RECLAMATION

Managing Water in the West

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

2013 Monitoring Results for National Marine Fisheries Service Permit 16608

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14. ABSTRACT
Steelhead abundance and distribution in the San Joaquin River (SJR) Basin have substantially decreased, 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 SJR upstream of the Merced River confluence that would, in the event of a capture, document and transport the fish to suitable habitats downstream from the mouth of the Merced River. Electrofishing, fyke traps, and trammel netting collection methods were used for detection of CV steelhead from approximately 3.5 miles upstream of Highway 165 Bridge to the confluence of the Merced River and adjoining sloughs. A total of 27 fish species comprised of 1,248 individuals were captured during Steelhead Monitoring Plan (SMP) activities from January 2013–March 2013. 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 San Joaquin River Restoration Program (SJRRP). Six out of 27 fish species captured were native to the SJR, but native fish species only comprised 6.4 percent of total individuals captured. Continued monitoring of adult CV steelhead migration in the Restoration Area is important to provide information regarding the progress of SJRRP while helping to protect fisheries.

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by

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ABSTRACT

Steelhead abundance and distribution in the San Joaquin River (SJR) Basin have substantially decreased, 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 SJR upstream of the Merced River confluence that would, in the event of a capture, document and transport the fish to suitable habitats downstream from the mouth of the Merced River. Electrofishing, fyke traps, and trammel netting collection methods were used for detection of CV steelhead from approximately 3.5 miles upstream of Highway 165 Bridge to the confluence of the Merced River and adjoining sloughs. A total of 27 fish species comprised of 1,248 individuals were captured during Steelhead Monitoring Plan (SMP) activities from January 2013–March 2013. 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 San Joaquin River Restoration Program (SJRRP). Six out of 27 fish species captured were native to the SJR, but native fish species only comprised 6.4 percent of total individuals captured. Continued monitoring of adult CV steelhead migration in the Restoration Area is important to provide information regarding the progress of SJRRP 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) 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, annual 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 SJR upstream of the Merced River confluence that would, in the event of a capture, document and transport the fish to suitable habitats downstream from the mouth of the Merced River.

Annual 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). 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 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 percent) 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 (Figure 1). Steelhead monitoring activities were proposed as the area of the SJR below Sack Dam to the confluence with the Merced River and adjoining sloughs. For this study, Sack Dam was considered the furthest upstream extent for CV steelhead migration because it is impassable except during flood conditions. During the winter of 2013 monitoring was confined to Reach 5 and the lower extent of 4B2 of the San Joaquin River Restoration Area (Figure 2) because SJRRP made no flow releases below Sack Dam, drying major portions of the Reach 4A channel. A total of approximately 18 river miles along the San Joaquin River were monitored as well as slough tributaries (totaling approximatley19.4 river miles) for a total of approximately 37.4 river miles monitored (Figure 2).

