CENTRAL VALLEY RECOVERY DOMAIN

5-Year Review:
Summary and Evaluation of

Central Valley Steelhead DPS

National Marine Fisheries Service
Southwest Region
Long Beach, CA

5-YEAR REVIEW
Central Valley Recovery Domain

Species Reviewed	Evolutionarily Significant Unit or Distinct Population Segment
Steelhead *(Oncorhynchus. mykiss)*	**Central Valley steelhead DPS**

1.0 GENERAL INFORMATION

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1.2 Introduction

Many West Coast salmon and steelhead (*Oncorhynchus* sp.) stocks have declined substantially from their historic numbers and now are at a fraction of their historical abundance. There are several factors that contribute to these declines, including: overfishing, loss of freshwater and estuarine habitat, hydropower development, poor ocean conditions, and hatchery practices. These factors collectively led to the National Marine Fisheries Service (NMFS) listing of 28 salmon and steelhead stocks in California, Idaho, Oregon, and Washington under the Federal Endangered Species Act (ESA).

The ESA, under Section 4(c)(2), directs the Secretary of Commerce to review the listing classification of threatened and endangered species at least once every five years. After completing this review, the Secretary must determine if any species should be: (1) removed from the list; (2) have its status changed from threatened to endangered; or (3) have its status changed

from endangered to threatened. The most recent listing determinations for west coast salmon and steelhead occurred in 2005 and 2006. This document summarizes NMFS's 5-year review of the ESA-listed Central Valley (CV) steelhead Distinct Population Segment (DPS).

1.2.1 Background on Listing Determinations

Under the ESA, a species, subspecies, or a distinct population segment (DPS) may be listed as threatened or endangered. To identify the proper taxonomic unit for consideration in an ESA listing for salmon we draw on our "Policy on Applying the Definition of Species under the ESA to Pacific Salmon" (ESU Policy) (56 FR 58612). According to this policy guidance, populations of salmon substantially reproductively isolated from other con-specific populations and representing an important component in the evolutionary legacy of the biological species are considered to be an ESU. In our listing determinations for Pacific salmon under the ESA, we treated an ESU as constituting a DPS, and hence a "species."

In 2006, we announced that NMFS would apply the joint U.S. Fish and Wildlife Service-National Marine Fisheries Service DPS policy (61 FR 4722) rather than our agency's ESU policy to populations of West Coast steelhead (*O. mykiss*). Under this policy, a DPS of steelhead must be discrete from other con-specific populations, and it must be significant to its taxon. A group of organisms is discrete if it is "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, and behavioral factors" (61 FR 4722). According to the DPS policy, if a population group is determined to be discrete, we must then consider whether it is significant to the taxon to which it belongs. Considerations in evaluating the significance of a discrete population include: (1) persistence of the discrete population in an unusual or unique ecological setting for the taxon; (2) evidence that the loss of the discrete population segment would cause a significant gap in the taxon's range; (3) evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere outside its historical geographic range; or (4) evidence that the discrete population has marked genetic differences from other populations of the species.

Artificial propagation (fish hatchery) programs are common throughout the range of ESA-listed West Coast salmon and steelhead. On June 28, 2005, we announced a final policy addressing the role of artificially propagated Pacific salmon and steelhead in listing determinations under the ESA (70 FR 37204). Specifically, this policy: (1) establishes criteria for including hatchery stocks in ESUs and DPSs; (2) provides direction for considering hatchery fish in extinction risk assessments of ESUs and DPSs; (3) requires that hatchery fish determined to be part of an ESU or DPS to be included in any listing of those units; (4) affirms our commitment to conserving natural salmon and steelhead populations and the ecosystems upon which they depend; and (5) affirms our commitment to fulfilling trust and treaty obligations with regard to the harvest of some Pacific salmon and steelhead populations, consistent with the conservation and recovery of listed salmon ESUs and steelhead DPSs.

To determine whether a hatchery program was part of an ESU or DPS, NMFS convened the Salmon and Steelhead Hatchery Advisory Group (SSHAG), which evaluated all hatchery stocks and programs and divided them into 4 categories (SHAGG 2003):

Category 1: The hatchery population was derived from a native, local population; is released within the range of the natural population from which is was derived; and has experienced only

relatively minor genetic changes from causes such as founder effects, domestication or non-local introgression.

Category 2: The hatchery population was derived from a local natural population, and is released within the range of the natural population from which is was derived, but is known or suspected to have experienced a moderate level of genetic change from causes such as founder effects, domestication, or non-native introgression.

Category 3: The hatchery population is derived predominately from other populations that are in the same ESU/DPS, but is substantially diverged from the local, natural population(s) in the watershed in which it is released.

Category 4: The hatchery population was predominately derived from populations that are not part of the ESU/DPS in question; or there is substantial uncertainty about the origin and history of the hatchery population.

Based on these categorical delineations, hatchery programs in SSHAG categories 1 and 2 are included as part of an ESU or DPS (70 FR 37204) although hatchery programs in other categories may also be included in an ESU or DPS.

Because the new hatchery listing policy changed the way NMFS considered hatchery fish in ESA listing determinations, we conducted new status reviews and ESA-listing determinations for West Coast salmon ESUs and steelhead DPSs using this policy. On June 28, 2005, we issued final listing determinations for 16 ESUs of Pacific salmon (including the Sacramento River winter-run Chinook salmon ESU) and on January 5, 2006 we issued final listing determinations for 10 DPSs of steelhead.

1.3 Methodology used to complete the review

Section 4(c) (2) of the ESA requires 5 year reviews for all species once listed to determine if a change in status is necessary. A Federal Register notice was published on March 18, 2010 (75 FR 13082) that announced the initiation of 5-year reviews for west coast salmon and steelhead and also opened a 60-day public comment period to solicit information relevant to the reviews. The Southwest Region (SWR) coordinated informally by letter with State and tribal co-managers to ensure those co-managers were informed about the 5-year reviews and had an opportunity to provide any comments or information. All relevant public comments were considered as part of this review.

Following the public comment period, three key steps were taken to complete the 5-year review for the Central Valley steelhead DPS. First, the Southwest Fisheries Science Center (SWFSC) reviewed all new and substantial scientific information generated since the last west coast status review and produced an updated biological status summary report for this DPS and all other listed salmon and steelhead in California (herein referred to as the "viability report"). The purpose of the viability report (Williams et al. 2011) was to assess whether or not the biological status of this DPS and the other listed salmon and steelhead had changed since the last status review was conducted. Second, staff from the Central Valley Office (CVO) of the Protected Resources Division (PRD) reviewed the viability report and assessed whether the five ESA listing factors (threats) had changed substantially since the 2005 listing determination for this DPS. To assess whether the five listing factors had changed substantially since 2005, several

key documents were reviewed including the Federal Register notices listed in Tables 1 and 2 and other relevant documents including:

(1) Central Valley Salmon and Steelhead Public Draft Recovery Plan (NMFS 2009a)
(2) Biological Opinion on the Long-term Operations of the Central Valley Project and State Water Project (NMFS 2009b)
(3) Listen to the River: An Independent Review of the CVPIA Fisheries Program (Cummins et al. 2008)
(4) Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin (Lindley et al. 2007)
(5) What caused the Sacramento River fall Chinook stock collapse? (Lindley et al. 2009)
(6) Migration and survival of juvenile salmonids in California's Central Valley and San Francisco estuary; 2007 and 2008 data (MacFarlane et al. 2008)

Finally, CVO PRD staff considered the viability report, the five factor analysis update including current threats to the species, and relevant conservation measures before making a recommendation about whether the listing status of the DPS or its geographic boundaries should be changed. In the CVO a team of three biologists formed the core working group that assimilated information from various sources to support this review and those of Sacramento River winter-run Chinook salmon and Central valley spring-run Chinook salmon.

Other information sources reviewed pertaining to the ESA status of this ESU included:

- Draft Central Valley Salmon and Steelhead Recovery Plan (2009)
- SWFSC Status Review Update Report (Williams et al. 2011)
- Central Valley steelhead hatchery assessments
- Recent biological opinions pertaining to the protection of Central Valley steelhead (especially the CVP-OCAP opinion)
- Peer-reviewed scientific publications
- Grey literature (annual reports)
- CDFG CVP/SWP salvage database
- the final rule listing CV steelhead as threatened (63 FR 13347)
- the final rule designating critical habitat for CV steelhead (70 FR 52488)

All literature and documents used for this review are on file at the SWR's CVO and Long Beach Office.

1.4 Background – Summary of Previous Reviews, Statutory and Regulatory Actions, and Recovery Planning

1.4.1 FR Notice citation announcing initiation of this review

75 FR 13082; March 18, 2010

1.4.2 Listing history

The CV steelhead was originally listed as threatened in 1998 after extensive review (63 FR 13347). Following a new status review (Good et al. 2005) and after application of the

agency's hatchery listing policy, NMFS reaffirmed its status as threatened and also listed several hatchery stocks as part of the DPS in 2006 (71 FR 834). See Table 1 for details.

Table 1. Summary of the listing history under the Endangered Species Act for the CV steelhead DPS in Central Valley Recovery Domain.

Salmonid Species	ESU/DPS Name	Original Listing	Revised Listing(s)
Steelhead *(O. mykiss)*	**Central Valley steelhead DPS**	**FR Notice:** 63 FR 13347 **Date listed:** 03/19/1998 **Classification:** Threatened	**FR Notice:** 71 FR 834 **Date listed:** 01/05/2006 **Classification:** Threatened

1.4.3 Associated rulemakings

The ESA requires NMFS to designate critical habitat for any species it lists under the ESA. Critical habitat is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation. We originally designated critical habitat for this DPS in 2000, but later withdrew that designation as a result of litigation. In 2005 we issued a new critical habitat designation for this DPS (Table 2).

Section 4(d) of the ESA directs NMFS to issue regulations to conserve species listed as threatened. This applies particularly to "take," which can include any act that kills or injures fish, and may include habitat modification. The ESA prohibits any take of species listed as endangered, but some take of threatened species that does not interfere with salmon survival and recovery can be allowed. In 2000, a 4(d) protective regulation was promulgated for this DPS that applied the section 9 take prohibitions and created several "take limits" addressing a range of activities impacting the DPS. In 2006 when the DPS listing status was reaffirmed as threatened, the 4(d) was modified to allow the take of hatchery origin fish under certain circumstances. Table 2 provides information on FR notices documenting these regulatory changes.

