvenile releases would increase to a maximum of 170,000, and up to 380 adult carcasses would be available for release as nutrient enrichment.

If the SCSCBP is permitted as proposed, CCC steelhead throughout the action area are reasonably likely to experience low beneficial effects to their salmon-based food sources because

coho salmon (eggs and juveniles) make up some portion of the CCC steelhead diet (NMFS 2016b). In addition, the nutrient loading from an increase in adult CCC coho salmon carcasses in Program streams would also benefit CCC steelhead because they serve as a source of marine-derived nutrients for the riverine food web (Joy et al. 2021).

However, under Alternative 2 (Proposed Action) it is also possible that juvenile CCC steelhead may experience low adverse effects from the increased abundance of hatchery-origin CCC coho salmon because of increased competition for resources (i.e., food and habitat), and increased predation. PCD-Risk modeling analysis conducted in the HGMP showed that ecological effects to naturally produced CCC steelhead from hatchery production was quite low (values of <3 out of possible maximum score of 100) over a range of hatchery release numbers, stream temperatures and the amount of time hatchery fish are likely to spend in each release stream (Table 7).

Table 7. PCD-Risk results for natural-origin CCC steelhead fry and parr/yearlings by HOR residence time in the stream and stream temperature. The maximum PCD-Risk value possible is 100 which results in complete loss of natural-origin fish.

7-Day Residence Time									
	Fry Release (HOR Coho Salmon)								
Temperature	*N* = 1,000			*N* = 2,000			*N* = 4,000		
(°C)	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
10	0.1	0.2	0.4	0.2	0.5	0.8	0.6	1.0	1.4
12	0.1	0.2	0.4	0.2	0.5	0.8	0.6	1.0	1.4
14	0.1	0.2	0.5	0.3	0.5	0.8	0.6	1.0	1.4
16	0.1	0.2	0.4	0.3	0.5	0.8	0.5	1.0	1.4
	Parr/Smolt Release (HOR Coho Salmon)								
Temperature	*N* = 1,000			*N* = 2,000			*N* = 4,000		
(°C)	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
10	0	<0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
12	0	<0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
14	0	<0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3
16	0	<0.1	0.2	0.1	0.1	0.2	0.3	0.3	0.3
14-Day Residence Time									
	N = 4,000 (HOR Coho Salmon)								
Temperature	Fry Release			Smolt Release					
(°C)	Min	Ave	Max	Min	Ave	Max			
16	1.2	1.9	2.8	0.5	0.5	0.6			

4.3.3 Other Fish Species

If FED is issued an ESA section 10(a)(1)(A) enhancement permit as described under Alternative 2 (Proposed Action), those species identified in Table 2 as a "predator of salmon eggs, fry, juveniles and adults", and/or those identified as benefiting from "fish carcasses from hatchery-

released fish" are reasonably expected to experience negligible beneficial effects. These beneficial effects will be realized through an increased abundance of CCC coho salmon (all life stages) in program streams, as described above in (Section 3.3).

Conversely, it is also possible that fish identified in Table 2 as "competing with salmonids for food and space" may experience negligible adverse effects due to increased competition with salmon and steelhead for resources.

Under Alternative 2 (Proposed Action), those species identified in Table 3 as a "predator of salmon eggs, fry, or juveniles" and/or those identified as benefiting from "carcasses of hatchery-origin fish" are reasonably expected to be negligibly beneficial under Alternative 2 (Proposed Action).

Under Alternative 2 (Proposed Action) it is also possible that fish identified in Table 3 as "competing with salmon for food and space" may experience negligible adverse effects due to decreased availability of resources (i.e., food and habitat) from increased competition with hatchery-origin juvenile coho salmon. However, these effects would be insignificant because the number of juvenile coho salmon released to streams as part of the program is still far below the natural abundance that would have naturally occurred and is low relative to the more abundant native fishes with which they may potentially compete. Furthermore, other native fish species (e.g., coastrange sculpin, threespine stickleback) remain abundant despite nearly two decades of hatchery releases. As with CCC steelhead, native fishes in these streams co-evolved with coho salmon and have developed dietary and habitat preferences within the aquatic community to minimize competition.

