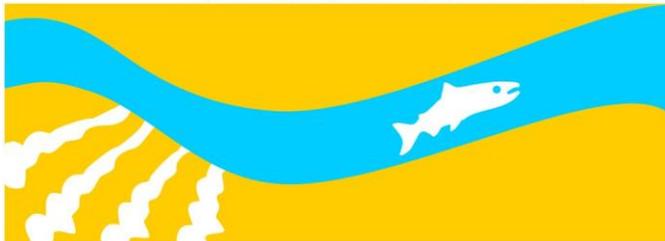


**Study 14**

# **Central Valley Steelhead Monitoring Plan**

**Final  
2015 Monitoring and Analysis Plan**

**SAN JOAQUIN RIVER**  
RESTORATION PROGRAM





# 1.0 Central Valley Steelhead Monitoring Plan

## **Theme(s):**

- Long-term monitoring

## **Related Question(s):**

Questions not developed for this theme to date.

## 1.1 Statement of Need

The Central Valley (CV) Steelhead Distinct Population Segment (DPS) includes naturally spawned populations of steelhead, and their progeny, in the Sacramento and San Joaquin rivers and their tributaries and is protected under the U.S. Endangered Species Act; 61 FR 4722 (NMFS, 2005). Tributaries include those that drain the western slopes of the Sierra Nevada Mountains (i.e., Mokelumne, Calaveras, Stanislaus, Tuolumne, Merced, Chowchilla, Fresno, upper San Joaquin, Kings, Kaweah, and Kern Rivers, and Caliente Creek (NMFS, 2009)). According to Eilers et al. (2010), CV steelhead are currently extirpated from all waters upstream of the Merced River and San Joaquin River confluence. However, irrigation return and Restoration Flows could attract adult steelhead into the Restoration Area. Attracted steelhead would not have access to appropriate spawning habitat due to a number of impassable barriers. Because of their listed status, the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) has previously implemented a steelhead monitoring and detection plan (SMP) for the San Joaquin River, upstream from its confluence with the Merced River that in the event of capture would result in recording, transportation, and subsequent release of the fish to the mouth of the Merced River.

## 1.2 Background

Potential routes to spawning habitats for migratory fish such as the CV steelhead (*Oncorhynchus mykiss*) are believed to have been historically unhindered in the San Joaquin River before completion of the Friant Dam. Although little detailed information on steelhead distribution and abundance in the San Joaquin River is available (McEwan, 2001, Lindley et al., 2006), steelhead in the Klamath River Basin typically overlapped with distributions of Chinook salmon (*O. tshawytscha*) though steelhead may distribute further upstream (Voight and Gale, 1998, as cited in McEwan, 2001). Therefore, steelhead may have spawned at least as far upstream as the natural barrier located at the present-day site of Mammoth Pool and the upper reaches of San Joaquin River tributaries. Modeling of potential steelhead habitat by Lindley et al. (2006) suggests that a portion of the upper San Joaquin River basin historically supported an independent

steelhead population. However, much of the habitat downstream from this population's modeled distribution may have been unsuitable for rearing because of high summer water temperatures. Lindley et al. (2006) concluded that suitable steelhead habitat existed historically in all major San Joaquin River tributaries, although to a lesser degree than in stream systems in the Cascades, Coast Range, and Northern Sierra Nevada. Additionally, steelhead are historically documented in the Tuolumne and Kings River systems (McEwan, 2001).

Steelhead abundance and distribution in the San Joaquin River Basin have substantially decreased (McEwan, 2001), and steelhead have been extirpated from the Restoration Area of the San Joaquin River Restoration Program (SJRRP) since the construction of Friant Dam. Based on their review of factors contributing to steelhead declines in the Central Valley, McEwan and Jackson (1996) concluded that basin-wide population declines were related to water development and flow management that resulted in habitat loss. Dams have blocked access to historical spawning and rearing habitat upstream, thus forcing steelhead to spawn and rear in the lower portion of the rivers where water temperatures are often high enough to be lethal (Yoshiyama et al., 1996, McEwan, 2001, Lindley et al., 2006). However, steelhead continue to persist in low numbers in the Stanislaus, Tuolumne, and Merced River systems (McEwan, 2001, Zimmerman et al., 2008).

