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

Issuance of ESA Section 10(a)(1)(A) Enhancement of
Survival and Scientific Research Permit 26495

NMFS Consultation Number: WCRO-2022-01057
NMFS ARN File Number: 151422WCR2022SR00100
Action Agency: National Marine Fisheries Service

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Central California Coast coho salmon (*Oncorhynchus kisutch*)	Endangered	Yes	No	No	No
Central California Coast steelhead (*O. mykiss*)	Threatened	Yes	No	No	No

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

Issued By:

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Date: June 30, 2022

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1 INTRODUCTION

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

1.1 Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

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

1.2 Consultation History

On April 5, 2022, NMFS received an application from NMFS' California Coastal Office in Santa Rosa/Santa Cruz (applicant) for an ESA Section 10(a)(1)(A) Enhancement of Survival and Scientific Research permit for the endangered Central California Coast (CCC) Evolutionarily Significant Unit (ESU) of coho salmon (*Oncorhynchus kisutch*) and threatened CCC Distinct Population Segment (DPS) of steelhead (*O. mykiss*) (NMFS 2022). Although the proposed activities are for the purpose of enhancing the conservation of endangered coho salmon and threatened steelhead, the activities would nonetheless result in take of the species. Accordingly, NMFS prepared this biological opinion to assess the effects of authorizing the requested type and amount of take on the CCC coho salmon ESU and the CCC steelhead DPS. This biological opinion is based on the best scientific and commercial data available, including the description of the enhancement activities (NMFS 2022), a knowledge of and experience in the watershed and streams where the enhancement activities will be conducted, and expected effects of the activities on steelhead and coho salmon.

1.3 Proposed Federal Action

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

The proposed federal action involves NMFS issuing a 10-year ESA Section 10(a)(1)(A) enhancement of survival and scientific research permit (Permit # 26495) to the applicant. The applicant has requested non-lethal take of juvenile and adult coho salmon and steelhead, tissue sampling, permission to recover carcasses, and implanting fish with passive integrated transponder [PIT] tags. Permit 26495 involves two elements: 1) rescue and relocation of salmonids; and 2) scientific research. The focus of this permit is the enhancement of critically endangered CCC coho salmon within coastal populations of California's Santa Cruz Mountains

(Figure 1) by rescuing and relocating fish at risk of becoming stranded in dewatered stream reaches. Steelhead encountered while rescuing coho salmon may also be rescued and relocated. Research elements will be implemented opportunistically. A brief summary of the field activities and requested type and amount of take (NMFS 2022) follows.

1.3.1 Coho Salmon and Steelhead Rescue and Relocation

The permit would grant NMFS (i.e., staff from the West Coast Region [WCR], the Southwest Fisheries Science Center [SWFSC], and NOAA's Restoration Center), the California Department of Fish and Wildlife (CDFW), and potentially other partners identified at a later time to conduct coho salmon and steelhead rescues and the collection of tissue samples. Rescue and relocation of coho salmon and steelhead will occur in stream sections experiencing natural dewatering or poor water quality during the dry season or prolonged periods of below average rainfall. Authorized staff will follow a predetermined communication and documentation protocol while implementing these relocation efforts. Standard scientific methods and equipment (e.g., backpack-electrofishing, nets, seines, portable air pumps, transport containers, water chillers, etc.) will be used during the capture and relocation of coho salmon and steelhead. Captured salmonids will be transported for release into habitats within the same watershed (when possible) that are determined likely to maintain adequate water and habitat quality through the remainder of the dry season. The criteria used for determining when a rescue is warranted is outlined in the NMFS-CDFW Anadromous Fish Rescue Strategy (2021) and the California Endangered Species Act Memorandum of Understanding issued to NMFS WCR by CDFW. The decision to proceed with a rescue and relocation operation will be based on the existence of any of the following conditions:

1. Observed or expected natural streamflow reduction that creates an imminent risk of habitat dewatering.
2. Documented or expected water quality characteristics (i.e., temperature or concentration of dissolved oxygen) that are known or believed to be harmful or lethal to the species.
3. Stream characteristics that increase the potential for predation or poaching that would eliminate most or all of the coho salmon and steelhead contained within discrete mesohabitats.
4. Observed or expected anthropogenic streamflow reduction that cannot or will not be halted to avoid an imminent risk of instream dewatering.
5. A "suitable" relocation area exists (characteristics of relocation areas are described later in this application).
6. The rescue and relocation would represent a meaningful contribution to the enhancement of the endangered CCC coho salmon ESU (e.g., factors to be considered include the number and life stage of the at-risk individuals).
7. All reasonable options for ameliorating the need for a rescue have been considered.

Prior to undertaking a rescue, NMFS and CDFW will identify the life stages in need of rescue as a means of determining a logical location for relocation. Possible relocation areas are listed below. Candidate areas must be capable of accommodating additional coho salmon and steelhead without creating detrimental effects (e.g., significantly increased competition for food, space, or cover) to individuals residing in or near the relocation area, and possess sufficient space, complex cover or shelter, water quality, and access to food. The possible relocation areas are as follows:

1. Instream areas within the same stream;
2. Instream areas in a different stream within the same watershed;
3. Estuary within the same watershed;
4. Instream areas or estuary within an adjacent watershed; and
5. Ocean.

With regard to adult coho salmon and steelhead, unspawned adults will be relocated upstream to viable spawning habitat within the stream captured. With regard to smolts and age-1 fish, individuals will be placed in the estuary or the farthest downstream reach where viable habitat exists. Age-0 fish will be placed in upstream reaches or estuary habitats where they can over-summer.

Coho salmon and steelhead are expected to be captured using backpack electrofishing and nets (seine and dip net). Backpack electrofishing will be conducted in stream locations that can be waded safely. Block-nets may be used to prevent fish from leaving a treatment area and to capture any stunned fish that drift downstream. Only field supervisors and crew members with appropriate training and experience will operate the electrofishing equipment. To further minimize impacts, electrofishing settings will be limited to only the minimum settings necessary for effectively capturing fish. Coho salmon and steelhead captured will be temporarily kept in either a container (minimum 5-gallon) with supplemental aeration, or in floating live cars as appropriate.

In habitats where electrofishing is not effective, a seine net (i.e., beach seine and dip net) may be used. To prevent fish from leaving the sampled habitat, block nets may be installed at the upstream and downstream boundary of the habitat prior to seining. Dip nets may be used to collect coho salmon and steelhead from shallow habitats. Any coho salmon or steelhead captured during a seine haul will be kept separate from other species in a container (minimum 5-gallon) with supplemental aeration, or in floating live cars, as appropriate.

1.3.2 Scientific Research

The subject permit authorizes specific staff listed on the permit to implement specified research. Authorized research activities could include any of the following: 1) salvaging carcasses or tissue samples to assess age, growth, and other life history information; and 2) tagging of juveniles and adults to track freshwater movements, survival, and growth. Standard scientific methods and procedures (e.g., PIT-tagging, fin-clip/DNA analysis, scale sampling, otolith collection and analysis, temporary anesthesia etc.) are proposed for implementing these research elements. Tissue samples will be transferred to, and analyzed by, the SWFSC. Juvenile coho salmon and steelhead that are sampled for tissues may be anesthetized and then released when recovered. Fish will be closely observed in an anesthetic bath of MS-222 (tricaine methanesulfonate) until loss of equilibrium is achieved but operculum movement is still present. Each sampling event will begin with a fresh 1% stock solution of buffered (sodium bicarbonate) MS-222 and dilute the stock solution as appropriate. The lowest concentration of MS-222 that will permit safe handling will be used (typically 60 parts per million buffered MS-222). Juvenile (young-of-the-year) salmonids will be anesthetized in plastic buckets in groups of 10 fish, whereas larger parr and smolts will anesthetized in groups of 2 fish. In all cases, fish will be processed immediately following loss of equilibrium. Stress coat may be added to the anesthetic solution as needed to combat stress from loss of the protective slime layer during handling. Fish will be allowed to recover in aerated stream water until normal behavior is observed. Water temperature in the recovery buckets or tubs will be monitored and maintained within two degrees Celsius of the ambient water temperature.

Tissue sampling will include fin clips and scale samples. Fin clips may be collected from juvenile (> 50 millimeter [mm] fork length) and adult salmonids for genetic analysis. Following anesthetization (MS-222), approximately 0.5 square centimeters of material will be excised from the tip of the caudal fin using scissors. The fin clip will be transferred to filter paper, placed in a labeled sample envelope and desiccated.

Scale samples may be collected from juvenile (> 60 mm fork length) and adult salmonids for age and life history determination. Following anesthetization (MS-222), scales are collected from a restricted area above the lateral line behind the dorsal fin by scraping the area with a small knife (juveniles) or by pulling/plucking with forceps (sub-adults and adults). Samples (10-15 scales per fish) are transferred to wax paper, placed in a labeled sample envelope and desiccated.

