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National Marine Fisheries Service Permit 16608 Report

Central Valley Steelhead Monitoring Plan for the San Joaquin River Restoration Area

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region and
Denver Technical Service Center

July 2012

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San Joaquin River Restoration Program

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by

Donald E. Portz, Norm Ponferrada, Eric Best, and Charles Hueth

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ABSTRACT

Steelhead abundance and distribution in the San Joaquin River (SJR) Basin have substantially decreased (McEwan 2001), and steelhead are now believed to be extirpated from the Restoration Area. Central Valley (CV) steelhead distinct population segment includes tributaries to the SJR and therefore the presence of CV steelhead must be monitored. Interim flows could attract adult steelhead into the Restoration Area and attracted fish would not have access to appropriate spawning habitat due to a number of impassable barriers. The Bureau of Reclamation implemented a steelhead monitoring and detection plan for the San Joaquin River upstream of the Merced River confluence that would, in the event of a capture, document and transport the fish to suitable habitats downstream of the mouth of the Merced River. Electrofishing, fyke traps, and trammel netting collection methods were used for detection of CV steelhead from approximately one mile upstream of Highway 165 Bridge to the confluence of the Merced River and adjoining sloughs. A total of 28 fish species comprising of 4,305 individuals were captured during Steelhead Monitoring Plan activities from December 2011–March 2012. During the SMP period no steelhead were detected in the study area. However, ancillary data that were collected is valuable in that it is the foundational information of fish community assemblages and native fishes for Reach 5 of the SJRRP. Seven out of 28 fish species captured were native to the SJR, but native fish species only comprised 2.1 % of total individuals captured. Continued monitoring of adult CV steelhead migration in the Restoration Area is important to provide information regarding the progress of the Restoration Program while helping to protect fisheries.

INTRODUCTION

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the Central Valley Project Friant Division Long-Term Contractors. After more than 18 years of litigation of this lawsuit, known as NRDC, *et al. v Kirk Rodgers*, *et al.*, a Settlement was reached. On September 13, 2006, the Settling Parties, including NRDC, Friant Water Users Authority, and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement, which was subsequently approved by the U.S. Eastern District Court of California on October 23, 2006. The Settlement establishes two primary goals: (1) Restoration Goal – To restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish, and (2) Water Management Goal – To reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim Flows and Restoration Flows provided for in the Settlement. These goals will require developing a fisheries management plan that implements an adaptive management approach that includes professional environmental review, review of structural modifications and designs, and technical support to provide the best quality data to define problems, prioritize actions, and increase the confidence in future decisions.

Potential routes to spawning habitats for migratory fish such as the Central Valley (CV) steelhead (*Oncorhynchus mykiss*) are believed to have been historically unhindered in the San Joaquin River (SJR) before completion of the Friant Dam. Although little detailed information on steelhead distribution and abundance is available (Lindley *et al.* 2006, McEwan 2001), they are mostly distributed higher in watersheds with large river systems than Chinook salmon (*Oncorhynchus tshawytscha*; 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 SJR tributaries. Modeling of potential steelhead habitat by Lindley *et al.* (2006) suggests that a portion of the upper SJR 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). Lindley *et al.* (2006) concluded that suitable steelhead habitat existed historically in all major SJR 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 SJR basin have substantially decreased (McEwan 2001), and steelhead have been extirpated from the

Restoration Area after 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). CV steelhead distinct population segment (DPS; smallest division of taxonomic species protected under the U.S. Endangered Species Act; 61 FR 4722) includes tributaries to the SJR 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).

Monitoring of CV steelhead populations in the SJR and its tributaries is especially challenging due to extremely low abundance of fish. CV steelhead populations are depressed to the point where monitoring opportunities are limited because sample sizes are too low to use statistical analyses (Eilers *et al.* 2010), and depressed to the point that even determination of presence is difficult. According to Eilers *et al*. (2010), CV steelhead are currently extirpated from all waters upstream of the Merced-San Joaquin river confluence. However, spring interim flows occurring from February 1–June 1 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. Therefore, the Bureau of Reclamation (Reclamation) implemented a steelhead monitoring and detection plan (SMP) for the San Joaquin River (SJR) upstream of the Merced River confluence that would, in the event of a capture, document and transport the fish to suitable habitats downstream of the mouth of the Merced River.

Fall interim flows occurring from October 1–December 1 could also attract adult steelhead into the Restoration Area if the interim flows are higher than the flows in the SJR tributaries. However, during fall interim flows, the Hills Ferry Barrier (HFB) is in place just upstream of the confluence with the Merced River and ongoing fish monitoring occurs at HFB. Steelhead that reach the HFB could be detected and potentially trapped or deterred from upstream migration. In the fall of 2010 and 2011, a trap was operated by the Reclamation, Denver Technical Service Center's fisheries biologist to assess the barrier's effectiveness. Some fall-run Chinook salmon were able to pass the barrier during the 2010 and 2011 interim flow period, so the effectiveness of HFB is in question (Portz *et al.* 2011, 2012 *in prep*). No steelhead were detected, however bar spacing on the trap could allow steelhead that are smaller and slimmer than salmon to escape.