Steelhead are the anadromous form (i.e., returning from sea to the river in order to spawn) of *O. mykiss*. The CV steelhead DPS was listed as a threatened evolutionarily significant unit by the National Marine Fisheries Service (NMFS) (NMFS, 1998). Critical habitat for CV steelhead DPS in the San Joaquin River Basin includes the Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers (NMFS, 2005). On August 15, 2011, NMFS completed the 5-year status review of CV steelhead DPS and recommended that they remain classified as a threatened species. Currently, CV steelhead DPS critical habitat extends upstream on the San Joaquin River to the confluence with the Merced River (NMFS, 2011).

CV steelhead are divided into two types: summer-run and winter-run. Summer-run steelhead are river-maturing fish species that require coldwater pools between 55°F and 70°F for holding and staging (Moyle, 2002). According to Lindley et al. (2006), summer-run steelhead have been extirpated because suitable summer holding habitats are located above impassable dams. Therefore, ocean maturing winter-run steelhead are the only type found in the Central Valley (Moyle, 2002).

Two to three year-old CV steelhead generally migrate to freshwater (Reynolds, 1993), and occurrence of adults in the San Joaquin River range between July and March of the following year, but peaks in January (CDFG, 2007) when small streams and tributaries are cool and well-oxygenated (Williams, 2006). Unlike other salmonids which can only spawn once before death, a percentage of steelhead population (17.2 percent) in California streams can return to the ocean and migrate back upstream to spawn again in subsequent years (Shapovalov and Taft, 1954).

## 1.3 Anticipated Outcomes

Because CV steelhead are thought to be extirpated from the Restoration Area, and none have been recovered in previous study years, it is anticipated that no steelhead will be recovered during these efforts. However, ancillary data that will be collected are valuable in providing foundational baseline information of fish community assemblages and native fishes for downstream reaches of the Restoration Area. Continued monitoring of adult CV steelhead migration in the Restoration Area provides important information regarding this species' distribution as well as providing data to support other fisheries monitoring studies under the SJRRP. Monitoring population abundance trends, rare and native species occurrences, and fish community assemblages will provide a biological indication of SJRRP's success.

The objectives of the study are to:

1. Monitor for adult steelhead CV Steelhead on the San Joaquin River from Sack Dam to the Merced River confluence.
2. Relocate CV steelhead, in the event of a capture, to more suitable habitat below the confluence with the Merced River.