Table 2. Summary of 4(d) protective regulations and critical habitat designation for the CV steelhead DPS in the Central Valley Recovery Domain.

Salmonid Species	ESU/DPS Name	4(d) Protective Regulations	Critical Habitat Designations
Steelhead *(O. mykiss)*	**Central Valley steelhead DPS**	**FR notice:** 65 FR 42421 **Date:** 07/10/2000	**FR notice:** 70 FR 52488 **Date:** 09/02/2005

1.3.4 Review History

Numerous scientific assessments have been conducted to assess the biological status of the CV steelhead DPS. A list of those assessments is provided in Table 3.

Table 3. Summary of previous scientific assessments for the CV steelhead DPS in the Central Valley Recovery Domain.

Salmonid Species	ESU/DPS Name	Document Citation
Steelhead *(O. mykiss)*	**Central Valley steelhead DPS**	Busby, P. J, T.C. Wainwright, G. J. Bryant, L. J. Lierheimer, R.S. Waples, F.W. Waknitz, and I. V. Lagomarsino. 1996. Status Review of West Coast Steelhead from Washington, Idaho, Oregon, and California Report No. NMFS-NWFSC-27. NOAA Technical Memorandum
		Good, T.P., R.S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.
		Lindley, S.T. , R.S. Schick, E. Mora, P.B. Adams, J. J. Anderson, S. Greene, C. Hanson, B.P. May, D. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2007. Framework for Assessing the Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science Volume 5.
		Lindley, S.T., R. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5(1), Article 4: 26 pages
		National Marine Fisheries Service. 2011. T. H. Williams, D. A. Boughton, S. T. Lindley, and B. C. Spence. Draft status review update for Pacific salmon and steelhead under the Endangered Species Act. Southwest Fisheries Science Center, Santa Cruz, CA. 109 pages.

1.3.5 Species' Recovery Priority Number at start of 5-year review

NMFS issued guidelines in 1990 (55 FR 24296) for assigning listing and recovery priorities. The recovery priority number is used to assess a species' priority for recovery plan development, implementation, and resource allocation and is based on three criteria: 1) magnitude of threat; 2) recovery potential; and 3) existing conflict with activities such as construction and development. Recovery priority numbers are designated from 1 (highest) to 12 (lowest) based on the criteria listed above. The recovery priority number for this DPS, as reported in the *2006-2008 Biennial Report to Congress on the Recovery Program for Threatened and Endangered Species (available at: http://www.nmfs.noaa.gov/pr/pdfs/laws/esabiennial2008.pdf)*, is listed in Table 4 below.

1.3.6 Recovery Plan or Outline

In 2009, NMFS released a draft multi-species recovery plan that addresses all three listed salmonids in the Central Valley, including this DPS (Table 4). This draft plan was released for public comment and is undergoing final revisions prior to publication as a final, approved recovery plan. NMFS anticipates the final recovery plan will be released in late 2011.

Table 4. Recovery Priority Number and Endangered Species Act Recovery Plans for the CV steelhead DPS in the Central Valley Recovery Domain.

Salmonid Species	ESU/DPS Name	Recovery Priority Number	Recovery Plans/Outline
Steelhead *(O. mykiss)*	**Central Valley Steelhead**	7	**Name of Plan:** Public Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead (October 2009) **Plan Status:** Draft http://swr.nmfs.noaa.gov/recovery/centralvalleyplan.htm

2.0 REVIEW ANALYSIS

2.1 Delineation of Species under the Endangered Species Act

2.1.1 Is the species under review a vertebrate?

ESU/DPS Name	YES*	NO**
Central Valley Steelhead	X	

** if "Yes," go to section 2.1.2*
*** if "No," go to section 2.2*

2.1.2 Is the species under review listed as a DPS?

ESU/DPS Name	YES*	NO**
Central Valley Steelhead	X	

** if "Yes," go to section 2.1.3*
*** if "No," go to section 2.1.4*

2.1.3 Was the DPS listed prior to 1996?

ESU/DPS Name	YES*	NO**	Date Listed if Prior to 1996
Central Valley Steelhead		X	

** if "Yes," give date go to section 2.1.3.1*
*** if "No," go to section 2.1.4*

2.1.3.1 Prior to this 5-year review, was the DPS classification reviewed to ensure it meets the 1996 policy standards?

In 1991 NMFS issued a policy to provide guidance for defining ESUs of salmon and steelhead that would be considered for listing under the ESA (56 FR 58612; November 20, 1991). Under this policy a group of Pacific salmon populations is considered an ESU if it is substantially reproductively isolated from other con-specific populations and it represents an important component in the evolutionary legacy of the biological species. This DPS was originally defined and listed under NMFS's ESU policy in 1998. The 1996 joint NMFS-FWS DPS policy affirmed that a stock of Pacific salmon (or steelhead) was considered a DPS if it represented an ESU of a biological species and also concluded that NMFS' ESU policy was a detailed extension of the joint DPS policy. Accordingly, we clearly considered the originally defined and listed ESU to

also be a distinct population segment under the ESA. After reassessing the status of steelhead ESUs in 2005, NMFS decided to use the joint NMFS-FWS DPS policy to define steelhead only DPSs and in 2006 announced final listing determinations for steelhead based on the DPS policy (71 FR 834). That analysis concluded that CV steelhead constituted a DPS under the joint DPS policy and that it continued to be a threatened species. In summary, therefore, the CV steelhead DPS has been found to meet the 1996 DPS policy standards.

2.1.1 Summary of relevant new information regarding the delineation of the DPS under review

Williams et al. (2011) did not identify any new information that was relevant to the geographic boundary of the CV steelhead DPS. If the San Joaquin River restoration project is successful and steelhead become established in that watershed, then the boundary of the DPS may need to be reconsidered. One recent study Garza and Pearse (2008), however, does provide information relevant to the inclusion of steelhead hatchery stocks in the DPS. In conjunction with the 2005 status review for the CV steelhead ESU (Good et al. 2005), NMFS reviewed available information on hatchery stocks and programs within the range of the ESU (Salmon and Steelhead Assessment Group 2003). This review concluded that the two hatchery stocks (Coleman National Fish Hatchery and Feather River hatchery) were no more than moderately divergent from natural steelhead populations and that two other hatchery stocks (Nimbus hatchery and Mokelumne River hatchery) were extremely divergent. Based on this assessment and use of NMFS' hatchery listing policy, we concluded that the Coleman NFH Feather River hatchery were part of the CV steelhead ESU and that the other two hatchery stocks were not part. The Coleman NFH and Feather River hatchery were formally included in the listed CV steelhead DPS in 2006.

The Garza and Pearse (2008) study analyzed the genetic relationships among Central Valley *O. mykiss* populations and found that all below-barrier populations were generally closely related, and that there was a high level of genetic similarity to Eel River and Klamath River steelhead in all below-barrier population samples. This raises an issue about whether or not the steelhead stocks propagated at the Nimbus and Mokelumne River hatcheries should be excluded from the CV steelhead DPS. These two stocks were excluded from the DPS because they originated from the Eel River which was obviously not from within the DPS. Because the Eel River strain appears to be widely introgressed in many Central Valley steelhead populations, it may be appropriate to re-evaluate whether or not these stocks should be in the DPS. The Garza and Pearse (2008) analysis did not include samples from the Mokelumne River Hatchery, but that stock is likely to be closely related to the Eel River strain since this hatchery has imported Nimbus steelhead brookstock for many years.

2.2 Recovery Criteria

2.2.1 Do the species have final, approved recovery plans containing objective, measurable criteria?

ESU/DPS Name	YES	NO
Central Valley steelhead DPS		**X**

The ESA requires recovery plans to incorporate (to the maximum extent practicable) objective, measurable criteria which, when met, would result in a determination in accordance with the provisions of the ESA that the species can be removed from the Federal List of Endangered and Threatened Wildlife and Plants (50 CFR 17.11 and 17.12). NMFS has not yet issued a final approved recovery plan for this DPS. In 2009, NMFS issued a draft proposed multi-species recovery plan that addressed this DPS and the two other listed salmonids in the Central Valley (Sacramento River winter-run Chinook salmon and Central Valley spring-run Chinook salmon), and that does contain proposed recovery criteria that are objective and measureable. The proposed criteria reflect the best available and most-up-to-date information on the biology of this DPS and its habitat and address both biological parameters as well as the 5 listing factors. For this DPS, the draft plan calls for a minimum of two viable steelhead populations within each of the four extant steelhead Diversity Groups in the Central Valley (i.e., the Basalt and Porous Lava Diversity Group, the Northwestern California Diversity Group, the Northern Sierra Nevada Diversity Group and the Southern Sierra Nevada Diversity Group).

2.2.2 Adequacy of recovery criteria

2.2.2.1 Do the recovery criteria reflect the best available and most up-to date information on the biology of the species and its habitat?

ESU/DPS Name	YES	NO
Central Valley steelhead DPS	**N/A**	**N/A**

As noted above, a final approved recovery plan has not been released for this DPS. However, the 2009 draft proposed multi-species plan does contain recovery criteria that reflect the best available and up-to-date information for this DPS based on the latest VSP criteria. The draft plan specifies that recovery criteria for steelhead populations address abundance, productivity, spatial diversity, and life-history diversity. The plan has extensively examined and categorized stressors to steelhead populations in the Central Valley, including migration barriers, flow alterations, habitat modification, and predation.

2.2.2.2 Are all of the 5 listing factors that are relevant to the species addressed in the recovery criteria?

ESU/DPS Name	YES	NO
Central Valley steelhead DPS	**X**	

As noted above, a final approved recovery plan has not been released for this DPS. The 2009 draft plan does not specifically address all of the 5 listing factors, but rather comprehensively evaluates all relevant current threats to the DPS and then prioritizes recovery actions that address the 5 listing factors. The draft recovery criteria are based on the VSP criteria for the DPS which when met will indirectly address the listing factors. The draft plan includes a thorough examination of the major stressors on this DPS including loss of historical habitat, modification of remaining habitat, the management of recreational fisheries impacting the DPS, and the potential impacts of hatcheries.