Central Valley Steelhead

Steelhead are the anadromous form (*i.e.*, returning from sea to the river in order to spawn) of *Oncorhynchus mykiss*. This anadromous fish is a DPS listed under the federal Endangered Species Act as threatened species by the National Marine Fisheries Service (NMFS; NMFS 1998). Critical habitat was designated for CV steelhead in 2005 (70 FR 52488). The designated critical habitat for CV steelhead in the San Joaquin River Basin include the Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced Rivers. On August 15, 2011, NMFS completed the 5-year status review of CV steelhead and recommended that CV steelhead DPS remain classified as a threatened species. Currently, CV steelhead DPS and critical habitat extends from the San Joaquin River to the confluence with the Merced River (NMFS 2011).

Steelhead in the California Central Valley 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. 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 is 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 between the months of December and 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%) in California streams can return to the ocean and migrate back upstream to spawn again in subsequent years (Shapolov and Taft 1954).

STUDY AREA

The Restoration Area for the San Joaquin River Restoration Program (SJRRP) includes the SJR between Friant Dam and its confluence with the Merced River. Steelhead monitoring activities were proposed as the area of the SJR below Sack Dam to the confluence with the Merced River and adjoining sloughs. Sack Dam was considered the furthest upstream extent for CV steelhead migration because it is impassable in low water year types. During the winter and spring 2011-2012 monitoring was confined to the river below Bear Creek as water was too shallow to navigate. Therefore, the extent of the sampling area was limited to approximately one mile upstream of Highway 165 Bridge to the confluence of the Merced River and slough tributaries.

METHODS

Migrating adult steelhead are difficult to monitor using techniques commonly used (*e.g.*, carcass surveys, snorkel surveys, redd counts) to assess salmon populations 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 or VAMP), high flows (*e.g.*, flood releases), and turbid water conditions. Three sampling methods were implemented for this CV steelhead monitoring plan:

***Sampling Method 1: Electrofishing* —** Electrofishing is a common method used in monitoring steelhead population (*e.g.*, Mill and Deer creeks, and Feather, American, Mokelumne, Stanislaus, and Merced rivers). One potential drawback for using electrofishing in rivers involves the difficulty in obtaining permits due to the possibility of injuring fish in anadromous salmonid waters (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 frequency was done monthly from December–March of the following year. Capture of resident fish multiple times was to be anticipated, thus monthly sampling was important to ensure fish recovery from sampling and handling stress between captures. Electrofishing methods followed the NMFS guidelines for sampling waters with anadromous fish. However, stated guidelines were for backpack electrofishing, but SMP researchers were not precluded from using boat electrofishing. NMFS were given substantial proof that the proposed techniques or equipments were necessary for the study and that listed species were safeguarded (NMFS 2000) and state scientific collecting permits were obtained for these sampling techniques.

California Department of Fish and Game (CDFG) boat electroshocker was used on December 13, 2011, January 24-25, 2012, February 6-9, 2012, and March 5-9 and 12-14, 2012 with a crew of CDFG and Reclamation staff. The settings were set at Low 50-500 volts with an average power of 40% depending on water conductivity and a direct current at 30 pulses per second to ensure that electrical injury to fish was minimized.

***Sampling Method 2: Fyke traps with wing walls* —** Fyke nets with wing walls and traps (Figure 1) were used to sample upstream migrating CV steelhead. Fyke nets have long been used to capture migrating fish to monitor their yearly changes and abundances. The nets were constructed of 3.7-cm mesh formed over a 1.5 m x 0.5 m rectangular lead hoop with 0.95 cm diameter solid round stock and three 1.5-m diameter hoops. The traps contained two 5 m-long throats with 15 or 25 cm diameter throats, and have a zipper for easy fish removal. Wings walls were

1.8 m deep and long enough to span the river. Nets were held in place with anchored t-posts and were deployed in sampling locations (*i.e.,* upstream of the confluence of the Merced River, the mouths of Mud, Slough, Salt Slough, Newman Wasteway, and downstream of Bear Creek near HWY 165 bridge). This proposed technique was implemented once the Hills Ferry Barrier was removed in mid-December. Fyke nets were deployed at sampling locations until March 15, 2012. Marking buoys and flashing amber lights were affixed for safety and to alert boaters of the nets presence. The traps were checked daily so the likelihood of fish being physically injured was low. In the event of a steelhead capture, the fish would have been measured, weighed, transported, and released downstream of the mouth of the Merced River.

Fyke nets were used in lieu of wire fyke traps for several reasons: fyke nets were relatively inexpensive and easy to install, not a boat passage impediment (can be pushed down in the water column for boat passage), easily replaced if damaged, easily transported, and no permitting was required to transport. Although, CDFG wire fyke trap can catch fish in high flows, it would have required a crane to remove the trap out of water under increased hydraulic pressure and in the event that the trap became silted.

