UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
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# Endangered Species Act (ESA) Section 7(a)(2) Biological and Conferencing Opinion and Fish and Wildlife Coordination Act Recommendations

## Renewal and Issuance of an ESA Section 10(a)(1)(A) One Enhancement Permit Affecting Central Valley Steelhead and Green Sturgeon in California Beginning in 2022 in the San Joaquin Restoration Program Restoration Area (Permit 16608-3R)

NMFS Consultation ECO Number: WCRO-2022-02222

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 Adversely Affect Critical Habitat? | Is Action Likely to Jeopardize the Species? | Is Action Likely to Destroy or Adversely Modify Critical Habitat? |
|---|---|---|---|---|---|
| California Central Valley steelhead (*O. mykiss*) | Threatened | Yes | No | No | NA |
| Southern DPS of North American green sturgeon (*A. medirostris*) | Threatened | Yes | No | No | NA |

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

**Issued By:** A. Catherine Marcinkevage

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**Date: December 14, 2022**

## LIST OF ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ACID | Anderson-Cottonwood Irrigation District Diversion Dam |
| CCV | California Central Valley |
| CDFG | California Department of Fish and Game |
| CDFW | California Department of Fish and Wildlife |
| Coleman | Coleman National Fish Hatchery |
| CRR | cohort replacement rates |
| CPUE | catch per unit effort |
| CV | Central Valley |
| CVI | Central Valley Index |
| CWT | coded-wire tag |
| DO | dissolved oxygen |
| DPS | distinct population segment |
| DQA | Data Quality Act |
| EBMUD | East Bay Municipal Utilities District |
| EFH | essential fish habitat |
| ESA | Endangered Species Act |
| ETF | Egg to fry |
| ESU | evolutionarily significant unit |
| FMPs | fisheries management plans |
| FRFH | Feather River Fish Hatchery |
| GPP | generated power pulsator |
| HAPCs | Habitat Areas of Particular Concern |
| iSCARF | Interim Salmon Conservation and Research Facility |
| MSA | Magnuson-Stevens Fishery Conservation and Management Act |
| NEP | Non-essential experimental population |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| PBFs | physical or biological features |
| PCE | primary constituent elements |
| PFMC | Pacific Fishery Management Council |
| PIT | passive integrated transponder |
| PVA | population viability analysis |
| Restoration Area | San Joaquin River Restoration Program Restoration Area |
| RBDD | Red Bluff Diversion Dam |
| RST | rotary screw trap |
| Settlement | Settlement in NRDC et al. v. Kirk Rodgers et al. |
| SJR | San Joaquin River |
| SJRRP | San Joaquin River Restoration Program |
| TRT | Central Valley Technical Review Team |
| Reclamation | U.S. Bureau of Reclamation |
| USFWS | U.S. Fish and Wildlife Service |
| VSP | viable salmonid population |
| YCWA | Yuba County Water Agency |
| YOY | young-of-year |

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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

The National Marine Fisheries Service (NMFS) prepared the biological 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 2 weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). A complete record of this consultation is on file at the Sacramento NMFS Office.

This document constitutes a biological opinion for California Central Valley (CCV) steelhead (*Oncorhynchus mykiss*) and the Southern Distinct Population (sDPS) of North American green sturgeon (*Acipenser medirostris*) including a conferencing opinion for Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*). Conferencing opinions, as opposed to biological opinions, are required when species encountered are treated as species proposed for listing. Pursuant to ESA section 10(j), for the purpose of this conferencing opinion, the CV spring-run Chinook salmon encountered in the action area constitute a nonessential experimental population (NEP), and are treated as a species proposed for listing. A conferencing opinion is only required if the analysis of the proposed action results in a jeopardy determination.

Although we concluded the proposed action will not jeopardize the continued existence of the species, the analysis for CV spring-run Chinook salmon is included in this biological opinion for informational purposes. The monitoring of capture for CV spring-run Chinook salmon within the NEP area (78 FR 79622; December 31, 2013) is covered under 10(a)(1)(A) permit #20571, issued to the USFWS, and is therefore not included under the proposed action. There will be no exempted take for CV spring-run Chinook salmon as part of this biological opinion, and the NEP of CV spring-run Chinook salmon will not be addressed in the Incidental Take Statement.

## 1.2 Consultation History

The initial permit, Permit 16608, was issued to the Bureau of Reclamation (Reclamation) on January 26, 2012. Permit 16608 authorized Reclamation for non-lethal take of listed salmonids during the San Joaquin River Restoration Program's (SJRRP) monitoring activities along locations on the San Joaquin River (SJR) between the base of Mendota Dam[1] and Sack Dam[2]

[1] Mendota Dam is northeast from the city of Mendota in Fresno County (Long/Lat: 36.788066760724575, -120.37236614232678).
[2] Sack Dam is near the Valeria Ave. (Dos Palos, CA 93620) intersection with the Poso Canal (Long/Lat: 36.983679228514795, -120.50011410501568) between Fresno and Madera Counties.

downstream to the confluence of the Merced River. The renewal of Permit 16608, Permit 16608-2R, extended the duration of the permit, which had been operating under interim expired status since March 31, 2014, through 2022, or five years from the date of issuance. The full consultation history for the first renewal is not directly relevant to this analysis and is not detailed here. The renewal consultation history is documented in the record for the Section 7 Consultations for Permit 16608 and Application 16608-2R, which are maintained by NMFS' California Central Valley Office in Sacramento, California.

On March 18, 2022, NMFS West Coast Region received a permit renewal request (Permit 16608-3R) from Reclamation to conduct species enhancement activities for CCV steelhead and the sDPS of North American green sturgeon in the SJRRP Restoration Area. The second renewal of Permit 16608, Permit 16608-3R, includes additional details of activities covered under Permit 16608. Updated activities requested in application 16608-3R are included in the Proposed Action Section (1.3) below.

A Notice of Receipt for the application for Permit 16608-3R (82 FR 3287) was published on July 5, 2022, in the *Federal Register* asking for public comment on the application. This took place after a period of pre-consultation between NMFS and Reclamation.

The public had 30 days to comment on the application. The public comment period ended on August 4, 2022. No public comments were received, thus application 16608-3R was not changed or modified. NMFS initiated an internal Section 7 consultation on August 4, 2022. The species affected by the potential issuance of Permit 16608-3R to Reclamation include CCV steelhead, which are ESA listed as threatened, CV spring-run Chinook salmon, which are designated as a nonessential experimental population within the action area, and the sDPS of North American green sturgeon, which are ESA listed as threatened.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 FR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. As a result, the 2019 regulations are once again in effect, and we are applying the 2019 regulations here. For purposes of this consultation, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

### 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). We considered, under the ESA, whether or not the proposed action would cause any other activities and determined it would not. In the absence of any such actions, the proposed action here is NMFS' proposal to issue the renewal Permit (16608-3R) to Reclamation.

We are proposing to issue a renewal of Permit 16608 pursuant to section 10(a)(1)(A) of the ESA. The permit would authorize Reclamation to take threatened CCV steelhead and threatened sDPS of North American green sturgeon. "Take" is defined in section 3 of the ESA; it means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect [a listed species] or to attempt to engage in any such conduct. The following analysis therefore examines the take that may affect the distinct population segments[3] (DPSs), which are the subject of this biological opinion and listed below; the NEP of Central Valley spring-run Chinook salmon is listed for information purposes only (Table 1).

**Table 1**: Information pertaining to original and current ESA listing and critical habitat designation of species present in the proposed action area. Reclamation does not anticipate encountering CV spring-run Chinook salmon based on past monitoring efforts, and did not request take amounts within the permit application.

| Species | Population | Original Final FR Listing | Current Final Listing Status | Critical Habitat Designated |
|---|---|---|---|---|
| Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*) | NEP | 01/30/2014<br>78 FR 79622<br>Threatened | 01/30/2014<br>78 FR 79622<br>Threatened | None |
| Steelhead[4] (*O. mykiss*) | California Central Valley DPS | 3/19/1998<br>63 FR 13347<br>Threatened | 1/5/2006<br>71 FR 834<br>Threatened | 9/2/2005<br>70 FR 52488 |
| North American green sturgeon[5] (*Acipenser medirostris*) | Southern DPS | 4/7/2006<br>71 FR 17757<br>Threatened | 4/7/2006<br>71 FR 17757<br>Threatened | 10/9/2009<br>74 FR 52300 |

***Permit 16608-3R - San Joaquin River Restoration Program Steelhead Monitoring***

**Activities authorized under Permit 16608:**

Enhancement Permit 16608 authorizes monitoring, research, and enhancement activities in the SJRRP Restoration Area (Restoration Area), upstream of the Merced River confluence, as outlined in the Steelhead Monitoring Plan (Portz *et al.* 2012). The Restoration Area, starts at the confluence of the SJR and Merced River and ends at Friant Dam, near Fresno, California, a distance of approximately 153 miles[6]. Permit 16608 was issued on January 26, 2012, and while it expired on March 31, 2014, activities authorized by Permit 16608 continued under interim expired status until the first permit renewal request was submitted to NMFS on December 16, 2016. NMFS' October 17, 2017, Decision Memorandum recommended the issuance of the renewed permit (Permit 16608-2R); internal ESA Section 7 consultation closed on October 17, 2017, with the issuance of a biological opinion to NMFS.

This biological opinion reflects the second renewal request by Reclamation. The Steelhead Monitoring Plan is conducted under the auspices of the SJRRP, which is a result of the

[2] A DPS of steelhead (71 FR 834) is considered to be "species" as the word is defined in section 3 of the ESA. In addition, we use the terms "artificially propagated" and "hatchery" interchangeably in the biological opinion (and the terms "naturally propagated" and "natural"); for further discussion on Pacific Salmon, see Waples 1991.

[4] Detailed CCV steelhead DPS and critical habitat information: http://www.westcoast.fisheries.noaa.gov/protected_species/salmon_steelhead/salmon_and_steelhead_listings/steelhead/california_central_valley/california_central_valley_steelhead.html

[5] Detailed green sturgeon southern DPS and critical habitat information: https://www.fisheries.noaa.gov/species/green-sturgeon#conservation-management

[6]Access program history and background: https://www.restoresjr.net/about/background-and-history/

Stipulation of Settlement in NRDC *et al*. v. Kirk Rodgers *et al*. (Settlement). One goal of the SJRRP is to include restoration flows for fish populations in the Restoration Area. Restoration flows will likely attract adult CCV steelhead into the Restoration Area downstream of Friant Dam prior to the completion of SJRRP habitat improvements.

The purpose of the Steelhead Monitoring Plan is to prohibit CCV steelhead from residing in the Restoration Area before restoration required by the Settlement is complete. Currently there are numerous passage impediments and CCV steelhead entering the Restoration Area do not have access to suitable spawning habitat, in most water years.

To avoid migration delays and false migration paths, adult individuals will be captured, transported, and released into the SJR downstream of the Merced River confluence. CCV steelhead could then continue their migration to suitable spawning habitat downstream of the Restoration Area in the lower SJR or its tributaries.

Permit 16608 authorizes Reclamation for non-lethal and unintentional lethal take of CCV steelhead during monitoring, capturing, and transportation activities in the mainstem SJR, and at entrances to bypasses and false migration pathways, between the base of Mendota Dam including Sack Dam downstream to the confluence of the Merced River.

The take activities authorized under Permit 16608 include: capture by boat electrofishing, fyke nets with wing walls and fish traps, or steelhead-specific trammel nets; and handling in the process of measuring, sexing, collection of scales and tissue, and checking for injuries and presence of tags of captured CCV steelhead. Captured fish would be authorized to be Floy© tagged with a unique identification number to document recaptures. Any captured CCV steelhead would be transported and released into the SJR downstream of the mouth of the Merced River. From permit authorization in 2012 to permit renewal application in 2022, monitoring activities did not result in the capture of any CCV steelhead under Permit 16608, likely due to low incidence of CCV steelhead in the SJRRP Restoration area.

**Proposed Renewal Activities Under Permit 16608-3R**

The renewal of Permit 16608 (Permit 16608-3R) would extend the duration of the permit through 2027, or five years from the date of issuance. The general scope and purpose of the second renewal application remain the same as those of the original permit application and previous renewal application (Permit 16608-2R). However, Reclamation requests a change in the permit renewal application to include incidental take coverage for the sDPS of North American green sturgeon. The basis for this request is below.

Because green sturgeon had not been recently observed or historically recorded spawning in the San Joaquin River, the previous permit renewal application did not address potential effects on green sturgeon based on the best available data at that time. However, on April 11, 2020, an adult green sturgeon was captured in a fyke trap at the Hills Ferry Barrier (Newman, Stanislaus County[7]) during SJRRP steelhead monitoring activities (Root *et al*. 2020). SJRRP biologists captured an adult green sturgeon in the downstream-most reach of the Restoration Area, approximately 200 meters upstream of the Merced River confluence. This is the first recorded

[7] Long/Lat: 37.347458, -120.974914

evidence of green sturgeon in the Restoration Area, thus there is a reasonable potential green sturgeon could be present, and therefore Reclamation includes the potential for incidental take of green sturgeon in the event green sturgeon are encountered during monitoring efforts as proposed under the permit renewal application (Permit 16608-3R)

### 1.3.1 Sampling Methods

Sampling Method 1: Boat or backpack electrofishing (raft-mounted electroshocker)

Sampling will be completed from December–April annually after the Hills Ferry Barrier is removed and adult CV fall-run Chinook salmon (*O. tshawytscha*) trap and haul operations have ceased for the season. Repeated capture of other native and non-native resident fish is anticipated, which will help provide recovery time from sampling and handling stress between sampling periods.

Electrofishing is a common method used in monitoring steelhead populations in California. Electrofishing methods will follow NMFS guidelines for sampling waters with anadromous fish (NMFS 2000). NMFS guidelines are for backpack electrofishing; however, researchers are not precluded from using other techniques or equipment as long proposed techniques or equipment are necessary for the study and that adequate safeguards are followed to protect sampled listed species. A backpack electroshocker is not a feasible method for monitoring the deeper canals of some the false riverine pathways and will not be used due to the large size and or depth of the sampling area.

In addition to backpack electroshockers, raft-mounted electroshockers will also be used to sample through shallow waters of the sampling locations within the mainstem SJR (*i.e.*, just upstream of the confluence of the SJR and Merced River, the mouth of Mud Slough, the SJR near the Highway 140 bridge, the mouth of Salt Slough, immediately downstream of Sack Dam, downstream of Mendota Dam, and at the return points of the Eastside and Mariposa bypasses). The raft-mounted electroshocker will have access to both deep and shallow water habitats and will use the same guidelines for initial and maximum electrical shock settings as for backpack electroshocking. The model of raft electroshocker where some of the electrofishing components are mounted is a Cataraft SR-17 Electroshocker, equipped with a Generator 5 generator-powered pulsator (GPP), control box 5.0 GPP, 3-chamber Dupont® Hypalon pontoons, electrofisher booms, electrode arrays, built-in foot switches, cathode array, hand-operated air pump, and an Evinrude® E25DTL engine.