2.2.2 List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information

As noted above, a final approved recovery plan has not been released for this DPS; however, a 2009 draft multi-species plan which does contain draft proposed criteria. A summary of these draft proposed criteria are presented below.

The draft plan specifies that recovery of this DPS will require multiple viable populations of steelhead in four Diversity Groups. Specifically, the plan calls for the following numbers and distribution of viable steelhead populations: (1) two viable populations in the Northwestern California Region, (2) two viable populations in the Basalt & Porous Lava Region, (3) three viable populations in the Northern Sierra Region, and (4) two viable populations in the Southern Sierra Region. For individual populations, draft proposed recovery criteria were developed by the Central Valley Technical Recovery Team (TRT), as described in Lindley et al. (2007), and were incorporated directly into the draft plan. The TRT developed two sets of criteria for establishing population viability based on available information. One set of criteria are based on the use of viability or extinction models if data and models are available to assess extinction risk. If such information is not available, the TRT developed a simpler set of criteria that address population size (*i.e.*, effective population size), population decline, catastrophic rate and effect, and hatchery influence. Under this set of criteria, a population would be considered at a low risk of extinction (*i.e.*, defined as < 5 percent chance of extinction within 100 years) if the following criteria are met:

- The effective population size must be > 500, or the population size must be > 2,500
- The population growth rate must show that a decline is not apparent or probable
- There must be no apparent or minimal risk of a catastrophic disturbance occurring
- Hatchery influence must be low, as determined by levels corresponding to different amounts, durations and sources of hatchery strays

2.3 Updated Information and Current Species Status

2.3.1 Analysis of Viable Salmonid Population (VSP) Criteria

This section is based on the status review update prepared by the SWFSC (Williams et al. 2011) for the 5-year review, as well as information compiled and evaluated by CVO PRD staff.

Summary of Previous Biological Review Team (BRT) Conclusions

Good et al. (2005) found that Central Valley steelhead was in danger of extinction, with a minority of the BRT viewing the ESU as likely to become endangered. The BRT's major concerns were the low abundance of naturally-produced anadromous fish at the ESU level, the lack of population-level abundance data, and the lack of any information to suggest that the monotonic decline in steelhead abundance evident from 1967-1993 dams counts has stopped.

Brief Review of TRT Documents and Findings

The CVTRT delineated more than 80 independent populations of Central Valley steelhead, along with a number of smaller dependent populations (Williams et al. 2011). Many of these historical populations are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Impassable dams also block significant portions of habitat for many other populations within watersheds even when not all habitat is blocked. Lindley et al. (2007) developed viability criteria for Central Valley salmonids. Using data through 2005, Lindley et al. (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of Central Valley 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.

New Data and Updated Analyses

Population trend data remain extremely limited for CV steelhead (Williams et al. 2011). The best population-level data come from Battle Creek where Coleman NFH operates a weir that blocks upstream movement of fish (Williams et al. 2011). However, changes in hatchery policies and transfer of fish over the years complicate the interpretation of these data (CVP PRD staff). For example, starting in 2005, Coleman NFH stopped transferring all ad-clipped (hatchery-origin) steelhead above the weir resulting in a large decrease in the overall numbers of fish passing the weir in subsequent years (Figure 1). Coleman NFH also transferred about 1,000 ad-clipped fish to Keswick Reservoir in 2003 and these fish are not included in the data. As a result, the only unbiased time series for Battle Creek is the number of unclipped (wild) steelhead returning since 2001. These data show a slight decline over the last ten years mostly because of the high returns observed in 2002 and 2003 (Figure 1). Williams et al. (2011) indicate that the

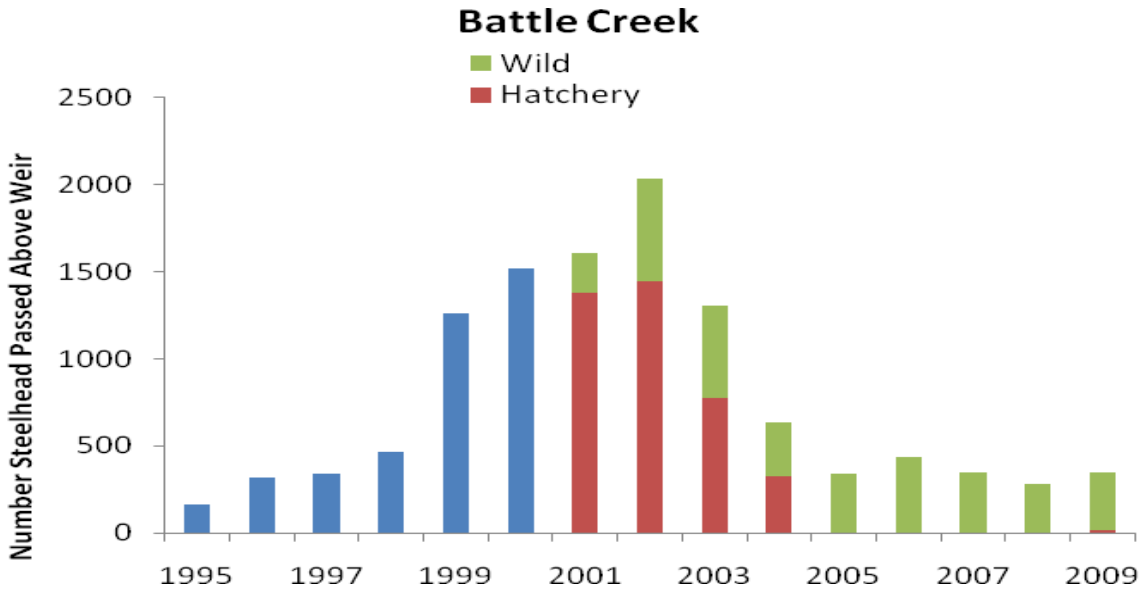

Figure 1. Steelhead returns to Battle Creek from 1995-2009. Beginning in 2001, fish were classified as either wild (unclipped) or hatchery produced (adipose-clipped). Data are from USFWS.

Battle Creek population declined significantly since the early 2000s, but their analysis did not take into account the fact that hatchery fish were not transferred above the barrier weir after 2005. Prior to halting the transfer of ad-clipped steelhead above the weir in 2005, the majority of fish transferred were of hatchery origin in the early 2000s (Figure 1).

Steelhead returns to Coleman NFH have varied considerably over the past five years (Figure 2). Since 2003, adults returning to the hatchery have been classified as wild (unclipped) or hatchery produced (ad-clipped). Wild adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relative stable in the range of 200-300 fish each year (Figure 2). Numbers of hatchery origin fish have fluctuated much more; however, ranging from 624 to 2,968 fish.

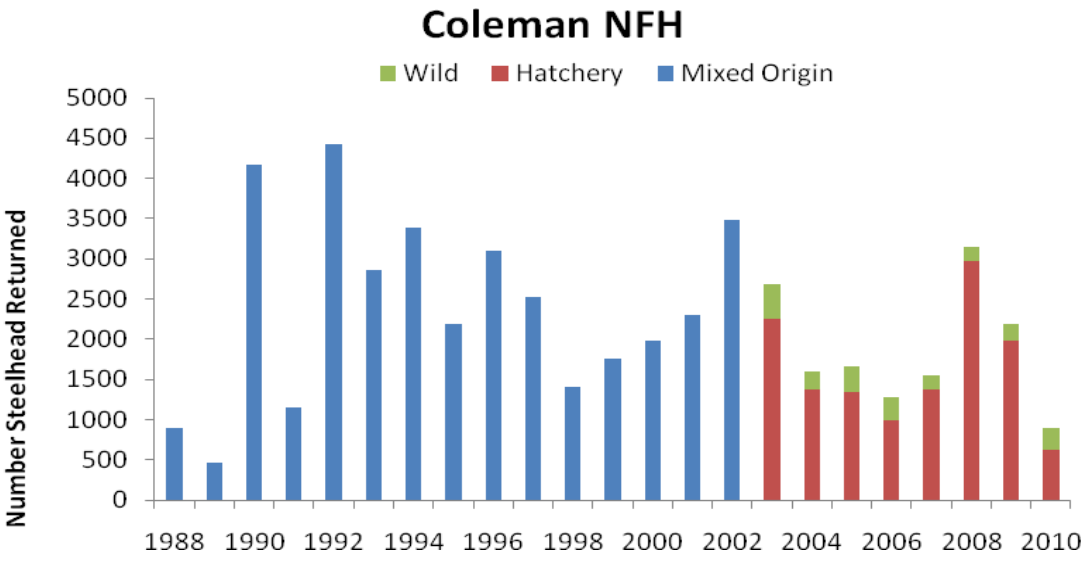

Figure 2. Steelhead returns to Coleman NFH from 1988-2010. Data are from USFWS.

Steelhead redd counts are made in Clear Creek and the American River, but the data are currently insufficient data to compute population metrics (Williams et al. 2011). An average of 151 steelhead redds have been counted annually in Clear Creek from 2001 to 2010 and the total number of observed redds has steadily increased since Saeltzer Dam was removed in 2000 (Figure 3; data from USFWS). The vast majority of steelhead in Clear Creek are likely of natural origin since hatchery fish are not stocked there and no hatchery origin fish were found during monitoring through at least 2008 (M. Brown, USFWS, pers. comm.).

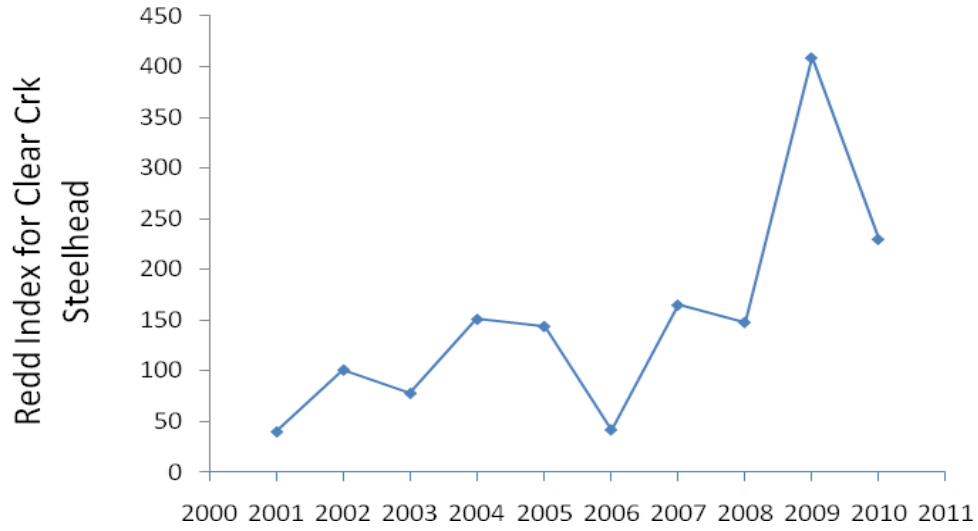

Figure 3. Redd counts on Clear Creek from 2001-2010. Data from USFWS.