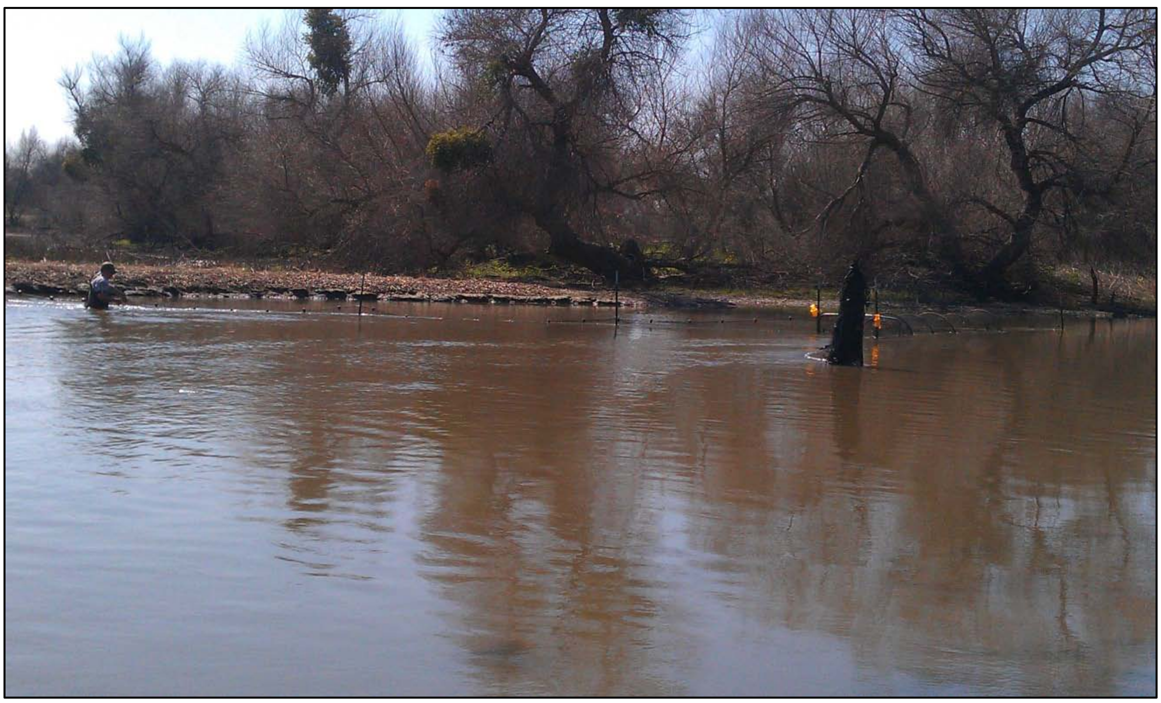

Figure 1. ─ Biologist installing a fyke net at Salt Slough.

Sampling Method 3: Steelhead specific trammel nets — Trammel nets (Figure 2) are most common as stationary gear to block off channels with low velocities or no flows. However, they can also be used to drift in short durations (*e.g.,* 20 min) in moving water currents. For this study, short duration drifting of trammel nets were deployed as well as stationary sets. Short fishing durations prevent fish from being severely entangled and lessen the chance of harm. Trammel nets were advantageous and relatively efficient in turbid waters. The nets consisted of three parallel vertical layers of netting; the inner net has a very small mesh size, while the outer nets have mesh size large enough for fish to pass. The larger and smaller mesh size nets form a pocket when fish try to swim through (Figure 3). Similar to seine nets, trammel nets were equipped with floats attached to the head rope and lead weights along the ground rope. Colored floats were attached to the head rope so boaters and other recreationists can be alerted to the nets and avoid entangling themselves, their boats, and/or their fishing gear. To ensure safety of steelhead, fisheries biologists tending the nets followed at a close distance to observe, reduce risk of entanglement, and retrieve nets in short time intervals. Sampling time depended on the number of fish and bycatch caught at each location. Trammel net sampling was used during adult steelhead migration December–March on the SJR.

Figure 2. ─ National Marine Fisheries Service and Reclamation biologists deploying trammel nets in the San Joaquin River downstream of Salt Slough.

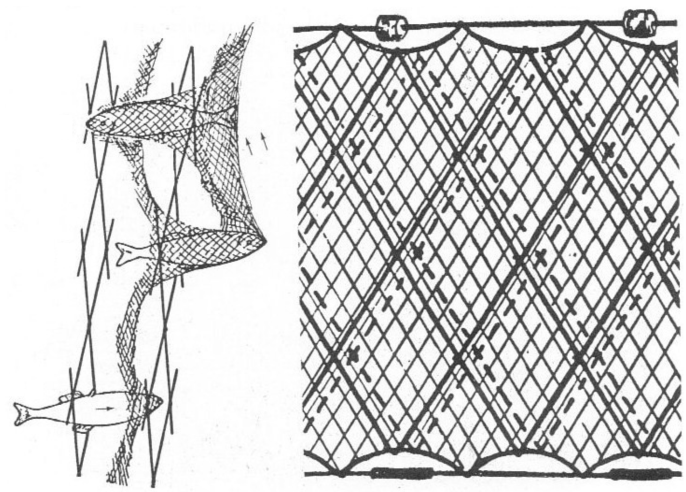

Figure 3. ─ Trammel net and its operation.

Fish Handling and Relocation — In the event that CV steelhead were captured during monitoring activities, fish would have been subjected to standard handling and transporting procedures. Captured steelhead would be recorded, measured (*i.e.*, fork length and total length), sexed (if possible), sampled for scales and tissues, and checked for injuries and presence of tags. Additionally, fish would have been Floy tagged with a unique identification number to document any recaptures that may occur in the study area. Captured steelhead were to be transported downstream of the mouth of the Merced River in a 550-L transport tank. The transport tank would have been immediately filled with river water prior to transport using a portable screened water pump. Steelhead were to be transferred from the river to the transport tank using a water-to-water transfer to help minimize stress and loss of slime. Oxygen gas was to be supplied using compress oxygen gas cylinders and micro-bubble diffusers to maintain dissolved oxygen levels at near saturation during transport. Sodium chloride would have been added to the transport water to decrease ionic gradient as a means to minimize stress. The truck was to be stopped after 30 minutes of transportation and each hour thereafter for visual inspection of the life-support system and fish wellbeing. Captured CV steelhead were to be acclimated in the transport tank to receiving water temperature and water quality at the predetermined release location. Steelhead would have been gently coaxed into a plastic vessel and a water-to-water transfer to the river accomplished.