4.3.4 Wildlife

The species identified in Table 3 as "potential predator of salmon eggs, fry, and juveniles" or as a "potential scavenger of adult salmon carcasses" are expected to be negligibly benefited by the Program.

Under Alternative 2 (Proposed Action) it is possible that species identified in Table 3 that may be a "potential prey item of salmon" may experience low adverse effects from predation by hatchery-origin coho salmon. These include California red-legged frog (*Rana draytonii*), a species listed as threatened under the Federal ESA (USFWS 2002). While there is some habitat overlap between the two species, the level of anticipated effects on the California red-legged frog from predation is expected to be negligible adverse because the number of juvenile coho salmon planned for release is still far below the natural historic abundance, and because California red-legged frog tadpoles are not considered a common prey item of juvenile coho salmon.

4.3.5 Cultural Resources

As described above, effects to cultural resources typically occur when an action disrupts or destroys cultural artifacts, disrupts cultural use of natural resources, or would disrupt cultural practices. Under Alternative 2 (Proposed Action), a permit for the SCSCBP would be issued, resulting in utilization of existing facilities for rearing and breeding of coho salmon, and transportation of fish between the program facilities and streams of the SCMDS. Because existing facilities and roadways would be utilized for associated SCSCBP operations, which

already avoid culturally important artifacts, there will be no significant effects to these cultural resources under Alternative 2 (Proposed Action).

Current and future SCSCBP activities involve the collection and rearing of juvenile fish and the rearing, spawning and release of adult fish throughout the action area. These activities are reasonably likely to increase both the numbers of coho salmon and populations throughout the action area. If the SCSCBP is successful, and the coho salmon populations recover, tribal trust assets and use for cultural purposes may be reinstated resulting in negligible beneficial effects to tribal cultural practices. However, because we are unable to determine the magnitude of these beneficial effects at this time, for analysis purposes we assume they would be negligible beneficial.

5 CUMULATIVE EFFECTS

5.1 Introduction

NEPA defines cumulative effects as the effects on the environment which results from the incremental effects of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period. (40 CFR 1508.7).

Council on Environmental Quality (CEQ) guidelines recognize that it is not practical to analyze the cumulative effects of an action from every conceivable perspective, but rather, the intent is to focus on those effects that are truly meaningful. In other words, if several separate actions have been taken or are intended to be taken within the same geographic area, all the relevant actions together (cumulatively) need to be reviewed, to determine whether the actions together could have a significant effect on the human environment. Past, present, and reasonably foreseeable future actions include those that are federal and non-federal. For this EA analysis, they also include those that are hatchery related (e.g., hatchery production levels) and non-hatchery related (e.g., human development).

Section 3, Affected Environment, describes the existing conditions for each resource and reflects the effects of past actions and present conditions. Section 4, Environmental Consequences, evaluates the effects of the alternative for each resource's existing conditions. This section considers the cumulative effects of each alternative in the context of past actions, present conditions, and reasonably foreseeable future actions and conditions in the action area.

5.2 Geographic and Temporal Scales

The cumulative effects analysis area is the portion of the CCC coho salmon ESU that spans the SCMDS (Section 1.3, Figure 2). The scope of the action considered here includes the broodstock rearing, and fish release activities into Program streams across the SCMDS. Adult collection and transport, egg incubation, juvenile rearing, and release activities would occur in localized areas only; associated effects of these activities are analyzed in Section 4, Environmental Consequences. The HGMP would be in effect after the associated ESA section 10(a)(1)(A) permit is issued and would remain in effect for up to ten years, or until NMFS determines that

the HGMP is no longer effective. During the ten-year life of the permit, NMFS will review the HGMP every five years, and the plan could be modified as warranted by NMFS.