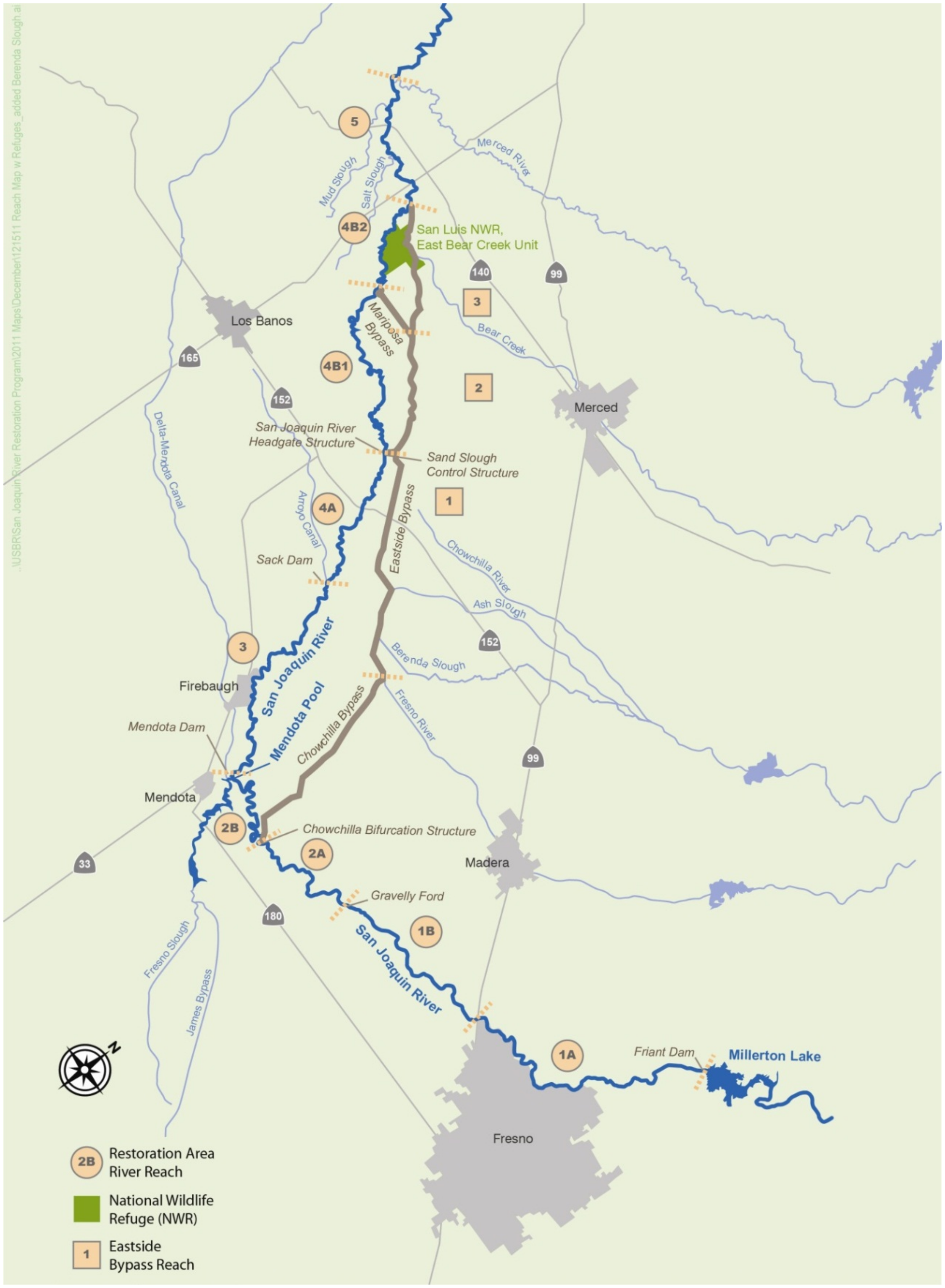


Figure 1.—Reaches within the San Joaquin River Restoration Area, San Joaquin Watershed, Central Valley, California.

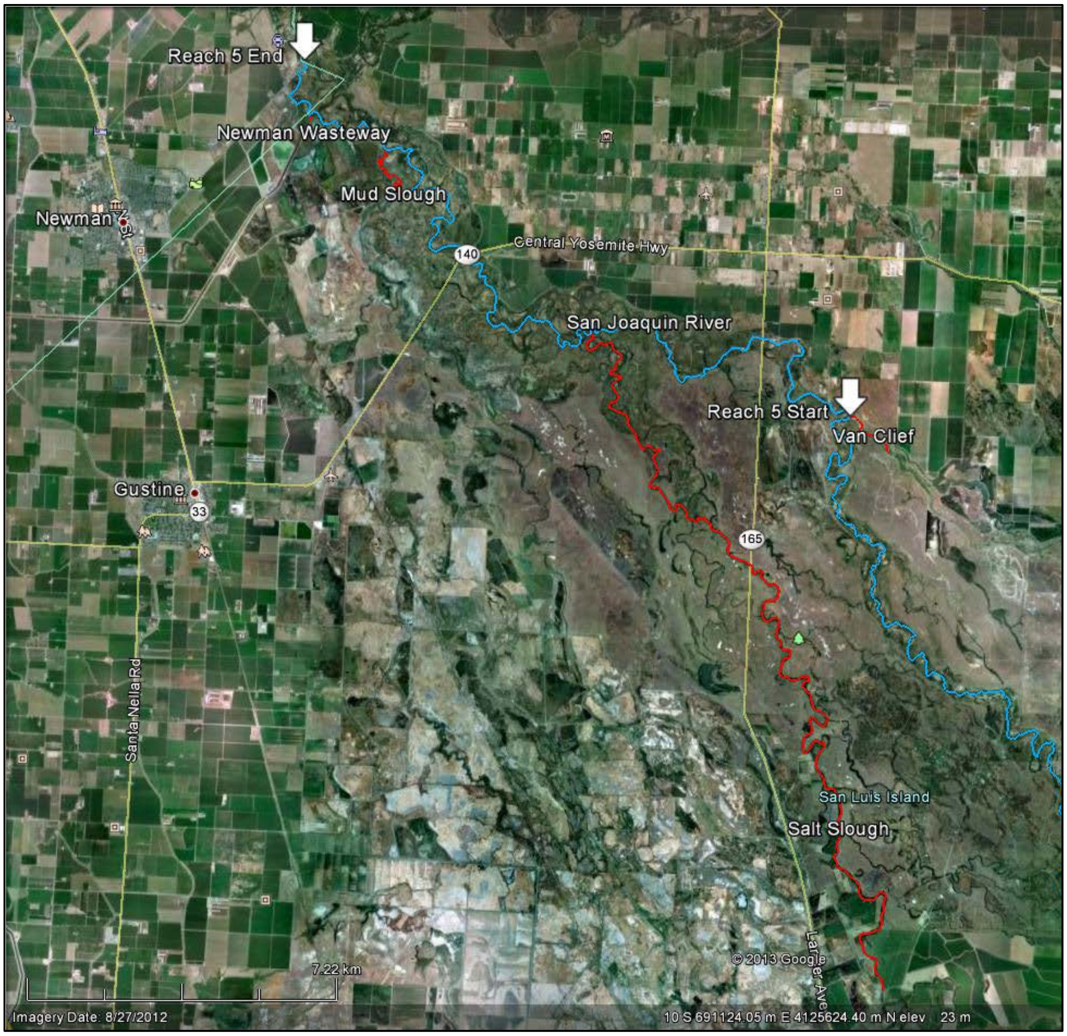


Figure 2.—Overview of Reach 5 of the San Joaquin River Restoration Area, defined as Salt Slough Confluence, Grasslands State Park, Mud Slough Confluence, Newman Wasteway, Merced River Confluence. Tributaries pertaining to steelhead monitoring are highlighted in red.