In the event that adult carcasses are encountered during rescue and relocation activities, individual carcasses will be scanned for the presence of tags (coded-wire tags [CWT] or PIT tags) and heads of whole bodies may be retained for tag extraction and otolith collection (adults). Adult salmonid carcasses left in the streams will receive a jaw tag. Tissues will be collected as outlined in the SWFSC's Genetic Tissue Collection Data form. Tissues, scales, and otolith samples will be provided to and analyzed by the SWFSC (110 McAllister Way, Santa Cruz, California 95060).

Salmonids greater than 65 mm fork length may be implanted with a 12 mm PIT tag. Fish selected for PIT-tagging will first be anesthetized using MS-222. Once the fish has lost equilibrium, a small incision will be made in the abdomen with a 12-gauge needle, followed by insertion of a PIT tag via syringe plunger down the shaft of the needle. The PIT tag is massaged into place and the fish is then placed into an aerated recovery tank, where it will be revived and later released to the wild. Adult salmonids may be tagged by intramuscular insertion of the PIT tag into the dorsal surface. The movement of PIT-tagged fish is monitored using stationary (fixed) and potentially portable PIT-tag antenna systems. Portable backpack antennas allow for individual sample units to be interrogated for the presence of PIT-tagged fish. As with electrofishing, each pass begins at the downstream end of the unit and moves upstream to the top of the unit. PIT tags are detected by antennas as they get within proximity to the submerged antenna.

The second type of antenna is a fixed antenna system. Fixed systems span some portion of the entire width of the creek and detect each PIT tag as a tagged fish swims through the antenna. Currently, stationary antenna systems are installed in the following watersheds of the Santa Cruz Mountains: Pescadero, Waddell, and Scott creeks, and the San Lorenzo River.

1.3.3 Impact Minimization Measures

Only trained staff from NMFS and CDFW are authorized to conduct the activities proposed. However, individuals not affiliated with NMFS or CDFW may assist in rescue and relocation efforts; the manner and extent of this assistance will be determined by the field lead. The specific NMFS and CDFW representatives engaging in the fish rescue and relocation must possess expertise in the areas of anadromous salmonid species identification, biology and ecology, fish-habitat relationships, as well as handling, collecting and relocating salmonid species. This experience must include applying measures to minimize stress and injury related to rescue and relocation operations and experience using the methods of capture. Only field equipment that has been thoroughly decontaminated following CDFW protocols for elimination of quagga mussel, New England Mud Snail, and various pathogens or diseases will be used.

To minimize the likelihood that salmonids will be harmed or killed during a rescue and relocation operation, the following measures will be implemented whenever NMFS and CDFW undertake such operations:

1. Allow only agency staff with sufficient experience and training in salmonid species identification, salmonid capture techniques, and capture equipment;
2. Minimize turbidity in the rescue area by limiting foot traffic;
3. Use block nets to enclose the rescue area as necessary and appropriate;
4. Place coho salmon and steelhead in a holding container with well-oxygenated, cool stream water;
5. Monitor and maintain suitable oxygen and temperature levels in holding containers;
6. Minimize physical disturbance and thermal changes to holding containers;
7. Acclimate fish in holding containers to relocation areas;
8. Minimize overcrowding in holding containers; and
9. Ensure lids are secured to holding containers during transport.

In addition to the above, the risk of injury or unintentional mortality will be minimized by: (1) following the rescue protocols designed to minimize injury or mortality, (2) revising methods or stopping collections if unacceptable levels of mortality arise, and (3) having rescues conducted by trained and experienced biologists.

Field activities associated with the various proposed enhancement components can occur year-round between the date of permit issuance (anticipated to be July 2022) and December 31, 2032. NMFS expects that the number of coho salmon and steelhead handled during rescues in any given year will vary substantially. The annual sum of take (Table 1) proposed across the various components of this effort is as follows: (1) non-lethal capture and release of up to 1,000 natural-origin juvenile coho salmon and 3,000 juvenile steelhead while electrofishing or by net; (2) non-lethal capture and release of up to 500 natural-origin juvenile coho salmon, 1,000 hatchery-origin juvenile coho salmon, and 1,000 juvenile steelhead while electrofishing or by net for the purpose of applying PIT-tags and collecting tissues (fin clips and scales); (3) non-lethal capture and release of up to 40 natural-origin and 60 hatchery-origin adult coho salmon and 150 adult steelhead using hand net or seine for the purpose of applying PIT-tags and/or floy tags, and for collecting tissues (fin clips and scales); and (4) collection and retention of up to 250 natural-origin adult coho salmon carcasses and 150 adult steelhead carcasses for the purpose of collecting tissues (fin-clips, scales, and otoliths). The potential annual unintentional lethal take resulting from the proposed enhancement activities is up to 75 natural-origin and 50 hatchery-origin juvenile coho salmon, 200 juvenile steelhead, 2 natural-origin and 3 hatchery-origin adult coho salmon, and 7 adult steelhead.

Figure 1. CCC coho salmon populations of the Santa Cruz Mountains Diversity Stratum.

Table 1. The annual sum of take proposed across the various components of Permit 26495.

Line	Species (status)	Origin	Lifestage	Sex	Authorized Take	Authorized Indirect Mortality	Take Action	Observe/Collect Method	Procedures	Details
1	CCC coho salmon ESU (Endangered)	Natural	Juvenile	♂ / ♀	1000	50	Capture/Handle/Release Animal	Electrofishing, Backpack		Capture method may include seine or dip-net.
2	CCC coho salmon ESU (Endangered)	Listed Hatchery Intact Adipose	Juvenile	♂ / ♀	1000	50	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Electrofishing, Backpack	Anesthetize; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	Capture method may include seine or dip-net.
3	CCC coho salmon ESU (Endangered)	Natural	Juvenile	♂ / ♀	500	25	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Electrofishing, Backpack	Anesthetize; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	Capture method may include seine or dip-net.
4	CCC coho salmon ESU (Endangered)	Natural	Adult	♂ / ♀	40	2	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Seine, Beach	Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	
5	CCC coho salmon ESU (Endangered)	Listed Hatchery Intact Adipose	Adult	♂ / ♀	60	3	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Seine, Beach	Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	
6	CCC coho salmon ESU (Endangered)	Natural	Spawned Adult/ Carcass	♂ / ♀	250	0	Observe/Sample Tissue Dead Animal	Hand/ Spatula/Knife	Tissue Sample Fin or Opercle; Tissue Sample Otolith; Tissue Sample Scale	Carcasses that are left in the creek will receive a jaw tag for identification.
7	CCC steelhead DPS (Threatened)	Natural	Juvenile	♂ / ♀	3000	150	Capture/Handle/Release Animal	Electrofishing, Backpack		Capture method may include seine or dip-net.
8	CCC steelhead DPS (Threatened)	Natural	Juvenile	♂ / ♀	1000	50	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Electrofishing, Backpack	Anesthetize; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	Capture method may include seine or dip-net.
9	CCC steelhead DPS (Threatened)	Natural	Adult	♂ / ♀	150	7	Capture/Mark, Tag, Sample Tissue/Release Live Animal	Seine, Beach	Tag, Floy; Tag, PIT; Tissue Sample Fin or Opercle; Tissue Sample Scale	Adults may include both pre-and post-spawned (kelts) fish.
10	CCC steelhead DPS (Threatened)	Natural	Spawned Adult/ Carcass	♂ / ♀	150	0	Observe/Sample Tissue Dead Animal	Hand/ Spatula/Knife	Tissue Sample Fin or Opercle; Tissue Sample Otolith; Tissue Sample Scale	Carcasses that are left in the creek will receive a jaw tag for identification.

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

2 ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

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

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

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

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

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

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

2.2 Rangewide Status of the Species and Critical Habitat

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

2.2.1 Species Description and Life History

The biological opinion analyses the effects of the federal action on the following federally listed species (Distinct Population Segment [DPS] or Evolutionarily Significant Unit [ESU]) and designated critical habitat:

Endangered Central California Coast (CCC) coho salmon ESU (*Oncorhynchus kisutch*)
Endangered (70 FR 37160; June 28, 2005)
Critical habitat (64 FR 24049; May 5, 1999);

Threatened Central California Coast (CCC) steelhead DPS (*O. mykiss*)
Threatened (71 FR 834; January 5, 2006)
Critical habitat (70 FR 52488; September 2, 2005).