A Smith-Root 5.0 GPP raft-mounted electrofisher (Smith Root, Vancouver, WA) will be used during this time using the following settings (*i.e.*, main unit controlling electrical output): pulsed direct current, voltage range set at 50-500 V, with a power output range of 10-60%, and cycle frequency from 15–60 Hz. Settings will be determined by water conductivity and adjusted to maximize capture efficiency while minimizing electrical exposure (i.e., lowest setting required to elicit response without extended shocking times). Sampling sites will include: Mud Slough, Salt Slough, Newman Wasteway, Eastside Bypass, Mariposa Bypass, Sand Slough Control Structure, and the base of Sack Dam.

Sampling Method 2: Fyke nets with wing walls and fish traps

Fyke nets will be used to survey upstream migrating steelhead. Fyke nets are constructed of 2.4-cm square #252 knotless nylon netting formed over 5 consecutive 1.2-m hoops and a 1.2-m square, welded-conduit frame entrance. The traps contain 2 throats with a 25-cm diameter opening.

A fyke net with wing walls may be useful to capture fish following the shorelines at various times of the day during the migration season. Wing walls, attached to the sides of the net opening, are 1.2 m deep and long enough to span the river (max wing length 30.5 m), with small floats spaced every 61 cm on top, and a lead line on bottom. The net entrances face downstream, with the wing walls extending to shore in a v-shaped pattern. Nets are held in place with anchored t-posts.

Fyke nets will be deployed in the following sampling locations: upstream of the confluence of the Merced River, mainstem San Joaquin River, mouths of Mud Slough, Newman Wasteway, and existing structure at Sack Dam. This p technique will be implemented once the Hills Ferry Barrier is removed (around mid-December) and may remain deployed until the end of April. Marker buoys will be placed up- and downstream of each fyke net, and flashing amber lights and visibility tape will be affixed to the net and wing walls to alert boaters of the net's presence. Daily checks will take place to reduce the likelihood of injuring fish.

Sampling Method 3: Steelhead-specific trammel nets

Trammel nets are most commonly used as stationary gear to block off channels with low velocities or no flows. Trammel nets will be continuously monitored and set for a maximum period of 4 hours. However, the proposed action also includes trammel net deployment during periods of high-velocity flows. Under high-velocity flows, the nets will be manned during the entire time of their deployment and their drift cycle will be limited to 10 minutes per deployment. The short duration drifting of a trammel net is necessary to minimize the amount of time captured fish are entangled thereby minimizing impacts to fish in the nets.

Trammel nets include three parallel vertical layers of netting. The inner net has a fine mesh size, while the outer nets have mesh sizes large enough for the fish to pass. The larger and smaller mesh size nets form a pocket when fish attempt to swim through the structure. Similar to seine nets, trammel nets are equipped with floats attached to the head rope and lead weights along the ground rope to keep them properly oriented. Trammel nets range in size from 0.9-1.8 m (3-6 ft.) tall and 11.4-30.5 m (37.5–100 ft.) long. A buoyant top line and weighted bottom line keeps the trammel net oriented vertically in the water column. Brightly colored buoys will be attached to the terminal ends of the net to alert boaters and other recreationists to the nets and avoid entangling themselves, their boats, or their fishing gear.

Only one trammel net will be drifted at a time, at the same locations in the mainstem SJR as identified in the descriptions of sampling methods 1 and 2. The trammel net used for this study is specifically designed for steelhead by integrating the following: 1) knotless netting to reduce abrasiveness; (2) very fine and soft (softer than nylon) multi-fiber polyester to reduce loss of scales; and (3) 2.54 cm diameter mesh used in order to prevent gilling of adults.

To ensure the safety of steelhead and green sturgeon, fisheries biologists tending the nets will follow at a close distance to observe risk of entanglement, and respond quickly to retrieve the nets. Sampling time will depend on the number of fish and bycatch caught at each location. Capture of the same fish multiple times is to be anticipated, thus monthly sampling is important to ensure fish recovery from stress between captures.

Sampling Method 4: Hand seines and beach seines

When electrofishing or fyke netting cannot be effectively used to capture steelhead, a hand or beach seines may be used to safely collect fish. This would be the primary means for collecting fish below a passage impediment or potentially entrained in a small canal or pool in shallow water.

Seines used for SJR steelhead monitoring will be constructed of 1/2 inch nylon knotless mesh, hand tied to a 5/16 inch hollow-braided polypropylene rope with 4-inch floats every 24 inches on top, and #10 leads every 12 inches on the bottom. These nets are 6 feet tall and 75 feet long. However, seines of various lengths and mesh sizes may be used depending on location, flows, river conditions, and size of target fish. Mesh size will be decreased for juvenile salmonids and knotted mesh will never be used to avoid abrasion risks.

The pattern of seining and seine size will depend on the structure of the pool to be seined. The objective is to cover the largest extent of the pool possible without risking having the seine hang-up on benthic debris or objects potentially allowing fish to escape.

Generally, the seine is deployed, circling the fish, and then pulled closer to the shore. The net poles on the ends are positioned forward and the lead-line is kept snug to the bottom as the net is pulled to shore. Personnel conducting the seining would take measures to not seine debris in a manner that could injure fish. The seine would be inspected for listed species while still in the water. Steelhead trapped in the seine purse would be removed from the net, processed for information, and placed in containers for transport to the release location. Transport containers are 15-gallon tubs and will be hand-carried to the transport tank. All non-target species will be returned to the water body where they were captured.

Sampling Method 5: Fyke traps

During high flood-flow conditions turbidity, depths, and debris loads may render other monitoring and capture methods challenging and ineffective. Therefore, steel fyke-traps may be deployed as an alternative to aforementioned methods (1-4) under high-flow conditions.

Steel fyke-traps have two chambers (42-in diameter) with a reduced funnel (22-in diameter) opening between chambers, and are constructed of 2.25-in plastic coated chainmail. These have a large internal compartment constructed of high tensile resin-infused netting, permitting capture and holding of adult salmonids without inadvertently causing injury or excessive stress. Traps are equipped with exclusion bars and plastic internal fykes to restrict entry and allow for escape of aquatic mammals. Traps would be deployed upstream of the Merced River confluence and would be checked at least once daily. Boat passage around the fyke trap would be made available, and orange buoys and flashing amber caution lights would alert river users to the trap's presence.

Handling and relocation

In the event a steelhead is captured during monitoring activities, data will be collected according to the Department of Fish and Wildlife Comprehensive Monitoring Plan for Steelhead in the California Central Valley (CDFW 2010).

When a CCV steelhead or green sturgeon is captured during monitoring activities, the captured fish would be subjected to handling procedures, as follows: 1) fish presence would be documented and the individual would be measured (fork length/total length) and sexed (to the extent possible given limitations of external sexual characteristics); 2) scale and tissue samples of each individual would be collected; 3) each fish will be checked for injuries and presence of identifying tags; 4) photo will be taken of each individual if the fish is without a unique identifying tag; 5) the fish would be PIT tagged with a unique identification number for future identification; and 6) captured green sturgeon would be released on site.

Transport for CCV steelhead will involve water to water transfers, a 550-liter transport tank, and smaller transport containers may be used for short distances (*i.e.*, where access to the stream is limited to access by foot). Immediately prior to transport, the tank would be filled with river water near the area of capture. Salt (NaCl) would be added to the transport water to decrease the cellular-holding water ionic gradient and minimize fish transport stress. Steelhead would then be transferred from the river to the transport tank with a water-to-water transfer to reduce handling stress and loss of slime. Oxygen would be supplied via compressed cylinder and micro-bubble diffusers to maintain dissolved oxygen (DO) levels near saturation. In the instance of extended transport duration (*i.e.*, > 30 minutes), an inspection of the fish and transport equipment would occur after the first 30 minutes, and each hour thereafter, to ensure equipment continued performance. Captured steelhead would be acclimated to receiving water conditions (*i.e.*, temperature and chemical gradients) at the release location.

Lethal water temperatures for migrating adult steelhead is 23-24° C (75° F). In order to not jeopardize CCV steelhead that may be present, no CCV steelhead monitoring will occur if river temperatures reach 20° C (68° F). Of note, temperatures during previous monitoring periods did not elevate beyond 18.4° C (65° F). In the unlikely event of a juvenile steelhead capture, scales and fin clip will only be collected from live steelhead when water temperatures are below 15.5° C (60° F).

### 1.3.2 Conditions for monitoring and research

Enhancement permits, which contain research and monitoring elements, include the following conditions to be followed before, during, and after the research activities are conducted. These conditions are intended to: (a) manage the interaction between scientists and listed salmonids by requiring research activities be coordinated among permit holders, and between permit holders and NMFS; (b) minimize impacts on listed species; and (c) ensure NMFS receives correct information about the effects the permitted activities have on the species concerned. All research permits we issue have the following conditions:

1. The permit holder must ensure listed species are taken only at the levels, by the means, in the areas and for the purposes stated in the permit application, and according to the conditions in this permit.

2. The permit holder must not intentionally kill or cause to be killed any listed species unless the permit specifically allows intentional lethal take.

3. The permit holder must handle listed fish with extreme care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided; *e.g.*, the holding units must contain adequate amounts of well-circulated water. When using gear that captures a mix of species, the permit holder must process listed fish first to minimize handling stress.

4. In most research conditions, researchers must stop capturing and handling listed fish if the water temperature exceeds 22° C at the capture site. Under these conditions, listed fish may only be identified and counted. Additionally, electrofishing is not permitted if water temperatures exceed 18° C. However, given that these activities are enhancement, and not standard research activities and because capture could likely rescue the fish from a false migratory pathway, capture techniques and handling may occur above 24° C. However, no electrofishing may occur above 18° C, and handling and marking techniques should be minimized (*i.e.*, no marking or tagging of fish) when temperatures exceed 22° C.

5. The permit holder must use a sterilized needle or scalpel for each individual injection when PIT-tags are inserted into listed fish.

6. The permit holder must exercise care during spawning ground surveys to avoid disturbing listed adult salmonids when they are spawning. Researchers must avoid walking in salmon streams whenever possible, especially where listed salmonids are likely to spawn. Visual observation must be used instead of intrusive sampling methods, especially when just determining fish presence.

7. The permit holder using backpack electrofishing equipment must comply with NMFS' Backpack Electrofishing Guidelines (NMFS 2000) available at http://www.nwr.noaa.gov/publications/reference_documents/esa_refs/section4d/electro2000.pdf.

8. The permit holder must obtain approval from NMFS before changing sampling locations or research protocols.

9. The permit holder must notify NMFS as soon as possible but no later than two days after any authorized level of take is exceeded or if such an event is likely. The permit holder must submit a written report detailing why the authorized take level was exceeded or is likely to be exceeded.

10. The permit holder is responsible for any biological samples collected from listed species as long as they are used for research purposes. The permit holder may not

transfer biological samples to anyone not listed in the application without prior written approval from NMFS.

11. The person(s) actually doing the research must carry a copy of the permit while conducting the authorized activities.

12. The permit holder must allow any NMFS employee or representative to accompany field personnel while they conduct the research activities.

13. The permit holder must allow any NMFS employee or representative to inspect any records or facilities related to the permit activities.

14. The permit holder may not transfer or assign this permit to any other person as defined in Section 3(12) of the ESA. This permit ceases to be in effect if transferred or assigned to any other person without NMFS' authorization.

15. NMFS may amend the provisions of this permit after giving the permit holder reasonable notice of the amendment.

16. The permit holder must obtain all other Federal, state, and local permits and authorizations needed for the research activities.

17. On or before January 31 of every year, the permit holder must submit to NMFS a post-season report in the prescribed form describing the research activities, the number of listed fish taken and the location, the type of take, the number of fish intentionally killed and unintentionally killed, the take dates, and a brief summary of the research results. The report must be submitted electronically on our permit website, and the forms can be found at https://apps.nmfs.noaa.gov/. Falsifying annual reports or permit records is a violation of this permit.

18. If the permit holder violates any permit condition they will be subject to any and all penalties provided by the ESA. NMFS may revoke this permit if the authorized activities are not conducted in compliance with the permit and the requirements of the ESA or if NMFS determines its ESA section 10(d) findings are no longer valid.

19. In the event that marine mammals are encountered, the researcher shall not deploy any sampling gear. If a marine mammal is encountered after gear has been deployed, the researcher shall immediately retrieve the gear. If, despite these measures, a marine mammal is inadvertently captured, it will immediately be released and the researcher will inform NMFS West Coast Region as soon as possible.

"Permit holder" means Reclamation or any employee, contractor, or agent of Reclamation who is acting under the authority of Permit 16608-3R.

# 2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, federal action agencies consult with NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide a biological 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 "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

ESA Section 4(d) protective regulations prohibit taking naturally spawned fish and listed hatchery fish with an intact adipose fin but do not prohibit taking listed hatchery fish that have had their adipose fins removed (70 FR 37160, 71 FR 834, 73 FR 7816). As a result, researchers are not required to have a permit to take hatchery fish that have had their adipose fin removed. Nevertheless, this document evaluates an impact analysis on both natural-origin and hatchery-origin fish to determine the effects of the action on each species as a whole.

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 species covered under this biological opinion 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 part 424) 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 biological opinion we use the terms "effects" and "consequences" interchangeably.

We use the following approach to determine whether the 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, then suggest a reasonable and prudent alternative to the proposed action.

## 2.2 Rangewide Status of the Species and Critical Habitat

This biological 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 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 biological 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 essential for the conservation of the species. As a reminder, the status discussion for CV spring-run Chinook salmon is only for information purposes because Reclamation did not request take of this species within the proposed permit application.

The ESA defines species to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." NMFS adopted a policy for identifying salmon DPSs in 1991 (56 FR 58612). It states a population or group of populations is considered an Evolutionarily Significant Unit (ESU) if it is "substantially reproductively isolated from conspecific populations," and if it represents "an important component of the evolutionary legacy of the species." The policy equates an ESU with a DPS. In 1996, NMFS and the United States Fish and Wildlife Service (USFWS) adopted a joint DPS policy, and in 2005 NMFS began applying that policy to steelhead and green sturgeon. Hence, CV spring-run Chinook salmon constitutes an ESU of the species *O. tshawytscha*; CCV steelhead constitutes a DPS of the species *O. mykiss;* and, green sturgeon has a southern DPS of the species *A. medirostris*. The designation of a nonessential experimental population of CV spring-run Chinook salmon in the Restoration Area is an additional factor to be considered. These ESUs and DPSs include natural-origin populations and hatchery populations, as described in the species status and designated critical habitat sections below (Table 2 and 3).