## 1.4 Methods

**Type of Study:** Field study

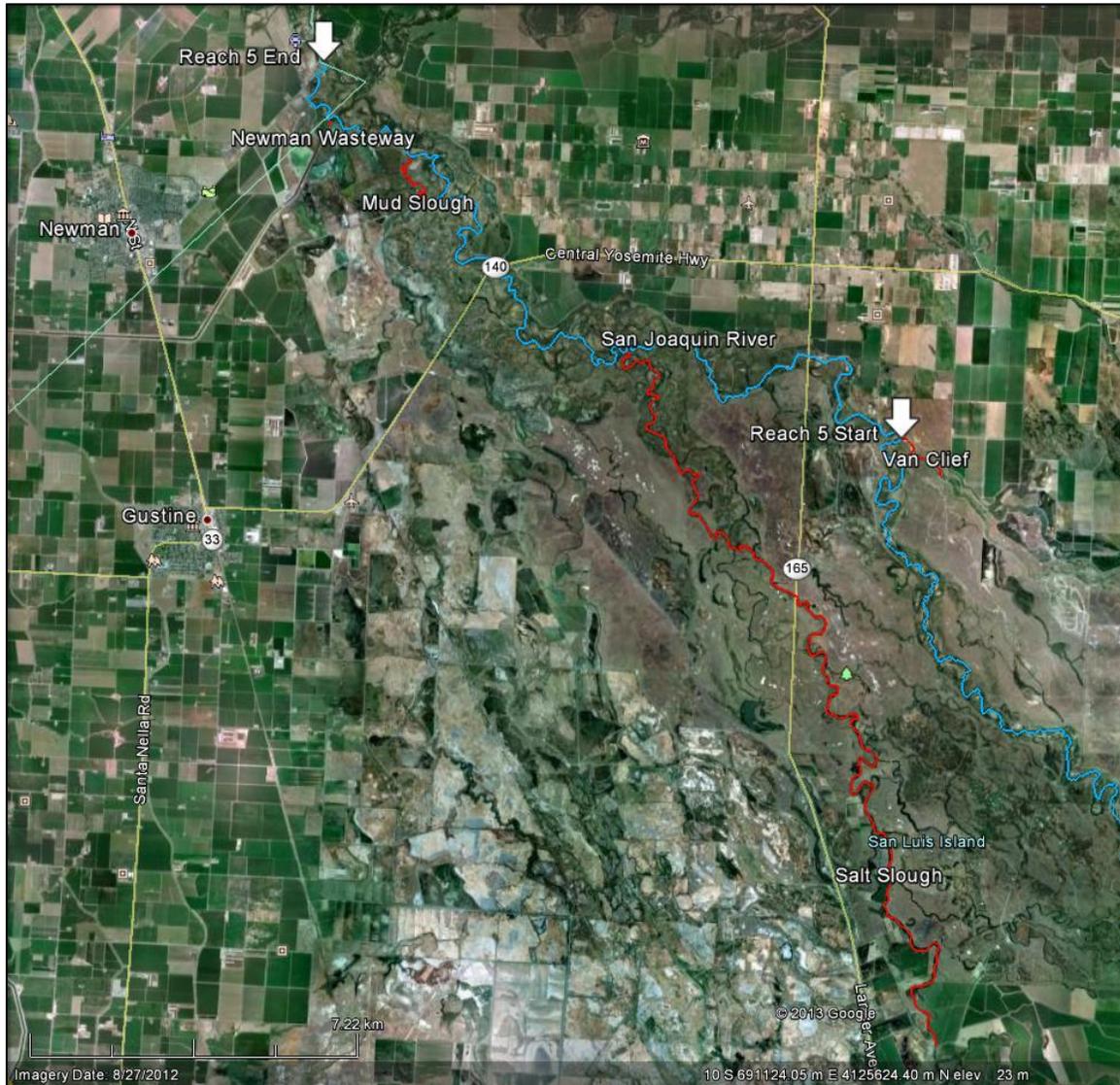
**Reach(es):** 3, 4, and 5

### 1.4.1 Study Area

Steelhead monitoring activities were proposed as the area of the San Joaquin River below Mendota Dam, or to the uppermost contiguous wetted section of the San Joaquin River, from the confluence with the Merced River, including the adjoining sloughs. However, this will likely be limited by the water spilling past Sack Dam being able to provide sufficient water to provide access through Reach 4 of the Restoration Area. In this case, sampling will occur to Mendota Dam, where no sufficient passage exists for upstream migrating fish. Given the likelihood that a sufficient quantity of water will not be available to wet Reach 4 to provide access to Reach 3, fish monitoring will take place only in Reaches 4B and 5.

During the 2014 survey period, the confluence of the Eastside Bypass with the San Joaquin River was considered the furthest upstream extent for CV steelhead migration because of low water conditions and impassable upstream barriers. A total of approximately 18 river miles along the San Joaquin River were monitored as well as slough tributaries (totaling approximately 19.4 river miles) for a total of approximately 37.4 river miles monitored (Figure 1).

## 1.4.2



Note: The blue line indicates the mainstem San Joaquin River and the red line indicates associated waterways (e.g., sloughs, wasteways).

**Figure 1. Overview of Reach 5 of the San Joaquin River Restoration Area (indicated by arrows), and Associated Waterways Which Included the Primary Central Valley Steelhead Monitoring Area During 2014**

## 1.4.3 Methodology

Migrating adult steelhead are difficult to monitor with commonly used salmonid monitoring techniques (e.g., carcass surveys, snorkel surveys, redd counts) due to their unique life-history traits. Steelhead, unlike salmon, may not die after spawning. Therefore, carcasses may not be available for a mark-recapture survey. In addition, steelhead migrate and spawn during the late-fall, winter, and spring months when rivers have periods of pulse flows (e.g., Vernalis Adaptive Management Plan (VAMP)), high flows (e.g., flood releases), and turbid water conditions. The following sampling methods will be used for the CV steelhead monitoring plan.

### ***Electrofishing***

Electrofishing is a common method used in monitoring steelhead populations (such as done in Mill and Deer creeks, and Feather, American, Mokelumne, Stanislaus, and Merced rivers). One potential drawback from electrofishing involves the difficulty in obtaining permits due to the possibility of injuring anadromous salmonids (Eilers, 2008). However, electrofishing effectiveness and safety have improved over time (Bonar et al., 2009). Design specifications to reduce injury to fish, and a comprehensive review of electrofishing literature can be found in Snyder (2003).