The CCC steelhead DPS includes steelhead in coastal California streams from the Russian River to Aptos Creek, and the drainages of Suisun, San Pablo, and San Francisco Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers. In addition, the DPS includes steelhead from one active artificial propagation program: The Don Clausen Fish Hatchery Program. The CCC coho salmon ESU includes coho salmon from Punta Gorda in northern California, south to, and including, Aptos Creek in central California, as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River System. In addition, the ESU includes coho salmon from the following artificial propagation programs: the Russian River Coho Salmon Captive Broodstock Program, and the Southern Coho Salmon Captive Broodstock Program.

The action area is within designated critical habitat for CCC steelhead and CCC coho salmon. CCC steelhead critical habitat is designated from the Russian River to Aptos Creek to a lateral extent of ordinary high water in freshwater stream reaches, and to extreme high water in estuarine areas. CCC coho salmon critical habitat is designated to include all river reaches assessable to listed coho salmon from Punta Gorda in northern California south to the San Lorenzo River in central California, and includes two tributaries to San Francisco Bay, Arroyo Corte Madera Del Presidio and Corte Madera Creek. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats).

2.2.1.1 Steelhead Life History

Steelhead are anadromous forms of *Oncorhynchus mykiss*, spending some time in both fresh- and saltwater. Juveniles migrate to the ocean where they mature. Adult steelhead return to freshwater rivers and streams to reproduce, or spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning in multiple years before death (Busby et al. 1996; Moyle 2002). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in central California coastal streams. Eggs (laid in gravel nests called redds), alevins (gravel dwelling hatchlings), fry (juveniles newly emerged from stream gravels), and other juvenile life stages all rear in freshwater until they migrate to the ocean where they reach maturity.

O. mykiss exhibit a variable life history. Coastal *O. mykiss* populations in central and southern California are classified into three principle life history strategies: fluvial-anadromous, lagoon anadromous, and freshwater resident or non-anadromous (Boughton et al. 2007). The anadromous forms of CCC steelhead are classified as "winter-run" steelhead because they emigrate from the ocean to their natal streams to spawn annually during the winter; although run times can extend into spring (Moyle 2002). Within the CCC steelhead DPS, adults typically enter freshwater between December and April, with peaks occurring in January through March (Wagner 1983; Fukushima and Lesh 1998). It is during this time that streamflow (depth and velocity) are suitable for adults to successfully migrate to and from spawning grounds. The minimum stream depth necessary for successful upstream migration is about 13 centimeters (cm), although short sections with depths less than 13 cm are passable (Thompson 1972). More optimal water velocities for upstream migration are in the range of 40-90 cm/s, with a maximum velocity beyond which upstream migration is not likely to occur of 240 cm/s (Thompson 1972).

Redds are generally located in areas where the hydraulic conditions limit fine sediment accumulations. Reiser and Bjornn (1979) found that gravels of 1.3-11.7 cm in diameter were preferred by steelhead. Survival of embryos is reduced when fines smaller than 6.4 mm comprise 20 to 25 percent of the substrate. This is because, during the incubation period, the intragravel environment must permit a constant flow of water in order to deliver dissolved oxygen and remove metabolic wastes. Studies have shown embryo survival is higher when intragravel velocities exceed 20 cm/hour (Coble 1961; Phillips and Campbell 1961). The number of days required for steelhead eggs to hatch is inversely proportional to water temperature and varies from about 19 days at 15.6˚ degrees (°) Celsius (C) to about 80 days at 5.6°C. Fry typically emerge from the gravel two to three weeks after hatching (Barnhart 1986). Other intragravel parameters such as the organic material in the substrate affect the survival of eggs to fry emergence (Shapovalov and Taft 1954; Everest et al. 1987; Chapman 1988).

Once emerged from the gravel, steelhead fry rear in edgewater habitats along the stream and gradually move into pools and riffles as they grow larger. Cover, sediment, and water quality are important habitat components for juvenile steelhead. Cover in the form of woody debris, rocks, overhanging banks, and other in-water structures provide velocity refuge and a means of avoiding predation (Shirvell 1990; Bjornn and Reiser 1991). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. In winter, juvenile steelhead become less active and hide in available cover, including gravel or woody debris. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Water temperature can influence the metabolic rate, distribution, abundance, and swimming ability of rearing juvenile steelhead (Barnhart 1986; Bjornn and Reiser 1991; Myrick and Cech 2005). Optimal temperatures for steelhead growth range between 10 and 19°C (Hokanson et al. 1977; Wurtsbaugh and Davis 1977; Myrick and Cech 2005). Fluctuating diurnal water temperatures are also important for the survival and growth of salmonids (Busby et al. 1996).

Although variation occurs, juvenile steelhead that exhibit an anadromous life history strategy usually rear in freshwater for 1-2 years (NMFS 2016a). Steelhead smolts emigrate episodically from freshwater in late winter and spring, with peak migrations occurring in April and May (Shapovalov and Taft 1954; Fukushima and Lesh 1998; Ohms and Boughton 2019). Steelhead smolts in California range in size from 120 to 280 mm (fork length) (Shapovalov and Taft 1954; Barnhart 1986). Smolts migrating from the freshwater environment may temporarily utilize the estuarine habitats for saltwater acclimation and feeding prior to entering the ocean.

Juvenile steelhead of the lagoon-anadromous life history rear in lagoons for extended periods (Smith 1990; Boughton et al. 2006; Hayes et al. 2008). Lagoons are a specific type of estuarine habitat where a seasonal impoundment of water develops after a sandbar forms at the mouth of the watershed, temporarily separating the fresh and marine environments (Smith 1990). Like other estuary types, bar-built lagoons can serve as important rearing areas for many fish and invertebrate species—including juvenile steelhead (Simenstad et al. 1982; Smith 1990; Robinson 1993; Martin 1995). Due to the combination of high prey abundance and seasonally warmer temperatures, juvenile steelhead that rear in lagoons have been found to achieve superior growth rates relative to upstream fish of the same cohort, and can therefore disproportionally represent future adult steelhead returns (Bond et al. 2008; Hayes et al. 2008). This is especially important considering that lagoon habitats often represent a fraction of the watershed area.

2.2.1.2 Coho Salmon Life History

The life history of the coho salmon in California has been well documented (Shapovalov and Taft 1954; Hassler 1987; Weitkamp et al. 1995). In contrast to the life history patterns of other anadromous salmonids, coho salmon in California generally exhibit a relatively simple three-year life cycle. Adult salmon typically begin the immigration from the ocean to their natal streams after heavy late-fall or winter rains breach the sand bars at the mouths of coastal streams (Sandercock 1991). Coho salmon are typically associated with small to moderately-sized coastal streams characterized by heavily forested watersheds; perennially-flowing reaches of cool, high quality water; dense riparian canopy; deep pools with abundant overhead cover; instream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates (Sandercock 1991). Immigration continues into March, generally peaking in December and January, with spawning occurring shortly after arrival at the spawning ground (Shapovalov and Taft 1954).

When in freshwater, optimal habitats for coho salmon include adequate quantities of: (1) deep complex pools formed by large woody debris; (2) adequate quantities of water; (3) cool water temperatures [when maximum weekly average water temperatures exceed 18°C coho salmon are absent from otherwise suitable rearing habitat (Welsh et al. 2001); temperatures between 12-14° C are preferred; and the upper lethal limit is between 25-26°C.]; (4) unimpeded passage to spawning grounds (adults) and back to the ocean (smolts); (5) adequate quantities of clean spawning gravel; and (6) access to floodplains, side channels and low velocity habitat during high flow events. Numerous other requirements exist (i.e., adequate quantities of food, dissolved oxygen, low turbidity, etc.), but in many respects these other needs are generally met when the six freshwater habitat requirements listed above are at a properly functioning condition.

The eggs generally hatch after four to eight weeks, depending on water temperature. Survival and development rates depend, in part, on fine sediment levels within the redd. Under optimum conditions, mortality during this period can be as low as 10 percent; under adverse conditions of high scouring flows or heavy siltation, mortality may be close to 100 percent (Baker and Reynolds 1986). McMahon (1983) found that egg and fry survival drops sharply when fines make up 15 percent or more of the substrate. The newly-hatched fry remain in the redd from two to seven weeks before emerging from the gravel (Shapovalov and Taft 1954). Upon emergence, fry seek out shallow water, usually along stream margins. As they grow, juvenile coho salmon often occupy habitat at the heads of pools, which generally provide an optimum mix of high food availability and good cover with low swimming cost (Nielsen 1992). In the spring, as yearlings, juvenile coho salmon undergo a physiological process, or smoltification, which prepares them for living in the marine environment. Emigration timing is correlated with precipitation events and peak upwelling currents along the coast. Entry into the ocean at this time facilitates more growth and, therefore, greater marine survival (Holtby et al. 1990).

