Central Valley Steelhead (*Oncorhynchus mykiss*) Monitoring Plan for the San Joaquin River Restoration Program

Statement of Need:

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. Bureau of Reclamation (Reclamation) in coordination with the Fisheries Management Work Group has proposed a Steelhead Monitoring Plan to facilitate detection of steelhead on the San Joaquin River (SJR) upstream of the Merced River confluence and transport to suitable habitats downstream of the mouth of the Merced River.

Fall interim flows occurring from October 1 to 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. In the fall of 2010, a trap was installed by the California Department of Fish and Game (CDFG) and operated by Reclamation, Denver Technical Service Center to assess the barrier's effectiveness. Some fall-run Chinook salmon were able to pass the barrier during the 2010 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.

Background:

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.

The potential routes for migratory fish such as the Central Valley (CV) steelhead (*Oncorhynchus mykiss*) are believed to have been historically abundant in the SJR. 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 apportion 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 due to 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, 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 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). However, 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 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.

Study Site:

The Restoration Area for the San Joaquin River Restoration Program (SJRRP) includes the SJR between Friant Dam and it's confluence with the Merced River. For this study, the monitoring will be from Sack Dam to the confluence of the Merced River. Sack Dam will be the upstream extent because it is impassable in low water year types.

Five sampling methods have been developed for this proposed adult steelhead monitoring plan.

Sampling Method 1: Raft Mounted Electroshocker

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 will be monthly from December through March of the following year. Capture of the same fish multiple times is be anticipated, thus monthly sampling is important to ensure fish recovery from stress between capture. Raft mounted electroshockers will be used in order to navigate through shallow waters of the sampling locations (*i.e.,* Mud Slough, Salt Slough, Newman Wasteway, Eastside Bypass, Mariposa Bypass, Sand Slough Control Structure, and base of Sack Dam). Electrofishing methods would refer to the NMFS guidelines for sampling waters with anadromous fish. However, the guidelines are for backpack electrofishing, but researchers are not precluded from using other techniques or equipments as long as NMFS are given substantial proof that proposed techniques or equipments are necessary for the study and that listed species are safeguarded (NMFS 2000). Additional permitting is necessary under this method.

This option has a high potential to be successfully implemented during 2012 spring interim flows. The significant constraints to this method are permitting and access to appropriate sampling locations.

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

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.*, VAMP), high flows (*e.g.*, flood releases), and turbid water conditions. A fyke net with wing walls and traps is the proposed sampling method to overcome difficulty of monitoring adult steelhead.

Fyke nets have long been used to capture migrating fish to monitor their yearly changes and abundances. This net tends to be the most useful in capturing fish that follow the shorelines at different times of the day during fish migration season. These nets are 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 contain two 5 m long throats with 15 or 25 cm diameter throats, and have a zipper for easy fish removal. Wings will be 1.8 m deep and 48.8 m long. A buoy will be affixed with a 10-m length of rope. Nets will be held in place with 22-kg

anchors and will be deployed in sampling locations (*i.e.*, upstream of the confluence of the Merced River, the mouths of Mud, Slough, Salt Slough, Newman Wasteway, and existing structure at Sack Dam). This proposed technique will be implemented once the HFB is removed around mid-December and will remain deployed at the sampling locations until March 15. The traps will be checked daily so the likelihood of fish being physically injured is low. Adult steelhead that get captured will be sampled, tagged, and released. Data from this trap will give an actual count of steelhead abundance migrating in the upper reaches of the SJR.

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

Sampling Method 3: Steelhead specific trammel nets

Trammel nets 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) on high velocity water. A short duration drifting of trammel net is necessary to prevent fish from being entangled for a long period of time. Trammel nets are advantageous and relatively efficient in turbid waters. This net consist 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 pass. The larger and smaller mesh size nets form a pocket when fish try to swim through. Similar to seine nets, trammel nets are equipped with floats attached to the head rope and lead weights along the ground rope. For safety reasons, brightly colored floats will be used to attach to the head rope so boaters and other recreationists can avoid entangling themselves, their boats, and/or their fishing gears with the nets while floated. To ensure safety of steelhead, fisheries biologists tending the nets follow at a close distance to observe, reduce risk of entanglement, and retrieve nets in short time intervals. Sampling time will depend on the number of fish and bycatch caught at each location.

Sampling will begin during adult steelhead migration (mid-December until mid-March) on a number of habitats on the SJR where steelhead may be present. Additional permitting is necessary under this method.

Fish Handling and Relocation

For all sampling methods listed above, captured adult CV steelhead will be subject to standard handling and transporting procedures. Captured steelhead will 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 will be Floy tagged with a unique identification number to document any recaptures that may occur in the study area.

Captured steelhead would be transported downstream of the mouth of the Merced River in transport tanks following proposed transport protocols. The transport tanks will be immediately filled with river water prior to transport using a portable screened water pump. Captured steelhead will be moved in and out of the transport truck using a water-filled vessel to help minimize stress and loss of slime. Oxygen gas will be supplied to the transport tanks using compress oxygen gas cylinders and micro-bubble diffusers to maintain dissolved oxygen levels at near saturation during transport. Transport water will be supplemented with sodium chloride to decrease ionic gradient as another way to minimize stress. The truck will be stopped after 30 minutes of transportation and each hour thereafter for visual inspection of the life-support system and fish wellbeing. Water will be tempered to the receiving water at the predetermined release location before transferring fish, by pumping receiving water directly into the transport tank until the temperature reaches that of the release water.

Contacts

Donald E Portz, Ph.D.
Fisheries Biologist
U.S. Department of the Interior, Bureau of Reclamation
Fisheries and Wildlife Resources Group
303-859-9505
dportz@usbr.gov

Norm Ponferrada
Fisheries Biologist
U.S. Department of the Interior, Bureau of Reclamation
Fisheries and Wildlife Resources Group
720-556-2379
nponferrada@usbr.gov

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