Sampling will be completed monthly, from January through March 2015. Repeated capture of resident fish is anticipated, thus intervals between sampling periods will help provide recovery time from sampling and handling stress. Electrofishing methods will follow NMFS guidelines for sampling waters with anadromous fish (NMFS, 2000). However, stated guidelines were for backpack electrofishing, though SMP biologists were not precluded from boat electrofishing. A Smith-Root 5.0 GPP raft-mounted electrofisher (Smith Root, Vancouver, WA) will be used during this time using the following settings: pulsed direct current, voltage range set at 50 to 500 Volts, with a power output range of 10 to 60 percent, and cycle frequency from 15 to 60 Hertz. 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).

### ***Fyke Nets***

Fyke nets will be used to survey for upstream migrating CV steelhead. Fyke nets are constructed of 2.4 centimeter square #252 knotless nylon netting formed over 5 consecutive 1.2 meter hoops and a 1.2 meter square, welded-conduit frame entrance. The traps contain 2 throats with a 25 centimeter diameter opening. Wings walls, attached to the sides of the net opening, are 1.2 meters deep and long enough to span the river (maximum wing length 30.5 meters), with small floats spaced every 61 centimeter on top, and a lead line on bottom. Nets are held in place with anchored t-posts. The net entrances face downstream, with the wing walls extending to shore in a v-shaped pattern. The following locations may be used for placing fyke nets from January 1 to March 15, 2015:

- Approximately 0.8 river mile upstream from the confluence of the Merced River with the San Joaquin River (Casey site)
- Mud Slough
- Salt Slough
- Near the confluence of the Eastside Bypass with the San Joaquin River (Van Clief site)

Marker buoys will be placed up- and downstream from 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.

### ***Trammel Nets***

Trammel nets are most commonly used as stationary gear to block off channels with low velocities or no flows. The nets consist of three parallel vertical layers of netting; the inner net has a smaller mesh size (small hole spacing to prevent steelhead from becoming gilled), while the outer nets have mesh sizes large enough for fish to pass. The larger and smaller mesh size nets form a pocket when fish try to swim through. 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. Trammel nets range in size from 0.9 meters to 1.8 meters (3 feet to 6 feet) tall and 11.4 meters to 30.5 meters (37.5 feet to 100 feet) long. Trammel nets are set for a nominal period of 24 hours.

### ***Fish Handling and Relocation***

In the event that CV steelhead are captured during monitoring activities, fish would have been subjected to the following handling and transporting procedures: Steelhead would be documented, measured (fork length and total length), sexed (if possible), scale and tissue samples collected, and checked for injuries and presence of identifying tags. Additionally, fish would be Floy tagged with a unique identification number for future identification. Captured steelhead would be transported downstream, near the San Joaquin River and Merced River confluence in a 550-Liter transport tank. 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 as a means to minimize 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 levels near saturation. In the instance of extended transport duration (i.e., greater than 30 minutes), an inspection of the fish and transport equipment would occur after the first 30 minutes, and each hour thereafter. Captured steelhead would be acclimated to receiving water conditions (i.e., temperature and chemical gradients) at the release location.

#### **1.4.4 Existing Information**

Previous CV steelhead monitoring efforts are reported for 2012 and 2013 under the on the SJRRP Data Reporting webpage.

#### **1.4.5 Study Duration**

Steelhead monitoring will occur from January 1 to March 15, 2015.

#### **1.4.6 Life Stage**

Monitoring will occur for upstream migrating adult CV steelhead.

#### **1.4.7 Compliance Considerations**

Categorical Exclusions (NEPA), Section 7 (ESA compliance), Section 10, State of California scientific collection permits, and other relevant permits will be obtained before starting this study.

### 1.4.8 Invasive species concerns

Hazard Analysis & Critical Control Points (HACCP) plans will be developed for this activity for aquatic nuisance species.

## 1.5 Deliverables and Schedule

Reported findings that document that presence or absence of CV steelhead in the Restoration Area, based on the fish captured during monitoring activities from January 1 to March 15, 2015 will be provided in a final report.