2.2.2 Status of the Listed Species

NMFS assesses four population viability[1] parameters to discern the status of the listed ESUs and DPSs and to assess each species ability to survive and recover. These population viability parameters are: abundance, population growth rate, spatial structure, and diversity (McElhany et al. 2000). While there is insufficient data to evaluate these population viability parameters quantitatively, NMFS has used existing information to determine the general condition of the populations in the CCC steelhead DPS and the CCC coho salmon ESU, and factors responsible for the current status of these listed species.

The population viability parameters are used as surrogates for numbers, reproduction, and distribution, which are included in the regulatory definition of "jeopardize the continued existence of" (50 CFR 402.02). For example, abundance, population growth rate, and distribution are surrogates for numbers, reproduction, and distribution, respectively. The fourth parameter, diversity, is related to all three regulatory criteria. Numbers, reproduction, and distribution are all affected when genetic or life history variability is lost or constrained, resulting in reduced population resilience to environmental variation at local or landscape-level scales.

2.2.2.1 CCC Steelhead DPS

Historically, approximately 70 populations of steelhead existed in the CCC steelhead DPS (Spence et al. 2008; Spence et al. 2012). Many of these populations (about 37) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts (Bjorkstedt et al. 2005). The remaining populations were dependent upon immigration from nearby CCC steelhead DPS populations to ensure their viability (McElhaney et al. 2000, Bjorkstedt et al. 2005).

While historical and present data on abundance are limited, CCC steelhead numbers are substantially reduced from historical levels. A total of 94,000 adult steelhead were estimated to spawn in the rivers of this DPS in the mid-1960s, including 50,000 fish in the Russian River –the largest population within the DPS (Busby et al. 1996). More recent estimates for the Russian River are on the order of 4,000 fish (NMFS 1997). Abundance estimates for smaller coastal streams in the DPS indicate low but stable levels with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vicente, Pudding, and Caspar creeks) of individual run sizes of 500 fish or less (62 FR 43937; August 18, 1997). Some loss of genetic diversity has been documented and attributed to previous among-basin transfers of stock and local hatchery production in interior populations in the Russian River (Bjorkstedt et al. 2005). In San Francisco Bay streams, reduced population sizes and fragmented habitat conditions has likely also depressed genetic diversity in these populations. For more detailed information on trends in CCC steelhead abundance, see Busby et al. 1996; NMFS 1997; Good et al. 2005; Spence et al. 2008; Williams et al. 2011; and Williams et al. 2016.

[1] NMFS defines a viable salmonid population as "an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100- year time frame" (McElhany et al. 2000).

CCC steelhead long-term population trends suggest a negative growth rate, indicating the DPS may not be viable in the long-term. Populations that historically provided enough steelhead immigrants to support dependent populations may no longer be able to do so, placing dependent populations at increased risk of extirpation. However, because CCC steelhead remain present in most streams throughout the DPS, roughly approximating the known historical range, CCC steelhead likely possess a resilience that has slowed their rate of decline relative to other salmonid species. The 2005 status review concluded that steelhead in the CCC steelhead DPS remain "likely to become endangered in the foreseeable future" (Good et al. 2005). On January 5, 2006, NMFS issued a final determination that the CCC steelhead DPS is a threatened species, as previously listed (71 FR 834).

The most recent status update concludes that steelhead in the CCC DPS remains "likely to become endangered in the foreseeable future", as new and additional information available since Williams et al. (2011) does not appear to suggest a change in extinction risk (Williams et al. 2016). In the most recent status review, NMFS concluded that the CCC steelhead DPS should remain listed as threatened (NMFS 2016b).

2.2.2.2 CCC Coho Salmon ESU

Historically, the CCC coho salmon ESU was comprised of approximately 76 coho salmon populations. Most of these were dependent populations that needed immigration from other nearby populations to ensure their long-term survival. Historically, there were 11 functionally independent populations and 1 potentially independent population of CCC coho salmon (Spence et al. 2008, Spence et al. 2012). Most of the populations in the CCC coho salmon ESU are currently doing poorly as a result of low abundance, range constriction, fragmentation, and loss of genetic diversity, as described below.

Brown et al. (1994) estimated that annual spawning numbers of coho salmon in California ranged between 200,000 and 500,000 fish in the 1940s, which declined to 100,000 fish by the 1960s, followed by a further decline to 31,000 fish by 1991. More recent abundance estimates vary from approximately 600 to 5,500 adults (Good et al. 2005). Williams et al. (2011) indicated that CCC coho salmon are likely to continue to decline in number. CCC coho salmon have also experienced acute range restriction and fragmentation. Adams et al. (1999) found that in the mid-1990s coho salmon were present in 51 percent (98 of 191) of the streams where they were historically present, and documented an additional 23 streams within the CCC coho salmon ESU in which coho salmon were found for which there were no historical records. More recent genetic research has documented reduced genetic diversity within subpopulations of the CCC coho salmon ESU (Bjorkstedt et al. 2005). The influence of hatchery fish on wild stocks has likely also contributed to the lack of diversity through outbreeding depression and disease.

Available data from the few remaining independent populations suggests population abundance continues to decline, and many independent populations that in the past supported the species overall numbers and geographic distributions have been extirpated. This suggests that populations that historically provided support to dependent populations via immigration have not been able to provide enough immigrants for many dependent populations for several decades. The near-term (10-20 years) viability of many of the extant independent CCC coho salmon populations is of serious concern. These populations may not have enough fish to survive additional natural and human caused environmental change.

The CCC coho salmon ESU also includes coho salmon from the following conservation hatchery programs: the Russian River Coho Salmon Captive Broodstock Program at Don Clausen Fish Hatchery in Sonoma County, California, and the smaller Southern Coho Salmon Captive Broodstock Program at Kingfisher Flat Hatchery in the Scott Creek watershed, Santa Cruz County, California. While differing in size and funding, both programs were initiated in 2001 in response to severely depressed coho salmon abundances. Fish are collected from the wild, brought into the hatcheries, genetically tested, and spawned to maximize diversity and prevent inbreeding. In the hatchery, fish are raised to various ages, fed krill, tagged, and released into streams throughout the watersheds. This release strategy allows the fish to imprint on the creek with the aim that they will return to these streams as adults so they can spawn naturally. Juvenile coho salmon and coho salmon smolts have been released into several Russian River tributaries and coastal watersheds in San Mateo and Santa Cruz counties.

None of the five diversity strata defined by Bjorkstedt et al. (2005) currently support viable coho salmon populations. According to Williams et al. (2016), surveys suggest CCC coho salmon abundance has improved slightly since 2011 within several independent populations (mainly north of San Francisco bay), although all populations remain well below their high-risk dispensation thresholds identified by Spence et al. (2008). The Russian River and Lagunitas Creek populations are relative strongholds for the species compared to other CCC ESU populations, the former predominantly due to out-planting of hatchery-reared juvenile fish from the Russian River Coho Salmon Captive Broodstock Program. The most recent status review (NMFS 2016b) documents conditions for CCC coho salmon have not improved since the last status review in 2011 (Williams et al. 2016). The overall risk of CCC coho salmon extinction remains high, and the most recent status review reaffirmed the ESU's endangered status (NMFS 2016a). NMFS's recovery plan (NMFS 2012) for the CCC coho salmon ESU identified the major threats to population recovery. These major threats include roads, water diversions and impoundments, and residential development.

2.2.3 Status of CCC Steelhead and CCC Coho Salmon Critical Habitat

PBFs for CCC steelhead critical habitat within freshwater include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development;
2. Freshwater rearing sites with:
    a) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    b) Water quality and forage supporting juvenile development; and
    c) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

PBFs for CCC steelhead critical habitat within estuarine areas include: areas free of obstruction and excess predation with; water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

For CCC coho salmon critical habitat, the following PBFs were identified: juvenile summer and winter rearing areas; juvenile migration corridors; areas for growth and development to adulthood; adult migration corridors; and spawning areas (64 FR 24049). Essential features (or PBFs as discussed above) for coho salmon include adequate: substrate; water quality, water quantity; water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions (64 FR 24049).

The condition of CCC steelhead and CCC coho salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, urban and agricultural land development, mining, stream channelization, and bank stabilization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Habitat impacts of concern include altered streambank and channel morphology, elevated water temperature, lost spawning and rearing habitat, habitat fragmentation, impaired gravel and wood recruitment from upstream sources, degraded water quality/quantity, lost riparian vegetation, and increased sediment delivery into streams from upland erosion (Weitkamp et al. 1995; Busby et al. 1996; 64 FR 24049; 70 FR 37160; 70 FR 52488).