METHODS

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 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 was done monthly from January–March 2013. 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 and equipment were necessary for the study and that listed species were safeguarded (NMFS 2000) and state scientific collecting permits were obtained for these sampling techniques.

A Reclamation raft electroshocker was used on January 14-15, 2013, February 12-13, 2013, and March 6-7, 2013 with a crew of Reclamation staff (Figure 3). The settings were set at low 50-500 volts with an average power of 55 percent depending on water conductivity and a direct current at 30 pulses per second to ensure that electrical injury to fish was minimized.

Figure 3.—Reclamation biologist sampling fish with an electrofishing raft.

Sampling Method 2: Fyke Traps with Wing Walls

Fyke nets with wing walls and traps (Figures 4 and 5) were used to sample upstream migrating CV steelhead. Fyke nets have long been used to capture migrating fish to monitor their yearly changes in abundance. The nets were constructed of 2.38-cm square #252 knotless nylon netting formed over 5 consecutive 1.22-m hoops and a 1.2 x 1.2 m welded conduit frame entrance. The traps contained 2 throats with a 25 cm diameter opening. Wings walls were 1.22 m deep and long enough to span the river (max wing length 30.5 m) with small floats spaced every 61 cm on top and a lead line on bottom. 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, Newman Wasteway, Van Clief Road, and within Salt Slough). This technique was implemented once the Hills Ferry Barrier was removed in mid-December 2012. Fyke nets were deployed at sampling locations until March 15, 2013. Marking buoys and flashing amber lights were affixed for safety and to alert boaters of the net's 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 from the mouth of the Merced River.

Figure 4.—Reclamation biologist deploying a fyke net in Mud Slough, Reach 5 of the San Joaquin River Restoration Area.

Figure 5.—Reclamation biologist inspecting a fyke net at Hills Ferry Barrier location near Newman, California.

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 California Department of Fish and Wildlife (CDFW) owns a wire fyke trap capable of catching fish in high flows, it was not used because 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.

Sampling Method 3: Steelhead Specific Trammel Nets

Trammel nets (Figure 6) 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 had a very small mesh size, while the outer nets had 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 6). Similar to seine nets, trammel nets were equipped with

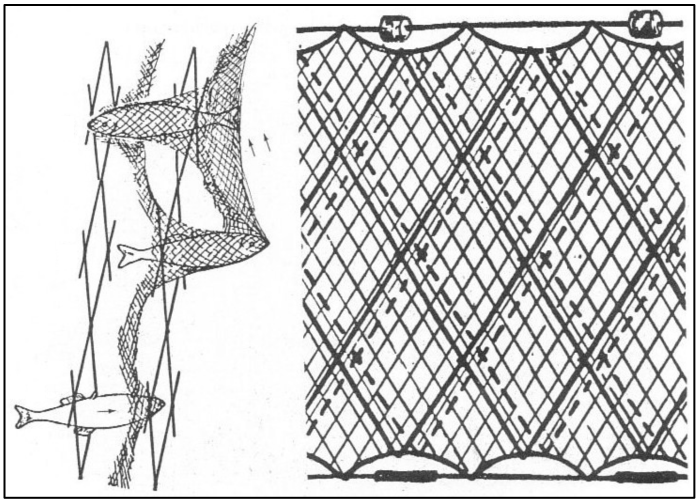


Figure 6.—Trammel net including an illustration of the pockets that are created by the entangled fish.

Figure 7.—Reclamation biologist retrieving a trammel net on the San Joaquin River, California.

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 could 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 by-catch caught at each location. Trammel net sampling was used during adult steelhead migration January–March, 2013 on the SJR. It should also be noted that although the data is broken into two seemingly different projects *i.e.*, Steelhead Monitoring Plan and Inventory and Monitoring, the methods and implementation are the same; therefore the data is within the scope and permitting of the Steelhead Monitoring Plan.

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 from 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 a compressed oxygen gas cylinder and micro-bubble diffusers to maintain dissolved oxygen levels near saturation. Sodium chloride would have been added to the transport water to decrease the cellular-holding water 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 fish and transport equipment. Captured CV steelhead were to be acclimated to receiving water temperature and water quality at the predetermined release location.

RESULTS

No CV steelhead were observed during this monitoring period in the SJR Restoration Area.

Electrofishing

Raft electrofishing yielded 23 fish species (Figure 8), representing 54 percent (n=673) of the cumulative total (n=1248) of all individuals captured across the three methods (see Table 4). Non-native fishes made up 95 percent (n=637) of individuals captured using this method. Native species comprised only 5 percent (n=36) of fish captured with this method, and 3 percent of the cumulative total. Electrofishing was the most successful methodology used, based on sheer numbers of individuals captured, as well as the diversity of individuals captured. No CV Steelhead were captured with this sampling method.

Selected locations within the study area were raft electrofished during the sampling season (Figure 9). The total generator shocking time was 21,211 sec (avg. 542.3 sec/location), and a total of 673 fish captured. Therefore, the catch per unit effort (CPUE) was 1.9 fish per minute (Table 1).