RESULTS

Electrofishing

There were 25 fish species caught totaling 2,671 individuals (Figure 4) and no CV steelhead were captured with this sampling method.

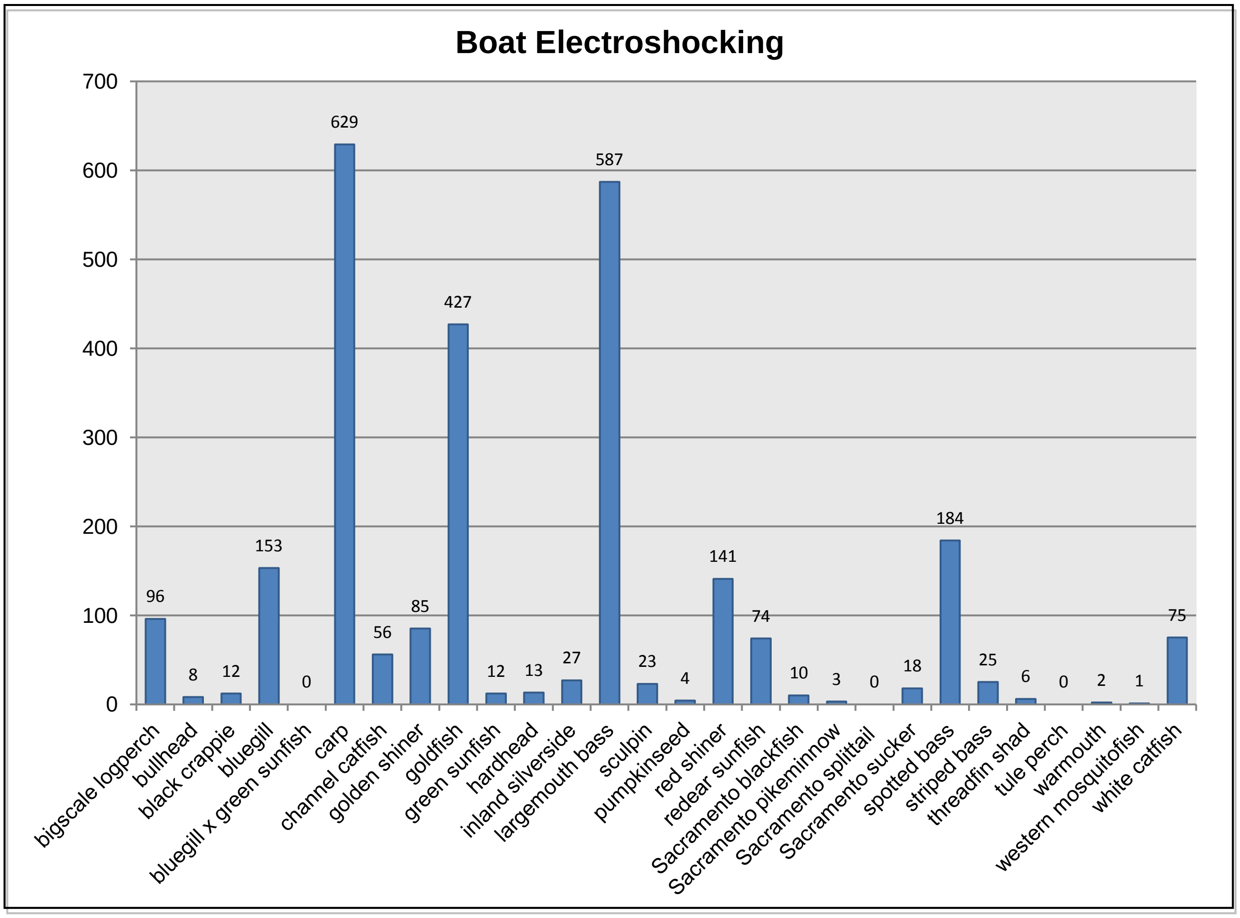

Figure 4. – Fish captured during Steelhead Monitoring Plan electrofishing sampling.

Selected locations within the study area were boat electrofished 55 times during the sampling season. The average generator time shocking was 574.2 sec, and an average of 48.56 fish per sample was captured. Therefore the catch per unit effort (CPUE) was .0845 fish per second or 5.07 fish per minute.

Fyke traps with wing walls

There were ten fyke nets deployed in the study area from approximately one mile upstream of the Highway 165 Bridge to near the SJR confluence with the Merced River. Nets were set at: (1) Hills Ferry Barrier location, (2) Butch's Levee, (3) Casey property boat ramp, (4) Newman Wasteway, (5) SJR Shovel Oxbow upstream of Newman Wasteway, (6) mouth of Mud Slough, (7) Mud Slough near Highway 140, (8) Upstream of Great Valley Grasslands State Park boat launch, (9) Salt Slough, and (10) SJR upstream of Highway 165 Bridge. The nets fished for 24 hours each day from January 21–27, 2012, February 8–16, 2012, and March 6–15, 2012. There were 16 fish species caught totaling 1,490 individuals (Figure 5).