Based on NMFS familiarity with the landscapes in which these critical habitats occur, these impacts continue to persist today. Widespread diverting of rivers and streams, as well as the pumping of groundwater hydraulically connected to streamflow, has dramatically altered the natural hydrologic cycle in many of the streams within the CCC steelhead DPS and CCC coho ESU which can delay or preclude migration and dewater aquatic habitat. Stream channelization, commonly caused by streambank hardening and stabilization, represents a very high threat to instream and floodplain habitat throughout much of the designated critical habitat for these three species, as detailed within the CCC coho salmon and CCC steelhead recovery plans (NMFS 2012, 2016a). Streambank stabilization confines stream channels and precludes natural channel movement, resulting in increased streambed incision, reduced habitat volume and complexity. Overall, the current condition of CCC steelhead and CCC coho salmon critical habitat is degraded, and does not provide the full extent of conservation value necessary for the recovery of the species.

The CZU Lightening Complex started as a series of lightening fires on August 16, 2020 across western Santa Cruz and San Mateo counties (California Department of Forestry and Fire Protection [Cal Fire] and California Department of Conservation [CDC] 2020). The fire was fully contained on September 22, 2020, but burned a total of 86,509 acres. Portions of the burned area represented some of the highest quality habitat for salmonids in the Santa Cruz Mountains.

Much of the burned areas in Santa Cruz County burned at low-intensities, and in areas with predominately redwood forest, most of the larger trees survived (Cal Fire and CDC 2020). Future winter storms may transport large quantities of ash, debris, and fine sediments into areas downslope from burned areas, in the near future.

Published work has identified storm water from roadways and streets as causing a high percentage of rapid mortality of adult coho salmon in the wild (Scholz et al. 2011) and laboratory settings (McIntyre et al. 2018). Subsequent laboratory studies showed this morality also occurred in to juvenile coho salmon (Chow et al. 2019) as well as to juvenile steelhead and chinook salmon (Brinkmann et al. 2022, McIntyre and Scholz, *unpublished results*, 2020). Recent publications have identified a degradation product of tires (6PPD-quinone) as the causal factor in this mortality at concentrations of less than a part per billion (Tian et al. 2022, Brinkmann et al. 2022, Tian et al. 2020; Peter et al. 2018). This contaminant is widely used by multiple tire manufacturers and the tire dust and shreds that produce it have been found to be ubiquitous where both rural and urban roadways drain into waterways (Sutton et al. 2019; Feist et al. 2017).

2.2.4 Global Climate Change

Another factor affecting the rangewide status of CCC steelhead and CCC coho salmon and aquatic habitat at large is climate change. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir et al. 2013). Snowmelt from the Sierra Nevada has declined (Kadir et al. 2013). While, CCC steelhead and CCC coho salmon in the Santa Cruz Mountains are not dependent on snowmelt driven streams and thus not affected by declining snow packs, they may have already experienced some detrimental impacts from climate change.

The threat to CCC steelhead and CCC coho salmon from global climate change is expected to increase in the future, and is already materializing in the form of prolonged drought, changes in the timing and magnitude of storms, their runoff, and dry season streamflow. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley et al. 2007; Moser et al. 2012). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe et al. 2004; Moser et al. 2012; Kadir et al. 2013). Total precipitation in California may decline and the magnitude and frequency of dry years may increase (Lindley et al. 2007; Schneider 2007; Moser et al. 2012). Similarly, wildfires are expected to increase in frequency and magnitude (Westerling et al. 2011; Moser et al. 2012).

In the San Francisco Bay region[2], warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan et al. 2012). Climate simulation models project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than

[2] Both the San Francisco Bay and Monterey Bay regions exhibit similar Mediterranean climate patterns. The action areas are located within the Monterey Bay region.

the historical annual average during the middle and end of the twenty-first century. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan et al. 2012). The action area experienced a multi-year drought in 2012-2016 which resulted in low instream flows, especially in the low flow season (June-October). More recently, low instream flows in summer 2021 likely led to poor survival of juvenile coho salmon and steelhead. The precipitation in late 2021 improved overall streamflow on the central California coast; however, due to an extremely dry period in January-March 2022, drought conditions are expected for the remainder of 2022 and possibly in subsequent years during the timeframe of the permit.

Estuaries may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002; Ruggiero et al. 2010). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008; Feely 2004; Osgood 2008; Turley 2008; Abdul-Aziz et al. 2011; Doney et al. 2012). The projections described above are for the mid to late 21st Century. In shorter periods, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007; Smith et al. 2007; Santer et al. 2011).

Finally, climate change is also affecting water circulation and temperature patterns in the marine environment. In fall 2014, and again in 2019, a marine heatwave, known as “The Blob”[3], formed throughout the northeast Pacific Ocean, which greatly affected water temperature and upwelling from the Bering Sea off Alaska, south to the coastline of Mexico. The marine waters in this region of the ocean are utilized by salmonids for foraging as they mature (Beamish 2018). Although the implications of these events on salmonid populations are not fully understood, they are having considerable adverse consequences to the productivity of these ecosystems and presumably contributing to poor marine survival of salmonids.

2.3 Action Area

“Action area” means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The proposed action will take place throughout the coastal streams of the Santa Cruz Mountains in San Mateo and Santa Cruz Counties, California (Figure 1). Specifically, this includes (inclusive from north to south) San Pedro Creek in San Mateo County to Valencia Creek in Santa Cruz County.

2.4 Environmental Baseline

The “environmental baseline” refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions

[3] https://www.fisheries.noaa.gov/feature-story/new-marine-heatwave-emerges-west-coast-resembles-blob

which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

2.4.1 Status of the Species in the Action Area

2.4.1.1 CCC Coho Salmon

Historically, CCC coho salmon were believed to inhabit all or most of the accessible coastal streams in Santa Cruz County. By the 1960s CCC coho salmon were believed present in seven populations in Santa Cruz County including the San Lorenzo River System (Bryant 1994). More recently, observations of coho salmon in the San Lorenzo River watershed have been scarce.

Wild or hatchery strays from the Southern Coho Salmon Captive Broodstock Program have the potential to enter and spawn in Santa Cruz County streams in any given year. NOAA's Southwest Fisheries Science Center (SWFSC) operates a PIT-tag antenna array at the Felton Diversion Dam on the San Lorenzo River, located just downstream of the confluence with Fall Creek. Since the winter of 2016-17, a small number of tagged hatchery-origin adults have been detected at the antenna each year (Table 2).

Table 2. Number of PIT-tagged coho salmon detected at the Felton Diversion Dam antenna during the winters of 2016-17 through 2019-20. Source: Southwest Fisheries Science Center.

Winter	Number of coho salmon detected
2016-17	1
2017-18	1
2018-19	9
2019-20	2

There is little evidence that coho salmon have reproduced successfully in the San Lorenzo River watershed over the last 30 years. Although adults are occasionally captured and released at the Felton Diversion Dam during the winter spawning season, juvenile coho salmon have not been observed in the watershed since 2005. Prior to this observation, the last credible report of successful coho salmon reproduction in the watershed occurred in 1981. The San Lorenzo River population is identified as an independent population in NMFS' coho salmon recovery plan and the reintroduction of fish from the captive broodstock program to tributaries of the San Lorenzo River will be central to successful recovery of coho salmon in the Santa Cruz Mountains Diversity Stratum (SCMDS) over the long term.

In the Scott Creek watershed, the status of the coho salmon population is well documented due to the operation of a life cycle research and monitoring station by the NOAA SWFSC and the University of California Santa Cruz since 2003. This comprehensive monitoring program has produced a time-series of key viability metrics including abundance, productivity, spatial structure, and diversity. Recent escapement of coho salmon to Scott Creek since winter 2002–

2003 has ranged from a high of 329 adults in 2004–2005, to a low of one returning adult in both 2009–2010 and 2011–2012. The coho salmon population in this watershed has been classified as a historically dependent population (Bjorkstedt et al. 2005), indicating that its dynamics and long-term persistence were likely dependent on recruits from other populations in the SCMDS.

Although there is a lack of contemporary data on adult returns to the Waddell Creek watershed, juvenile surveys conducted annually since 1992 indicate that recruitment has been extremely poor over the past 12 years and all three coho salmon broodlines are likely functionally extirpated (Smith 2020; NMFS 2012). Also, small numbers of adult coho salmon have been detected in Waddell Creek each winter since 2014–2015 via stationary PIT tag antenna arrays in the lower basin (J. Kiernan, SWFSC, *unpublished data*). The coho salmon population in this watershed was historically dependent on adult recruits from other populations in the diversity stratum.

Classified as a dependent watershed in the NMFS (2012b) final coho salmon recovery plan, San Vicente is the only watershed in the diversity stratum (other than Scott Creek and Waddell Creek) with an extant population of coho salmon, albeit at exceptionally low abundance. Coho salmon are also present in Laguna and Majors creeks.