In the American River, an average of 154 redds were counted annually between 2002-2010 and the available data suggests a declining trend (Figure 4; data from Hannon and Deason 2008, Hannon et al. 2003, Chase 2010).

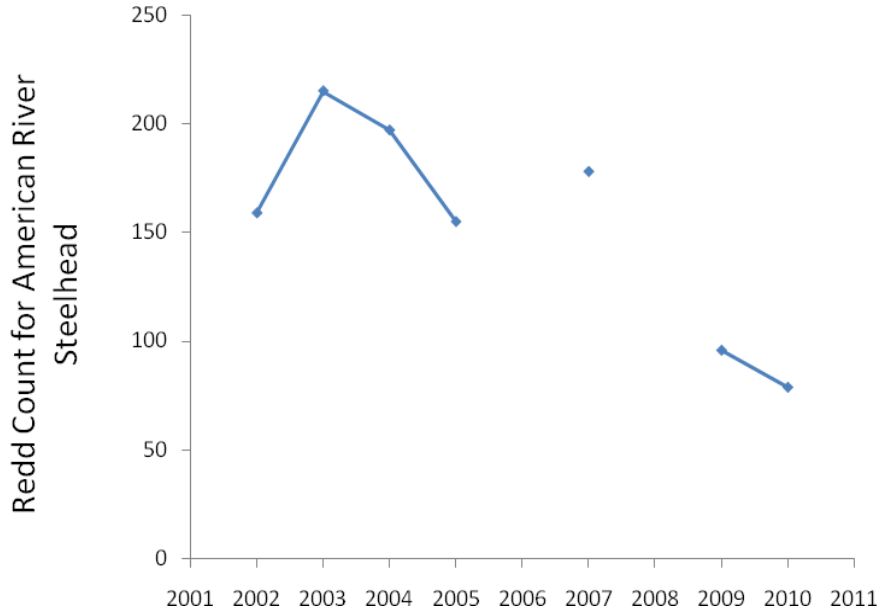

Figure 4. Steelhead redd counts from USBR surveys on the American River from 2002-2010. Surveys could not be conducted in some years due to high flows and low visibility.

The East Bay Municipal Utilities District (EBMUD) has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season. Based on data from these surveys, the overall trend suggests that redd numbers have slightly increased over the years (Figure 5). According to Satterthwaite et al. (2010), it is likely that most of the *O. mykiss* spawning in the Mokelumne River are non-anadromous (ore resident) fish rather than steelhead.

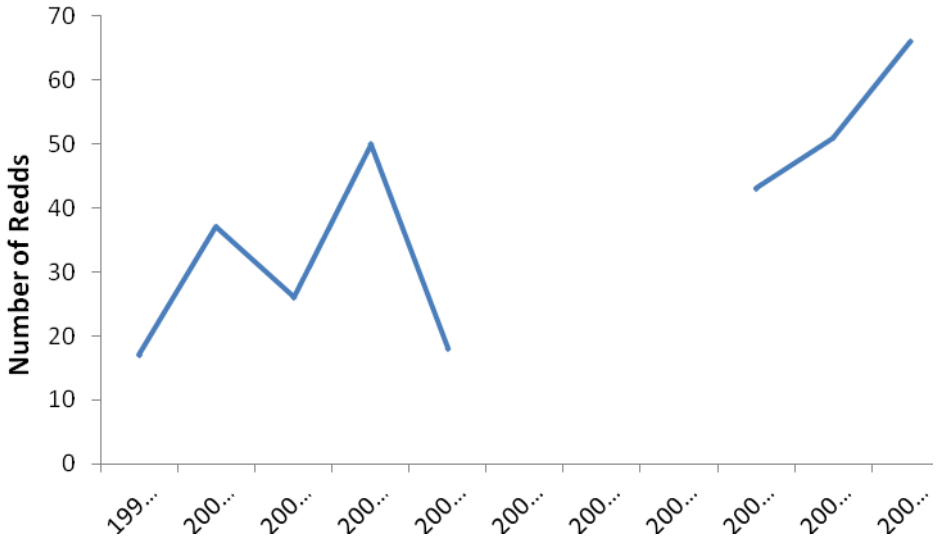

Figure 5. Redd counts from EBMUD surveys on the Lower Mokelumne River between 2000-2010.

Steelhead returns to the Feather River Hatchery have decreased substantially in the last several years with only 679, 312 and 86 fish returning in 2008, 2009 and 2010, respectively (Figure 6). Because almost all of the returning fish are of hatchery origin and stocking levels have remained fairly constant over the years, the data suggest that adverse freshwater and/or ocean survival conditions have caused or at least contribute to these declining hatchery returns. The Central Valley experienced three consecutive years of drought (2007-2009) which would likely have impacted parr and smolt growth and survival and poor ocean conditions are known to have occurred in at least 2005 and 2006 which impacted Chinook populations in the Central Valley and may well have also impacted steelhead populations. Preliminary return data for 2011 from CDFG suggest a strong rebound in return numbers in 2011, with 712 adults returning to the hatchery through April 5. Based on steelhead returns to the hatcheries and the redd counts on Clear Creek, the American River, and the Mokelumne River, it appears that wild fish may not have been impacted by poor freshwater and marine rearing conditions as much as hatchery origin fish over the last several years. This may reflect greater fitness of naturally produced steelhead relative to hatchery fish, and certainly merits further study.

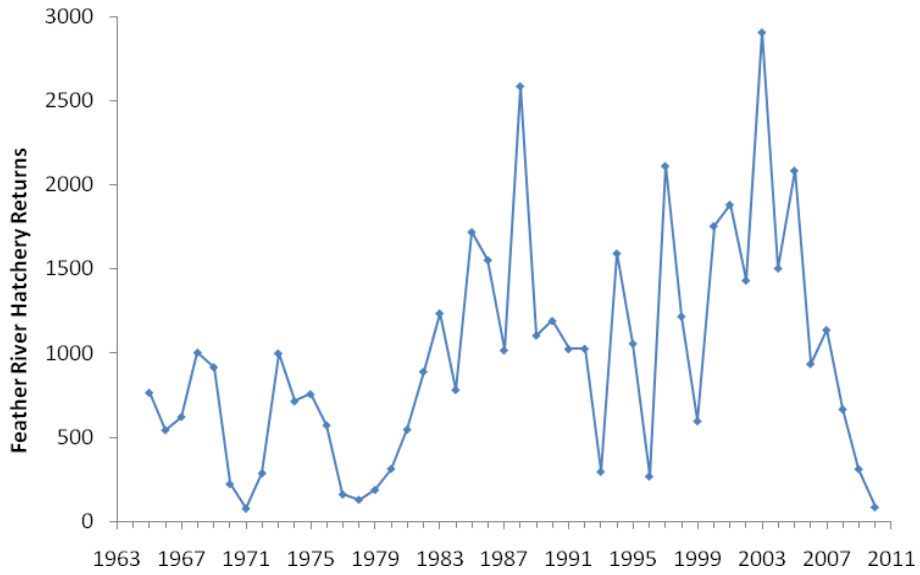

Figure 6. Steelhead returns to the Feather River Hatchery from 1965-2010.

The Chipps Island midwater trawl dataset from the USFWS provides information on the trend in the overall abundance of the CV steelhead DPS (Williams et al. 2011). Updated through 2010, the trawl data indicate that the apparent decline in natural production of steelhead has continued since the 2005 status review (Figure 7). Catch-per-unit-effort has fluctuated over the past decade, but the proportion of the catch that is ad-clipped (100% of all hatchery produced steelhead have been ad-clipped since 1998) has steadily increased, exceeding 90% in recent years and reaching 95% in 2010 (Williams et al. 2011). Because hatchery releases have been fairly constant over the years, these data suggest that natural production of steelhead has been declining.