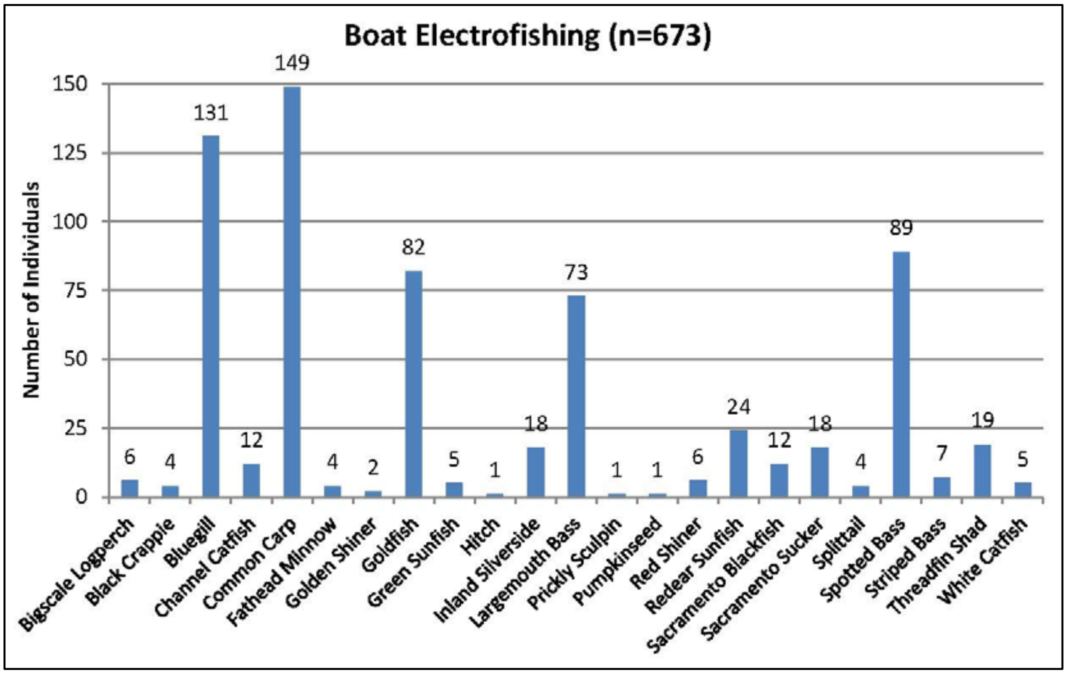


Figure 8.—Fish captured during 2013 Steelhead Monitoring Plan electrofishing sampling.

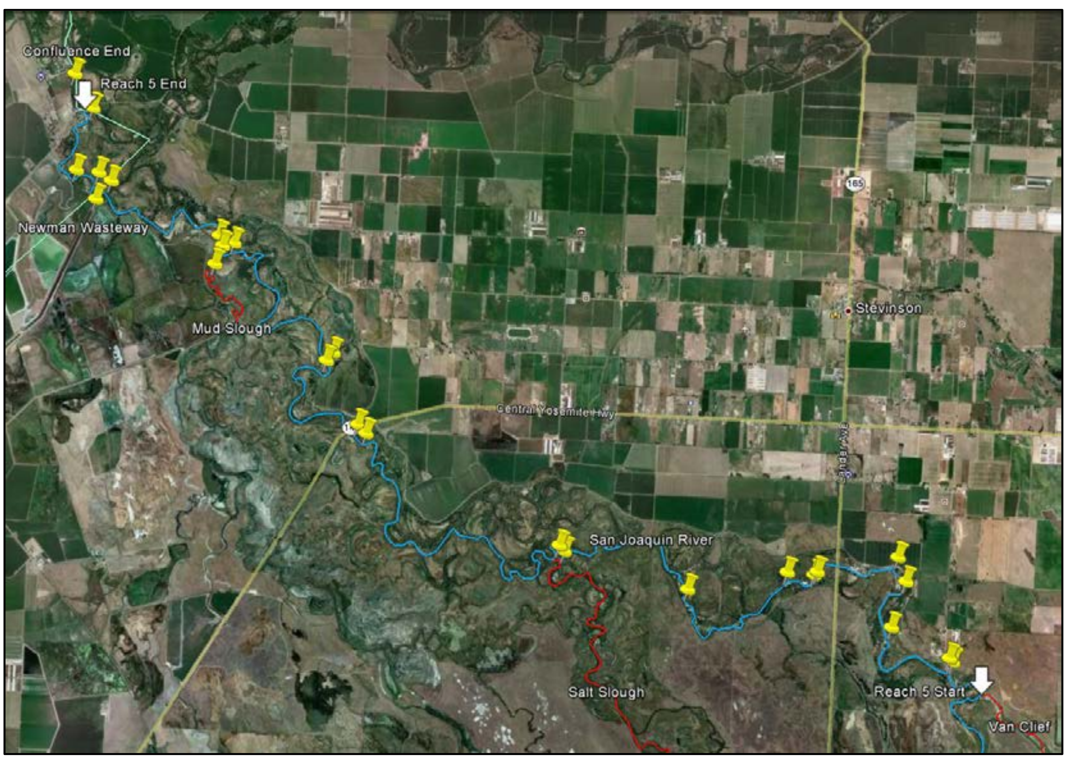


Figure 9.—Locations of boat electroshocking throughout Reach 5 of the San Joaquin River, California. Markers represent approximate start locations as some of the markers represent multiple shocking locations at this resolution.