**Table 2**. Description of species, original and current Endangered Species Act listing classification and summary of species status.

| Species and Recovery Plans | Listing Classification and Federal Register Notice | Status Summary |
|---|---|---|
| Central Valley (CV) spring-run Chinook salmon ESU<br><br>CV salmonid recovery plan (NMFS 2014) | Threatened,<br>70 FR 37160<br>June 28, 2005<br><br>Threatened<br>64 FR 50394<br>September 16, 1999 | According to the NMFS 5-year species status review (NMFS 2016), the status of the CV spring-run Chinook salmon ESU, until 2015, had improved since the 2010, 5-year species status review. The improved status is due to extensive restoration, and increases in spatial structure with historically extirpated populations (Battle and Clear Creeks) trending in the positive direction. Recent declines of many of the dependent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Monitoring data showed sharp declines in adult returns from 2014 through 2018 (CDFW 2017). Viability information since the 2015 viability assessment (Williams *et al*. 2016) has been incorporated into the analysis of this consultation and will be reflected in an updated 5-year status review in 2022. |
| California Central Valley (CCV) steelhead Distinct Population Segment (DPS)<br><br>CV salmonid recovery plan (NMFS 2014) | Threatened,<br>71 FR 834<br>January 5, 2006<br><br>Threatened<br>63 FR 13347<br>March 19,1998 | According to the NMFS 5-year species status review (NMFS 2016), the status of CCV steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Most natural-origin CCV populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead. While updated data on steelhead in the American River is mostly based on hatchery returns, natural spawning populations within the Sacramento tributaries have fluctuated, but showed a steady decline in the past 10 years (Scriven *et al*. 2018). Viability information since the 2015 viability assessment has been incorporated into the analysis of this consultation and will be reflected in an updated 5-year status review in 2022. |
| Southern Distinct Population Segment (sDPS) of North American Green Sturgeon<br><br>Recovery Plan for the sDPS of North American Green Sturgeon<br>(NMFS 2018) | Threatened,<br>71 FR 17757<br>April 7, 2006 | According to the NMFS 5-year species status review (NMFS 2021) and the 2018 final recovery plan (NMFS 2018), some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers. Also, several habitat restoration actions have occurred in the Sacramento River Basin, and spawning was documented on the Feather and Yuba Rivers. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the only spawning location that is known to support the sDPS occurs in a single reach of the main stem Sacramento River. Current threats include poaching and habitat degradation. A recent method has been developed to estimate the annual spawning run and population size in the upper Sacramento River so species can be evaluated relative to recovery criteria (Mora *et al*. 2018). Although passage improvements have occurred at Fremont Weir and spawning events have been documented in the Feather and Yuba Rivers, no changes to the species status or threats are evident since the last review (NMFS 2021). |

**Table 3**. Description of Critical Habitat, Designation, and Status Summary.

| Critical Habitat | Designation Date and Federal Register Notice | Description |
|---|---|---|
| Central Valley (CV) spring-run Chinook salmon ESU | September 2, 2005; 70 FR 52488 | Critical habitat for CV spring-run Chinook salmon includes stream reaches of the Feather, Yuba and American Rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear Creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water mark. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation.<br>PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas.<br>Although the current conditions of PBFs for CV spring-run Chinook salmon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable. |
| California Central Valley (CCV) steelhead DPS | September 2, 2005; 70 FR 52488 | Critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba and American Rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear Creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation.<br>PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas.<br>Although the current conditions of PBFs for steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable. |
| sDPS of North American Green Sturgeon | October 9, 2009, 74 FR 52300 | Critical habitat includes the stream channels and waterways in the Delta to the ordinary high water line. Critical habitat also includes the main stem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Yuba River upstream to Daguerre Dam. Critical habitat in coastal marine areas include waters out to a depth of 60 fathoms, from Monterey Bay in California, to the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are included as critical habitat for sDPS green sturgeon.<br>PBFs considered essential to the conservation of the species for freshwater and estuarine habitats include: food resources, substrate type or size, water flow, water quality, migration corridor; water depth, sediment quality. In addition, PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas.<br>Although the current conditions of PBFs for sDPS green sturgeon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable. |

### 2.2.1 California Central Valley (CCV) Steelhead DPS

#### A. Life History

1. Egg to parr

Water temperature is a significant environmental variable in regard to the length of time required for CCV steelhead eggs to hatch. Steelhead eggs hatch in three to four weeks at 10° C (50° F) to 15° C (59° F) (Moyle 2002). After hatching, alevins remain in the gravel for an additional two to five weeks while absorbing their yolk sacs, and emerge in spring or early summer (Barnhart 1986). A compilation of data from multiple surveys has shown that steelhead prefer a range of substrate sizes between approximately 18 mm and 35 mm (Kondolf and Wolman 1993). Fry emerge from the gravel usually about four to six weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Coble (1961) noted a positive correlation exists between DO levels and flow within redd gravel, and Rombough (1988) observed a critical threshold for egg survival between 7.5 mg/L and 9.7 mg/L. Upon emergence, fry inhale air at the stream surface to fill their air bladders and absorb the remains of their yolks in the course of a few days. Fry begin exogenous feeding after these activities (Barnhart 1986, NMFS 1996).

The newly emerged juveniles move to shallow, protected areas within the stream margin (McEwan and Jackson 1996). This life stage is referred to as parr. As steelhead parr increase in size and their swimming abilities improve, they increasingly exhibit a preference for higher velocity and deeper mid-channel areas over shallow margin areas (Hartman 1965, Everest and Chapman 1972, Fontaine 1988). Growth rates have been shown to be variable and are dependent on local habitat conditions and seasonal climate patterns (Hayes *et al*. 2008).

In general, productive steelhead juvenile rearing habitat is characterized by complexity, primarily in the form of cover, which can be deep pools, woody debris, aquatic vegetation, or boulders. Adequate cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991). Optimal water temperatures for growth range from 15° C (59° F) to 20° C (68° F) (McCullough *et al*. 2001, Spina *et al*. 2006). Cherry *et al*. (1975) found preferred temperatures for rainbow trout ranged from 11° C (51.8° F) to 21° C (69.8° F) depending on acclimation temperatures (Myrick and Cech 2001) and food availability.

Juvenile steelhead (parr) rear in freshwater for one to three years before migrating to the ocean as smolts (Moyle 2002). The time parr spend in freshwater is inversely related to their growth rate, with faster-growing members of a cohort smolting and leaving at an earlier age but a smaller size (Peven *et al*. 1994, Seelbach 1993). Age at first maturity and the proportion of repeat spawners varies among populations; in the Central Valley, most steelhead return to their natal streams as adults at a total age of two to four years (Hallock *et al*. 1961, McEwan and Jackson 1996). Deer and Mill Creeks rotary screw traps monitoring (1994 to 2010) showed most silvery parr and smolts were caught in the spring months from March through May, while fry and parr peaked later in the spring (May and June) and were fairly common in the fall (October through December) as well (Johnson and Merrick 2012).

2. <u>Smolt migration</u>

Juvenile steelhead will often migrate downstream as parr in the summer or fall of their first year of life, but this is not a true smolt emigration (Loch *et al*. 1988). Smolt migrations occur in the late winter through spring, when juveniles have undergone a physiological transformation to survive in the ocean, and become slender in shape, bright silvery in coloration, with no visible parr marks. In contrast to the upper Sacramento River tributaries, Lower American River juvenile steelhead have been shown to smolt at a very large size (270 to 350 mm FL), and nearly all smolts were age-1 (Sogard *et al.* 2012). Emigrating steelhead smolts use the lower reaches of the Sacramento River and the Delta primarily as a migration corridor to the ocean. Some rearing behavior is thought to occur in tidal marshes, non-tidal freshwater marshes, and other shallow water habitats in the Delta prior to entering the ocean (NMFS 2014).

3. <u>Ocean behavior</u>

Unlike Pacific salmon, steelhead do not appear to form schools in the ocean (Behnke 1992). Steelhead in the southern part of their range appear to migrate close to the continental shelf, while more northern populations may migrate throughout the northern Pacific Ocean (Barnhart 1986). It is possible California steelhead may not migrate to the Gulf of Alaska region of the north Pacific as commonly as more northern populations such as those in Washington and British Columbia. Burgner (1993) reported no coded-wire tagged steelhead from California hatcheries were recovered from the open ocean surveys or fisheries that were sampled for steelhead between 1980 and 1988. Only a small number of disk-tagged fish from California were captured. Pearcy (1990) found the diets of juvenile steelhead caught in coastal waters of Oregon and Washington were highly diverse and included many species of insects, copepods, and amphipods, but by biomass the dominant prey items were small fishes (including rockfish and greenling) and euphausids.

4. <u>Spawning</u>

CCV steelhead generally enter freshwater from August to November (with the of the movement a peak in September (Hallock *et al*. 1961)), and spawn from December to April, with a peak in January through March, in rivers and streams where cold, well oxygenated water is available (Williams 2006; Hallock *et al*. 1961; McEwan and Jackson 1996). Timing of upstream migration is correlated with high flow events, such as freshets, and the associated change in water temperatures (Workman *et al*. 2002). Adults typically spend a few months in freshwater before spawning (Williams 2006), but very little is known about where they hold between entering freshwater and spawning in rivers and streams. Female steelhead construct redds in suitable gravel and cobble substrate, primarily in pool tailouts and heads of riffles. For more details on estimates for fecundity reference NMFS' October 17, 2017, Biological Opinion and references therein for the first renewal of the subject enhancement permit (Permit 16608-2R).

Unlike Pacific salmon, steelhead are iteroparous, meaning they are capable of spawning multiple times before death (Busby *et al*. 1996). However, it is rare for steelhead to spawn more than twice before dying; and repeat spawners tend to be biased towards females (Busby *et al*. 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al*. 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported repeat spawners were relatively numerous (17.2 percent) in Waddell Creek. Null *et al*. (2013) found between 36 percent and 48 percent of kelts released from Coleman National Fish Hatchery (Coleman NFH) in 2005 and 2006 survived to spawn the following spring, which is in sharp contrast to what Hallock (1989) reported for Coleman NFH in the 1971 season, where only 1.1 percent of adults were fish that had been tagged the previous year. Most populations have never been studied to determine the percentage of repeat spawners. Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider *et al*. 1986).

5. Kelts

Post-spawning steelhead (kelts) may migrate downstream to the ocean immediately after spawning, or they may spend several weeks holding in pools before outmigrating (Shapovalov and Taft 1954). Studies show kelts may remain in freshwater for an entire year after spawning (Teo *et al*. 2011), but that most return to the ocean (Null *et al*. 2013). The temporal occurrence of adult and juvenile CCV steelhead at various locations in the Central Valley region are described in NMFS' October 17, 2017, Biological Opinion and references therein (Table 2) for the first renewal of the subject enhancement permit (Permit 16608-2R).

**B. Description of Viable Salmonid Population Parameters**

As an approach to determining the conservation status of salmonids, NMFS developed a framework for identifying attributes of a viable salmonid population. The intent of this framework is to provide parties with the ability to assess the effects of management and conservation actions and ensure their actions promote the listed species' survival and recovery. This framework is known as the VSP concept (McElhany *et al.* 2000). The VSP concept measures population performance in terms of four key parameters: abundance, population growth rate, spatial structure, and diversity.

1. Abundance and productivity

For a discussion on the historical CCV steelhead run sizes reference NMFS' October 17, 2017, Biological Opinion and references therein for the first renewal of the subject enhancement permit (Permit 16608-2R).

Current abundance data is limited to returns to hatcheries and redd surveys conducted on a few rivers. The hatchery data is the most reliable as redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the CCV winter-spring spawning period. Two artificial propagation programs were listed as part of the DPS—Coleman National Fish Hatchery and Feather River Hatchery winter-run steelhead hatchery stocks. For details on fitness of naturally produced steelhead relative to hatchery fish including Coleman NFH operations on Battle Creek, redd counts in the American River and in Clear Creek, and historical returns of steelhead to the Feather River Hatchery reference NMFS' October 17, 2017, Biological Opinion for the first renewal of the subject enhancement permit (Permit 16608-2R).

Steelhead are present throughout most of the watersheds in the Central Valley, but often in low numbers, especially in the San Joaquin River tributaries, and population abundance data remain limited for this DPS. While the total hatchery populations have continued to increase in abundance in recent years, the state of natural-origin fish remains poor and largely unknown (SWFSC 2022). Investigators suggest current monitoring is insufficient for reliable estimates and argue a reallocation of monitoring resources will improve the overall understanding of the interaction between resident *O. mykiss* and listed steelhead; this interaction would provide better data to estimate the vital rates needed to evaluate the effects of recovery actions for the species (see Eschenroeder *et al*. 2022).

Recent expansions in monitoring, such as in the Yuba, Stanislaus, and Tuolumne Rivers and the San Joaquin River tributaries, have allowed several populations to be evaluated using viability criteria for the first time, and many show declines. Data collected through 2019 from the Chipps Island midwater trawl, which provides information on the trends in abundance for the DPS as a whole, indicate the production of natural-origin steelhead remains very low relative to the abundance of hatchery-origin steelhead (SWFSC 2022).

2. Spatial structure

About 80 percent of the historical spawning and rearing habitat once used by anadromous *O. mykiss* in the CV is now upstream of impassible dams (Lindley *et al*. 2006). Many historical populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the CCV steelhead DPS. Steelhead were found as far south as the Kings River (and possibly Kern River systems in wet years) (McEwan 2001). Native American groups such as the Chunut people have accounts of steelhead in the Tulare Basin (Latta 1977).

Steelhead are distributed throughout the CV below the major rim dams (Good *et al.* 2005, NMFS 2016). Zimmerman *et al.* (2009) used otolith microchemistry to show *O. mykiss* of anadromous parentage occur in all three major SJR tributaries, but at low levels, and these tributaries have a higher percentage of resident *O. mykiss* compared to the Sacramento River and its tributaries.

Monitoring detected low numbers of steelhead in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams previously thought to be devoid of steelhead (McEwan 2001). Recent monitoring efforts on the Stanislaus River, Tuolumne River, Merced River, and Dill and Mill Creeks[8], detected steelhead in low numbers (Starr and Day 2020, FISHBIO 2012, FISHBIO 2013a, FISHBIO 2013b, FISHBIO 2013c, CDFW 2013, 2021 Lower Tuolumne River Annual Report[9]). However, in other years monitoring using rotary screw traps failed to detect steelhead (S.P. Cramer & Associates 2000, Bradbury and Hickey 2019).

Implementation of CDFW's Steelhead Monitoring Program (Eilers *et al*. 2010[10]) began during the fall of 2015[11]. The low adult returns to the San Joaquin tributaries and the low numbers of juvenile emigrants typically captured suggest existing populations of CCV steelhead on the Tuolumne, Merced, and lower San Joaquin Rivers are severely depressed. The loss of these populations would significantly impact CCV steelhead spatial structure and further challenge the viability of the CCV steelhead DPS.