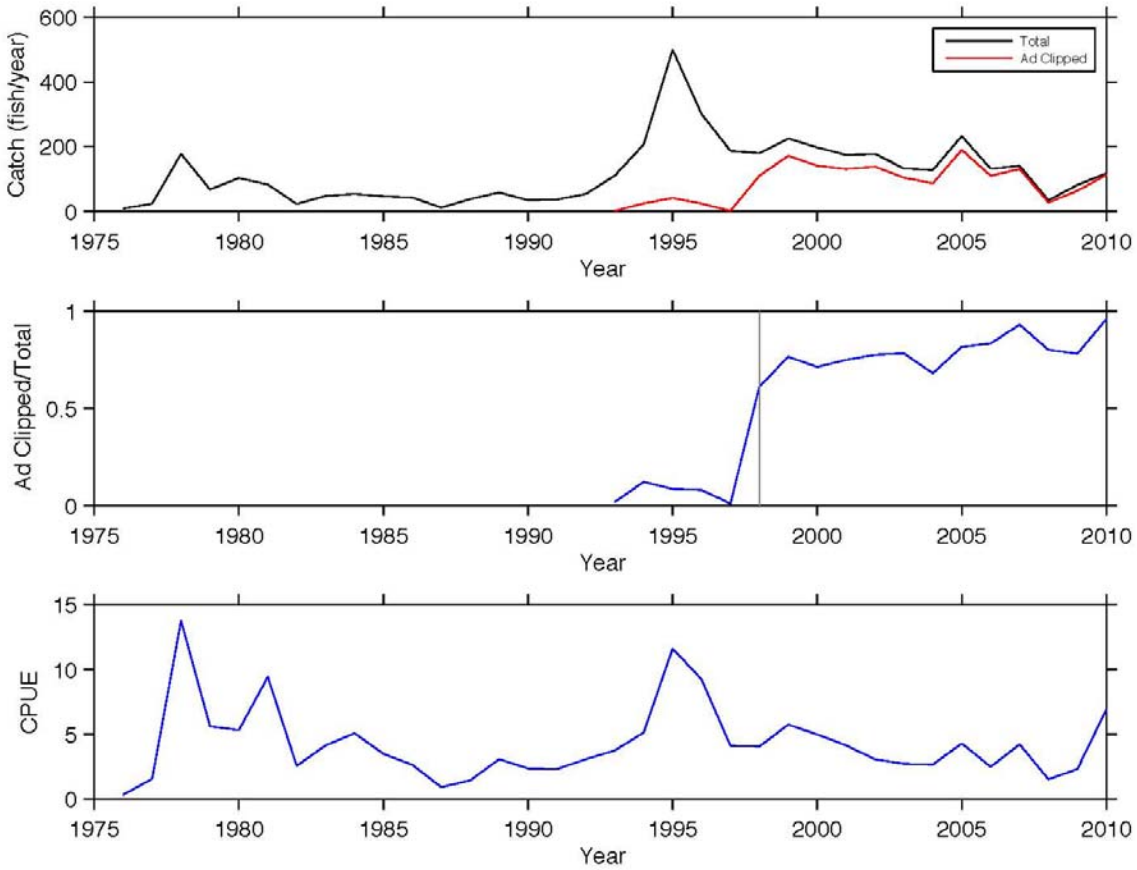

Figure 7. Top: Catch of steelhead at Chipps Island by the USFWS midwater trawl survey. Middle: Fraction of the catch bearing an adipose fin clip. 100% of steelhead production has been marked since 1998, denoted with the vertical gray line. Bottom: Catch per unit effort in fish per million m-3 swept volume. Source: Williams et al. 2011.

Steelhead salvage data from the fish collection facilities at the Federal and State pumping plants in the southern Delta are another source of information on the relative abundance of CV steelhead over time, as well as the production of wild steelhead relative to hatchery steelhead (CDFG; ftp.delta.dfg.ca.gov/salvage). The annual salvage of steelhead at the facilities has fluctuated dramatically since 1993, but there has been a marked decline in the total number of salvaged fish over the past decade, with the largest decline in the number of salvaged hatchery origin fish (Figure 8). The percentage of salvaged fish that are wild has also fluctuated over the

past decade, but has also declined in the past several years.

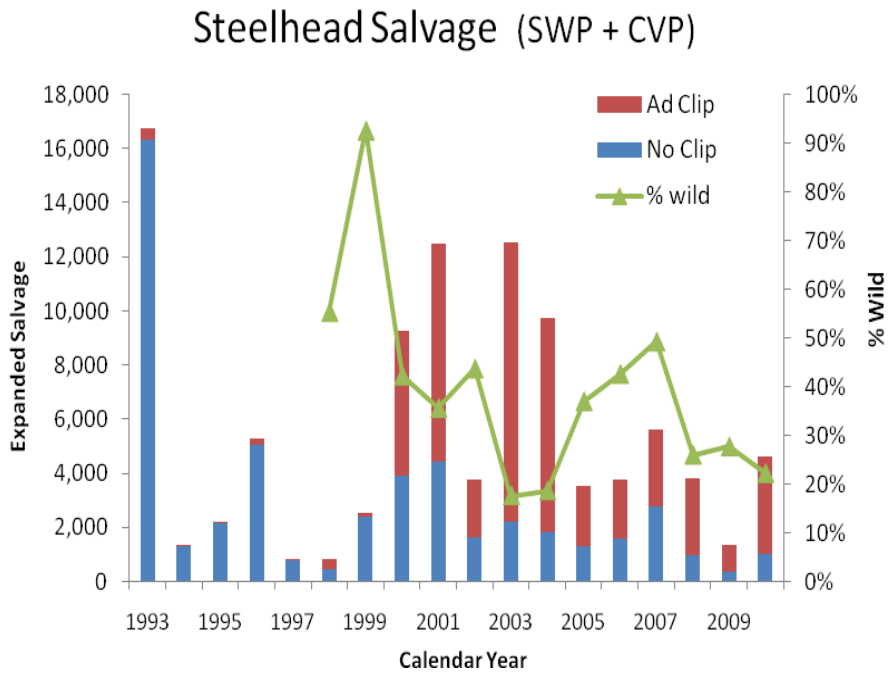

Figure 8. Steelhead salvaged in the Delta fish collection facilities from 1993 through 2010. All hatchery steelhead have been adipose fin-clipped since 1998. Data from CDFG, at: ftp.delta.dfg.ca.gov/salvage.

The available information indicates that steelhead occur in most of the Central Valley watersheds, but are generally present in low numbers especially in the San Joaquin River tributaries. Zimmerman et al. (2009) used otolith microchemistry to show that *O. mykiss* of anadromous parentage occur in all three major San Joaquin River tributaries, but at low levels, and that these tributaries have a higher percentage of resident *O. mykiss* compared to the Sacramento River and its tributaries. The Mossdale trawls conducted annually by CDFG and USFWS capture steelhead smolts, although usually in very small numbers.

Garza and Pearse (2008) analyzed the genetic relationships among Central Valley steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were 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.

Overall, the status of Central Valley steelhead appears to have worsened since the Good et al. 2005 status review when the BRT concluded that the DPS was in danger of extinction (Williams et al. 2011). Analysis of catch data from the Chipps Island monitoring program suggests that natural steelhead production has continued to decline and that hatchery origin fish represent an increasing proportion of the juvenile production. Information from the Delta salvage facilities also suggests a general decline in the natural production of steelhead. Limited information for some individual populations suggests a decline in abundance, but data for the Battle Creek population indicate the declines have been relatively moderate since 2005 and that the population

in Clear Creek is increasing. Hatchery populations (Coleman NFH and Feather River hatchery) suggest hatchery populations have declined in the last several years perhaps in response to poor freshwater and ocean habitat conditions.

2.3.2 Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

Section 4(a)(1) of the ESA and the listing regulations (50 CFR Part 424) set forth procedures for listing species. NMFS must determine, through the regulatory process, if a species is endangered or threatened based upon any one or a combination of the following factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or education purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human-made factors affecting its continued existence. New information relating to each of these five listing factors is discussed below including discussion of important conservation efforts being made to protect the species where appropriate.

2.3.2.1 Present or threatened destruction, modification, or curtailment of its habitat or range

In listing the CV steelhead DPS as threatened in 1998, NMFS emphasized the loss of historical spawning and rearing habitat as one of the major factors responsible for the decline of the species (63 FR 13347). This habitat loss and degradation is due to a combination of water development projects and operations that include, but are not limited to: (1) the presence of impassable dams, water diversions, and hydroelectric operations on almost every major river in the Central Valley; (2) antiquated fish screens, fish ladders, and diversion dams on streams throughout the Sacramento River Basin; and (3) levee construction and maintenance projects that do not incorporate fish-friendly designs. All of those projects and operations reduce the habitat quality and/or quantity for steelhead. The massive alterations to river channels from the gold mining era also continue to impact aquatic habitats throughout much of the Central Valley. Busby et al. (2006) cited other land use practices that have degraded steelhead habitat in the Central Valley including forestry, agriculture, and urbanization of watersheds.

Good et al. (2005) described the threats to Central Valley salmon and steelhead as falling into three broad categories: loss of historical spawning habitat, degradation of remaining habitat, and genetic threats from the stocking programs. Cummins et al. (2008) attributed the much reduced biological status of anadromous salmonid stocks in the Central Valley, including steelhead, to the construction and operation of the Central Valley Project (CVP) and State Water Project (SWP):

> "*Construction and operation of the CVP and SWP have altered flows, reduced water quality, and degraded environmental conditions and reduced habitat for fish and wildlife in the Central Valley from the headwaters to the Delta. This includes the native anadromous fish of the Central Valley -- winter, spring, fall and late-fall chinook, steelhead and sturgeon. Adult runs that once numbered in the millions have been reduced to thousands or less.*
>
> *The transformation of the natural Sacramento/San Joaquin river systems into a massive water storage and delivery system includes dams and diversions that*

have blocked access for anadromous salmonids to much of their historical habitat. Development of the CVP and State Water Project has significantly modified the natural hydrologic, geomorphic, physical and biological systems. The modified river system significantly impacts the native salmon and steelhead production as a result of fragmented habitats, migration barriers, and seasonally altered flow and habitat regimes."

Threats associated with this listing factor continue to impact CV steelhead populations throughout the Central Valley; however, in the past several years many habitat restoration programs and conservation plans have been implemented that, in aggregate are expected to provide substantial benefits to the species and its habitat. These programs are detailed below.

Clear Creek Restoration Program. Seltzer Dam on Lower Clear Creek, a tributary to the upper Sacramento River, was removed in 2000, thereby opening up approximately 10 miles of stream habitat to anadromous salmonids including steelhead. Since this dam removal, there has been extensive gravel augmentation and regulation of instream flows and water temperatures both as part of the Clear Creek Restoration Program and as required by NMFS' CVP-OCAP biological opinion. This program has been successful in restoring Clear Creek habitat conditions such that the watershed now supports a small but increasing population of steelhead. The USFWS has monitored steelhead redds in Clear Creek since 2001 and has documented a steady increase which indicates the steelhead population has responded to the new and improved habitat conditions (see section 2.3.1).

Battle Creek Salmon and Steelhead Restoration Project. This restoration project will eventually remove five dams on Battle Creek, install fish screens and ladders on three dams, and end the diversion of water from the North Fork to the South Fork. When the program is completed, a total of 42 miles of mainstem habitat and six miles of tributary habitat will be opened up to anadromous salmonids, including the SRWRC salmon ESU. Phases lA (North Fork Battle Creek actions) and 1B (a tailrace connector project) have been funded; Phase 2 (South Fork Battle Creek actions) has not been completely funded. Wildcat Diversion Dam on the North Fork of Battle Creek was removed in 2010. Phase 2 is scheduled to be completed between 2012 and 2014. Improved habitat conditions in Battle Creek should support returning steelhead that are currently being passed above the CNFH weir (see section 2.3.1).