Table 1.—Boat electrofishing per unit of time per number of fish captured

Boat Electrofishing Total (n=673)				
Electrofishing	**Seconds**	**Minutes**	**Fish Captured**	**CPUE per Minute**
Steelhead Monitoring	14,342	239.03	406	1.699
Inventory and Monitoring	6,869	114.48	267	2.332
Total	**21,211**	**353.51**	**673**	**1.904**

Fyke Traps with Wing Walls

There were 18 fish species caught totaling 393 individuals (Figure 10). Fyke netting represented 31 percent of the cumulative total (n=1248) of all individuals captured. Non-native fishes were 98 percent (n=384) of individuals captured using this method, and 31 percent of the cumulative total. Native species comprised only 2 percent (n=9) of fish captured with this method, and 0.7 percent of the cumulative total. No CV Steelhead were captured using this method.

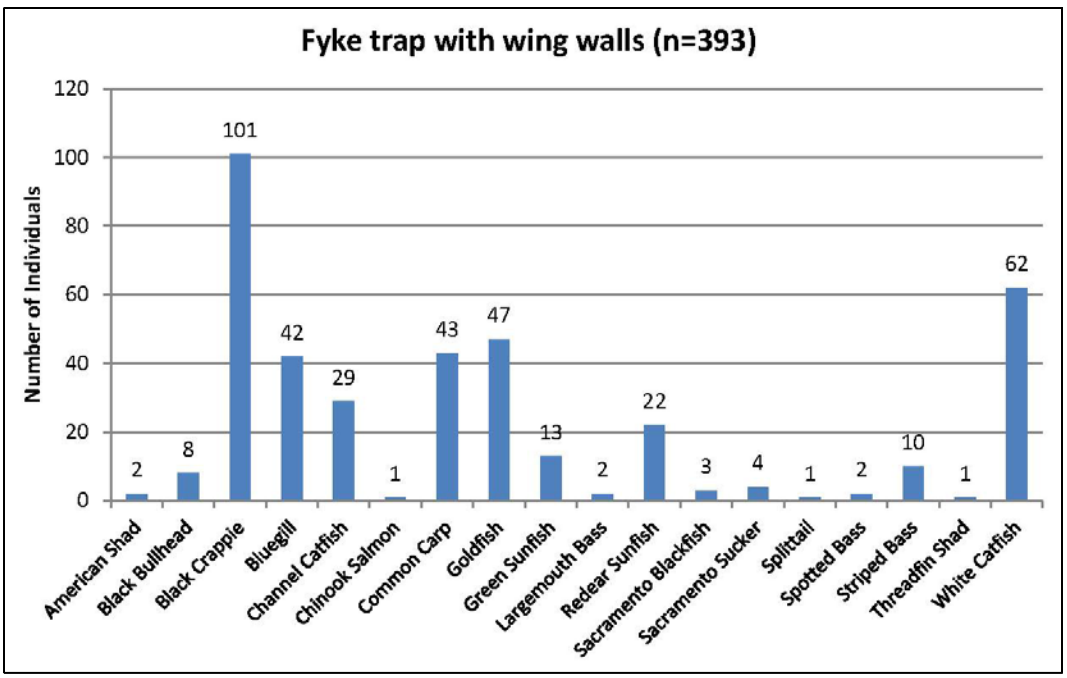


Figure 10.—Fish captured during Steelhead Monitoring Plan fyke sampling.

Five fyke nets were deployed throughout the study area from approximately 2.8 river miles 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) Mud Slough, (3) Newman Wasteway, (4) Salt Slough, (5) and Van Clief (Figure 11).