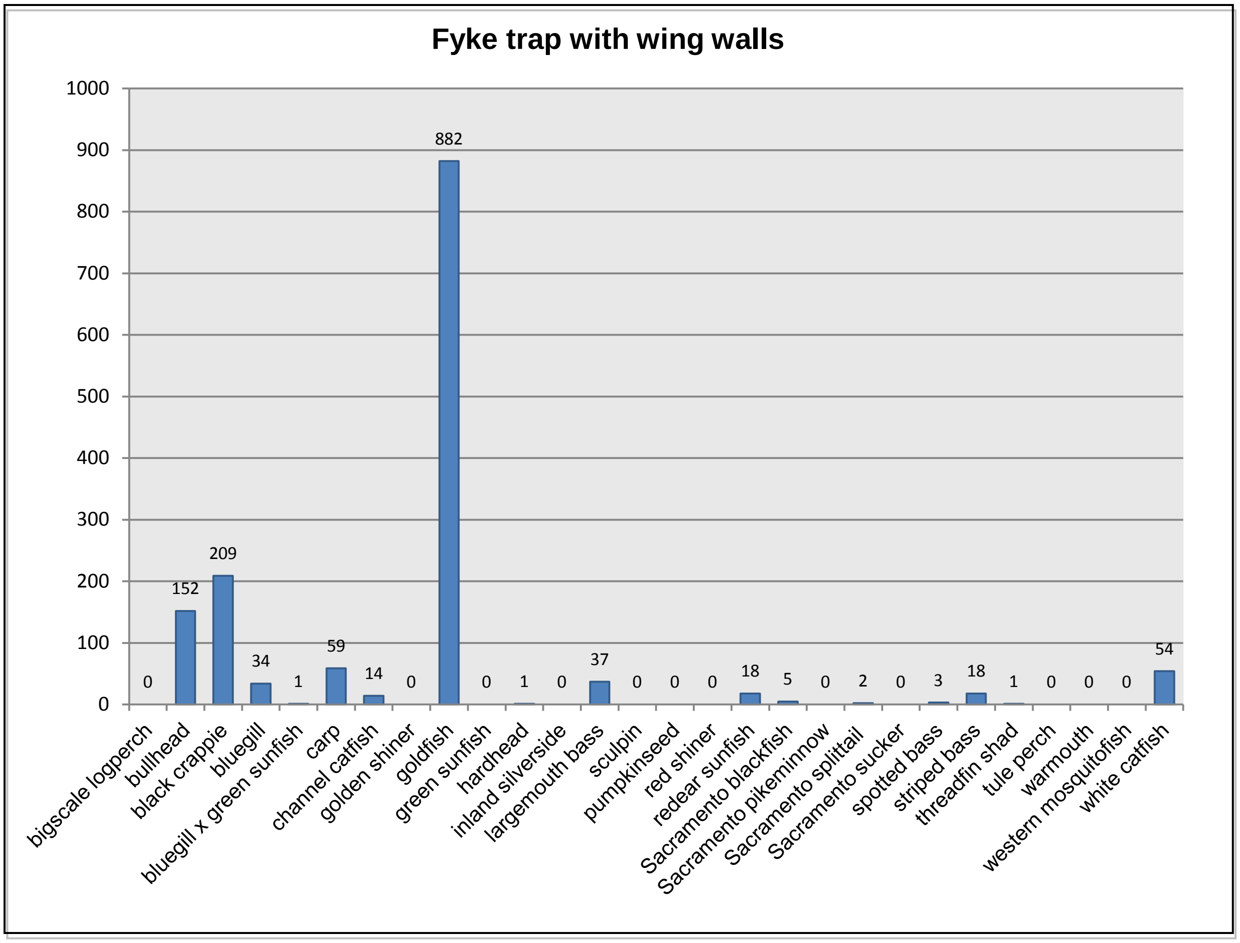

Figure 5. ─ Fish captured during Steelhead Monitoring Plan fyke sampling.

The ten fyke locations fished for a combined total of 115 days during the sampling period. However, beavers (*Castor canadensis*) chewed through the fyke nets on 13 different occasions and two nets collapsed due to high flows. For this reason, 15 days will not be incorporated to the total days of fyke net deployments. The CPUE was 14.90 fish captured per day or 1.49 fish per trap per day. The CPUE was inflated due to a large school (*i.e.*, 627 goldfish) of fish that were caught in the Newman Wasteway fyke net on February 16, 2012.

Steelhead-specific trammel nets

Trammel nets were deployed or drifted randomly throughout Reach 5 of the Restoration Area on January 26-29, 2012, February 9, 2012, and March 7-14, 2012. These nets were measured in feet that varied in sizes: 3×40, 3×50, 4×50, 4×75, 5×50, 5×100, and 6×50. There were 17 fish species caught totaling 144 individuals (Figure 6), but no CV steelhead was captured. A total of 52 net deployments with varying sizes occurred during sampling period. The total square footage was 13,410 with 155 hours of soak time. Therefore, the CPUE is 0.93 fish per 86.5 ft^2/hr.