NMFS considered whether the Pacific Ocean should be included in the cumulative effects analysis area. Available knowledge and research abilities are insufficient to discern the role and contribution of the Proposed Action to density dependent interactions affecting salmon and steelhead growth and survival in the Pacific Ocean. NMFS' general conclusion is that the influence of density dependent interactions on growth and survival are likely small compared to the effects of large scale and regional environmental conditions. While there is evidence that hatchery production, on scales much larger than the Proposed Action, can affect salmon survival at sea, the extent of the effect or level of influence is not yet understood or predictable, nor is there any evidence that programs of this size have any discernible effects in the ocean. Thus, direct, indirect, and cumulative effects of the SCSCBP on the Pacific Ocean are not expected.

5.3 Effects on Climate Change from Alternatives

Neither of the alternatives are expected to result in significant effects to climate change. No activities would occur under Alternatives 1 and 2 that would result in significant changes to greenhouse gas emissions or other pollutants that are likely to contribute to environmental conditions associated with climate change.

Under Alternative 1 (No Action), the amount of carbon emitted due to the SCSCBP would be reduced to zero. Under Alternative 2 (Proposed Action), carbon emissions would increase to approximately 0.01 tons of carbon emitted each year from transporting fish between the three broodstock rearing facilities and Program streams for release. Carbon emissions were calculated using the Environmental Protection Agencies (EPA) calculator website[8]. While there will be an increase in carbon emissions under Alternative 2 (Proposed Action), the quantity of emissions is exceptionally low[9] and not expected to result in significant cumulative effects to climate change.

5.4 Reasonably Foreseeable Future Actions

These actions have occurred in the past, are currently occurring, and are expected to continue into the foreseeable future throughout the ten-year life of the permit.

5.4.1 Timber Harvest

Timber harvest can result in increases in sediment to waterways, reductions in stream shading from loss of vegetation, and reductions in the amount of woody debris that enters into streams (NMFS 2012; NMFS 2016b). Based on recent trends, NMFS reasonably expects that, on average, at least one timber harvest project might occur every year during the life of the ten-year permit in the action area. While management of timber harvest has improved in recent decades with the onset of the California Forest Practice Rules implemented by the California Department of Forestry, legacy effects are likely still affecting environments in the action area. These effects include increased sediment loads into streams, and reduced stream complexity by removal of

[8] https://www3.epa.gov/carbon-footprint-calculator/

[9] Emissions occur primarily from the transport of fish to and from hatchery facilities and release sites which is expected to be less than 1,000 miles per year.

woody debris (NMFS 2012; NMFS 2016b). It is reasonably expected that present and future timber harvest in the action area will have much lower adverse environmental effects now that timber harvest projects from the Big Creek Lumber Company are subject to California Forest Practice Rules. Furthermore, both San Mateo and Santa Cruz County have developed and implemented more stringent timber harvest rules that provide protections beyond those required in the California Forest Practice Rules. For example, both counties only allow for selective harvest and not clear-cut, even-age management harvest practices. Considering the above rules and measures regarding timber harvest, coupled with the Program's measures to protect water quality, the cumulative effects of the Proposed Action are not expected to result in any discernable change to the quality of waterways or the aquatic habitats they provide.

5.4.2 Water Diversions

Increased water diversions can reduce stream flow which provides habitat for fish rearing and spawning. Aside from Loch Lomond Reservoir in the San Lorenzo River watershed, there are no water storage reservoirs to maintain dry season base flows in streams within the action area. Stream flow in other streams throughout the action area is affected by water diversions including residential and agricultural wells and small diversions. The state water resources control board (SWRCB) regulates direct diversions and storage of flow, and issues and monitors water rights for compliance with permits. Recently, the California Department of Water Resources developed the Sustainable Groundwater Management Act, which requires local regulators achieve sustainable groundwater management by 2042, including avoiding significant and unreasonable streamflow depletion[10]. With either of the proposed alternatives, there will be no change to water diversions.