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[8] https://www.psmfc.org/steelhead/2018/CliffordT_MonitoringDistribution.pdf

[9] Turlock and Modesto Irrigation Districts, Project No. 2299 – Article 58 Annual Report for 2021. Accessed here: https://elibrary.ferc.gov/eLibrary/filelist?accession_number=20220331-5083&optimized=false

[10] Access document: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=25786

[11] Projects under the program began July 2015 under contract with Pacific States Marine Fisheries Commission and continued through March 2017.

3. <u>Diversity</u>

*a. Genetic Diversity:* CCV steelhead abundance and growth rates continue to decline, largely the result of a significant reduction in the amount and diversity of habitats available to these populations (Lindley *et al*. 2006). Reductions in population size are also supported by genetic analysis (Nielsen *et al*. 2003). Garza and Pearse (2008) analyzed the genetic relationships among CCV steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were often more closely related to below barrier fish from other watersheds than to *O. mykiss* above barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact above barriers, but may have been altered below barriers by stock transfers.

The genetic diversity of CCV steelhead is also compromised by hatchery origin fish, which likely comprise the majority of the annual spawning runs, placing the natural population at a higher risk of extinction (Lindley *et al*. 2007). There are four hatcheries (Coleman National Fish Hatchery, Feather River Fish Hatchery (FRFH), Nimbus Fish Hatchery, and Mokelumne River Fish Hatchery) in the Central Valley which combined release approximately 1.6 million yearling steelhead smolts each year. These programs are intended to mitigate the loss of steelhead habitat caused by dam construction. Today hatchery origin fish now appear to constitute a major proportion of the total abundance in the DPS. Two of these hatchery stocks (Nimbus and Mokelumne River hatcheries) originated from outside the DPS (primarily from the Eel and Mad Rivers) and therefore are not presently considered part of the CCV steelhead DPS.

*b. Life-History Diversity*: Steelhead in the Central Valley historically consisted of both summer-run and winter-run migratory forms, defined by their state of sexual maturity at the time of river entry and the duration of their time in freshwater before spawning.

Only winter-run (ocean maturing) steelhead currently are found in Central Valley rivers and streams (Moyle 2002, McEwan and Jackson 1996). Summer-run steelhead were extirpated due to a lack of suitable holding and staging habitat such as cold-water pools in the headwaters of Central Valley streams, presently upstream of impassible dams (Lindley *et al*. 2006).

4. <u>Summary of DPS viability</u>

All available information indicates natural CCV steelhead have continued to decrease in abundance over the past 25 years (Good *et al.* 2005, NMFS 2016). Hatchery production and returns are dominant over natural fish production and returns, and one of the four hatcheries is dominated by Eel/Mad River origin steelhead stock. Hatchery releases have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the past decade.

Although there have been recent restoration efforts in the SJR tributaries, CCV steelhead populations in the SJR and its tributaries continue to show an overall very low abundance, and fluctuating return rates. Lindley *et al*. (2007) developed viability criteria for Central Valley salmonids. Using data through 2005, Lindley *et al*. (2007) found data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

Widespread distribution of wild steelhead in the Central Valley would provide the spatial structure necessary for the DPS to survive and avoid localized catastrophes. However, most wild CCV populations are low in abundance and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change and drought. The genetic diversity of CCV steelhead has likely been impacted by low population abundance and high numbers of hatchery fish relative to wild fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

The most recent status review of the CCV steelhead DPS (NMFS 2016) found population status appears to have remained unchanged since the 2011 status review (NMFS 2011c). The lack of improved natural production as estimated by exit at Chipps Island, and low abundances coupled with large hatchery influence in the Southern Sierra Nevada diversity group, are cause for concern (SWFSC 2022). In addition to the major populations being reliant on hatchery supplementation, the influence of hatchery-origin steelhead, which are not part of the DPS also threaten the genetic diversity of this species. Nimbus Hatchery steelhead were founded from coastal steelhead populations, and continued introgression of strays from this program with natural-origin American River steelhead poses a risk to the CCV steelhead DPS (SWFSC 2022).

### 2.2.2 Central Valley spring-run Chinook salmon Evolutionarily Significant Unit (ESU)

#### A. Life History

1. <u>Adult migration and holding</u>

Chinook salmon runs are designated on the basis of adult migration timing. Adult CV spring-run Chinook salmon leave the ocean to begin their upstream migration in late January and early February (CDFG 1998) and enter the Sacramento River and tributaries (*e.g.*, Butte, Mill, Deer Creeks) in early spring (Yoshiyama *et al.* 1998, Lindley *et al.* 2004). Adult migration peaks around mid-April in Butte Creek, and mid- to end of May in Mill and Deer Creeks, and is complete by the end of July in all three tributaries ((Lindley *et al.* 2004)). Under historical, pre-dam conditions, CV spring-run Chinook salmon utilized mid- to high-elevation streams, which provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature (Yoshiyama *et al.* 1998).

During their upstream migration, adult Chinook salmon require stream flows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate stream flows are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 3º C (38º F) to 13º C (56º F) (Bell 1991, CDFG 1998). Boles (1988) recommends water temperatures below 18º C (65º F) for adult Chinook salmon migration, and Lindley *et al*. (2004) report adult migration is blocked when temperatures reach 21º C (70º F), while fish can become stressed as temperatures approach 21º C (70º F). Reclamation reports CV spring-run Chinook salmon holding in upper watershed locations prefer water temperatures below 15.6º C (60º F); salmon can tolerate temperatures up to 18º C (65º F) before they experience an increased susceptibility to disease (Williams 2006).

2. Adult spawning

CV spring-run Chinook salmon spawning occurs in September and October (Moyle 2002). Chinook salmon typically mature between 2 and 6 years of age (Myers *et al.* 1998), but primarily at age 3 (Fisher 1994). Between 56 and 87 percent of adult CV spring-run Chinook salmon entering the Sacramento River basin to spawn are 3 years old (Calkins *et al*. 1940, Fisher 1994). CV spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. The temporal occurrence of adult and juvenile CV spring-run Chinook salmon in the Sacramento River are described in NMFS' October 17, 2017, Biological Opinion and references therein for the first renewal of the subject enhancement permit (Permit 16608-2R).

CV spring-run Chinook salmon spawning typically occurs in gravel beds at the tails of holding pools (USFWS 1995, NMFS 2007). Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs, and suitable water temperatures, depths, and velocities for redd construction and adequate oxygenation of incubating eggs. The range of water depths and velocities in spawning beds Chinook salmon find acceptable is broad. Velocity typically ranging from 1.2 feet/second to 3.5 feet/second, and water depths greater than 0.5 feet (YCWA *et al*. 2007). The upper preferred water temperature for spawning Chinook salmon is 13º C to 14º C (55º F to 57º F) (Chambers 1956, Smith 1973, Bjornn and Reiser 1991, CDFG 2001). Chinook salmon are semelparous, meaning they spawn once and then die.

3. Eggs and fry incubation to emergence

The spring-run Chinook salmon embryo incubation period encompasses the time period from egg deposition through hatching, as well as the additional time while alevins remain in the gravel while absorbing their yolk sac prior to emergence. A compilation of data from multiple surveys has shown Chinook salmon prefer a range of substrate sizes between approximately 22 mm and 48 mm (Kondolf and Wolman 1993). The length of time for spring-run Chinook salmon embryos to develop depends largely on dissolved oxygen and water temperatures as discussed below.

Incubating eggs are vulnerable to adverse effects from floods, siltation, desiccation, disease, predation, poor gravel permeability, and poor water quality. Studies of Chinook salmon egg survival to emergence conducted by Shelton (1955) indicated 87 percent of fry emerged successfully from large gravel with adequate subgravel flow. Incubating eggs require sufficient concentrations of dissolved oxygen. (Coble 1961) noted a positive correlation exists between dissolved oxygen (DO) levels and flow within redd gravel, and Geist *et al*. (2006) observed an emergence delay of 6-10 days at 4 mg/L DO relative to water with complete oxygen saturation.

Colder water necessitates longer development times as metabolic processes are slowed. In well-oxygenated intergravel environs where water temperatures range from about 5 to 14º C (41 to 55.4º F) embryos hatch in 40 to 60 days and remain in the gravel as alevins for another 4 to 6 weeks, usually after the yolk sac is fully absorbed (NMFS 1997, Rich 1997, Moyle 2002, NMFS 2014). A significant reduction in egg viability occurs at water temperatures above 14º C (57.5º F) and total embryo mortality can occur at temperatures above 17º C (62º F) (NMFS 1997). Alderdice and Velsen (1978) found the upper and lower temperatures resulting in 50 percent pre-hatch mortality were 16º C and 3º C (61º F and 37º F), respectively, when the incubation temperature was held constant. As water temperatures increase, the rate of embryo malformations also increases, as well as the susceptibility to fungus and bacterial infestations.

During the 4 to 6-week period when alevins remain in the gravel, they utilize their yolk-sac to nourish their bodies. As their yolk-sac is depleted, fry begin to emerge from the gravel to begin exogenous feeding in their natal stream. Newly emerged fry disperse to the margins of their natal stream between November through March (Moyle 2002), seeking out shallow waters with slower currents, finer sediments, and bank cover and begin feeding on zooplankton, small insects, and small invertebrates. Some fry may take up residence in their natal stream for several weeks to a year or more while others migrate downstream to suitable habitat. Once started downstream, fry may continue downstream to the estuary and rear or may take up residence in river reaches farther downstream for a period of time ranging from weeks to a year (Healey 1991).

4. Juvenile rearing and outmigration

Once juveniles emerge from the gravel, they initially seek areas of shallow water and low velocities while they finish absorbing the yolk sac and transition to exogenous feeding (Moyle 2002). Many also will disperse downstream during high-flow events. As is the case in other salmonids, there is a shift in microhabitat use by juveniles to deeper, faster water as they grow larger. Microhabitat use can be influenced by the presence of predators which can force fish to select areas of heavy cover and suppress foraging in open areas (Moyle 2002).

When juvenile Chinook salmon reach a length of 50 mm to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures. In the mainstems of larger rivers, juveniles tend to migrate along the margins and avoid the elevated water velocities found in the thalweg of the channel. Migration cues, such as increasing turbidity from runoff, increased flows, changes in day length, or intraspecific competition from other fish in their natal streams may spur outmigration of juveniles when they reach the appropriate stage of development (Kjelson *et al.* 1982, Brandes and McLain 2001). Juvenile Chinook salmon migration rates vary considerably depending on the physiological stage of the juvenile and hydrologic conditions (see Cordoleani *et al*. 2018). Kjelson *et al.* (1982) found Chinook salmon fry travel as fast as 30 km per day in the Sacramento River.

Emigration occurs from November through May (CDFG 1998, Snider and Titus 2000). Studies in Butte Creek (Ward *et al.* 2003, McReynolds *et al.* 2007) found the majority of CV spring-run Chinook salmon migrants to be fry, which emigrated primarily during December, January, and February; these movements appeared to be influenced by increased flow. Small numbers of CV spring-run Chinook salmon were observed to remain in Butte Creek to rear and migrated as yearlings later in the spring. Juvenile emigration patterns in Mill and Deer Creeks are very similar to patterns observed in Butte Creek, with the exception of Mill and Deer Creek juveniles typically exhibit a later young-of-the-year migration and an earlier yearling migration (Lindley *et al.* 2004, Cordoleani *et al*. 2018).

5. Estuarine rearing

Within the estuarine habitat, juvenile Chinook salmon movements are dictated by the tidal cycles, following the rising tide into shallow water habitats from the deeper main channels and returning to the main channels when the tide recedes (Levings 1982, Levings *et al*. 1986, Healey

1991). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs following the tides into shallow water habitats to feed (Allen and Hassler 1986). Available data indicate juvenile Chinook salmon use Suisun Marsh extensively both as a migratory pathway and rearing area as they move downstream to the Pacific Ocean (Aha *et al*. 2021).

6. Ocean rearing

Once in the ocean, juvenile Chinook salmon tend to stay along the California Coast (Moyle 2002). This is likely due to the high ocean productivity close to shore caused by the upwelling of the California Current. These food-rich waters are important to Chinook salmon ocean survival, as indicated by a decline in survival during years when the current does not flow as strongly and upwelling decreases (Moyle 2002, Lindley *et al.* 2009). After entering the ocean, juveniles become voracious predators of small fish and crustaceans, and invertebrates such as crab larvae and amphipods. As they grow larger, fish increasingly dominate their diet. They typically feed on whatever pelagic plankton is most abundant, usually herring, anchovies, juvenile rockfish, and sardines.

The ocean stage of the Chinook life cycle lasts one to five years. Information on salmon abundance and distribution in the ocean is based upon coded wire tag (CWT) recoveries from ocean fisheries. CWT returns indicate Sacramento River Chinook salmon congregate off the California coast between Point Arena and Morro Bay.

**B. Description of VSP parameters**

As an approach to evaluate the likelihood of viability of the CV spring-run Chinook salmon ESU, and determine the extinction risk of the ESU, NMFS uses the VSP concept. In this section, we evaluate the VSP parameters of abundance, productivity, spatial structure, and diversity. These specific parameters are important to consider because they are predictors of extinction risk, and the parameters reflect general biological and ecological processes critical to the growth and survival of salmon (McElhany *et al.* 2000).

1. Abundance and Productivity

The historical San Joaquin River salmon runs were the most southerly, regularly occurring large populations of chinook salmon in North America, and they possibly were distinctly adapted to the demanding environmental regime of the southern Central Valley (Brown 2001). The Central Valley drainage as a whole is estimated to have supported CV spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). CV spring-run Chinook salmon were originally most abundant in the SJR and its tributaries where the run ascended to high-elevation streams fed by snow-melt where they over-summered until the fall spawning season (Yoshiyama *et al*. 1996, Brown 2001). CV spring-run occupied the upper and middle elevation reaches (1,000 to 6,000 feet) of the San Joaquin and Sacramento River tributaries (Stone 1872, Rutter 1904, Clark 1929). Construction of Friant Dam on the SJR began in 1939, and when completed in 1942, blocked access to all upstream habitat.

For past trends of FRFH CV spring-run Chinook salmon, specifically, the number of juvenile adipose-clipped individuals released, please reference NMFS' October 17, 2017, Biological

Opinion and references therein for the first renewal of the subject enhancement permit (Permit 16608-2R). The collection of most recent yearly juvenile releases (2017-2022) at the hatchery can be seen here: https://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/SacramentoValleyTributaryMonitoring/FeatherRiverFishHatchery.aspx.