Bay-Delta Conservation Plan. The purpose of the Bay Delta Conservation Plan (BDCP) is to help recover endangered and sensitive species, including the CV steelhead DPS, and their habitats in the Delta in a way that also will provide for a more reliable water supply. A proposed BDCP water conveyance system would include new points of diversion in the north Delta in concert with improvements to the current through-Delta water export system in the south Delta. Actions under discussion include operation of a dual conveyance system, habitat restoration, and measures to reduce other stressors to the Delta ecosystem and covered species, such as improved flows in Old and Middle Rivers. However, implementation of BDCP would also cause a reduction in flows below the Sacramento River diversion points, especially during fall and spring months, which could impact emigrating smolts and immigrating adults. BDCP is in a developmental stage, its implementation is uncertain, and any new benefits or threats to steelhead resulting from the plan would not occur for many years. A first draft of the plan was released in 2010 (BDCP 2010).

CVPIA Anadromous Fish Restoration Program. The Central Valley Improvement Act (CVPIA) established the Anadromous Fish Restoration Program (AFRP) in 1992 with the goal of making "all reasonable efforts to at least double natural production of anadromous fish in California's Central Valley streams on a long-term, sustainable basis". Anadromous fish covered under AFRP include all races of Chinook salmon, steelhead, sturgeon, striped bass and American shad. The program is administered jointly by the Bureau of Reclamation and USFWS. Approximately $15 million/year of CVPIA restoration funds will be used for the purpose of protecting, restoring, and enhancing special-status species and their habitats in areas directly or indirectly affected by the Central Valley Project. Through the AFRP, Federal funding for beneficial projects include annual spawning gravel augmentation, instream flow management (i.e., use of 800 thousand acre feet of CVPIA b(2) water from the Central Valley Project), and habitat restoration projects (e.g., Battle Creek, Clear Creek, and Butte Creek). The Anadromous Fish Screen Program also works to optimize fish screen funds with partnership-based sources such as Wildlife Conservation Board, CDFG, and the Ecosystem Restoration Program (see below) and local sources. These screens are important for protecting ESA listed salmonids such as the CV steelhead DPS.

In 2010, the AFRP continued to fund restoration projects that improved habitat, survival, and passage of anadromous fish in several Central Valley streams including Antelope and Cottonwood Creeks and the Calaveras, Cosumnes, Merced, Mokelumne, Stanislaus, and Tuolumne rivers. The program will continue to collect fish population data for Bear, Cottonwood, and Cow creeks and in the Stanislaus and Yuba rivers to facilitate evaluation of restoration actions.

Specific river projects listed in the 2011 CVPIA work plan that are expected to benefit CV steelhead and its habitat include:

- Antelope Creek: construction on fish passage improvements at Edwards Diversion Dam is scheduled to begin in the summer of 2011.
- Big Chico Creek: the Iron Canyon Fish Ladder Project will open up eight miles of spawning and rearing habitat when completed. This project still needs an $870,000 to complete.
- Butte Creek: the ACID Siphon Project will improve passage at a partial low flow barrier. The design and permits were completed in 2010.
- Cow Creek: modifications to the Millville Diversion Dam (removal of the dam and siphon structure) will open up 10 miles of habitat on Clover Creek, a small tributary to Cow Creek.
- Yuba River: the Hammon Bar Habitat Restoration Project will plant cottonwood trees at four sites, covering 129 acres in total.
- Bear River: an assessment will be made of summer rearing habitat for steelhead with plans for potential restoration.
- American River: habitat restoration, including extension of a gravel bar, and gravel augmentation to restore a side channel.
- Mokelumne River: gravel augmentation at several sites to improve spawning habitat.
- Calaveras River: a fish passage improvement project will retrofit Budiselich Flashboard Dam and improve access to about ten miles of habitat. In addition, designs have been

completed and the permit process initiated on a project to improve fish passage at the Caprini and California Traction Railroad crossings.

- Stanislaus River: the Lancaster Road Project will restore 640 ft. of riparian habitat and the Honolulu Bar Project will restore 2.47 acres of riparian floodplain and 485 ft. of side-channel habitat. A study of *O. mykiss* movement using acoustic transmitters is planned.
- Merced River: designs and permits have been completed for the Merced River Ranch Floodplain Enhancement Project which will add 12,000 cu yds. of gravel for spawning habitat and restore six acres of riparian floodplain and 1.23 miles of spawning habitat.
- Tuolumne River: the Bobcat Flat Restoration Project will remove gravel and coarse material from 11 acres of highly disturbed floodplain (dredger mining spoils), and restore about 1.6 miles of spawning and rearing habitat.

Ecosystem Restoration Program. The Ecological Restoration Program (ERP) has completed seven years of an ambitious 30-year plan to restore ecological health and improve water management in the San Francisco Bay and Sacramento-San Joaquin Delta. Under the 2000 CALFED Record of Decision (ROD), the DFG fulfills the role as the State's Implementing Agency for ERP and is currently managing more than 85 ongoing and approximately 10 newly funded projects. The ERP enables actions from all of its program elements to be completed in compliance with the Federal ESA, the California Endangered Species Act, and California's Natural Communities Conservation Planning regulations. The objectives of the ERP are to: 1) prepare comprehensive ecosystem restoration plans for the Sacramento and San Joaquin Rivers, 2) support scientific reviews, and 3) coordinate fish screen and fish passage projects with the AFRP, CVPIA, and other stakeholders to achieve DFG fish passage goals.

Program activities for 2010-2011 include work in the following areas:

- Bay-Delta Conservation Plan
- Contaminants and Water Quality
- Ecosystem Restoration Program's 2010-2011 Proposal Solicitation Package (PSP)
- Non-Native Invasive Species Program
- Performance Measures

Since 2000, the ERP has funded 490 projects in the Central Valley for a total of approximately $629 million of which about 75% are complete. These projects have met or exceeded nearly 80% of the 119 milestones for the first stage of the program. The ERP has protected or restored more than 150,000 acres of habitat including the following actions:

- Contributed to the restoration and protection of 8,000 acres of wetlands in San Pablo Bay and Suisun Marsh
- Protected more than 11,000 acres and 18 river miles for riparian and shaded-riverine-aquatic habitat restoration
- Enhanced or restored more than 3,900 acres and 59 miles of riparian and riverine aquatic habitat
- 500 acres of fresh emergent wetland in the San Joaquin River Region were enhanced, protected, and/or restored
- Installed or improved 70 fish screens (11 that draw >250 cfs)

- Restored stream habitats and removed impediments to salmonid passage in critical areas including Clear Creek, Battle Creek, Cottonwood Creek, Tuolumne River, Cosumnes River, Mokelumne River and the Merced River.
- Protected 16,000 acres of agricultural land largely through conservation easements with private landowners.

Butte Creek. Recent conservation actions have improved habitat conditions for Butte Creek steelhead. Completion of the Willow Slough Weir Project (new culverts and a new fish ladder) in 2010 improved fish passage through the Sutter Bypass. In addition, since 2000, real-time coordinated operations of the Desabla Centerville FERC Project No. 803 have been implemented to reduce the water temperature-related effects of the project on spring-run Chinook salmon adults during the summer, which will also benefit steelhead parr. There are also proposals to monitor steelhead as part of the project (need reference).

*Feather River***.** Through the Oroville FERC License Settlement, DWR has committed to implementing low-flow channel habitat improvements, which would benefit steelhead spawning and rearing. Currently, nearly all the steelhead that return to the Feather River Hatchery are hatchery fish, indicating that spawning and/or rearing habitat for steelhead in the Feather River is very poor.

Lower Yuba River Habitat Restoration. The U.S. Army Corps of Engineers initiated a long-term gravel augmentation program in 2010 that is intended to improve spawning habitat in the uppermost reach of the lower Yuba River. Other lower Yuba River habitat restoration actions that are reasonably certain to occur in the next several years include improved fish passage at Daguerre Point Dam (known to have passage problems at high flows), a long-term program to add woody material to the river in an effort to increase habitat complexity, and a riparian enhancement project intended to improve rearing habitat in the short- and long-term. In addition, the FERC re-licensing process for the Yuba River Project is likely to include monitoring studies of *O. mykiss* in the Lower Yuba River over the next five years.

San Joaquin River Restoration Program. The San Joaquin River Restoration Program (SJRRP) calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam, releases of water from Friant Dam to the confluence of the Merced River, and the reintroduction of spring-run Chinook salmon. The first flow releases from Friant Dam in support of the SJRRP occurred in October 2009. Key SJRRP milestones include: (1) reintroducing spring-run Chinook salmon by December 2012; (2) completing all high priority channel and structural construction activities by December 2013; and (3) releasing the full restoration flows in 2014. Though this program is focused on spring-run Chinook salmon, it has the potential to improve habitat for steelhead as well. It is unclear if summer water temperatures will be cold enough to support steelhead parr.

NMFS 2009 biological opinion on the long-term operations of the Central Valley Project and State Water Project. NMFS' 2009 biological opinion addresses the long term operations of the Central Valley Project (CVP) and State Water Project (SWP) and contains several mandatory actions that are intended to ensure the continued existence of the CV steelhead DPS and other listed salmonids is not jeopardized and their critical habitat is not adversely modified. Actions described in the 2009 biological opinion that are intended to improve spawning and rearing habitat include:

- Implementation of Shasta Reservoir storage plans and Keswick Dam release schedules and procedures designed to provide cold water for spawning and rearing [underway];
- Modification of Red Bluff Diversion Dam gate operations such that they are open from September 1 through June 14 each year to improve upstream migration for adults as well as downstream survival of juveniles [underway]. By May 2012 the diversion dam must be operated with the gates out year-round;
- Funding to assist in completing the Battle Creek Restoration Project [underway];
- Funding to support the CVPIA Anadromous Fish Screen Program [underway];
- Modification of the Delta Cross Channel gate operations
- Habitat restoration of 17,000 – 20,000 acres of seasonally inundated floodplain habitat in the lower Sacramento River basin to improve juvenile salmonid rearing starting in 2013 [underway];
- Implementation of multiple actions to improve flow (reduce negative flows at Old and Middle River) and habitat conditions in the Delta to improve juvenile survival [underway].
- Implementation of multiple actions on Clear Creek designed to provide more suitable flows and water temperatures and increase the availability of spawning habitat through gravel additions [underway];
- Measures on the Stanislaus River to set specific temperature criteria, flow schedules, riparian habitat restoration, and gravel augmentation; and
- Measures on the American River to set specific temperature criteria and analyze additional measures to improve temperatures such as a temperature control device, flow schedules

In addition to these habitat improvement actions, the biological opinion includes a phased fish passage program that is intended to ultimately expand habitat for this DPS above Folsom Dam on the American River. Phases of the fish passage program include habitat evaluations through January 2012, pilot reintroductions from January 2012 through January 2015, and implementation of the long-term program by January 31, 2020. On the Stanislaus River a pilot steelhead passage program is "encouraged" but not required.