Fish from the captive broodstock program have intermittently been outplanted to San Vicente Creek over the past decade principally as yearlings. Recently however, multiple life stages (i.e., unfed fry, yearlings, and adults) have been released in some years. Annual estimates of coho salmon escapement to San Vicente Creek have ranged between 0 and 65 individuals as estimated from redd surveys conducted between 2012 and 2018 (Pacific States Marine Fisheries Commission, *unpublished data*). The coho salmon population in this watershed was historically dependent on recruits from other populations in the diversity stratum.

While both adult and juvenile coho salmon have been reported in Soquel Creek during the last decade, their presence is rare and attributed to straying from Scott Creek. It is unlikely that a viable coho salmon population has existed in the watershed for at least 50 years. The coho salmon population in this watershed was historically dependent on recruits from other populations in the diversity stratum. Coho salmon have not been observed in the Aptos Creek watershed since the early 1970s.

Although the occurrence of juvenile coho salmon would be rare, there is potential for small numbers of fish to be present during implementation of the Program's practices. However, based on the information discussed above and no observations of coho salmon in Program project areas since 2005, we expect only a very small number of CCC coho salmon would be present in Program project areas during Program activities in the next 10 years.

2.4.1.2 CCC Steelhead

Steelhead are present in most of Santa Cruz County's streams that are accessible from the ocean including Waddell Creek, Scott Creek, San Vicente Creek, Laguna Creek, Majors Creek, Baldwin Creek, Wilder Creek, the San Lorenzo River, Arana Gulch, Rodeo Gulch, and Soquel Creek (California Natural Diversity Database 2003). The San Lorenzo River watershed supports one of the largest steelhead populations within the Santa Cruz Mountains Diversity Stratum

(NMFS 2016a). This population is functionally independent and likely provides frequent dispersal to nearby smaller coastal populations. Recovery criteria for the CCC steelhead San Lorenzo River population is a spawner density target of 3,200 (NMFS 2016a).

2.4.1.3 Status of Critical Habitat in the Action Area

The action area is designated critical habitat for CCC steelhead and CCC coho salmon, and supports spawning, rearing, and migration of these listed species. PBFs include substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions.

The current condition of most salmonid habitat, including critical habitat, in San Mateo and Santa Cruz County streams is degraded from conditions that are known to support robust populations of salmon and steelhead. Some areas of adequate habitat remain, along with a few areas of good quality. Table 3 summarizes the condition of coho salmon and steelhead habitat in Santa Cruz County streams.

Table 3. Summary of Habitat Conditions for coho salmon and steelhead in Santa Cruz County watersheds[4]

Watershed	Spawning Habitat	Juvenile Rearing Habitat
Waddell Creek	Good quality habitat for both coho salmon and steelhead. Waddell and Scott considered the best spawning habitats for anadromous species south of San Francisco. However spawning habitats are compromised by sedimentation andhigh levels of embeddedness.	Sub-adequate pool habitat, shelter habitat, and floodplain connectivity are major limiting factors articulated in the Final Recovery Plan for Central California Coast (CCC) coho salmon Evolutionarily Significant Unit (ESU) (NMFS 2012).
Scott Creek	Good quality habitat for both coho salmon andsteelhead. Coho salmon habitat under-utilized.Waddell and Scott considered the best spawning habitats for anadromous species south of San Francisco. However, habitats are compromised by sedimentation and high levelsof embeddedness.	Sub-adequate pool habitat, shelter habitat, and floodplain connectivity are major limiting factors articulated in the Final Recovery Plan for CCC coho salmon ESU (NMFS 2012).
San VicenteCreek	Areas of good quality habitat exists for both coho salmon and steelhead, though recent observations indicate that spawning gravels may be insufficient to support both species.	Rearing habitat for juvenile steelhead and coho salmon appear to be adequate. The lower reaches do contain deep pools and large woody debris (LWD), recent work on backwaters and future work to increase LWD should improve rearing conditions for coho salmon.
Laguna Creek	Spawning habitat quality varies.	Rearing habitat for juvenile steelhead is adequate.
Majors (Coja) Creek	Spawning habitat for steelhead limited - gravels for steelhead scarce.	Rearing habitat poor for steelhead (better for resident trout in upstream sections).
Baldwin Creek	Salmonid spawning habitat exists, fair condition with large-sized substrate.	Juvenile rearing habitat apparently abundant and of high quality.

[4] Based on review of Shapovalov and Taft 1954; Smith 1990; Bryant 1994; Titus et al. 2002; Swanson Hydrology & Geomorphology; D.W. Alley and Associates 2002; Hagar 2003.

Watershed	Spawning Habitat	Juvenile Rearing Habitat
San Lorenzo River and Tribs	Spawning habitat quality varies throughout watershed. In general, spawning conditions are considered to be sub-optimal in the San Lorenzo River. Lower and middle San LorenzoRiver have poor spawning conditions due to theinput of high fine sediment loads from tributarystreams. High quality spawning habitat occurs in localized patches in tributaries.	Juvenile production more limited by restricted rearing conditions resulting from low summer streamflow, shallow pool conditions, and the absence of good escape cover. In the middle and lower River, excessive fine sediment loads have resulted in high embeddedness in riffles and runs and a general loss of total habitat area. Rearing conditions remain adequate to support a high proportion of fast-growing juveniles. In the upper river and tributaries, cooler temperatures and low primary productivity result in slow growing salmonids in the tributaries. The dominant limiting factor for juvenile production is the presence of excessive sediment without enough large woody material to act as scour objects, thus reducing habitat depth and available escape cover.
Arana Gulch	Spawning habitat is extremelypoor. Substrate at the tails of pools where spawning would be likely is primarilycomprised of silt and fine sand.	Rearing habitat is generally limited due to shallow pool depths and lack of scour objectssuch as bedrock and large boulders.
Soquel Creek	Spawning habitat is variable. Extremely mobile streambed conditions result in low spawning success (washing away or burying spawning redds). There is high embeddedness in riffle and run habitat.	Rearing habitat generally poor for coho salmon due lack of LWD and pools and low summer baseflow. Juvenile steelhead rearing habitat is generally poor due to lack of LWD and low summer baseflow.
Aptos Creek	Quantity and quality are good to very good for coho salmon.	Depth and shelter of pools, frequency of LWD, floodplain connectivity, and estuary function are poor for coho salmon.

Regarding coastal San Mateo County streams, three main watersheds historically supported CCC coho salmon as well as current CCC steelhead runs: San Gregorio, Pescadero-Butano and Gazos. Several other watersheds and streams that support CCC steelhead runs include: San Pedro, Pilarcitos, Lobitos Creek, and Tunitas Creek. Sedimentation has been a longstanding problem in the Pescadero-Butano Creek and San Gregorio Creek watersheds and they are listed as impaired for sediment under the Clean Water Act Section 303(d) list. The pollution factors for these streams are high coliform count and sedimentation/siltation. The potential sources of these pollutants are nonpoint sources.

The San Gregorio watershed has recently seen increasing residential development but remains primarily pastoral with cattle and sheep grazing, timber harvesting, and recreational trails being the main commercial uses. Because of the large private ownership and development potential, water diversions and low base flows are an important issue in this watershed. In 1993, water rights in the San Gregorio watershed were adjudicated and a minimum stream bypass flow was established. However, the prescribed bypass flows are too low to assure viable coho salmon populations (California Department of Fish and Game 2004). Recent restoration activities in this watershed include the Alpine Creek Fish Passage Project that was completed in 2019 restoring 3 miles of habitat for salmonids by modifying a culvert, removing a fish ladder and falling weirs, and reconstructing 425 feet of stream channel.

Within the Pescadero-Butano watershed, the Pescadero Lagoon and Marsh is the pathway to the Pacific Ocean for Pescadero and Butano Creek salmonids. Several years of sedimentation and flooding issues have degraded this estuary and caused numerous fish kills, including listed CCC steelhead, due to low oxygen levels. A recent restoration project has rechanneled the marsh and removed sediment that should reduce the anoxic conditions that caused fish kills. The first release of hatchery coho salmon into this watershed since restoration was completed occurred in fall of 2020. Pilarcitos Creek provides water to local residents and has two dams to regulate flows and water supply. Impacts resulting from human activity have degraded the overall watershed condition, threatening habitat conditions for steelhead. In addition, water demand has increased with the growth of residential, agricultural, and industrial development in the Pilarcitos Creek watershed, decreasing the amount of water available for surface flow in streams. There are several stakeholders who have formed an integrated water management plan to better guide and protect beneficial uses in this watershed with a top priority being protection and enhancement of stream flow and riparian conditions to support steelhead and other native species.