5.4.3 Habitat Restoration

Habitat restoration can counteract negative consequences of land uses, including those listed above by restoring stream processes and increasing habitat quantity and quality. Funding for habitat restoration projects is provided by federal, state or privately sourced grants. California's Fisheries Restoration Grant Program (FRGP)[11] is a program that uses Federal and State species recovery plans as well as watershed management plans to guide restoration of salmon habitat with the goal of ensuring species survival and protection. Over the past 30 years, the FRGP and other grants have funded projects throughout coastal California, with multiple projects within the action area. While it is expected that the FRGP and other grants will continue to support habitat-based recovery actions similar to past efforts, this restoration is dependent on continued funding that is difficult to predict over time. Habitat restoration is reasonably expected to occur under either alternative and will incrementally benefit salmon and steelhead within the action area. These restoration efforts are likely to moderately benefit habitat, which will increase over time, considering the incremental nature of restoration projects. Benefits from habitat restoration are expected to affect salmon and steelhead survival similarly under all alternatives. Therefore, these efforts, along with the Proposed Action, will cumulatively increase survival and abundance of salmon and steelhead.

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[10] https://water.ca.gov/programs/groundwater-management/sgma-groundwater-management

[11] https://wildlife.ca.gov/Grants/FRGP#:~:text=FRGP%20administers%20a%20competitive%20grant,nonprofit%20organizations%2C%20and%20private%20landowners.

5.4.4 Steelhead Program at KFH

The MBSTP is currently developing an ESA section 10(a)(1)(A) enhancement permit application and HGMP for the reoperation of an integrated steelhead hatchery program for the San Lorenzo River. If approved, the steelhead program may share space at KFH for spawning, egg incubation and potentially juvenile rearing, in addition to rearing facilities in the San Lorenzo River basin. For the basis of this analysis, MBSTP's steelhead program is reasonably expected to resume operations in the near future. This future action may occur under either alternative within the cumulative analysis area. The steelhead program would utilize KFH and therefore would also be exempt from the NPDES permit. Juvenile steelhead would be released only into the San Lorenzo River and therefore would avoid effects to the remainder of the action area (i.e., program streams). In addition, adverse effects to CCC coho salmon at KFH due to competition for space and resources within the hatchery environment would be further minimized by priorities established by the resource agencies based on the Federal and State listing status of each species.

5.4.5 California Recreational Steelhead Fishery

CDFW maintains a regulated, recreational sport fishery for steelhead that overlaps with all program streams within the action area. Current fishing regulations restrict the steelhead fishery to on Saturdays, Sundays, Wednesdays, legal holidays and opening and closing days from December 1 through March 7, and only select portions of each stream are open to fishing. Anglers may only use barbless hooks. In program streams of the Santa Cruz Mountains, current regulations allow two hatchery steelhead adults to be kept per day, which are marked with an adipose fin clip, and all natural-origin steelhead adults must be released. Although regulated, due to the temporal overlap between the two species adult run-times (e.g., December to March) there remains some potential for adverse effects to natural- or hatchery-origin CCC coho salmon that are incidentally captured during the state's recreational fishery. Incidental injury to or mortality of coho salmon adults may occur from hooks, as well as landing and handling the fish. Due to listing status of both CCC coho salmon (endangered) and CCC steelhead (threatened) it is unlikely that harvest rates of CCC steelhead will increase over baseline.

6 CUMULATIVE EFFECTS BY RESOURCE

6.1 Introduction

The following provides an assessment of the cumulative effects of Alternative 1 (No Action), Alternative 2 (Proposed Action) in combination with the past, present, and foreseeable future actions on each resource analyzed in this EA (i.e., water quantity and quality, salmon and steelhead, other fish species, wildlife, and cultural resources). If there are no anticipated effects from reasonably foreseeable future actions then there will be no mention of that action in the analysis below.

6.2 Water Quantity and Quality

Water quality within the SCMDS is expected to remain unchanged under all alternatives. Discharge standards for KFH are exempt from NPDES by the CCRWQCB. Within the reasonably foreseeable future, the discharge standards for KFH and other actions are not expected to change with the implementation of either Alternative 1 (No Action) and Alternative

2 (Proposed Action). Discharge standards were established for the DCFH by the NCRWQCB through an NPDES permit to ensure water quality concerns. Within the reasonably foreseeable future, the discharge standards established NPDES permits for DCFH and other actions are not expected to change. Therefore, there would be negligible cumulative adverse effects from effluent on receiving waters with implementation of the alternatives. While climate change is expected to continue increasing air and water temperatures, leading to changes in precipitation patterns and streamside vegetation, these changes are expected to have a low adverse effect on water quantity and water quality in the SCMDS, combined with either alternative. When considered cumulatively, neither alternative is expected to change current conditions as there is little to no consumptive use of water, and the discharge from the hatchery is regulated.