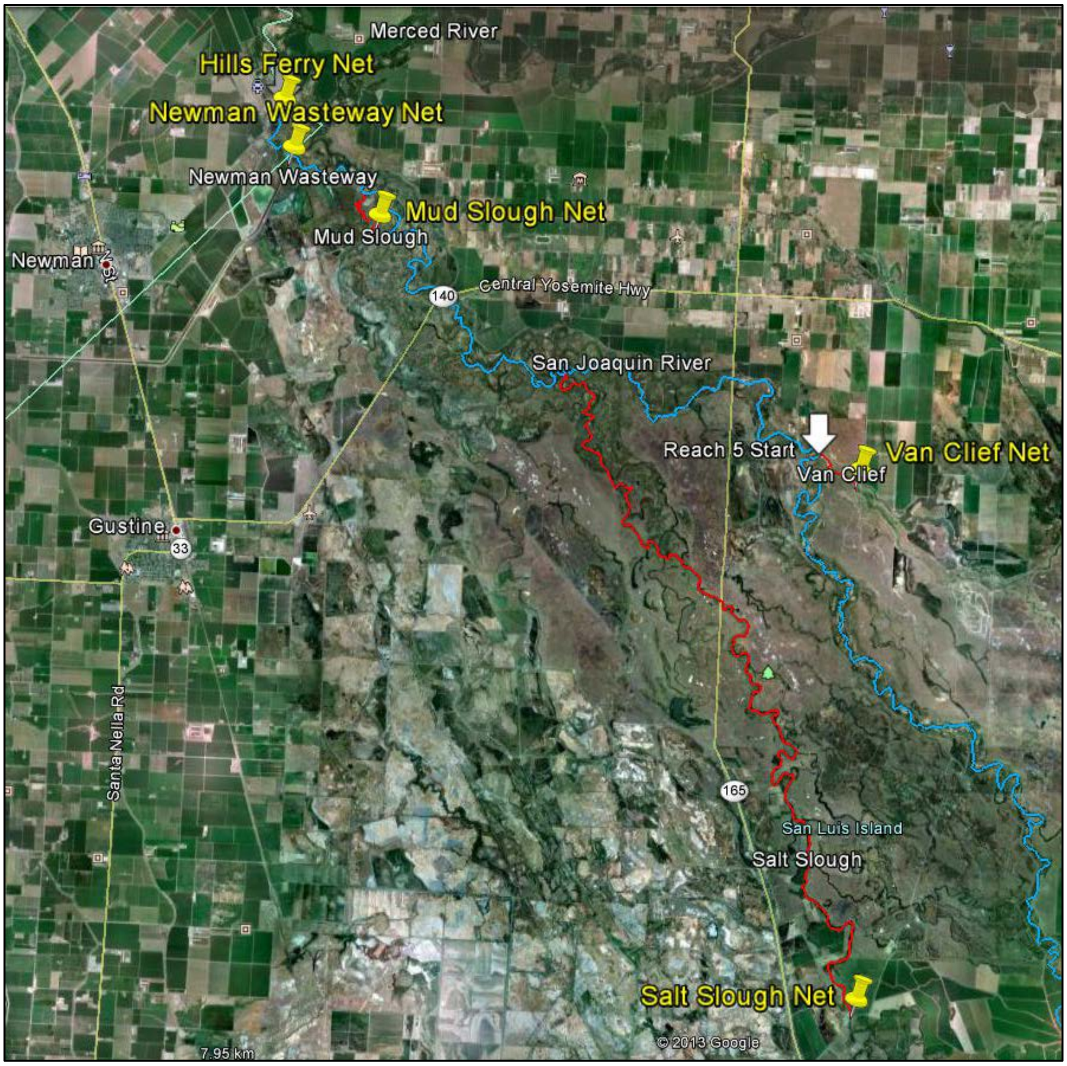


Figure 11.—Fyke net locations throughout Reach 5 of the San Joaquin River Restoration Area, California.

Fishing hours differed between nets due to net damage or dangerous flows resulting in safety concerns, however when in the water, nets fished for approximately 24 hours each day from January 17–24, 2013, February 4–14, 2013, and March 4–14, 2013.

The five fyke locations fished for a combined total of 116.6 days during the sampling period. However, beavers (*Castor canadensis*) chewed through the fyke net traps on 13 different occasions. For this reason, 13.5 days will not be incorporated to the total days of fyke net deployments. Fishing hours for fyke nests exclusive of beaver damage total 103 days (2,473.3 hours). The CPUEs for each trapping location are provided in Table 2. The nets had a cumulative average of 3.8 fish per trap per day (Table 2).

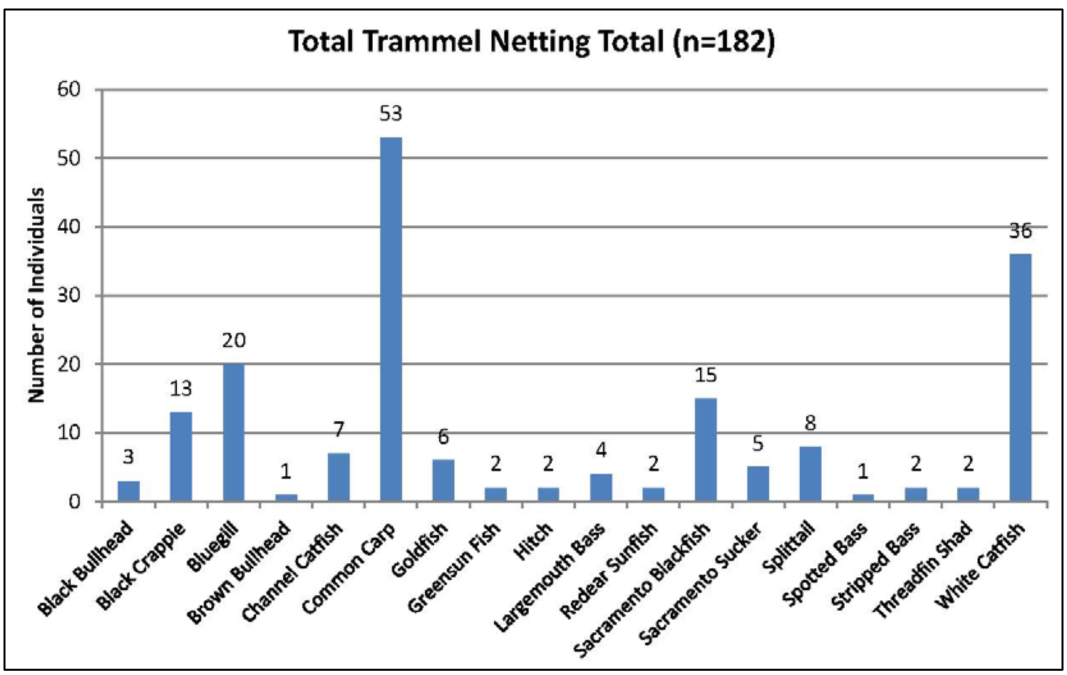
Table 2.—Total of fyke netting hours per number of fish captured by location