*Milestones (2015):*

|           |   |
|-----------|---|
| January 1 | Begin CV steelhead monitoring                             |
| March 15  | Complete CV steelhead monitoring                          |
| June      | Final report made available for SJRRP and NMFS permitting |

## 1.6 Budget

The total cost estimate is \$243,872 for 2015.

**Table 1-1. Proposed 2015 Budget**

| <b>Task</b>   | <b>Cost</b>      |
|---|------------------|
| 4 Skill Level 2 biologists (\$95/hour/biologist); 12*12-hr. days each month | \$164,160        |
| 2 weeks data entry  | \$7,600          |
| Report writing (2 biologists, 2 weeks)                                      | \$15,200         |
| Travel (airfare, lodging, per diem, truck, fuel, parking, etc.)             | \$52,912         |
| Miscellaneous   | \$2,000          |
| SJRRP presentation and meeting attendance                                   | \$2,000          |
| <b>Total</b>  | <b>\$243,872</b> |

## 1.7 Point of Contact / Agency Principal Investigator

Donald E. Portz, Ph.D, Bureau of Reclamation, 303-445-2220, Denver Federal Center, PO Box 25007, Denver, Colorado 80225

## 1.8 References

California Department of Fish and Game (CDFG). 2007. California Steelhead fishing report-restoration card. A Report to the Legislature.

Eilers, C.D., J. Bergman, and R. Nelson. 2010. A comprehensive monitoring plan for

steelhead in the California Central Valley. The Resources Agency: Department of Fish and Game: Fisheries Branch Administrative Report Number: 2010–2.

Lindley S.T., R.S. Schick, A. Agrawal, M. Goslin, T.E. Pearson, E. Mora, J.J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R.B. MacFarlane, C. Swanson, and J.G. Williams. 2006. Historical population structure of Central Valley steelhead and its alteration by dams. *San Francisco Estuary and Watershed Science* 4, Issue 1, Article 2.

McEwan, D.R. 2001. Central Valley Steelhead IN: Contributions to the biology of central valley salmonids. *Fish Bulletin* 179.

Moyle, P.B. 2002. *Inland Fishes of California*. University of California Press, Berkeley.

McEwan, D. and T.A. Jackson. 1996. Steelhead restoration and management plan for California. California Department of Fish and Game, Sacramento. 234 p.

National Marine Fisheries Service (NMFS). 1998. Endangered and threatened species: threatened status for two ESUs of steelhead in Washington, Oregon, and California. March 19, 1998. *Federal Register* 63 (453):13347–13371.

\_\_\_\_\_. 2005. Endangered and threatened species; designation of critical habitat for seven evolutionarily significant units of Pacific salmon and steelhead in California. *Federal Register* 70 (170):52488–52627.

\_\_\_\_\_. 2009. 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. Sacramento Protected Resources Division.

\_\_\_\_\_. 2011. Endangered and threatened species; take of anadromous fish. *Federal Register* 76:77490–77491.

Reynolds, F.L., T.J. Mills, R. Benthin, and A. Low. 1993. Restoring Central Valley streams: a plan for action. California Department of Fish and Game, Inland Fisheries Division, Sacramento.

Shapovalov, L. and A.C. Taft. 1954. The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. California Department of Fish and Game, *Fish Bulletin* 98. 375 p.

Williams, J.G. 2006. Central Valley salmon: a perspective on Chinook and steelhead in the Central Valley of California. *San Francisco Estuary and Watershed Science* 4(3): Article 2. 416 p.

Yoshiyama, R.M., E.R. Gerstung, F.W. Fisher, and P.B. Moyle. 1996. Historical and present distribution of Chinook salmon in the Central Valley drainage of California,

Sierra Nevada Ecosystem Project: final report to congress, Volume III: Assessments, commissioned reports, and background information, University of California, Center for Water and Wildlife Resources, Davis, CA, pp. 309–362.

Zimmerman, C.E., G.W. Edwards, and K. Perry. 2008. Maternal origin and migratory history of *Oncorhynchus mykiss* captured in rivers of the Central Valley, California. Final Report. Prepared for California Department of Fish and Game, Contract P03853006. March 2008.  
[[http://www.delta.dfg.ca.gov/AFRP/documents/Zimmerman\\_et\\_al.pdf](http://www.delta.dfg.ca.gov/AFRP/documents/Zimmerman_et_al.pdf)]

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