FERC Relicensing on San Joaquin River Tributaries. PG&E's license for the Merced Falls Project on the Merced River expires in 2014. Preliminary negotiations have included discussions to improve fish passage at the Crocker-Huffman Dam which would allow access up to Merced Falls Dam, thereby pening up about two miles of habitat to Central Valley steelhead. The license for the Don Pedro Project on the Tuolumne River, owned by Turlock & Modesto Irrigation Districts, will expire in May 2016. This project has been voluntarily releasing more summer flow than required under their current license and there has been a small improvement in *O. mykiss* snorkel counts in the Tuolumne River (Stillwater Sciences 2009).

Draft Central Valley Salmon and Steelhead Recovery Plan. A public draft recovery plan for Central Valley salmon and steelhead was released by NMFS in 2009. This plan is intended to serve as a road map for recovering Central Valley spring-run Chinook salmon, winter-run Chinook salmon, and steelhead. The plan contains prioritized actions based on a comprehensive threats assessment. While the plan itself does not include dedicated funding for recovery efforts, it will help guide conservation planning efforts including those carried out under the large

comprehensive programs discussed above.

While some conservation measures have been successful in improving habitat conditions for CV steelhead over the past decade, access to historic habitat remains blocked in many cases and fundamental problems still remain with the quality of the species remaining habitat (see Lindley et al. 2009 and Cummins et al. 2008) and it continues to be highly degraded. Overall, major habitat expansion and restoration for this species will require access to habitat (i.e. fish passage) above several rim dams in the Central Valley and restoration of its current habitat, including the Delta. In summary, the loss of historical habitat and the degradation of remaining habitat both continue to be major threats to this DPS.

2.3.2.2 Overutilization for commercial, recreational, scientific, or educational purposes

Steelhead historically supported an important recreational fishery in the Central Valley and continue to be a recreational fishery target. The State of California does not allow the retention of natural (or wild) steelhead in the Central Valley, but does allow fishing for hatchery origin steelhead, and their retention, in some areas. This fishery is not currently authorized under the ESA, but NMFS does coordinate with the State of California to ensure that the fishing regulations minimize impacts on natural or wild steelhead. There is some concern about hooking and handling stress causing mortality of steelhead parr and smolts on popular rivers such as the American and Feather. High water temperatures in the summer and fall likely contribute to any mortality caused by angling. CDFG has proposed a study on the American River to evaluate the extent of this problem. There is no commercial fishery for steelhead in rivers of the Central Valley and very few adults are reported caught in ocean fisheries, though there may be some by-catch that goes unreported. There is no new information indicating that impacts to CV steelhead from fisheries have changed in severity since the 2005 status review.

NMFS issues permits under the ESA for scientific research that stipulate specific conditions to minimize take of steelhead. These permitted studies provide information about steelhead in the Central Valley that is useful for management and conservation of the DPS and are not considered a factor for the decline of this species. There is no new information indicating that impacts from the issuance of research permits have changed in severity since the 2005 status review.

2.3.2.3 Disease or predation

Disease

Naturally occurring pathogens may pose a threat to CV steelhead and artificially propagated steelhead are susceptible to disease outbreaks such as the Infectious Hematopoietic Necrosis Virus (IHNV) and Bacterial Kidney Disease. Very little current or historical information exists to assess the impact of these and other diseases on CV steelhead. In general, however, naturally spawned fish are considered less susceptible to pathogens than hatchery origin fish. There is evidence of some disease in parr on American River (rosy anus documented by Rob Titus, CDFG) which may be linked to high summer and fall water temperatures in that system. Overall, there is no new information indicating that impacts from disease have changed in severity since the 2005 status review.

Predation

Predation on steelhead parr and smolts by both native (pikeminnow) and non-native predators (striped bass, largemouth bass, smallmouth bass) is highly likely both in their natal rivers and during their migration though the lower rivers and the Delta. In Clifton Court Forebay, tagged hatchery smolts are known to be heavily preyed upon by striped bass. Recent Experiments (VAMP 2008, VAMP 2009) have shown that predation on emigrating Chinook salmon smolts is a major contributing Steelhead smolts are larger and faster than Chinook smolts and may be less predation, but predation on steelhead still likely occurs even if it is difficult to quantify. In general, predation on steelhead is not considered to be a significant factor in the species decline, but for some localized populations it may be problematic depending on the concentration of predators or unique habitat features that increase susceptibility to predation. Lastly, there is little evidence that hatchery steelhead prey on naturally produced wild steelhead. Most diet studies of steelhead have been on parr in rivers and streams and they have shown that their diets are dominated by invertebrates, with few if any fish consumed.

California sea lions and Pacific harbor seals are known predators of salmonids, and their populations have been increasing in abundance. Predation by these marine mammals may significantly influence salmonid abundance in some local populations when other prey species are absent and physical conditions lead to the concentration of salmonid adults and juveniles (Cooper and Johnson 1992). Although fishes form the principal food sources of many marine mammals, steelhead are very likely a minor component of their diet given the low abundance of wild steelhead in the Central Valley. Although there are likely more seals and sea lions than existed at the time of the last status review, there is no information suggesting that predation from these species are a significant threat to CV steelhead.

Overall, there is no new information indicating that impacts from predation have changed in severity since the 2005 status review.

2.3.2.4 Inadequacy of existing regulatory mechanisms

Monitoring

At the time the Central Valley steelhead DPS was listed as threatened in 1998 (63 FR 13347), the lack of monitoring data for most populations was cited as a major concern. Lack of monitoring continues to be a problem for this DPS. The CDFG, with funding from the Bureau of Reclamation, has just completed a monitoring plan for CV steelhead with the goal of improving adult escapement estimates. If fully implemented, this monitoring plan will provide steelhead abundance data for several watersheds in the Central Valley and eventually allow for the long-term tracking of populations in a way that currently exists for the three species of Chinook salmon in the Central Valley. The likelihood that this program will be funded and implemented is uncertain.

Water Quality Regulation

Laws intended to protect California's water quality include the federal Clean Water Act and Porter-Cologne Act (California Water Code). Agencies implementing these laws have directed considerable attention to salinity regulation in the Delta in order to ensure that freshwater is

available for irrigating agricultural lands and for municipal and industrial uses. Poor water quality in the Delta resulting from agricultural and urban sources is a factor contributing to the ongoing collapse of the Delta ecosystem, which was detected when four pelagic fish species simultaneously and dramatically declined in abundance in 2002. Stronger implementation and enforcement of the Clean Water Act and the Porter-Cologne Act are needed in order to control agricultural (e.g., pesticides) and urban (e.g., ammonium) water pollution throughout the Central Valley.

2.3.2.5 Other natural or manmade factors affecting the DPS' continued existence

Hatchery Programs

Previous status reviews of this DPS have identified hatchery fish influence as a significant threat to its genetic integrity and diversity. Williams et al. (2011) identify the increasing dominance of hatchery fish relative to naturally produced fish as a significant concern. There are four hatcheries (Coleman NFH, Feather River fish hatchery, Nimbus fish hatchery, and Mokelumne River fish hatchery) in the Central Valley which combined release approximately 600,000 yearling steelhead smolts each year. These programs are intended to mitigate for the loss of steelhead habitat caused by dam construction, but hatchery origin fish now appear to constitute a major proportion of the total abundance in the DPS. As noted previously, two of these hatchery stocks (Nimbus and Mokelumne River hatcheries) originated from outside the DPS (mainly from the Eel River) and are not presently considered part of the DPS.

Potential threats to natural steelhead from hatchery programs include: 1) mortality of natural steelhead in fisheries targeting hatchery origin fish, 2) competition for prey and habitat, 3) predation by hatchery origin fish on younger natural fish, 4) disease transmission, and 5) genetic introgression by hatchery origin fish that spawn naturally and interbreed with local natural populations.

High densities of hatchery fish in some rivers may cause competition with wild parr and smolts. This problem will be greatest when hatchery smolts residualize. How often this occurs in Central Valley Rivers is unknown. What is known is that some hatchery smolts do stray into other rivers. For example, hatchery smolts have been documented in the Vaki camera at Daguerre Dam on the Yuba River and most likely originated from the Feather River. How long they remain upstream before emigrating to the ocean, or if they become resident fish is unknown.

Introgression of stray domestic rainbow trout with steelhead either during egg take or in-river spawning may be occurring, as genetic sampling has documented their presence in at least one Central Valley hatchery (Garza and Pearse 2008). Garza and Pearse (2008) also found that all below-dam steelhead populations in the Central Valley were genetically closely related, and that they had a high level of genetic similarity to Eel River and Klamath River steelhead. Since the steelhead broodstock at the Nimbus and Mokelumne River hatcheries are of Eel River origin, which is an out-of-DPS source, the genetic data suggests that progeny from those hatcheries have become widely introgressed with natural populations throughout the Central Valley. The impacts of such introgression are uncertain, but there appears to have been a loss of local genetic diversity and population structure over time.

It is unclear if the impacts of hatchery programs have changed in severity since the last review, but new information clearly suggests a loss of genetic diversity and population structure over time. Overall, impacts from hatcheries continue to be a ongoing threat to this DPS.

Drought

The Central Valley experienced drought-like conditions from 2007 through 2009. Lindley et al. (2009) found that these drought conditions contributed to the decline of Chinook salmon in the Central Valley as a result of low flows, reduced freshwater habitat, and higher water temperatures, and also favored introduced warm water species (*e.g.*, striped bass, largemouth bass, and smallmouth bass) that prey on juvenile salmonids. It is very likely that these adverse conditions also reduced the already limited amount and quality of habitat for steelhead over this period. It is possible that the very low numbers of adult steelhead seen at the Feather and Coleman hatcheries in the last two years were at least partly related to the drought, although there may have been other contributing factors including poor ocean conditions.