Fyke Netting Exclusive of Beaver Damage				
Location	**Hours Fished**	**Fish Captured**	**Days Fished**	**Fish per day**
Hills Ferry	549.04	8	22.88	0.35
Mud Slough	251.15	20	10.47	1.91
Newman Wasteway	606.55	124	25.27	4.91
Salt Slough	490.2	26	20.43	1.27
Van Clief	576.33	215	24.01	8.95
Fyke Net total	**2473.27**	**393**	**103.05**	**3.82**

Trammel Nets

Trammel netting accounted for a total of 18 species (Figure 12), representing 15 percent (n=182) of the cumulative total (n=1248) of all individuals captured across the three methods (see Table 4). Non-native fishes captured made up 84 percent (n=152) of individuals captured using this method, and 12 percent of the cumulative total. Native species comprised only 16 percent (n=30) of fish captured with this method, and 2 percent of the cumulative total. No CV Steelhead were captured using this method.

Figure 12.—Fish captured during Steelhead Monitoring Plan using trammel net sampling,



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Trammel nets were deployed or drifted opportunistically throughout Reach 5 of the Restoration Area from January 17–24, 2013, February 4–14, 2013, and March 4–14, 2013 (Figure 13). 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. A total of 59 net deployments with varying sizes occurred during sampling period. The total deployed square footage was 29,535 ft^2 with 1967.7 total hours of fishing time. Therefore, the cumulative CPUE is 0.03 fish per 10,000 ft^2/hr (Table 3).

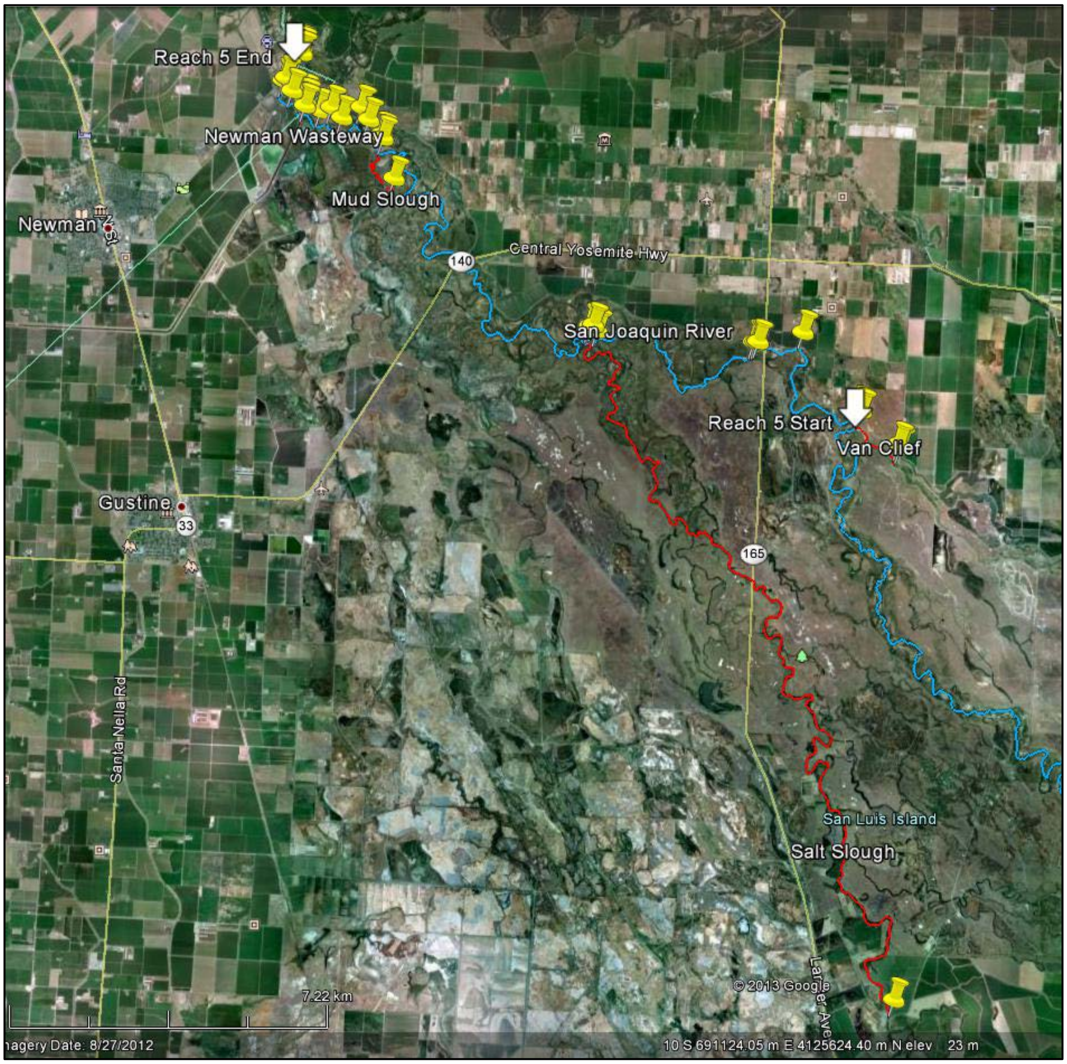

Figure 13.—Trammel netting locations in Reach 5 of the San Joaquin River, California. Markers represent approximate locations and may represent multiple nets or nets in close proximity at this resolution.