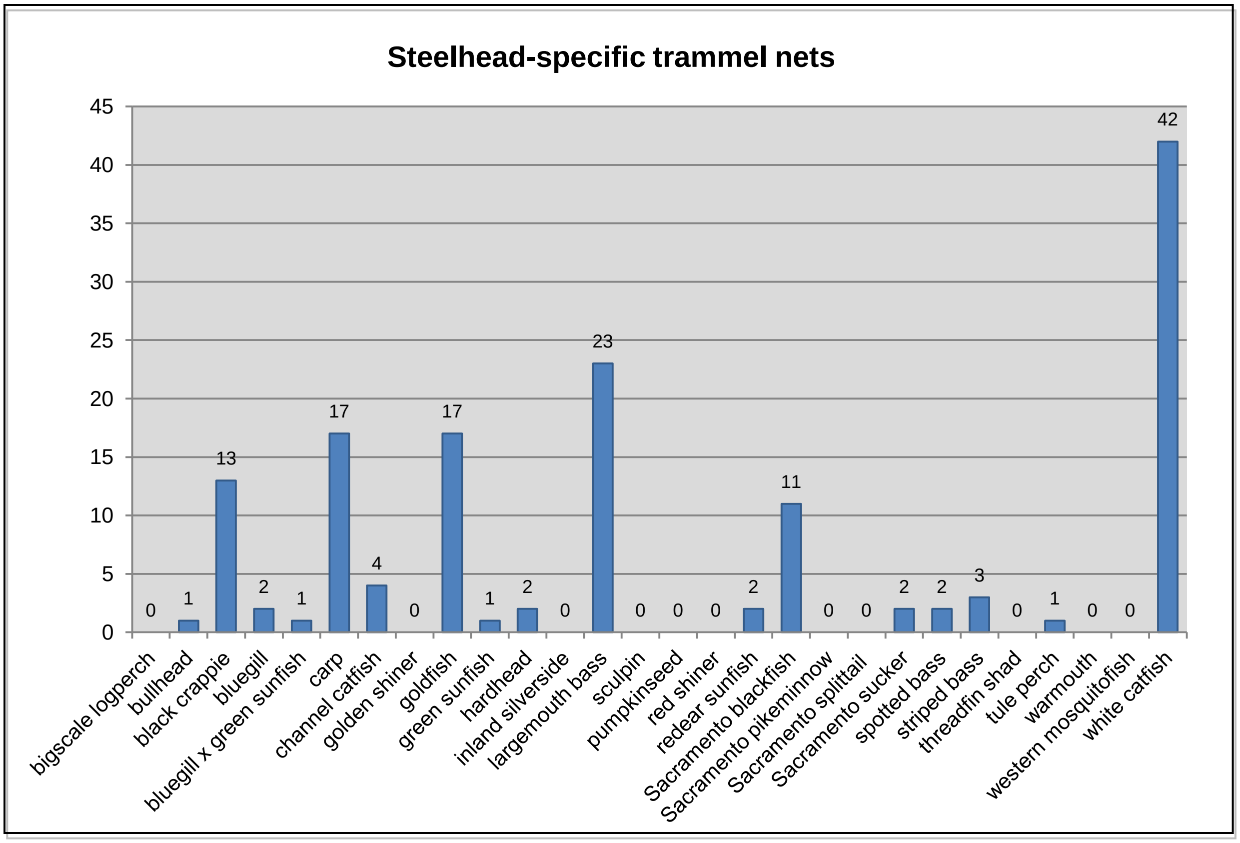

Figure 6. ─ Fish captured during Steelhead Monitoring Plan using steelhead-specific trammel nets sampling.

Combined Results

A total of 28 fish species comprising of 4,305 individuals were captured during the entire sampling period (Figure 7). Only 2.57 % captured with boat electroshocker, 0.54 % from fyke nets, and 12.5 % from trammel nets were native fish species (Figure 8). Seven out of the 28 species were natives that consisted of: (1) hardhead (*Mylopharodon conocephalus*), (2) sculpin (*Cottus spp.*),

(3) Sacramento blackfish (*Orthodon microlepidotus*), (4) Sacramento pikeminnow (*Ptychocheilus grandis*), (5) Sacramento splittail (*Pogonichthys macrolepidotus*), (6) Sacramento sucker (*Catostomus occidentalis*), and (7) tule perch (*Hysterocarpus traski*). Native fish species were only 2.1 % of total individuals captured (91 out of 4,305 fish). Figure 9 represents the composition of San Joaquin River native and non-native fish species captured during sampling season combining all three sampling methods.