Returns of adult CV spring-run Chinook salmon in the Feather River increased following the extreme drought years, from a low of 762 in 2017 to over 7,200 adults in 2018, and preliminary data suggest 2019 adult returns may be nearly twice that of 2018 (Azat 2021). The majority of adults (96%) spawning in the Feather River (2015-2019) are of hatchery origin (Palmer-Zwahlen *et al*. 2019 and 2020, Letvin *et al*. 2020, 2021a, and 2021b). The remainder of the Feather River adults in addition to all other populations estimated for this ESU resulted in the estimate of 6,756 natural-origin adults annually, based on the three-year averages (SWFSC 2022).

CV spring-run Chinook salmon Sacramento River tributary populations in Mill, Deer, and Butte Creeks are likely the best trend indicators for the CV spring-run Chinook salmon ESU as a whole because these streams contain the majority of the abundance, and are currently the only independent populations within the ESU. Generally, annual abundance estimates display a high level of fluctuation, and the overall number of CV spring-run Chinook salmon remain well below estimates of historical abundance (SWFSC 2022).

In 2021, a total of 13,899, mortalities were documented during the pre-spawn mortality survey in Butte Creek; the magnitude of pre-spawn mortalities was significant given the adult returning cohort was estimated at over 21,580 (Nichols 2022). The density of the population in the upper reaches of the holding habitat likely exacerbated the spread of pathogen transmission and contributed to the rapid spike in pre-spawn mortality.

Some other tributaries to the Sacramento River, such as Clear Creek and Battle Creek, have seen modest population gains from 2001 to 2021(Garman 2019, Azat 2021). For past trends of adult escapement for CV spring-run Chinook salmon, please reference NMFS' October 17, 2017, Biological Opinion and references therein for the first renewal of the subject enhancement permit (Permit 16608-2R).

In the absence of numeric abundance targets, cohort replacement rates (CRR) are indications of whether a cohort is replacing itself in the next generation. For past cohort replacement rates for CV spring-run Chinook salmon, please reference NMFS' October 17, 2017, Biological Opinion and references therein for the first renewal of the subject enhancement permit (Permit 16608-2R). For recent population estimates, reference CFDW Grandtab 2022 (Azat 2021).

Juvenile releases for the NEP population of CV spring-run Chinook salmon into the San Joaquin River have steadily increased from 89, 850, in 2017 to 243, 059 in 2020 (NMFS 2016, 2019, 2020; SJRRP 2020). For the SJRRP NEP, it is possible some of the experimental hatchery fish released in previous years will return to spawn this year. In 2018, a total of 30 Program spring-run Chinook salmon were caught in the ocean fishery (see NMFS 2020).

All populations of CV spring-run Chinook salmon continue to decline in abundance, with the exception of two dependent populations (SWFSC 2022). The total abundance (hatchery- and natural-origin spawners) of CV spring-run Chinook salmon in the Sacramento River basin in

2019 was approximately half of the population size in 2014 and close to the decadal lows that occurred as recently as the last two years (Azat 2020). The Butte Creek spring-run population has become the backbone of this ESU, in part due to extensive habitat restoration and the accessibility of floodplain habitat in the Butte Sink and the Sutter Bypass for juvenile rearing in the majority of years. Butte Creek remains at low risk, yet all viability metrics for the ESU have been trending in a negative direction in recent years (SWFSC 2022). Most dependent spring-run populations have been experiencing continued and, in some cases, drastic declines (SWFSC 2022).

2. Spatial structure

The Central Valley Technical Review Team estimated there were 18 or 19 independent populations of CV spring-run Chinook salmon, along with a number of dependent populations, all within four distinct geographic regions, or diversity groups under historical conditions (Lindley *et al.* 2004; see Figure 3-2, page 70 in NMFS 2014). Of these populations, three independent populations persist (Mill, Deer, and Butte Creeks) in the Northern Sierra Nevada Diversity Group (SWFSC 2022). Reappearance of CV spring-run Chinook salmon in the San Joaquin River tributaries is anticipated by NMFS to be the beginning of natural dispersal processes into rivers where they were extirpated. Planned reintroduction efforts on the Yuba River, upstream of Shasta and Oroville Dams and downstream of Friant Dam, when fish-passage projects are complete would improve the viability of this ESU.

With one of four diversity groups currently containing viable independent populations, the spatial structure of CV spring-run Chinook salmon is reduced.

As noted above, a NEP population of CV spring-run Chinook salmon was designated to authorize reintroduction downstream of Friant Dam for the SJRRP (78 FR 79622; December 31, 2013). Annual releases of juvenile CV spring-run Chinook salmon have occurred each year beginning in 2014 (SWFSC 2022). Since the 2017-18 monitoring period, genetic-based evidence of CV spring-run Chinook salmon presence has been detected suggesting the first volitionally-returning spring-run Chinook salmon to the study area.

Surveys in 2017 revealed 13 CV spring-run chinook salmon redds (McKenzie *et al*. 2018). During the 2017-2018 monitoring period (Hutcherson *et al*. 2018), early in the season, fry were predominately captured at upstream RSTs. Since 2017, presence of CV spring-run Chinook salmon has been detected on the San Joaquin River (NMFS 2019). Consequently, for the first time since Program inception, natural production occurred in the San Joaquin River (Durkacz *et al*. 2019, NMFS 2020).

In April 2019, CV spring-run Chinook salmon successfully spawned in Reach 1 of the study area (SJRRP 2020). A total of 19 returning adult spring-run Chinook salmon were successfully captured and transported from Reach 5 into Reach 1 in good condition (NMFS 2020). By the time the 2019 migration season was over and spawning season ended, 209 redds were detected (SJRRP 2020). See Table 3 for a summary of fish counts in the SJRRP study area in 2019-2020. Available information indicates the Program's returns are beginning to be representative of a natural population which would contain multiple generations of fish that made it out as juveniles in both hydrologically wetter (2017) and drier (2016) years.

**Table 3**. Fish Counts for 2019 and 2020 (see SJRRP 2020).

| Activity | 2019 | 2020 |
|---|---|---|
| **Juvenile spring-run released** | 211,025 | 243,059 |
| **Yearling spring-run released** | 10,451 | 5,094 |
| **Excess broodstock released (adult, Reach 1)** | 114 | 285 |
| **Spring-run trap and haul** | 23 | 57 |
| **Spring-run adult trap and haul released Reach 1** | 20 | 48 |
| **Estimated total spawning spring-run adult** | 418+ | 333 |
| **Carcasses recovered** | 168 | 48 |

Surveys (Kennedy and Cannon 2005) conducted between October 2002 to October 2004 on the Stanislaus River identified adults in June 2003 and 2004, as well as fry in December of 2003, indicating the presence of CV spring-run Chinook salmon. In addition, monitoring on the Stanislaus River since 2003 and on the Tuolumne River since 2009, has indicated upstream migration of adult CV spring-run Chinook salmon (Anderson *et al.* 2007), and 114 adult were counted on the video weir on the Stanislaus River between February and June in 2013 with only seven individuals without adipose fins (FISHBIO 2015). Finally, rotary screw trap (RST) data provided by USFWS corroborates the CV spring-run Chinook salmon adult timing, by indicating there are a small number of fry migrating out of the Stanislaus and Tuolumne Rivers at a period coinciding with CV spring-run juvenile emigration (Franks 2014). Although there have been observations of springtime running Chinook salmon returning to the SJR tributaries in recent years, there is insufficient information to determine the specific origin of these fish, and whether or not they are straying into the basin or returning to natal streams. Genetic assessment or natal stream analyses oftissues will inform our understanding of the relationship of these fish to the ESU.

Lindley *et al.* (2007) described a general criteria for "representation and redundancy" of spatial structure, which was for each diversity group to have at least two viable populations. More specific recovery criteria for the spatial structure of each diversity group have been laid out in NMFS' Recovery Plan (NMFS 2014). According to the criteria, one viable population in the Northwestern California Diversity Group, two viable populations in the Basalt and Porous Lava Diversity Group, four viable populations in the Northern Sierra Nevada Diversity Group, and two viable populations in the Southern Sierra Nevada Diversity Group, in addition to maintaining dependent populations are needed for recovery. Additional efforts, particularly reintroduction of CV spring-run Chinook salmon to high quality habitats upstream of impassable dams, are needed to make the ESU viable.

3. <u>Diversity</u>

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

The CV spring-run Chinook salmon ESU comprises two genetic complexes. Analysis of natural and hatchery CV spring-run Chinook salmon stocks in the Central Valley indicates the Northern Sierra Nevada Diversity Group in Mill, Deer, and Butte Creeks have retained greater genetic integrity relative to the Feather River population. The Feather River CV spring-run Chinook salmon have introgressed with the Feather River fall-run Chinook salmon, and it appears that the Yuba River CV spring-run Chinook salmon population may have been impacted by FRFH fish straying into the Yuba River (and likely introgression with wild Yuba River fall-run has occurred). Diversity of the CV spring-run Chinook salmon ESU has been further reduced with the loss of the majority if not all of the SJR CV spring-run Chinook salmon populations. Significant efforts as outlined in NMFS' Recovery Plan (NMFS 2014) are necessary to improve the diversity of the CV spring-run Chinook salmon population.

4. Summary of ESU viability

The NMFS' Southwest Fisheries Science Center – Santa Cruz (SWFSC) concluded status of CV spring-run Chinook salmon ESU has probably deteriorated since the 2005 status review and its extinction risk increased (Williams *et al.* 2011). More recently, the SWFSC concluded the status of CV spring-run Chinook salmon (through 2014) has probably improved since the 2010/2011 status review and the ESU's extinction risk may have decreased, however the ESU is still facing significant extinction risk, and that risk is likely to increase over at least the next few years as the full effects of the recent drought are realized (Williams *et al*. 2016). Investigators conclude further loss of phenotypic diversity will have critical impacts on population persistence in a warming climate (see Cordoleani *et al*. 2021). As water temperatures rise due to ongoing drought conditions and climate change, CDFW anticipates the spatial distribution of holding populations will shrink within the coolest reaches, consequently, increasing the potential for larger pathogen outbreaks and mortality events in future years (Nichols 2022).

### 2.2.3 sDPS of North American Green Sturgeon

#### A. Life History

Green sturgeon are known to range from Baja California to the Bering Sea along the North American continental shelf. During late summer and early fall, subadults and non-spawning adult green sturgeon can frequently be found aggregating in estuaries along the Pacific coast (Emmett *et al*. 1991, Moser and Lindley 2007). Using polyploid microsatellite data, Israel *et al*. (2009) found green sturgeon within the Central Valley belong to the sDPS of North American green sturgeon. Additionally, acoustic tagging studies have shown the species spawning within the Sacramento River are exclusively the sDPS of North American green sturgeon (Lindley *et al*. 2011, Colborne *et al*. 2022). In waters inland from the Golden Gate Bridge in California, the species is known to range through the estuary and the Delta and up the Sacramento, Feather, and Yuba Rivers (Israel *et al*. 2009, Cramer Fish Sciences 2011, Seesholtz *et al*. 2014, Miller *et al*. 2020). Green sturgeon may use areas of the San Joaquin River upriver of the Delta, however spawning events are currently thought to be limited to the upper Sacramento River and its tributaries. There is no known modern usage of the upper San Joaquin River by green sturgeon, and adult spawning has not been documented there (Jackson and Van Eenennaarn 2013).

However, on April 11, 2020, an adult green sturgeon was captured in a fyke trap at the Hills Ferry Barrier during SJRRP steelhead monitoring activities in the San Joaquin River (Root *et al*. 2020).

Research indicates the sDPS is composed of a single, independent population, which principally spawns in the mainstem Sacramento River and also breeds opportunistically in the Feather River and possibly the Yuba River (Beamesderfer et al. 2004, Cramer Fish Sciences 2011, Seesholtz *et al*. 2014). Concentration of adults into a very few select spawning locations makes the species highly vulnerable to poaching and catastrophic events. The apparent, but unconfirmed, extirpation of spawning populations from the San Joaquin River narrows the available habitat within their range, offering fewer habitat alternatives.

Successful spawning of green sturgeon in other accessible habitats in the Central Valley (*i.e.*, the Feather River) is limited, in part, by late spring and summer water temperatures (NMFS 2015, 2021). Similar to salmonids in the Central Valley, green sturgeon spawning in tributaries to the Sacramento River is likely to be further limited if water temperatures increase and higher elevation habitats remain inaccessible. Additionally, investigators documented distinct out-migration periods between subsequent spawning migration events (see Colborne *et al*. 2022).

## B. Description of sDPS of North American Green Sturgeon Viability

1. <u>Population Abundance</u>

The viability of the sDPS of North American green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into a few locations. The risk of extinction is believed to be moderate. Although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2021). The SWFSC recently updated the total population estimate to 17,723 reproductive adults (Dudley 2021).

In general, the sDPS of North American green sturgeon year class strength appears to be highly variable with overall abundance dependent upon a few successful spawning events (NMFS 2010, Ulaski and Quist 2021). Survey results (Mora *et al*. 2015) estimate an average annual spawning run of 223 (using dual-frequency identification sonar (DIDSON) and 236 (using telemetry) fish. This estimate does not include the number of spawning adults in the lower Feather or Yuba Rivers, where green sturgeon spawning was confirmed (Seesholtz *et al*. 2014). Annual spawner count estimates in the upper Sacramento River from 2010 to 2019 found the sDPS only met the spawner demographic recovery criterion (*i.e.*, spawning population size of at least 500 individuals in any given year) in one of those years (NMFS 2021).

Two long-term data sources estimate trends in abundance for the species: (1) salvage numbers at the state and federal pumping facilities (CDFW 2017), and (2) by incidental catch of green sturgeon by the CDFW's white sturgeon sampling/tagging program (DuBois and Harris 2015). Historical estimates from these sources are likely unreliable because the sDPS was likely not considered in incidental catch data, and salvage does not capture rangewide abundance in all water year types. A decrease in the abundance has been inferred from the amount of take observed at the south Delta pumping facilities, the Skinner Delta Fish Protection Facility, and the

Tracy Fish Collection Facility. These data should be interpreted with some caution because operations and practices at the facilities have changed over the project lifetime, which may affect salvage data. These data likely indicate a high production year versus a low production year qualitatively, but cannot be used to rigorously quantify abundance.

2. Spatial Structure

Miller *et a*l. (2020) recorded adult and subadult presence year-round in the Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, and Central San Francisco Bay, although spawning adults often use the area as a migration corridor, passing through within a few days of entering. These adults migrate into the Sacramento River to spawn, although small numbers of adults have also been observed in the Yuba and Feather Rivers and San Joaquin River (NMFS 2021). Removal of the RBDD barrier allowed the species to freely access a larger area of the Sacramento River compared to when RBDD was operating in 2011 (NMFS 2021).

The Anderson-Cottonwood Irrigation District Diversion Dam (ACID) is the current upriver extent of green sturgeon passage in the Sacramento River (71 FR 17757; April 7, 2006). The upriver extent of green sturgeon spawning, however, is approximately 30 kilometers downriver of ACID where water temperature is higher during late spring and summer (Heublein *et al*. 2009). Thus, if water temperatures increase with climate change, temperatures adjacent to ACID may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected. It is uncertain, however, if green sturgeon spawning habitat exists closer to ACID, which could allow spawning to shift upstream in response to climate change.