Combined Sampling Results

A total of 27 fish species comprised of 1,248 individuals were captured during the entire sampling period (Figure 14). Non-native fishes were 94 percent (n=1173) of all fish captured with the common carp (20.9 percent), bluegill (16.5 percent),

Table 3.—Trammel netting total (fish per 10,000 net ft/hr)

Trammel Netting Total					
	Hours Fished	**Net Size (ft^2)**	**Fish Captured**	**Fish per 10,000 ft^2**	**Fish per 10,000 net ft^2/hr**
Steelhead Monitoring	709.52	10216	120	117.46	0.166
Inventory and Monitoring	1258.14	19319	62	32.09	0.026
Total	**1967.66**	**29535**	**182**	**61.62**	**0.031**

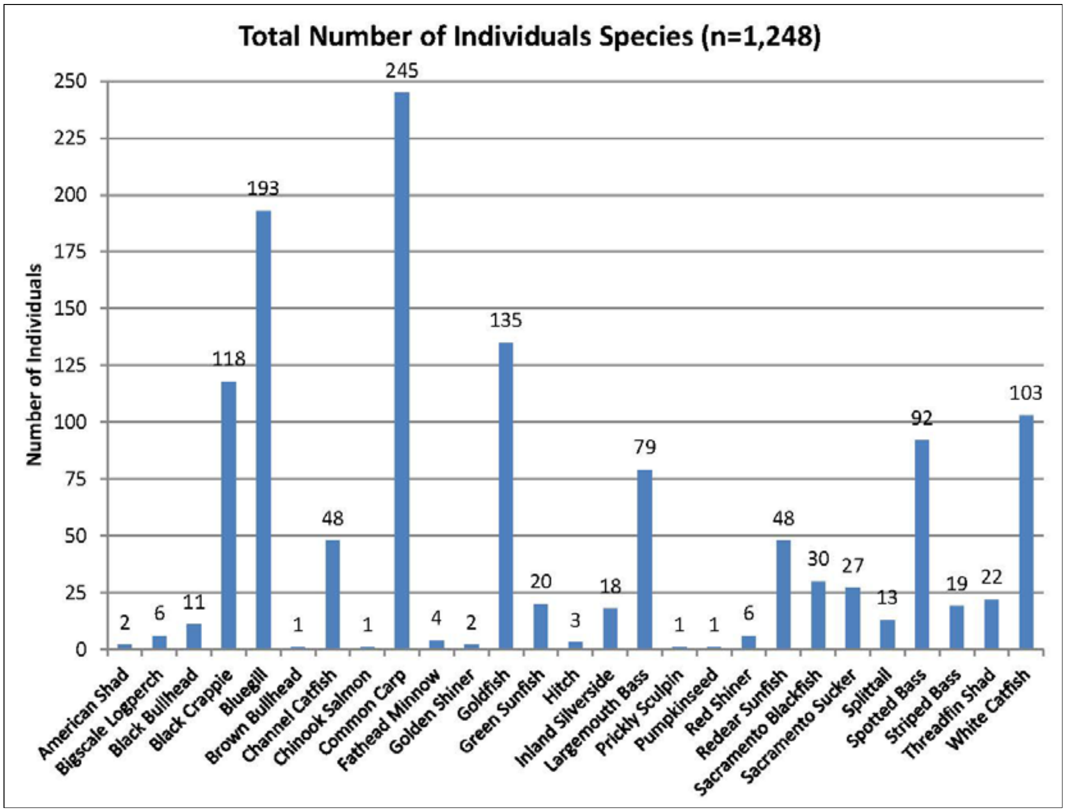

Figure 14.—Total number of fish captured by fish species.

and goldfish (11.5 percent) comprising almost 50 percent (n=573) of non-native fish captured (n=1173), and 46 percent (n=1248) of all fish captured (Table 4). Native species were only 6 percent (n=75) of individuals captured during the sampling period. Native species largely consisted of Sacramento blackfish (40 percent), Sacramento sucker (36 percent), and Sacramento splittail

Table 4.—Percentage of total fish captures by method

Method	Percentage of Non-Native Fish	Percentage of Native Fish	Percentage of Total Fish Captured
Boat Electroshocking	54% (n=637)	48% (n=36)	54% (n=673)
Fyke Net	33% (n=384)	12% (n=9)	31% (n=393)
Trammel Net	13% (n=152)	40% (n=30)	15% (n=182)
Total	**94% (n=1173)**	**6% (n=75)**	**100% (n=1248)**

(13 percent) that summed a cumulative total of 93 percent of native fish captures, and 5.6 percent (n=70) of all fish (see Table 4). A male Chinook salmon was captured at Mud Slough using a fyke net January 20, 2013.

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. Annual 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 baseline information of fish community assemblages and native fishes for Reach 5 of the SJRRP. Six out of 27 fish species captured were native to the SJR, though populations of these native fish species were much less represented compared to non-native. Only 6 percent 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, the 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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