Most of the streams in coastal San Mateo County have little to no flood control modifications and meander through dense forests in the higher elevations. Although these streams are relatively free from the infrastructure constraints common throughout San Mateo and Santa Cruz counties, there are challenges in these watersheds including water diversions, lack of riparian management and water quality issues mentioned above.

The long-term effects of climate change have been presented above, and include changes to air and water temperature and the timing and magnitude of precipitation events that may affect steelhead, coho salmon, and critical habitat by changing water quality, streamflow levels, and salmonid migration in the action area. The threat to salmonids in the action area from climate change is likely to mirror what is expected for the rest of Central California. NMFS expects that average dry season air temperatures in the action area will continue to increase, heat waves will become more extreme, and droughts and wildfire will occur more often (Hayhoe et al. 2004; Lindley et al. 2007; Schneider 2007; Westerling et al. 2011; Moser et al. 2012; Kadir et al. 2013). Many of these changes are likely to further degrade CCC steelhead and CCC coho salmon critical habitat within the action area by, for example, reducing streamflow during the dry season and raising summer water temperatures.

Such changes to the regional climate could also lead to drier forest conditions and an increased threat of wildfires. As noted above, the CZU Lightening Complex burned 86,509 acres across western Santa Cruz and San Mateo counties. An increase in frequency of such events could reduce canopy cover, large wood recruitment, and increase fine sediment yield to streams within the action area, which would have some adverse consequences on the PBFs for spawning and rearing habitats.

2.4.2 Previous ESA Section 7 Consultations and Section 10(a)(1)(A) Permits in the Action Area

NMFS's North-Central Coastal California Office conducts numerous informal and formal section 7 consultations in San Mateo and Santa Cruz counties each year. The majority of these consultations were informal consultations that did not adversely affect listed species. A low number (less than 5) of formal biological opinions are issued each year that authorize take and have terms and conditions that minimize take of listed anadromous fish. There has not been a jeopardy or adverse modification of critical habitat biological opinion issued by NMFS for actions located in Santa Cruz or San Mateo counties.

NMFS has issued section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions for scientific research and monitoring that occur in the action area. Salmonid monitoring approved under these programs includes carcass surveys, smolt outmigration trapping, and juvenile density surveys. In general, these activities are closely monitored and require measures to minimize take during the research activities. NMFS determined these research activities are unlikely to affect future adult returns.

2.5 Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

2.5.1 Effects on Critical Habitat

Full descriptions of the effects of the proposed enhancement and research activities are in the following sections. In general, the permitted activities would be: 1) electrofishing; 2) capturing fish using nets of various types; 3) collecting biological samples from live fish; and 4) PIT- and floy-tagging. All of these techniques are minimally intrusive in terms of their effect on habitat because they would involve very little, if any, disturbance of streambeds or adjacent riparian zones. Some fish collection activities may temporarily disturb substrate, displace benthic invertebrate prey, and increase turbidity just above the water surface. However, such actions affect small spatial areas and are brief in duration, so these effects are expected to be ephemeral and attenuate rapidly. Therefore, none of the activities analyzed in this Opinion will measurably affect any habitat PBF function or value described earlier (see section 2.2.2).

2.5.2 Effects on the Species

As discussed above, the proposed enhancement and research activities would not measurable affect any of the listed species' habitat. The actions are therefore not likely to measurably affect any of the listed species by reducing that habitat's ability to contribute to their survival and recovery.

Although not identified as a factor for decline or a threat preventing recovery, enhancement and scientific research and monitoring activities have the potential to affect the species' survival and recovery by killing listed salmonids—whether intentionally or not. As mentioned above, NMFS has issued numerous section 10(a)(1)(A) scientific research permits allowing listed species to be taken and sometimes killed. NMFS has also issued numerous authorizations for state scientific research programs under ESA section 4(d). Actual take levels associated with these activities are almost certain to be a substantially lower than the permitted levels. A primary reason for this is most researchers do not handle the full number of juveniles or adults they are allowed. That is, for the vast majority of scientific research permits, history has shown that researchers generally take far fewer salmonids than the allotted number of salmonids every year.

The authorized activities under the permit are expected to result only in minimal adverse effects while the majority of effects are expected to be beneficial. Coho salmon and steelhead will be subject to direct and indirect effects associated with aspects of the proposed action. The main risk to individual fish involves unintentional harm and mortality during the process of capture and handling while conducting rescue, relocation, and research activities. However, this potential harm and mortality is expected to be low and limited to a small proportion of the total CCC coho ESU and CCC steelhead DPS. Additionally, these activities include measures expected to minimize, if not eliminate, the risk of injury and mortality.

Further, the benefits of conducting the authorized activities are expected to more than compensate for the anticipated potential adverse effects to a small number of individual fish. For example, relocating salmonids from naturally dewatering stream reaches is expected to promote survival and growth of individual fish, thereby enhancing the ESU and DPS as a whole. Only fish that are determined to be in danger of mortality due to habitat drying or intolerable water quality will be rescued. The proposed research elements are also expected to produce long-term conservation benefits for the species by informing science-based management of the species, including advanced protection measures through improved monitoring and controls on anthropogenic activities.

2.5.2.1 Fish Capture and Handling

The primary effect of the proposed activities on the listed species would be in the form of capturing and handling fish. We discuss effects from handling and anesthetizing fish, and the general effects of capture using seines and dip-nets here. We discuss effects from backpack electrofishing in more detail below.

Harassment caused by capturing, handling, and releasing fish generally leads to stress and other sub-lethal effects that are difficult to assess in terms of their impact on individuals, populations, and species (Sharpe et al. 1998). Handling of fish may cause stress, injury, or death, which typically are due to overdoses of anesthetic, differences in water temperatures between the river and holding buckets, depleted dissolved oxygen in holding buckets, holding fish out of the water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 18ºC or dissolved oxygen is below saturation. Fish transferred to holding buckets can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in nets and buckets. Decreased survival of fish can result when stress levels are high because stress can be immediately debilitating and may also increase the potential for vulnerability to subsequent challenges (Sharpe et al. 1998). The permit conditions identified in Section 1.3 contain measures that mitigate the factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish. When these measures are followed, the majority of fish typically recover fairly rapidly from handling. However, NMFS anticipates up to 5% of the fish captured and handled could be killed.

2.5.2.2 Electrofishing

Electrofishing is a process by which an electrical current is passed through water containing fish in order to stun them, which makes them easy to capture. It can cause a suite of effects ranging from disturbing the fish to killing them. The percentage of fish that are unintentionally killed by electrofishing varies widely depending on the equipment used, the settings on the equipment, and the expertise of the technician (Sharber and Carothers 1988, McMichael 1993, Dalbey et al. 1996; Dwyer and White 1997). Research indicates that using continuous direct current (DC) or low-frequency (30 Hz) pulsed DC waveforms produce lower spinal injury rates, particularly for salmonids (Fredenberg 1992, McMichael 1993, Sharber et al. 1994, Snyder 1995).

Most studies on the effects of electrofishing on fish have been conducted on adult fish greater than 300 mm in length (Dalbey et al. 1996). Electrofishing can have severe effects on adult salmonids. Adult salmonids can be injured or killed due to spinal injuries that can result from forced muscle contractions. Sharber and Carothers (1988) reported that electrofishing killed 50 percent of the adult rainbow trout in their study.

Spinal injury rates are substantially lower for juvenile fish than for adults. Smaller fish are subjected to a lower voltage gradient than larger fish (Sharber and Carothers 1988) and may, therefore, be subject to lower injury rates (e.g., Hollender and Carline 1994; Dalbey et al. 1996; Thompson et al. 1997). McMichael et al. (1998) reported a 5.1% injury rate for juvenile Middle Columbia River steelhead captured by electrofishing in the Yakima River subbasin.

When using appropriate electrofishing protocols and equipment settings, shocked fish normally revive quickly. Studies on the long-term effects of electrofishing indicate that even with spinal injuries, salmonids can survive long-term; however, severely injured fish may have stunted growth (Dalbey et al. 1996, Ainslie et al. 1998). The applicant will minimize effects to listed species by using only field supervisors and crew members with appropriate training and experience to operate the electrofishing equipment. To further minimize impacts, methods and electrofishing settings will be limited to only the minimum settings necessary for effectively capturing fish. Coho salmon and steelhead captured will be temporarily kept in either a container (minimum 5-gallon) with supplemental aeration, or in floating live cars as appropriate. Overall, NMFS anticipates up to 5% of fish encountered during electrofishing could or killed.