Spawning was confirmed in the Feather and Yuba Rivers during years with higher flow (Seesholtz *et al*. 2015, Beccio 2018, 2019). An adult green sturgeon was observed in a pool on the Stanislaus River (near Oakdale) during October 2017, which was confirmed by NMFS and other fisheries agencies (Anderson *et al*. 2018). On April 11, 2020, an adult green sturgeon was captured in a fyke trap at the Hills Ferry Barrier along the mainstem of the San Joaquin River during SJRRP steelhead monitoring activities (Root *et al*. 2020); the fish was documented during the spawning period for sDPS of North American green sturgeon, thus monitoring efforts for green sturgeon within the SJR should be increased to further understand their habitat extent (NMFS 2021).

3. Diversity

Whether the sDPS displays diverse phenotypic traits, such as ocean behavior, age at maturity, and fecundity, or if there is sufficient diversity to buffer against long-term extinction risk is not well understood. It is likely the diversity of the sDPS is low, given recent abundance estimates (NMFS 2015, Mora *et al*. 2018, NMFS 2021). Investigators provided an analysis of archived fin rays and revealed highly variable growth among individuals (see Ulaski and Quist 2021). Recent observations show a difference in the holding areas occupied by the species during any given sampling year, thus, there is temporal and spatial variation in the holding areas occupied by green sturgeon within the Sacramento River (NMFS 2021).

4. Summary of sDPS viability

Ultimately, the most critical biological needs of the sDPS are unobstructed passage, functional spawning and rearing habitat with appropriate water flow and temperature regimes, minimal risk of entrainment, take (*e.g.*, poaching, stranding, fisheries bycatch), and enhanced understanding of the impacts of contaminants and climate change (NMFS 2018). New research documents spawning by green sturgeon in the Feather and Yuba Rivers multiple years, although it is periodic, and not continuous as required to meet the recovery criterion for continuous spawning for populations in these rivers (NMFS 2021). Given the limited number of occurrences and lack of consistent successful spawning events in additional spawning locations, the limited spatial distribution of spawning continues to make this DPS vulnerable. The species continues to face multiple stressors, and their extinction risk associated with global change is poorly understood, thus current research needs include estimating natural mortality, monitoring year-class strength and recruitment, and assessing trends in population abundance (Ulaski and Quist 2021).

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley, and aquatic habitat at large, is climate change (see Herbold *et al*. 2018).

Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al.* 2000, Crozier *et al*. 2019). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). An altered seasonality results in runoff events occurring earlier in the year due to a shift in precipitation falling as rain rather than snow (Roos 1991, Dettinger *et al.* 2004). Specifically, the Sacramento River basin annual runoff amount for April-July has been decreasing since about 1950 (Roos 1991). Increased temperatures influence the timing and magnitude patterns of the hydrograph. The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases, which rapidly melt spring snowpack (VanRheenen *et al.* 2004). Factors modeled by VanRheenen *et al*. (2004) show the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100% in shallow snowpack areas). Additionally, an air temperature increase of 2.1° C (3.8° F) is expected to result in a loss of about half of the average April snowpack storage (VanRheenen *et al*. 2004). The decrease in spring SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the Central Valley, where snowpack is shallower than in the SJR watersheds to the south.

Projected warming is expected to affect CV spring-run Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5° C (9° F), it is questionable whether CV spring-run Chinook salmon populations can persist (Williams 2006, Crozier *et al*. 2019) absent reintroduction actions into areas with coldwater upstream of barrier dams. Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951- 1980, the most plausible projection for warming over Northern California is 2.5° C (4.5° F) by 2050 and 5° C by 2100, with a modest decrease in precipitation (Dettinger 2005). Chinook salmon in the Central Valley are at the southern limit of their range, and warming will shorten the period in which the low elevation habitats are thermally acceptable. This would particularly affect fish emigrating as fingerlings, mainly in

May and June, and especially those in the San Joaquin River and its tributaries (see Munsch *et al*. 2019).

Adult CV spring-run Chinook salmon are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson *et al.* 2011). CV spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in the natal stream for one to two summers prior to emigrating, and would be susceptible to warming water temperatures. In Butte Creek, fish are limited to low elevation habitat currently thermally marginal, as demonstrated by high summer mortality of adults in 2002, 2003, and 2021, and will become intolerable if the climate warms as expected. Ceasing water diversion for power production from the summer holding reach in Butte Creek resulted in cooler water temperatures, more adults surviving to spawn, and extended population survival time (Mosser *et al.* 2013).

Although CCV steelhead will experience similar effects of climate change to CV spring-run Chinook salmon because they are also blocked from the majority of their historical spawning and rearing habitat, the effects may be even greater in some cases. Impacts may be greater because juvenile CCV steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures downstream of dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14° C to 19° C (57° F to 66° F). Steelhead require colder water temperatures for spawning and embryo incubation relative to salmon (McCullough *et al.* 2001). In fact, McCullough *et al*. (2001) recommended an optimal incubation temperature at or below 11° C to 13° C (52° F to 55° F). Successful smoltification in steelhead may be impaired by temperatures above 12° C (54° F) as reported in Richter and Kolmes (2005). As stream temperatures warm due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but potentially at the expense of decreased survival due to higher metabolic demands and increased presence and activity of predatory fish. Stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild CCV steelhead populations. Investigators evaluated outmigration survival through the Sacramento–San Joaquin River Delta, and ultimately suggested hydrodynamic manipulation and habitat improvements to support juvenile CCV steelhead in a changing climate (see Buchanan *et al*. 2021).

Key climate factors for the sDPS of North American green sturgeon include water temperature, timing of snowmelt and runoff, altered streamflow regimes, and drought. Water temperature regulates spawning and larval development and survival. Runoff timing and altered streamflow regimes also influence spawning timing and estuarine conditions, impacting recruitment and foraging. Drought can exacerbate warm stream temperatures and low flow conditions (CVLCP 2017). Investigators recommend mitigating salt intrusion in nursery habitats and maintaining water temperatures within optimal ranges during peak spawning periods in an effort to reverse abundance declines within the species population (Rodgers *et al*. 2019).

In summary, observed and predicted climate change effects are generally detrimental to anadromous fish species (Crozier *et al*. 2019; 2021) so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure *et al*. 2013). Creative and big solutions are needed to recover listed species and investigators call for examining conservation options to sustain salmonids in an era of change (Kocik *et al*. 2022).

## 2.3 Action Area

"Action area" means all areas directly or indirectly affected by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The proposed study area as described by Reclamation includes where monitoring efforts will occur within a portion of the SJRRP's Restoration Area.

In 2006 a settlement was reached between the Natural Resources Defense Council, Friant Water Users Authority and the U.S. Departments of the Interior and Commerce to establish a restoration plan for roughly 124 miles of the San Joaquin River downstream of Friant Dam. The proposed action area begins at Mendota Dam, roughly 50 miles downstream of Friant Dam, thus the action area is only a portion of the SJRRP's Restoration Area. The action area is from the base of Mendota Dam and downstream to the confluence of the Merced River, including select locations on the Mariposa and Eastside bypasses, and the entrances to the following off-channel sloughs: Mud Slough, Salt Slough, and Newman Wasteway. All monitoring sites lie within the Middle San Joaquin-Lower Stream hydrologic unit code (HUC), Mile 182.0 to mile 118.0. Reference Reclamation's map, which includes the boundaries of the action area: https://www.fisheries.noaa.gov/west-coast/habitat-conservation/san-joaquin-river-restoration.

Mendota Dam is the upstream extent of the action area because it is impassable by CCV steelhead and the sDPS of North American green sturgeon in most water year types. Downstream of the Merced River confluence is the southern extent of the action area because the SJRRP Restoration Flows may attract CCV steelhead into the Restoration Area prior to completion of habitat improvements and measures to obscure false migratory pathways, and attracted fish would not have access to spawning habitat due to impassable barriers. Consequently, the downstream end of the action area (Merced River confluence with the San Joaquin River) is the first, available site for relocating CCV steelhead so they can subsequently find suitable habitat for migration, spawning, and rearing.

## 2.4 Environmental Baseline

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

*Recovery Plan*. The action area has been subject to the San Joaquin River Stipulation of Settlement, which formed the SJRRP. NMFS' recovery plan for Central Valley Chinook salmon and steelhead (NMFS 2014) includes recovery actions for the action area, which focus on providing fish passage at existing structures as outlined in the San Joaquin River Stipulation of Settlement (available at http://restoresjr.net/) including: (1) modifications to the Sand Slough Control Structure; (2) modification of the Reach 4B head gate; (3) reconstruction of Sack Dam to ensure unimpeded fish passage; (4) construction of a Mendota Pool Bypass; (5) modifications to structures in the Eastside and Mariposa Bypasses channels; and (6) fixing other passage impediments including but not limited to road crossings and drop structures. Currently, none of these improvements have been completed.

*Past Enhancement.* Between December 1 and April 30, in 2019 and 2020, Reclamation conducted a steelhead monitoring and detection plan in the Restoration Area using electrofishing, fyke traps, and trammel nets (2020 only); no CCV steelhead were detected in either year (Root and Sutphin 2020). For the seventh consecutive monitoring effort (2012-2020) since the inception of the SMP, no steelhead were detected.

*Planned Research.* Scientific research and monitoring activities have the potential to adversely affect the species' survival and recovery by killing listed salmonids and southern green sturgeon. Several dozen section 10(a)(1)(A) scientific research permits are in effect in California that authorize lethal and non-lethal take of listed species. In addition, NMFS has also re-authorized the California state scientific research programs under ESA section 4(d). The table below displays the total take NMFS authorized for ongoing research under the ESA sections 10(a)(1)(A) and 4(d) (Table 4).

**Table 4.** Total expected take of salmon and steelhead for scientific research and monitoring in 2022.

| **DPS/ESU and Origin** | **Adults Handled** | **Adults Killed** | **Juveniles Handled** | **Juveniles Killed** |
|---|---|---|---|---|
| **CV spring-run Chinook salmon: Natural** | 1,624 | 28 | 845,961 | 17,494 |
| **CV spring-run Chinook salmon: Listed Hatchery Adipose Clip** | 739 | 87 | 32,234 | 3,966 |
| **CCV Steelhead: Natural** | 3,411 | 117 | 68,936 | 1,988 |
| **CCV Steelhead: Listed Hatchery Adipose Clip** | 2,513 | 203 | 27,695 | 1,808 |
| **sDPS of North American green sturgeon: Natural** | 346 | 9 | 6,549 | 190 |

Actual take levels associated with these activities are almost certainly lower than the authorized levels. There are two reasons for this. First, most researchers do not handle or kill the full number of juveniles (or adults) they are allowed. Second, the estimates of mortality for each proposed study are purposefully inflated to account for potential accidental deaths and it is therefore very likely that fewer fish—especially juveniles—would be killed during any given research project than the researchers are allotted, in some cases many fewer.

The environmental baseline is the result of the impacts that many activities (summarized below) have had on the various listed species' survival and recovery. It is also the result of the effects that climate change has had in the region (see Section 2.2.3 for discussion). Many of the past and present impacts on the species themselves (effects on abundance, productivity, etc.) are included in the Status of the Species section (see Section 2.2).

### 2.4.1 Status of the Species in the Action Area

2.4.1.1 Status of CCV steelhead

Historical abundance of CCV steelhead in the action area is difficult to determine, but CCV steelhead were once widely distributed (McEwan 2001). If CCV steelhead are currently present in the action area, then the likelihood of survival would be low because current conditions do not reliably provide suitable rearing or migratory habitat.

CCV steelhead have been captured in the three main tributaries of the SJR: the Stanislaus, Tuolumne, and Merced Rivers. However, they likely do not currently occur in the SJR mainstem upstream of the lower terminus of Reach 5 (as defined by the SJRRP) within the action area (Eilers *et al.* 2010). Monitoring results in 2012, 2013, and 2014 failed to detect CCV steelhead in the action area, indicating they have been extirpated from all reaches of the action area and the SJRRP Restoration Area (SJRRP 2012). However, CCV steelhead are capable of accessing Reach 1 (outside of the action area) during flood conditions when the river or bypasses flow continuously from Friant Dam to the Merced River confluence. Monitoring would continue in the action area as part of the CCV Steelhead Monitoring Plan (SJRRP 2015) but Reclamation is not responsible for flood flows, therefore access to areas available during flood flows are not a part of the action area.

Presence of anadromous fish upstream of the action area would initially be controlled by the progression of restoration actions within the SJRRP. Over the course of SJRRP proposed construction and restoration actions, the likelihood of salmonid presence in the area would increase due to the construction of fish passage improvements in the Restoration Area, and the increase in the regularity and volume of attraction flows. However, the likelihood of CCV steelhead presence in the action area would continue to be low, unless large flood releases were to occur. If CCV steelhead successfully migrate and spawn in Reach 1, then juveniles and kelts could emigrate through the action area.

CCV steelhead present in the action area during the early stages of proposed fish-passage restoration actions would likely experience low survival rates because the conditions would not yet reliably provide suitable rearing or migratory habitat. Planned improvements in fish passage and restoration flows as part of the SJRRP are likely to encourage some straying and recolonization of the Restoration Area inclusive of the action area.

2.4.1.2 Status of CV spring-run Chinook salmon

Historically, CV spring-run Chinook salmon spawned in the SJR from about the present-day location of Friant Dam to as far upstream as Mammoth Pool (River Mile 322) (McBain and Trush 2002). During the late 1930s and early 1940s, as Friant Dam was being constructed, large runs returned to the river. After the dam was completed and the reservoir was filling, runs of

30,000 to 50,000 fish continued to return and spawn in the river downstream of Friant Dam. Following dan construction, large sections of the SJR upstream of the Merced River confluence were dewatered and CV spring-run Chinook salmon were extirpated between the Merced River and Friant Dam by 1950 (McBain and Trush 2002).

The SJRRP started releasing juvenile CV spring-run Chinook salmon into the SJR: 60,114 juveniles from the FRFH in 2014, 54,924 juveniles from the FRFH in 2015, 57,320 juveniles from the FRFH and 47,550 juveniles from the Interim Salmon Conservation and Research Facility (iSCARF) in 2016, and 38,106 juveniles from FRFH and 51,044 juveniles from iSCARF in 2017. On April 9, 2019, the first returning CV spring-run Chinook salmon adults were detected in the action area in more than 65 years (SJRRP 2020).