Habitat restoration actions will likely help to incrementally improve water quality and quantity by reducing erosion and sediment delivery to streams, improving large wood loading and increasing riparian habitat. These activities are expected to have high beneficial effects.

In summary, there is a high likelihood that there will be low to moderate cumulative adverse effects on water quantity and quality from the various activities within the action area in combination with either of the alternatives. Although, the Proposed Action is likely to restore salmon populations that were lost due to past degradation of water resources, and habitat restoration will likely offset some potential adverse effects.

6.3 Salmon and Steelhead

The climate influences freshwater stream temperature and flow, and because salmon and steelhead depend upon these streams during distinct stages of their life history cycle, their populations are likely to be affected by climate change. Changes in temperature, rainfall, snowpack, and vegetation are likely to have serious adverse effects on salmon and steelhead populations (NMFS 2008; NMFS 2012). Physical characteristics of river and stream environments found along the West Coast, which include the action area, are expected to be altered from climate change. In the recent past "California has experienced below average precipitation, record high surface air temperatures, and record low snowpack" (NMFS 2016a). These environmental changes that are expected to occur from climate change are reasonably expected to disrupt the natural distribution, behavior, growth, and survival of salmon and steelhead throughout the action area.

Salmon and steelhead population abundance naturally alternates between higher and lower levels on temporal and spatial patterns that may last decades or centuries and on more complex ecological scales than can be easily observed (Rogers et al. 2013). The effects of climate change on salmon and steelhead are described in general in ISAB (2007) and are variable among species and life history stages (Table 8). Changes in streamflow and water temperature resulting from climate change would likely affect both natural-origin and hatchery-origin salmon and steelhead. Under Alternative 1 (No Action) and Alternative 2 (Proposed Action) the moderate level of adverse effects on salmon and steelhead from climate change are expected to be similar because climate change would affect fish habitat under each alternative in the same manner. However, while climate change is reasonably likely to place additional stress on the conservation and recovery of the CCC coho salmon ESU, NMFS does not expect that long-term climate change

effects will be significant to have an appreciable effect on the CCC coho salmon ESU during the 10-year life of the permit.

Table 8. Examples of potential effects of climate change on salmon life stages and life history periods.

Life Stage	Potential Effects
Egg	● Increased water temperatures and decreased flows during spawning migrations would increase pre-spawn mortality and reduce egg deposition for some species. ● Increased water temperatures would increase maintenance metabolism, leading to smaller fry. ● Increased water temperatures would result in faster embryonic development, leading to earlier hatching. ● Increased mortality for some species because of more frequent winter flood flows. ● Lower flow would decrease access to or availability of spawning areas.
Juvenile (Spring and Summer Rearing)	● Faster yolk utilization from increased water temperatures may lead to early emergence. ● Smaller fry are expected to have lower survival rates. ● Growth rates would be slower if food is limited. ● Lower flows would decrease habitat capacity. ● Sea level rise would eliminate or diminish the tidal wetland capacity.
Juvenile (Overwinter Rearing)	● Smaller size at start of winter is expected to result in lower winter survival. ● Mortality would increase because more frequent floods. ● Warmer winter temperatures would lead to higher metabolic demands, which may decrease winter survival if food is limited, or increase winter survival if growth and size are enhanced. ● Warmer winter temperatures may increase predator activity/hunger, which can decrease winter survival.
Juvenile and Adult (Out-Migration)	● Earlier snowmelt and warmer temperatures may cause earlier emigration to the estuary and ocean either during favorable upwelling conditions, or prior to the period of favorable ocean upwelling. ● Increased predation risk in the mainstem because of higher consumption rates by predators at the elevated spring water temperatures. ● Earlier sandbar formation due to low flows could impede juvenile migration.
Adult	● Increased water temperatures may delay fish migration. ● Increased water temperatures may also lead to more frequent disease outbreaks as fish become stressed and crowded. ● Longer sandbar persistence due to low flows could delay adult migration.