2.5.2.3 Tagging and Marking

Techniques such as PIT-tagging, FLOY-tagging, and fin-clipping are common to many scientific research efforts using listed species. All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or even kill the marked fish. NMFS anticipates up to 5% of the fish tagged and marked could be killed. This section discusses each of the marking processes and its associated risks.

A PIT tag is an electronic device that relays signals to a radio receiver; it allows salmonids to be identified whenever they pass a location containing such a receiver (e.g., any of several dams) without researchers having to handle the fish again. The tag is inserted into the body cavity of the fish just in front of the pelvic girdle. The tagging procedure requires that the fish be captured and extensively handled; therefore, any researchers engaged in such activities will follow the conditions listed previously in this Opinion (as well as any permit-specific conditions) to ensure that the operations take place in the safest possible manner. In general, the tagging operations will take place where there is cold water of high quality, a carefully controlled environment for administering anesthesia, sanitary conditions, quality control checking, and a carefully regulated holding environment where the fish can be allowed to recover from the operation.

PIT tags have very little effect on growth, mortality, or behavior. The few reported studies of PIT tags have shown no effect on growth or survival (Prentice et al. 1987; Jenkins and Smith 1990; Prentice et al. 1990). For example, in a study between the tailraces of Lower Granite and McNary dams (225 km), Hockersmith et al. (2000) concluded that the performance of yearling Chinook salmon was not adversely affected by gastrically- or surgically-implanted sham radio tags or PIT-tags. Additional studies have shown that growth rates among PIT-tagged Snake River juvenile fall Chinook salmon in 1992 (Rondorf and Miller 1994) were similar to growth rates for salmon that were not tagged (Conner et al. 2001). Prentice and Park (1984) also found that PIT-tagging did not substantially affect survival in juvenile salmonids. The growth and survival of brown trout (>/ 18 cm) does not appear to have been altered by floy-tagging (O'Grady 1984).

2.5.2.4 Tissue Sampling

Tissue sampling techniques such as fin-clipping are common to many scientific research efforts using listed species. All sampling, handling, and clipping procedures have an inherent potential to stress, injure, or even kill the fish. This section discusses tissue sampling processes and its associated risks.

Fin clipping is the process of removing part or all of one or more fins to obtain non-lethal tissue samples and alter a fish's appearance (and thus make it identifiable). When entire fins are removed, it is expected that they will never grow back. Alternatively, a permanent mark can be made when only a part of the fin is removed or the end of a fin or a few fin rays are clipped. Although researchers have used all fins for marking at one time or another, the current preference is to clip the adipose, pelvic, or pectoral fins. Marks can also be made by punching holes or cutting notches in fins, severing individual fin rays (Welch and Mills 1981), or removing single prominent fin rays (Kohlhorst 1979).

Many studies have examined the effects of fin clips on fish growth, survival, and behavior. The results of these studies are somewhat varied; however, it can be said that fin clips do not generally alter fish growth. Studies comparing the growth of clipped and unclipped fish generally have shown no differences between them (e.g., Brynildson and Brynildson 1967). Moreover, wounds caused by fin clipping usually heal quickly—especially those caused by partial clips.

Mortality among fin-clipped fish is also variable. Some immediate mortality may occur during the marking process, especially if fish have been handled extensively for other purposes (e.g., stomach sampling). NMFS anticipates up to 5% of the fish sampled for tissues may be killed. Delayed mortality depends, at least in part, on fish size; small fishes have often been found to be susceptible to it and Coble (1967) suggested that fish shorter than 90 mm are at particular risk. The degree of mortality among individual fishes also depends on which fin is clipped. Studies show that adipose- and pelvic-fin-clipped coho salmon fingerlings have a 100% recovery rate (Stolte 1973). Recovery rates are generally recognized as being higher for adipose- and pelvic-fin-clipped fish in comparison to those that are clipped on the pectoral, dorsal, and anal fins (Nicola and Cordone 1973). Clipping the adipose and pelvic fins probably kills fewer fish because these fins are not as important as other fins for movement or balance (McNeil and Crossman 1979). Mortality is generally higher when the major median and pectoral fins are clipped. Mears and Hatch (1976) showed that clipping more than one fin may increase delayed mortality, but other studies have been less conclusive.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation [50 CFR 402.02 and 402.17(a)]. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.4).

NMFS does not anticipate any cumulative effects in the action area other than those ongoing actions already described in the Environmental Baseline above. Given current baseline conditions and trends, NMFS does not expect to see significant changes in cumulative effects in the near future due to existing development and use of water in the watershed. NMFS assumes the rate of such development and water use would be similar to that observed in the last decade.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

The proposed action will take place throughout the coastal streams of the Santa Cruz Mountains in San Mateo and Santa Cruz Counties, California that support endangered CCC coho salmon and threatened CCC steelhead. CCC coho salmon and CCC steelhead have declined from their historic abundances due to the widespread degradation and loss of historic habitats caused by factors including hydrologic modifications (reservoir storage, surface diversions, and groundwater pumping), land use change (urbanization, timber harvest, agriculture, and mining), construction of dams and other migration impediments, channelization and disconnection from floodplains, and the introduction of non-native and invasive species. Coho salmon and steelhead populations within the diversity stratum have declined substantially over the past several decades.

Permit 26495 involves two elements: 1) rescue and relocation of salmonids; and 2) scientific research. Coho salmon and steelhead are expected to be present in the action area during the time the proposed action will be implemented and, therefore, subject to direct and indirect effects associated with aspects of the proposed action. The main risk to individual coho salmon and steelhead involves effects due to capture and relocation and tagging. The adverse effects include potential injury or mortality during the process of capture and relocation during rescue and study activities, but precautions are in place to minimize the risk of injury and mortality to 5% or less of those fish captured. The potential annual mortality (up to 125 juvenile and 5 adult coho salmon and 200 juvenile and 7 adult steelhead) of fish captured amounts to a minor fraction of CCC coho salmon ESU and CCC steelhead DPS total abundance. The total mortalities are small and spread out across the Santa Cruz Mountains Diversity Stratum and are therefore unlikely to have any lasting detrimental effect on the species numbers, reproduction, or distribution. Fish that are otherwise not rescued but for the proposed permit are anticipated to die. Overall, the impacts to the species are expected to be beneficial. The rescue and relocation activities will enhance survival of individuals and the research activities will improve understanding of steelhead and coho.

Any impacts from the permit activities to critical habitat will be negligible. Wading, seining, netting, and operating an electrofisher in the action area may cause temporary disturbances, but would not alter or diminish the conservation value of the critical habitat for CCC steelhead or CCC coho.

Future climate change could affect CCC steelhead and CCC coho salmon and their designated critical habitats within the action area. Some potential consequences of climate change in the Monterey Bay region are increases in both air and water temperatures, and changes in the timing and magnitude of storms, their runoff, and dry season streamflow. These projections further highlight the importance of rescuing and relocating salmonids from drying streams within the CCC steelhead DPS and CCC coho salmon ESU.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of the CCC steelhead DPS, nor destroy or adversely modify its designated critical habitat.

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence CCC coho salmon, nor destroy or adversely modify its designated critical habitat.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered.

The issuance of permit 26495 authorizes intentional take of endangered CCC coho salmon and threatened CCC steelhead that is related to the enhancement of these populations through coho salmon and steelhead rescue operations and research as described in the permit. NMFS does not anticipate any take of listed species that is incidental to the action. This opinion does not authorize any taking of a listed species under section 10(a) or immunize any actions from the prohibitions of section 9(a) of the ESA.

There isn't any incidental take because all the take contemplated in this document would be carried out under the permit that allows the permit holder to directly take the animals in question. The action is considered to be direct take rather than incidental take because in every case the actual purpose is to take the animals while carrying out a lawfully permitted activity. Thus, the take cannot be considered "incidental" under the definition given above.

Because the action would not cause any incidental take, we are not specifying an amount or extent of incidental take that would serve as a reinitiation trigger. Nonetheless, the amounts of direct take have been specified and analyzed in the effects section above (2.5). Those amounts—displayed in Table 1 and discussed in the effects analyses—constitute hard limits on both the amount and extent of take the permit holder would be allowed in a given year. Those amounts are also noted in the reinitiation clause just below because exceeding them would likely trigger the need to reinitiate consultation.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

NMFS has no conservation recommendation related to the proposed action considered in this biological opinion.

2.11 Reinitiation of Consultation

This concludes formal consultation for the issuance of ESA Section 10(a)(1)(A) Enhancement of Survival and Scientific Research Permit 26495 for endangered CCC coho salmon and threatened CCC steelhead.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

3 DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

3.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the National Marine Fisheries Service and the California Department of Fish and Wildlife. Other interested users could include local stakeholders. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome].

3.2 Integrity

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

3.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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