When adult CV spring-run Chinook salmon return they are trapped between the Hills Ferry Barrier and Sack Dam and hauled to Reach 1. Trap and transport will continue until there is unimpeded passage, which is anticipated to occur in 2024. With unimpeded passage, there will also be an increased possibility of CV spring-run Chinook salmon from outside the Restoration Area naturally straying into the action area. These fish will be treated as part of the experimental population once they enter the Restoration Area. Some migrating adult CV spring-run Chinook salmon may bypass the traps at the Hills Ferry Barrier location and continue migrating upstream. When adult CV spring-run Chinook successfully spawn in Reach 1, juveniles could emigrate through the action area.

The Mendota Pool compact bypass channel is scheduled to open in 2026, allowing CV spring-run Chinook salmon to migrate through the action area unimpeded. Once the compact bypass channel is opened, the likelihood of CV spring-run Chinook salmon migrating through the action area would significantly increase. Similarly, the likelihood of emigrating juveniles would significantly increase after the compact bypass is functional.

2.4.1.3 Status of the sDPS of North American green sturgeon

Under historical conditions green sturgeon likely used the action area for migration and feeding. Following the development of Friant Dam and other large dams on the SJR tributaries conditions for green sturgeon became unsuitable. With the improved flows provided by the SJRRP Settlement it is anticipated that green sturgeon will return to the SJR and inhabit the action area.

### 2.4.2 Factors Limiting Recovery

The action area encompasses a portion of the Restoration Area, which may be used by the CV spring-run Chinook salmon ESU, the CCV steelhead DPS, and the sDPS of North American green sturgeon. Many of the factors affecting these species throughout their range are discussed in the Status of the Species section of this biological opinion.

The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs affecting listed salmonids and green sturgeon in the action area. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Flows released from Millerton Reservoir through Friant Dam have generally dried up or gone subsurface before or once reaching Gravelly Ford. Water pumped from the Delta via the Delta Mendota Canal forms

Mendota Pool at the bottom of reach 2B. Mendota Pool has been dewatered multiple times for construction and maintenance of water conveyance infrastructure. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices upstream require peak flood discharges to be held back and released over a period of weeks to avoid overwhelming the flood-control structures downstream of the reservoirs (*i.e.* levees and bypasses). Consequently, managed flows in the mainstem of the river often truncate the peak of the flood hydrograph and extend the reservoir releases over a protracted period. These actions reduce or eliminate the scouring flows necessary to mobilize gravel and clean sediment from the spawning reaches of the river channel and disrupt natural sediment transfer in general.

High water temperatures also limit habitat availability for listed salmonids in the lower SJR. High summer water temperatures in the lower SJR can exceed 72º F and create a thermal barrier to the migration of adult and juvenile salmonids (Myers *et al*. 1998). In addition, water diversions at the dams (*i.e.,* Friant, Goodwin, New Don Pedro, Tulloch, New Exchequer Dams and others) for agricultural and municipal purposes have reduced in-river flows downstream of the dams. These reduced flows frequently result in increased temperatures during the critical summer months which potentially limit the survival of juvenile salmonids (Reynolds *et al*. 1993) and holding habitat for CV spring-run Chinook salmon.

Point and nonpoint sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of and within the action area. Environmental stressors as a result of low water quality can lower reproductive success and may account for low productivity rates in fish (Klimley 2002). Organic contaminants from agricultural drain water, urban and agricultural runoff from storm events, and high trace element (*i.e.*, heavy metals) concentrations may deleteriously affect early life-stage survival of fish in the SJR (USFWS 1995).

The transformation of the SJR from a meandering waterway lined with a dense riparian corridor, to a highly leveed system under varying degrees of control over riverine erosional processes resulted in homogenization of the river, including effects to the river's sinuosity. Flood-control structures reduce sinuosity, where the channel shifts away from being complex and ecologically-rich to a simpler, ecologically-impoverished, single-thread channel (Skidmore and Wheaton 2022). The adverse impacts of post-Anthropocene fluvial responses on sinuosity may help explain historical and ongoing declines in salmonid populations (Powers *et al*. 2022).

## 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 Research effects on species

As discussed below, the proposed research activities would have no measurable effects on CCV steelhead or green sturgeon habitat. The actions are therefore not likely to affect habitat, and therefore will not jeopardize CCV steelhead or the sDPS of North American green sturgeon.

The primary effect of the proposed enhancement activities on the listed species would be capturing and handling the fish. While the proposed activity would provide a net benefit by transporting the fish to areas that have access to more suitable habitat, and by providing monitoring and research data, capturing, handling, and releasing fish generally leads to stress and other sub-lethal effects, and fish do sometimes die from these processes. The following subsections describe the types of activities being proposed. Each is described in terms broad enough to apply to all the relevant permits. The activities would be carried out by trained professionals using established protocols. The effects of the activities have been well documented and are discussed in detail below. Further, by accepting the Permit, Reclamation agrees to incorporate NMFS' pre-established set of mitigation measures described in the Proposed Action (Section 1.3) of this biological opinion. They are incorporated (whenever relevant) into every permit that includes these research and monitoring components as part of the conditions to which all researchers must adhere.

***Observing/harassing***

For some parts of the proposed studies, listed fish would be observed in-water (*e.g.*, by Vaki Riverwatcher monitoring). Direct observation is the least disruptive method for determining a species' presence/absence and estimating their relative numbers. Its effects are also generally the shortest-lived and least harmful of the research activities discussed in this section because a cautious observer can effectively obtain data while only slightly disrupting the fishes' behavior. Harassment is the primary form of take associated with these observation activities, and few if any injuries (and no deaths) are expected to occur—particularly in cases where the researchers observe from the stream banks or by video, rather than in the water. Because these effects are so small, there is little a researcher can do to mitigate them except to avoid disturbing sediments, gravels, and, to the extent possible, the fish themselves, and allow disturbed fish the time they need to reach cover.

***Capturing/handling***

Any physical handling can be stressful to fish (Sharpe *et al.* 1998). The primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures between the river and wherever the fish are held, unsuitable dissolved oxygen conditions, the amount of time that fish are held out of the water, and physical trauma. Stress on salmonids and green sturgeon increases rapidly from handling if the water temperature exceeds 18º C or dissolved oxygen is below saturation. Fish transferred to holding tanks can experience trauma if care is not taken in the transfer process. Fish can also experience stress and injury from overcrowding in traps if the traps are not emptied regularly. Debris buildup at traps can also kill or injure fish if the traps are not cleared regularly (Sharpe *et al.* 1998). The permit conditions stipulate measures that will mitigate or avoid such 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, fish typically recover fairly rapidly from handling.

*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.

Tissue sampling is a common practice in fisheries science characterizing the genetic “uniqueness” and quantifying the level of genetic diversity within a population. Tissue samples should be a small (< 1.0 $cm^2$) fin-clip collected from soft pelvic or caudle fin tissues using a pair of sharp scissors. Tissue samples should be preserved in individually labeled vials containing 95 percent ethanol. The adverse effects of fin-clipping ESA-listed fish may include stress and injury from handling and damaged fins resulting in infection and delayed mortality. However, in general, most wounds caused by partial fin-clips heal quickly and do not alter fish growth.

Researchers will follow several precautionary measures to reduce the risk of stress and injury to ESA-listed fish from fin-clipping, including: (1) only a very small amount of fin tissue (not more than 1.0 $cm^2$) will be collected from any fin, but primarily the upper lobe of the caudal fin; (2) fin-clips will be collected only from ESA-listed fish which appear to be in good condition and are not exhibiting injuries or abnormal behavior; and (3) all ESA-listed fish will be closely observed and allowed to recover fully before being released.

*Tagging/marking*

Techniques such as PIT tagging, coded wire tagging, fin-clipping, and the use of radio transmitters 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. This section discusses each of the marking processes and its associated risks.

A PIT tag is an electronic device that relays passive signals to a radio receiver and allows individuals carrying the tags to be identified whenever they pass a location containing such a receiver without researchers having to recapture and handle the fish again to record its presence in the area. A PIT tag is usually inserted into the body cavity of the fish just in front of the pelvic girdle.

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). Studies have shown growth rates among PIT-tagged Snake River, Idaho, 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 documented PIT-tagging did not substantially affect survival in juvenile salmonids. Similarly, coded wire-tagging procedures appear to have negligible effect on survival in green sturgeon for the purpose of informing spatio-temporal distribution of the species (see Miller *et al*. 2020). Miller *et al*. (2020) explained this method has no significant impact on juvenile sturgeon survival, growth, or swimming performance.

***Electrofishing***
Electrofishing is a process by which an electrical current is passed through water in an effort to stun fish and make them easy to capture. In larger streams and rivers, electrofishing units are sometimes mounted on boats or rafts as backpack units produce insufficient shocks to sample these deeper areas. These units produce more current and are able to cover larger and deeper areas and, as a result, can have a greater negative effect on fish. However, in such environments it may be more difficult for samplers to recognize situational differences and adapt the electrofishing protocols so they are the least harmful to fishes. For example, in areas of lowered water visibility, researchers may be unable to visually detect spawning adults and avoid them during electrofishing excursions.

Electrofishing can cause a suite of effects ranging from simply disturbing the fish to actually killing them if the voltage is not appropriate for the water conditions or fish size. The amount of unintentional mortality attributable to electrofishing varies widely depending on the equipment used, the settings on the equipment, and the expertise of the technician. Electrofishing can have severe effects on adult salmonids when conducted improperly. Adult salmonids can suffer from spinal injuries caused by the forced muscle contraction following electrical shocks that are too strong. For example, Sharber and Carothers (1988) reported improperly conducted electrofishing killed 50 percent of the adult rainbow trout in their study.

Most of the studies on the effects of electrofishing on fishes have been conducted on adult fish greater than 300 mm in length (Dalbey *et al.* 1996). The relatively few studies that have been conducted on juvenile salmonids indicate spinal injury rates are substantially lower than they are for adult fish. 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) found a 5.1 percent injury rate for juvenile Middle Columbia River steelhead captured by electrofishing in the Yakima River subbasin.

The incidence and severity of electrofishing damage is partly related to the type of equipment used and the waveform produced (Sharber and Carothers 1988, McMichael 1993, Dalbey *et al.* 1996, Dwyer and White 1997). Continuous direct current (DC) or low-frequency (30 hertz) pulsed DC have been recommended for electrofishing for salmonids (Fredenberg 1992, Snyder 1992, Dalbey *et al.* 1996) because lower spinal injury rates, particularly in salmonids, occur with these waveforms (Fredenberg 1992, McMichael 1993, Sharber *et al.* 1994, Dalbey *et al.* 1996). Only a few recent studies have examined the long-term effects of electrofishing on salmonid survival and growth (Dalbey *et al.* 1996, Ainslie *et al.* 1998). These studies indicate although some of the fish suffer spinal injury, few die as a result. However, severely injured fish grow at slower rates and sometimes they show no growth at all (Dalbey *et al.* 1996), which is detrimental to their overall survival.

Permit conditions will require all researchers follow NMFS' electrofishing guidelines (NMFS 2000). The guidelines require field crews be trained in observing animals for signs of stress and shown how to adjust electrofishing equipment to minimize that stress. All areas will be visually searched for fish before electrofishing may begin. Electrofishing will not be conducted in the vicinity of known redds or spawning adults. All electrofishing equipment operators are trained by qualified personnel to be familiar with equipment handling, settings, maintenance, and safety. Operators will work in pairs to increase both the number of fish that may be seen and the ability to identify individual fish without having to net them. Working in pairs also allows the researcher to net fish before they are subjected to higher electrical fields. Only DC units are used, and the equipment will be regularly maintained to ensure proper operating condition. Voltage, pulse width, and rate are kept at minimal levels and water conductivity is tested at the start of every electrofishing session so those minimal levels can be determined. Due to the low settings used, shocked fish normally revive instantaneously. Fish requiring revivification will receive immediate, adequate care. In all cases, electrofishing will be used only when other survey methods are not feasible.

The preceding discussion focused on the effects of using a backpack unit for electrofishing and the ways those effects would be mitigated. The environmental conditions in larger, more turbid streams can limit researchers' ability to minimize impacts on fish. That is, in areas of lower visibility it can be difficult for researchers to detect the presence of adults and thereby take steps to avoid them. In any case, the permit conditions requiring the researchers to follow NMFS' electrofishing guidelines apply to researchers intending to use boat electrofishing as well.

***Fyke Net with Wing Walls***
A fyke net with wing walls attached to the sides of the net opening, will be 1.2 m deep and long enough to span the river (max wing length 30.5 m), with small floats spaced every 61 cm on top, and a lead line on bottom. The net entrances face downstream, with the wing walls extending to shore in a v-shaped pattern. Nets are held in place with anchored t-posts. A fyke net has the potential to cause a fish to lose scale and dermal mucus from contact with the net, wing walls, or capture net. Also, fish can become over crowded if traps are not cleared often enough. The permit conditions stipulate measures that will mitigate or avoid such factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish.

***Trammel nets***
Trammel nets include three parallel vertical layers of netting. The inner net has a fine mesh size, while the outer nets have mesh sizes large enough for the fish to pass. The larger and smaller mesh size nets form a pocket when fish attempt to swim through the structure. Similar to seine nets, trammel nets are equipped with floats attached to the head rope and lead weights along the ground rope to keep them properly oriented. Trammel nets range in size from 0.9-1.8 m (3-6 ft.) tall and 11.4-30.5 m (37.5–100 ft.) long. A buoyant top line and weighted bottom line keeps the trammel net oriented vertically in the water column. Brightly colored buoys will be attached to the terminal ends of the net to alert boaters and other recreationists to the nets and avoid entangling themselves, their boats, or their fishing gear. Fish can lose scales and dermal mucus from the contact with the net. Also, fish can be suffocated if they are not removed from a trammel net quickly and carefully. The permit conditions stipulate measures that will mitigate or avoid such factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish.

***Hand and Beach Seine***
A seine is a net that traps fish by encircling them with a long wall of webbing. Typically, the top edge of a seine has floats, the bottom edge is weighted, and the seine has a brail (wooden pole) on each end. As the net is closed the fish become concentrated in the net. Seines are usually large enough that they are fished by two or more people though can be small enough to be fished by one person. Generally, seines are set in an arc around the targeted fish and then dragged to shore.

Seines are effective for sampling littoral areas of lentic habitats. In lotic habitats, seines are most easily used in areas of low velocity, but can be used in high velocity areas if the brails are held in place while someone approaches the net from upstream, herding fish into the net. To be most effective, a seine needs to be deployed quickly enough that the target species cannot escape the encircling net. Accordingly, habitat structure and complexity negatively influence seine efficiency by reducing the speed at which one deploys a seine and by offering escape cover. Small fish can be gilled in the mesh of a seine. Scales and dermal mucus can be abraded by contacting the net. Fish can be suffocated if they are not quickly removed from the net after the net is removed from the water to process the fish. Also, the fish can be crushed by the handler when removing the net from the water. The permit conditions stipulate measures that will mitigate or avoid such factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish.