Sources: Glick et al. 2007; ISAB 2007; Beamish et al. 2009; Beechie et al. 2013

6.4 Other Fish Species

Like salmon and steelhead, other fish species (Table 2) may also be negatively affected by climate change, water diversions, and resource extractions such as logging from timber harvest due to the potential loss and degradation of their aquatic habitat and/or their inability to adapt to the changing conditions. However, these effects may be counterbalanced by current and future habitat restoration efforts. Under Alternative 2 (Proposed Action), there will be no expected change in adverse effects compared to current conditions when added to the other cumulative effects in the action area. It is reasonably expected that beneficial effects will occur to other fish species when compared cumulatively with other reasonably foreseeable future actions in the effects area. Under Alternative 1 (No Action), these benefits would not occur, therefore, there would be no offset of the cumulative negative effects discussed above.

6.5 Wildlife

Adverse cumulative effects from climate change, and resource extraction are expected to negatively affect wildlife (Table 3) in ways like those described above for salmon and steelhead. These adverse effects are reasonably likely to be somewhat mitigated by current and future habitat restoration efforts in the action area together with the Proposed Action.

Under Alternative 1 (No Action), the contribution of eggs, fry, juveniles, and adults that the Program currently produces that benefit wildlife that prey on these various salmon life stages will not occur. Alternative 2 (Proposed Action) would not only maintain the current contributions made by the Program but would increase the abundance of salmon life history stages available throughout the action area from production at the hatchery. When added to other past, present, and reasonably foreseeable future actions described above in Section 5, the KFH's contribution of eggs, fry, juvenile, and adult salmon will result in beneficial cumulative effects for wildlife that prey on these life history stages.

6.6 Cultural Resources

Adverse cumulative effects from climate change, resource extraction, and habitat restoration are not expected to have a negative effect on cultural resources listed above in Section 3.8.

As described in Sections 6, 4.2.5, and 4.3.5, current operations associated with the Program avoid culturally important sites in the action area. Alternative 1 (No Action) would result in no change from current conditions, and furthermore would not result in any cumulative effects to cultural resources. Under Alternative 2 (Proposed Action), negligible beneficial effects may occur to cultural uses and tribal trust assets throughout the action area from increased abundance of CCC coho salmon and other species, which are reasonably expected to increase throughout the life of the ten-year permit.

7 AGENCIES AND PERSONS CONSULTED

7.1 Tribes

Per the Bureau of Indian Affairs, there are no federally recognized tribes in the action area of the Santa Cruz Mountains. The Dry Creek Rancheria Band of Pomo, California was consulted on by

NMFS' on May 4, 2018, during the HGMP/EA review period for the RRCSCBP at DCFH on Dry Creek. This included all fish being reared at DCFH including coho salmon that are part of the SCSCBP.

As described in Section 3.6 Cultural Resources, NMFS sent letters to Native American tribes identified by the NAHC as being culturally affiliated with the program area and who may have knowledge of cultural resources within the program area to offer consultation and to seek their assistance with the potential identification of sites of religious or cultural significance in the program area that may be affected by program activities. These tribes included:

- Association of Ramaytush Ohlone
- Amah Mutsun Tribal Band,
- Amah Mutsun Tribal Band of Mission San Juan Bautista,
- Costanoan Ohlone Rumsen-Mutsen Tribe,
- Indian Canyon Mutsun Band of Costanoan,
- Muwekma Ohlone Indian Tribe of the San Francisco Bay Area,
- Wuksache Indian Tribe/Eshom Valley Band, and
- Costanoan Rumsen Carmel Tribe

7.2 National Marine Fisheries Service

NMFS staff and contractors that developed this EA are:

- Kevin Malone (NMFS contractor)
- Ryan Bernstein (NMFS contractor)
- Joel Casagrande (NMFS)

8 LITERATURE CITED

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9 APPENDIX A

Southern Coho Salmon Captive Broodstock Program Hatchery and Genetic Management Plan