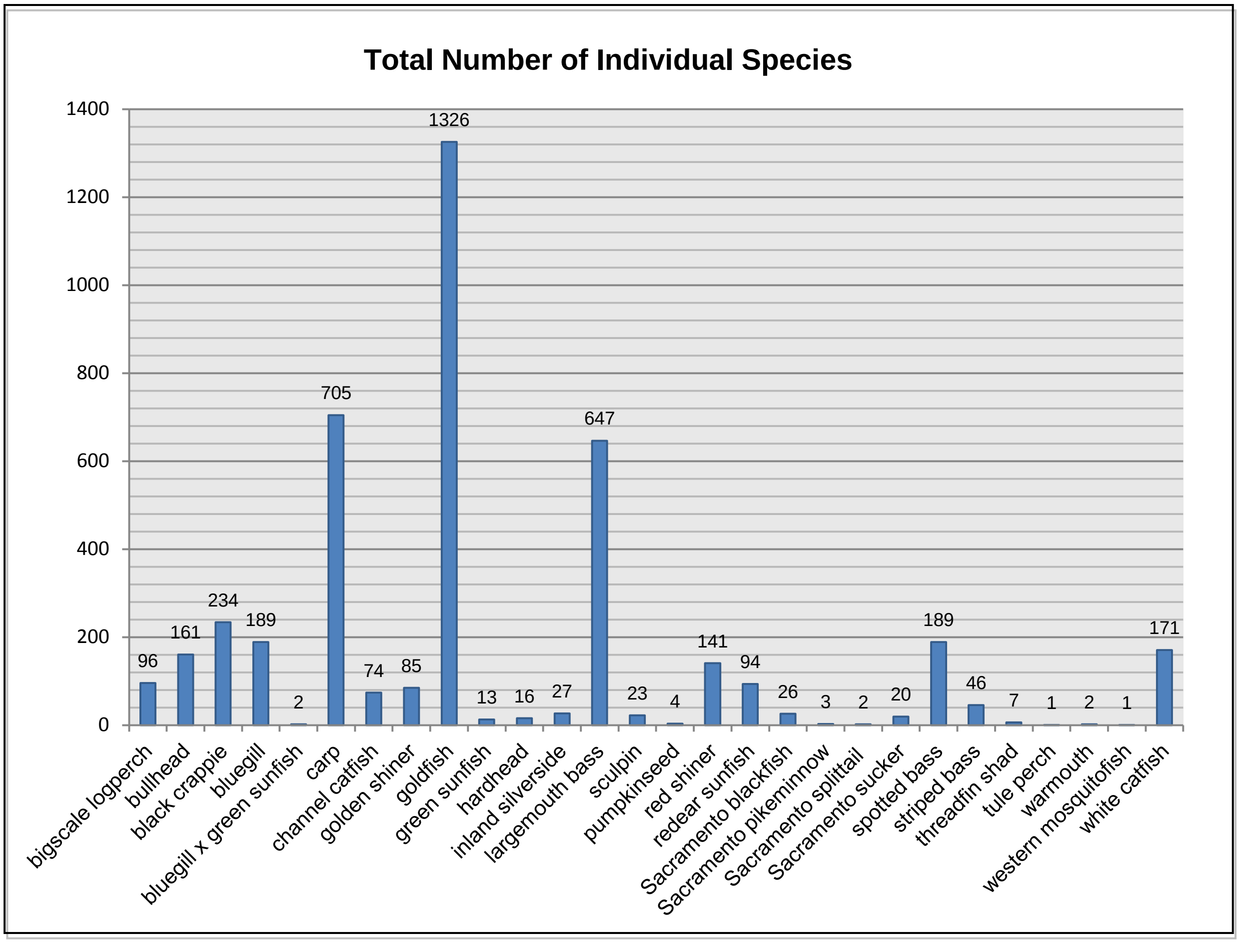

Figure 7. ─ Total number of fish captured using the three sampling methods.

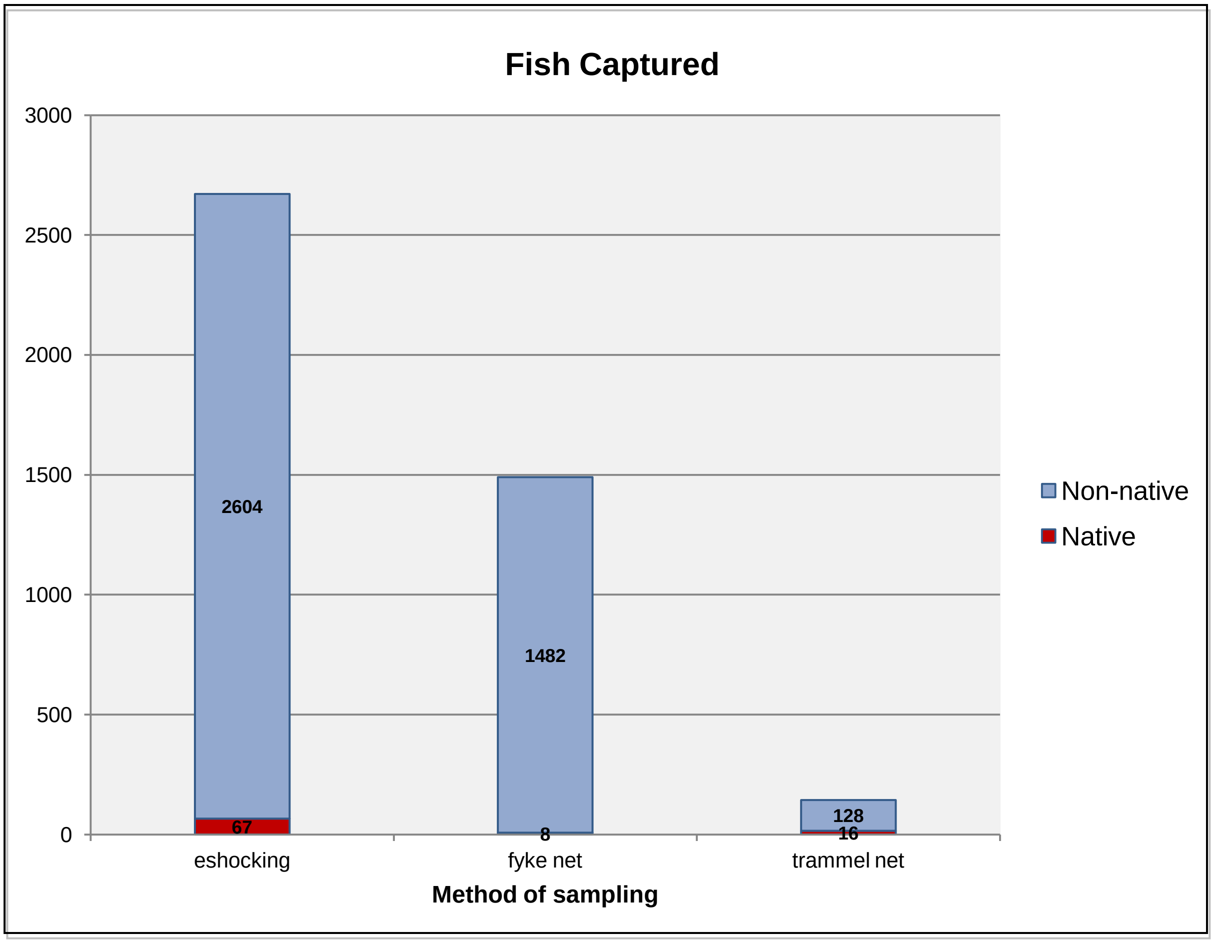

Figure 8. – Native vs. non-native San Joaquin River fish numbers captured for each sampling method.