Climate Change

Lindley et al. (2007) summarized several studies (Hayhoe et al. 2004, Dettinger et al. 2004, Dettinger 2005, Van Rheenen et al. 2004, Knowles and Cayan 2002) that describe how anthropogenic driven climate change is expected to alter the Central Valley and the possible effects to anadromous salmonids from the predicted climate changes. Climate model results for the Central Valley are broadly consistent in that they predict future temperatures will warm significantly, total precipitation may decline, the variation in precipitation may substantially increase (*i.e.*, more frequent flood flows and critically dry years), and snowfall will decline significantly (Lindley et al. 2007). Not surprisingly, future climate change-driven temperature increases are expected to further limit the amount of suitable habitat available to anadromous salmonids. The potential for more frequent flood flows might be expected to reduce the abundance of populations as egg scour becomes a more common occurrence. The increased frequency of critically dry years also would be expected to reduce salmonid abundance since low flows in the Central Valley during juvenile rearing and outmigration periods are associated with poor survival (Kjelson and Brandes 1989, Baker and Morhardt 2001, Newman and Rice 2002). In addition to habitat effects, climate change may also impact Central Valley salmonids through fish community effects. For example, warmer water temperatures would likely increase the abundance and metabolism of predators leading to increased predation and reduced juvenile salmonid survival (Vigg and Burley 1991). Peterson and Kitchell (2001) showed that on the Columbia River, pikeminnow predation on juvenile salmon during the warmest year was 96 % higher than during the coldest year. In summary, climate change is expected to exacerbate existing stressors and pose new threats to Central Valley salmonids by reducing the quantity and quality of inland freshwater habitat (Lindley et al. 2007).

Ocean Conditions

Over the last five years, there has been a period of widespread decline in all Central Valley Chinook salmon stocks. An analysis by Lindley et al. (2009) that examined fall-run Chinook found that unusual oceanic conditions led to poor growth and survival for juvenile salmon entering the ocean from the Central Valley during the spring of 2005 and 2006 and most likely contributed to low returns in 2008 and 2009. This reduced survival was attributed to weak

upwelling, warm sea surface temperatures, low prey densities, and poor feeding conditions in the ocean. When poor ocean conditions are combined with drought conditions in the freshwater environment the productivity of salmonid populations can be significantly reduced. Although it is unclear how these unusual ocean conditions affected Central Valley steelhead, it is highly likely they were adversely impacted by a combination of poor ocean conditions and drought over the past five years.

2.4 Synthesis

The CV steelhead DPS was first listed as a threatened ESU in 1998. In 2006 is status was reaffirmed as threatened and it was defined as a DPS under the joint NMFS-FWS DPS policy. The DPS is comprised of multiple, small populations distributed throughout most areas of the Central Valley. Critical habitat was designated in 2005 and includes most occupied habitat below major dams in the Central Valley. The DPS includes two hatchery populations (Coleman NFH and Feather River hatchery). Two additional hatchery populations (Nimbus and Mokelumne River Hatchery) also are present in the Central Valley, but they were founded from out-of-DPS broodstock and are not considered part of the DPS. Recent genetic information suggests that below dam populations throughout the Central Valley are similar genetically and that genetic diversity and population structure may have been lost over time. The new genetic information suggests that the membership status of the Nimbus and Mokelumne River hatcheries should be reconsidered.

The Central Valley Technical Recovery Team evaluated the population structure of the CV steelhead DPS and concluded there were more than 80 independent populations along with a number of smaller dependent populations. Many of these historical populations are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Impassable dams also block significant portions of habitat for many other populations within watersheds even when not all habitat is blocked. Using data through 2005, Lindley et al. (2007) found the data were insufficient to determine the status of any of the naturally-spawning populations of Central Valley steelhead, except for those spawning in rivers adjacent to hatcheries. These hatchery influenced populations were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

Overall, the status of the CV steelhead DPS appears to have worsened since the most recent status review when it was considered to be in danger of extinction (Good et al. 2005). Analysis of catch data from the Chipps Island monitoring program suggests that natural steelhead production has continued to decline and that hatchery origin fish represent an increasing proportion of the juvenile production in the Central Valley. Data from the Delta fish salvage facilities also suggests a general decline in the natural production of steelhead. Data on hatchery populations (Coleman NFH and Feather River hatchery) suggest they have declined in the last several years perhaps in response to poor freshwater and ocean habitat conditions. Limited information suggest some individual steelhead populations in the Central Valley are declining in abundance, but more complete data for the Battle Creek population indicate the declines there have been relatively moderate since 2005 and that the population in Clear Creek is increasing. One continuing area of strength for the CV steelhead DPS is its widespread spatial distribution throughout most watersheds in the Central Valley. Though most monitored populations are small (and sometimes very small), steelhead can be found in most of the major rivers and streams of the Sacramento River, the San Joaquin River, and eastside tributaries including the

Mokelumne River and Calaveras River. The steelhead population in Clear Creek has clearly benefited from the removal of Saeltzer Dam, resulting in one of the strongest steelhead populations in the Central Valley.

All of the factors originally identified as being responsible for the decline of this DPS are still present though in some cases they have been reduced by regulatory actions (*e.g.*, NMFS CVP-SWP biological opinions in 2004 and 2009, actions required by CVPIA, actions in Clear Creek, etc.). Good et al. (2005) described the threats to Central Valley salmon and steelhead as falling into three broad categories: loss of historical spawning habitat, degradation of remaining habitat, and genetic threats from the stocking programs. Cummins et al. (2008) attributed the much reduced biological status of anadromous salmonid stocks in the Central Valley, including steelhead, to the construction and operation of the Central Valley Project (CVP) and State Water Project (SWP). Important conservation efforts have been implemented including the 2009 CVP-SWP biological opinion, CVPIA restoration efforts, and others as detailed previously. Efforts have continued to implement the Battle Creek Restoration Project which will eventually open up 42 miles of high quality habitat to steelhead. Although these efforts have provided benefits to steelhead and its habitat in the Central Valley, threats from lost habitat and degraded habitat continue to be important factors affecting the status of this DPS. Impacts to CV steelhead from harvest, research activities, disease and predation were considered relatively minor factors in previous reviews, and there is little or no evidence indicating impacts from these factors have changed. In contrast, threats from other factors such as hatcheries, drought, poor ocean survival conditions, and climate change have not been addressed and/or they have increased since the last status review and some are likely responsible for the recent declining abundance of the DPS.

In summary**,** the most recent biological information suggests that the extinction risk of this DPS has increased since the last status review and that several of the listing factors have contributed to the decline, including recent years of drought and poor ocean conditions. There continue to be ongoing threats to the genetic integrity of natural or wild steelhead from hatchery steelhead programs in the Central Valley, but it is unclear if or how this factor has influenced the overall viability of the DPS. The best available information on the biological status of the DPS and continuing and new threats to the ESU indicate that its ESA status as a threatened species is appropriate. Long term recovery of this DPS will require improved freshwater habitat conditions, abatement of a wide range of threats including genetic threats from hatchery populations, and the reintroduction of steelhead to some of its historic habitat.

3.0 RESULTS

3.1 Recommended Classification

Based upon a review of the best the available information, we recommend that the CV steelhead DPS remain classified as a threatened species. However, this review indicates that the biological status of this ESU has worsened since the last status review, and therefore, we recommend that its status be reassessed in 2-3 years if it does not respond positively to improvements in environmental conditions and management actions. In the interim, the status of the DPS should be monitored carefully and the SWR in collaboration with the SWFSC should carefully review and assess the most recent genetic information for this DPS, including information for the four steelhead hatchery stocks, to re-assess the DPS membership status of the Nimbus and

Mokelumne River hatcheries. New information resulting from this genetics review should be incorporated into any updated status review for the DPS.

3.2 New Recovery Priority Number

No change is recommended in the recovery priority number for this DPS.

3.3 ESU Boundary and Hatchery Stocks

No change is recommended at this time in the DPS boundary or membership status of any hatchery stock.

4.0 RECOMMENDATIONS FOR FUTURE ACTIONS

We recommend the following future actions be implemented to promote conservation of the CV steelhead DPS:

(1) Secure funding for the CDFG Comprehensive Central Valley Steelhead Monitoring Plan

(2) Conduct monitoring of steelhead smolts in representative watersheds in the Central Valley. Possible sites include the Battle Creek weir, the Daguerre Dam fish ladder, or a diversion structure on the Lower Yuba River. This monitoring should include trapping, sampling, and tagging smolts at these locations to determine run timing, size and age at smolting, and smolt to maiden spawner survival.

(3) Hatchery and Genetic Management Plans (HGMPs) should be developed for all Central Valley steelhead hatchery programs that include collection of biological data from a subset of all returning fish, including scale samples, length, weight, sex, origin, and state of maturity. Hatcheries should conduct studies of smolt survival using modern tagging methods such as PIT tags and acoustic tags.

(3) Finalize the draft Central Valley Salmon and Steelhead Recovery Plan.

(4) Implement Battle Creek restoration and fish passage.

(5) Improve passage for both juvenile and adult steelhead in all streams.

(6) Implement the RPAs contained in the 2009 CVP-OCAP biological opinion including provisions for: fish passage above dams; removal of the Red Bluff Diversion Dam gates; restoration of floodplain habitat; and improved juvenile survival through the Delta.

5.0 REFERENCES

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NATIONAL MARINE FISHERIES SERVICE
5-YEAR REVIEW
Central Valley Recovery Domain
Central Valley Steelhead

Current Classification: Threatened

Recommendation resulting from the 5-Year Review: Retain current ESA classification as threatened and current DPS boundary. Continue to include hatchery stocks in the DPS.

REGIONAL OFFICE APPROVAL:

Lead Regional Administrator, NOAA Fisheries

Approve: _____ Date: _____

Cooperating Regional Administrator, NOAA Fisheries

_____Concur _____ Do Not Concur

Signature_____ Date_____

HEADQUARTERS APPROVAL:

Assistant Administrator, NOAA Fisheries

_____Concur _____ Do Not Concur

Signature_____ Date_____