***Fyke traps***

Fyke traps are essentially large cylinders, 10 feet in diameter and 19 feet in length. They are open at one end and contain two funnels which act as a one-way passage for fish and direct them into a pot or impounding area. The traps are always fished with the back or open end downstream. The two funnels face the same way, with the small openings upstream, and a fish must swim through both to enter the pot. The funnels and the exterior of the trap are covered with wire mesh netting. Captured fish are removed with a dip net through a door on the top of the pot or impounding area which opens into the pot.

To process fish, the trap should be rolled up the bank very slowly. If it is there is a large catch, the trap should remain submerged in fairly deep water to avoid overcrowding. Fish can then be dipped out of the holding area until the density becomes low again. The trap can then be rolled a little farther up the bank or out of the water and the fishing process repeated. If the trap is rolled too far or too fast, then even medium-sized fish may injure themselves by swimming into the mesh. If the trap is moved slowly the fish remain relatively calm and the likelihood of injury or mortality is reduced. The permit conditions stipulate measures that will mitigate or avoid such factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish.

***Dip nets***

Dip nets are bag-shaped nets affixed to a frame attached to a handle. The net is placed under the fish and then lifted from the water in a scooping motion. Dip nets are useful when collecting fish that have been trapped by other methods, such as electrofishing or trap nets. Scales and mucus can be abraded by the net, and fish can be crushed by the frame when the handler is attempting to catch them. The permit conditions stipulate measures that will mitigate or avoid such factors that commonly lead to stress and trauma from handling, and thus minimize the harmful effects of capturing and handling fish.

### 2.5.2 Species-specific effects of the action

***Permit 16608-3R Take Activities***

Under Permit 16608-3R, Reclamation will continue to conduct the research and monitoring activities already authorized under Permit 16608, with additions, as described in Section 1.3. In summary, take activities to be authorized under Permit 16608-3R would include: capture by boat or backpack electrofishing, fyke nets (with wing walls and fish traps), trammel nets, fyke traps, and hand seines, handling (measuring, sexing, collection of scales and tissue, PIT tagging, and checking for injuries and presence of tags), and transport of captured CCV steelhead. Captured CCV steelhead would be transported and released in the SJR downstream of the mouth of the Merced River. Water quality parameters including temperature and dissolved oxygen would be monitored and maintained while fish were being transported. Reclamation does not expect to capture CV spring-run Chinook salmon during these activities because based on past monitoring efforts suggest CV spring-run Chinook salmon will not be present during the proposed action. The post-capture handling of CV spring-run Chinook salmon would be covered under ESA10(a)(1)(A) permit #20571, issued to the USFWS, and is therefore not included under the take activities in this biological opinion.

Reclamation is requesting the following amounts of ESA take for CCV steelhead and the sDPS of North American green sturgeon (Table 5):

**Table 5.** Requested take by species and origin for Permit 16608 – 3R. All take is capture/sample/ transport including observing and harassing adult life stage fish.

| Species | Life Stage | Requested Take | Unintentional Mortality |
|---|---|---|---|
| **CCV steelhead** | Listed Hatchery Adipose Clip | 17 | 2 |
| **CCV steelhead** | Natural | 17 | 2 |
| **sDPS of North American green sturgeon** | Natural | 9 | 0 |

Because the majority of the fish that would be captured are expected to recover with no ill effects, the true effects of the proposed action are best seen in the context of the fish the action is likely to kill. To determine the effect of these losses for the DPS on the whole, it is necessary to compare them to the total estimated abundance for the DPS, found in Table 6.

**Table 6.** Percentage of the estimated annual abundance of adults, by species and origin, likely to be killed as authorized by Permit 16608-3R.

| Species | Origin | Percent Mortalities |
|---|---|---|
| **CCV steelhead** | Listed Hatchery Adipose Clip | 0.052 |
| **CCV steelhead** | Natural | 0.118 |
| **sDPS of North American green sturgeon** | Natural | 0.0 |

These research and enhancement activities may remove a maximum of 0.118 percent (two individuals) of naturally produced, adult CCV steelhead as a result of the proposed permit renewal. These are small effects, and most likely the actual effect would be smaller as the mortality and take is estimated conservatively. A conservative estimate provides some buffer to allow for unusual and unpredictable events with high levels of take and mortality. Further, the purpose of the take is to translocate the fish to areas with PBFs for spawning. Therefore, losses incurred would be in the context of activities, which have a conservation benefit for the species. Collection of these data are necessary for understanding potential benefits of the SJRRP. All research findings will be used to benefit ESA-listed steelhead and green sturgeon through improved conservation and management practices. An effect of the research that cannot be quantified is the conservation benefit to the species resulting from the research. Results from this research should assist in providing information on occurrence and return timing of CCV steelhead and individuals from the sDPS of North American green sturgeon in the action area.

### 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).

#### A. Agricultural Practices

Agricultural practices in the action area may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow in stream channels. Unscreened agricultural diversions throughout the SJR entrain fish including juvenile salmonids. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the SJR. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect salmonid reproductive success and survival rates (Dubrovsky *et al.* 1998a, Dubrovsky *et al.* 1998b, Daughton 2003).

#### B. Increased Urbanization

Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. For example, between 2019 and 2020 the population of Mendota[12] grew from 11,531 to 12,173, a 5.57% increase. Merced[13] is currently growing at a rate of 0.85% annually and its population has increased by 1.71% since the most recent census, which recorded a population of 86,333 in 2020. Some of the activities associated with increased urbanization, particularly those situated away from waterbodies, would not require Federal permits, and thus would not undergo review through the ESA section 7 consultation process with NMFS. This does not preclude effects from these actions. For example, there are studies about negative effects of tire tread chemicals in

[12] https://datausa.io/profile/geo/mendota-ca#about
[13] https://worldpopulationreview.com/us-cities/merced-ca-population

stormwater run off having significant physical effects on coho salmon in Washington state (Tian *et al* 2020). An increase in local population can have an effect on the toxin load of stormwater run off.

**2.7 Integration and Synthesis of Effect**

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species. These assessments are made in full consideration of other authorized research, which may affect the various listed species.

In the Rangewide Status of the Species section (Section 2.2) of this biological opinion, NMFS estimated the average annual abundance for adult and juvenile listed salmonids including green sturgeon. For CCV steelhead and CV spring-run Chinook salmon, we estimated abundance for adult returning fish and outmigrating smolts. For hatchery propagated juvenile salmonids, we use hatchery production goals or an average of hatchery releases over the years. Table 7 displays the estimated annual abundance of hatchery-propagated and naturally produced ESA-listed fish including green sturgeon. Note for CV spring-run Chinook salmon, juvenile hatchery production estimates are a combination of estimated annual production from both the Sacramento River system and the SJRRP.

**Table 7.** Recent three-year means for estimated species returns and estimated juvenile outmigrations (SWFSC 2022).

| Species | Life Stage | Natural Origin | Listed Hatchery Adipose Clip |
|---|---|---|---|
| **CV spring-run Chinook salmon** | Adult | 6,756 | 2,083 |
| **CV spring-run Chinook salmon** | Smolt | 1,838,954 | 2,000,000 |
| **CCV Steelhead** | Adult | 11,494 | N/A |
| **CCV Steelhead** | Smolt | 1,307,442 | 1,050,000 |
| **sDPS of North American green sturgeon** | Adult | 2,106 | N/A |
| **sDPS of North American green sturgeon** | Sub-Adult | 11,055 | N/A |
| **sDPS of North American green sturgeon** | Juvenile | 4,387 | N/A |

The extent of straying cannot be anticipated. The effect of the proposed take will be considered against estimates of abundance for the DPS, with the knowledge the proposed take is designed to benefit the species by transporting CCV steelhead to locations outside of the Restoration Area where they are more likely to complete their life cycle. The following tables combine the proposed take for Permit 16608-3R considered for each species (Table 8) and then compare those totals to the estimate annual abundance of each species under consideration (Table 9).

**Table 8.** Total requested take and mortalities for Permit 16608-3R and percentages of the listed units by life stage and origin.

| ESU/DPS | Life Stage | Origin | Requested Take | % of Listed Unit Taken | Requested Mortality | % of Listed Unit Killed |
|---|---|---|---|---|---|---|
| **CCV steelhead** | Adult | Natural | 17 | 1.00 | 2 | 0.12 |
| **CCV steelhead** | Adult | Adipose Clipped | 17 | 0.44 | 2 | 0.05 |
| **sDPS of North American green sturgeon** | Adult | Natural | 9 | 0.43 | 0 | 0 |

The activities contemplated in this biological opinion are predicted to kill a maximum of 2 natural origin CCV steelhead and no sDPS of North American green sturgeon. Overall, there would be a very small impact on the species' abundance. Any impact on listed species productivity would likely be positive, as captured fish would be translocated to locations with better access to more suitable spawning habitat. Effects on species spatial structure or diversity would be minimal, but overall the permitted actions are a component of the SJRRP, which aims to increase the spatial range of anadromous salmonids in the Central Valley.

**Table 9.** Percentage of abundance that may be lost among the listed species for all previously authorized research and the permit actions analyzed in this biological opinion. There has been no previous authorization nor permit request for lethal take of the sDPS of North American green sturgeon.

| ESU/DPS | Origin | Adults Killed | Percentage of Abundance |
|---|---|---|---|
| **CCV steelhead** | Natural | 23 | 1.36 |
| **CCV steelhead** | Listed Hatchery Adipose Clipped | 13 | 0.34 |
| **CV spring-run Chinook salmon**[14] | Natural | 74 | 0.65 |
| **CV spring-run Chinook salmon**[14] | Listed Hatchery Adipose Clipped | 38 | 0.46 |

As the Table 9 illustrates, the dead fish from the permit in this biological opinion and all the previously authorized research would amount to a few tenths of a percent of each species' total abundance in most cases. Since the first 16608 permit was authorized in 2012 no steelhead have been captured or handled so no take has been reported under permits 16608 or 16608-2R. However, in some cases, the mortality included in this biological opinion and all previously authorized research could amount to a more substantial percentage. Therefore, we reviewed mortality for CCV steelhead by origin and life stage. There is neither expected or requested mortality by Reclamation and no previous authorized mortality for the sDPS of North American green sturgeon under the permit actions.

[14] See footnote 16.

***California Central Valley steelhead***

When combined with scientific research and monitoring permits already approved (see section 2.4 Environmental Baseline), potential mortality for CCV steelhead would range from 0.34 to 1.36 percent of estimated species abundance (depending on origin (Table 9) across the DPS. The potential mortality for adult origin (Listed Hatchery Adipose Clipped) is a net population loss of 0.34 percent. Potential mortality for natural origin CCV steelhead from all research activities in the DPS is 1.36 percent of estimated adult abundance. The activities analyzed in this biological opinion represent a small fraction of this potential mortality. The majority of the proposed mortality has been previously analyzed and found not to jeopardize the species.

The number of fish authorized to be taken is likely less than authorized. This determination is due to conservative estimates of abundance, as described in Section 2.2 and because researchers generally request more take than actually occurs. It is probable researchers will take fewer fish than estimated, and the actual effect is less than documented in. The quantity of mortality authorized in this biological opinion offsets losses that are predicted to occur in the if the actions proposed by Reclamation were not to occur.

***Critical Habitat***

There is no designated critical habitat for any of the species analyzed in the action area.

***DPS-Level Effects***

As noted in the status of the species sections, listed species require substantial improvement in the condition of their habitat and other factors affecting their survival if they are to recover. The SJRRP activities, as outlined in the settlement agreement, are designed to facilitate that goal for CV spring-run Chinook salmon in the Restoration Area. Actions proposed under Permit 16608-3R are an important component for the SJRRP. When the SJRRP has progressed further, and habitat conditions, connectivity, and flow in the Restoration Area have improved, the activities included in Permit 16608-3R will no longer be necessary. The proposed action will not exacerbate the negative cumulative effects discussed in this biological opinion (habitat alterations, etc.) and the enhancement component of the Permit will increase the likelihood affected fish would reach suitable spawning habitat. Research and monitoring components of the Permit would serve to limit adverse effects by increasing knowledge of species' requirements, habitat use, and abundance.

The adverse effects of climate change on listed species and their habitats within the action area are likely to continue. Given the proposed actions short time frames and limited areas, those negative effects, while somewhat unpredictable, are too small to be effectively gauged as an additional increment of harm over the time span considered in this analysis. Moreover, the actions would not contribute to climate change. While cumulative effects and climate change continue their negative trends, it is unlikely the proposed actions would have any additive impact to the pathways by which those effects are realized (*e.g.*, a small reduction in CCV steelhead abundance would have no effect on increasing stream temperatures or continuing land development).

When adding the increment of effect represented by the proposed actions, the proposed enhancement and research activities would have slight negative effects on CCV steelhead abundance. However, those reductions are so small as to have a negligible effect on the species' survival and recovery, and would be countered by a potential beneficial effect on species' productivity.

In summary, NMFS expects the detrimental effects on the species to be minimal and those impacts would only be seen in terms of slight reductions in adult abundance. Because these reductions are negligible, the combination of actions would have no appreciable effect on the species' diversity or spatial structure. The proposed action is anticipated to be beneficial and adverse impacts to the DPS will be negligible. Finally, we expect the proposed actions analyzed in this biological opinion to provide important information for the conservation and management of the species. NMFS does not expect the proposed action to reduce appreciably the likelihood of both survival and recovery of the species in the wild, nor reduce the value of designated or proposed critical habitat for the conservation of the species.

## 2.8 Conclusion

After reviewing and analyzing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion the proposed action is not likely to jeopardize the continued existence of CCV steelhead or the sDPS of North American green sturgeon.

## 2.9 Incidental Take Statement

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

As previously stated in this biological opinion, the action area contains a NEP population of CV spring-run Chinook salmon (78 FR 79622, December 31, 2013). This species is included in this document as a conferencing opinion with Reclamation and as an internal conferencing opinion with NMFS. One of the purposes of an incidental take statement is to lay out the amount or extent of take beyond which individuals carrying out an action cannot go beyond without being in possible violation of section 9 of the ESA. That purpose is fulfilled here by the amounts of proposed (requested) direct take laid out in the effects section above (2.4). Those amounts constitute limits on both the amount and extent of take the permit holders would be allowed in a given year. This concept is also reflected in the reinitiation clause below.

### 2.10 Reinitiation of Consultation

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

In the context of this biological 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 biological opinion's effects analysis section (2.4) are exceeded, then 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 biological opinion addresses these DQA components, documents compliance with the DQA, and certifies this biological 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 consultation are the applicants and funding/action agencies listed on the first page. Individual copies of this biological opinion were provided to the applicant, Reclamation. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

### 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, 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 biological opinion contain more background on information sources and quality.

***Referencing:*** All supporting materials, information, data, and analyses are properly referenced. They follow standard scientific referencing style.

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

## 4. REFERENCES

### 4.1 Federal Register Notices

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