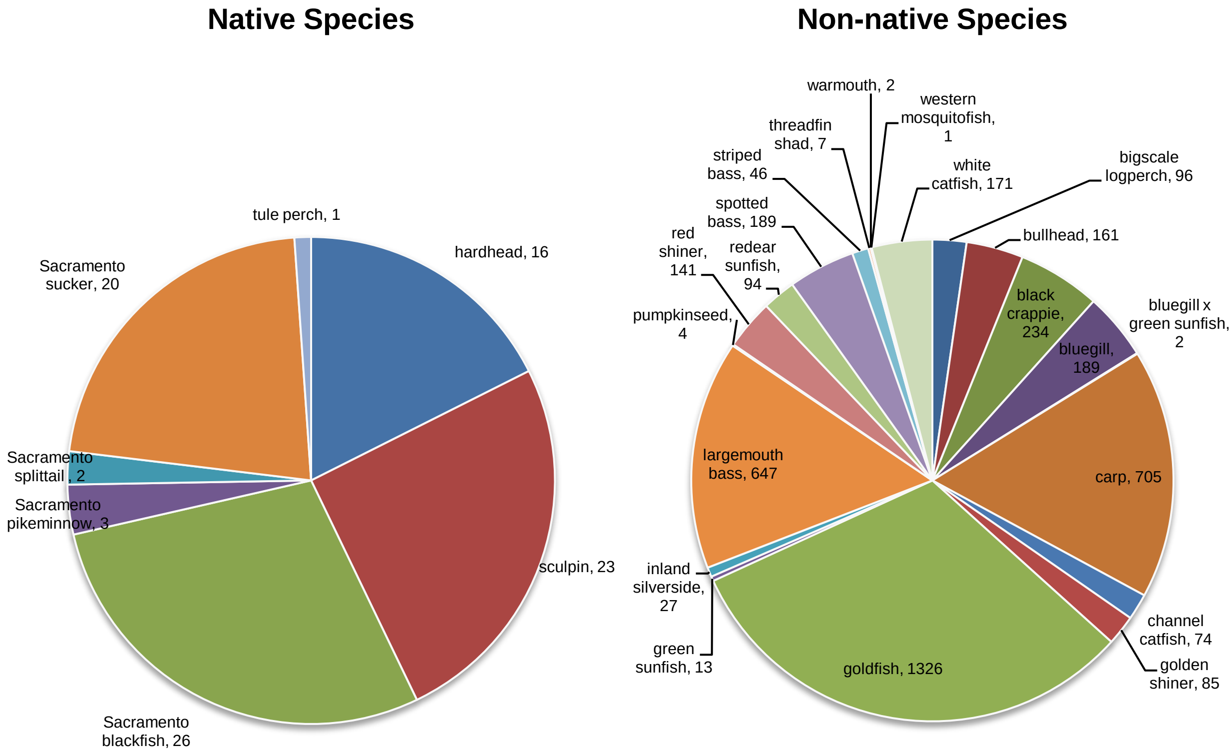

Figure 9. – Composition of San Joaquin River native and non-native fish species captured.

DISCUSSION

Historically, the SJR Restoration Area was a potential migratory pathway for CV steelhead to reach their spawning grounds. However, little detailed information on their distribution and abundance is available for these river reaches. The upper SJR basin may have historically supported a steelhead population but much of the downstream habitat is unsuitable for rearing because of high summer water temperatures (Lindley *et al.* 2006). Suitable steelhead habitat existed historically in all major SJR tributaries and there is potential for this fish to return under interim flows. Fall interim flows occurring from October 1 to December 1 and Spring interim flows occurring from February 1 to June 1 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. However this is thought to be relatively unlikely because CV steelhead are currently extirpated from all waters upstream of the Merced-San Joaquin river confluence (Eilers *et al*. 2010).

Monitoring of CV steelhead populations in the SJR and its tributaries is especially challenging due to extremely low abundance or absence of fish. During the SMP period no steelhead were detected in the study area. However, ancillary data that were collected is valuable in that it is the foundational information of fish community assemblages and native fishes for Reach 5 of the SJRRP. Seven out of 28 fish species captured were native to the SJR, though populations of these native fish species were much less represented compared to non-native. Only 2.1 % of total individuals captured were native to California waters.

Lastly, the steelhead monitoring plan is an important study for the SJRRP to ensure its commitment to restore and maintain fish populations within the Restoration Area. Although no CV steelhead were detected or captured during this sampling period, continued monitoring of adult CV steelhead migration in the Restoration Area is important to provide information regarding the progress of the Restoration Program. Monitoring population abundance trends, rare and native species occurrences, and fish community assemblages will provide a biological indication of SJRRP's success.

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