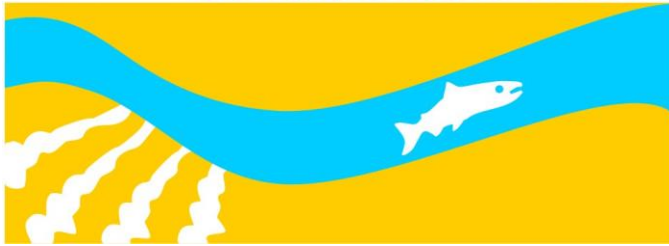


Study 45

Rotary Screw Trap Monitoring

**Final
2015 Monitoring and Analysis Plan**

**SAN JOAQUIN RIVER
RESTORATION PROGRAM**



1.0 Rotary Screw Trap Monitoring

Theme(s):

- Long-term monitoring

Related Question(s): Questions not developed for this theme to date.

1.1 Statement of Need

The Restoration Goal for the San Joaquin River Restoration Program (SJRRP) is to restore and maintain fish populations in “good condition” in the mainstem San Joaquin River below Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish. In order to evaluate progress towards achieving the Restoration Goal, rotary screw trap (RST) monitoring is needed to examine natural production of juvenile Chinook salmon in the system, with the long-term aim of providing descriptive information on the abundance, timing, size, and condition of these fish. Such efforts will provide a means of tracking progress towards meeting SJRRP objectives and determining degree of success of the Restoration Goal, as well as providing feedback to inform future restoration actions.

1.2 Background

Beginning 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 California’s Central Valley Project Friant Division contractors. After nearly two decades of litigation, the lawsuit known as *NRDC, et al., v. Kirk Rodgers, et al.*, reached a Settlement. The Settling Parties, including NRDC, Friant Water Users Authority (now the Friant Water Authority), and the U.S. Departments of the Interior and Commerce, agreed on the terms and conditions of the Settlement which was approved on October 23, 2006. Implementation of the Settlement is accomplished through the SJRRP, a comprehensive multi-agency effort to restore water flows and healthy fish populations, including reintroduction of spring- and fall-run Chinook salmon, to the San Joaquin River between Friant Dam and the Merced River confluence (the Restoration Area).

Successful reintroduction of Chinook salmon populations to the Restoration Area will require bringing together several related but independent actions that include flow conveyance, channel improvements, habitat restoration, structural modifications, and fish reintroductions. The SJRRP has worked to meet these targets by developing a number of channel modification projects intended to improve habitat and passage conditions, by evaluating options that allow for reintroduction to occur while channel modification

projects are implemented and by conducting research and monitoring necessary to inform restoration actions. One such monitoring activity includes the use of RSTs to evaluate natural production of juvenile Chinook salmon in the system.

RST monitoring began in the spring of 2013 (March through June), operating one RST near the SR-99 Bridge, and continued in 2014 (December through February) with RSTs operated at the SR-99 and San Mateo sites. Much information and experience was gained during preliminary monitoring efforts including a better understanding of RST assembly, deployment, operation (i.e., cleaning, processing, maintenance, data recording and analysis), and efficiency releases (i.e., fish marking, holding, releasing). However, further experience and site-specific information at additional RST locations is needed before long term RST monitoring sites can be determined, and provide information on the abundance, timing, size, and condition of juvenile Chinook salmon natural produced in the Restoration Area. Continued assessments into the suitability of RST locations and optimizing trap efficiencies is an important step for this monitoring activity, and may take several seasons under various river flow conditions to achieve.

1.3 Anticipated Outcomes

Study goals: To further evaluate RST sites/locations while working to optimize trap efficiencies.

Study objectives:

1. Assess the suitability of each RST site and location
2. Optimize trap efficiencies
3. Establish a long term plan for juvenile Chinook Salmon RST monitoring that will eventually assess:
 - a. The abundance of naturally produced juvenile Chinook Salmon in the Restoration Area
 - b. Assess size/condition of juvenile Chinook Salmon at each trapping location
 - c. Determine migration timing of juvenile Chinook Salmon

The primary objectives of preliminary RST monitoring efforts are to evaluate site suitability and trap efficiencies of deployed RSTs that will be used to determine long-term monitoring sites. The long-term objectives for monitoring will be to assess (1) juvenile Chinook Salmon abundance, estimated by capturing marked juveniles below primary spawning reaches, (2) migration timing of naturally produced juveniles, (3) size/growth, based on changes in mean size of captured juveniles over time, (4) condition, assessed by condition factor and, (5) survival, measured as the difference in capture rates as juveniles migrate downstream past RST sites. Supplementary information gained in the near-term on relative abundance, timing, size, and condition of juvenile

Chinook salmon naturally produced in the Restoration Area may also be used to inform future restorations efforts with the aim of achieving the SJRRP's Restoration Goal.

1.4 Methods

Type of Study: Field

Reach(es): Reaches 1, 2

Monitoring activities are expected to commence when fry begin to emerge from the gravel (i.e., November for spring-run, December for fall-run), and continue until there are 10 consecutive days with no catch after June 1st. The actual dates when sampling begins and ends may be modified to account for a variety of environmental factors. Monitoring will continue annually with an unknown stoppage date. RSTs will be operated following guidance presented in the U.S. Fish and Wildlife Service's "Draft Rotary Screw Trap Protocol for Estimating Production of Juvenile Chinook Salmon" (USFWS 2008). Collections of juvenile will consist of both natural/river reared fish and artificially reared and marked fish. Marked fish will be used for trap efficiency testing. If considered necessary, captured juveniles may be transported between December and July of each year to aid juvenile emigration assistance efforts, and may continue until river conditions allow for their downstream migration. After which, it is anticipated that juveniles will only be transported in low water years, when river conditions create the need.

1.4.1 Rotary Screw Traps

RSTs consist of a funnel-shaped cone that is screened and suspended in water between floating pontoons. The cone rotates as water flows past the trap, guiding fish moving downstream into a live box that is attached to the rear of the trap cone. RSTs are usually installed at a fixed location that can continuously sample for extended periods of time. When placed properly and calibrated, RSTs can provide reliable estimates of juvenile abundance.

RSTs used in 2015 SJRRP monitoring efforts will be deployed near the SR-99 Bridge (Figure 1), and downstream of the San Mateo Road Crossing (Figure 2). These sites were determined to have suitable hydraulic conditions, reliable access, and are downstream of areas where Chinook salmon spawned in the Restoration Area. These trap locations will remain fixed each year unless changes in channel configuration or hydraulic conditions warrant adjustments. Trap locations will be documented with photographs and GPS. To the extent possible, traps will be positioned in locations: (1) where a relatively high percentage of the total stream or river discharge flows through the trap cone (2) where they can operate effectively over the entire range of discharge conditions (3) directly downstream of a riffle, and (4) in the thalweg of the river channel.

Water velocities at trap sites where an 8-foot diameter RST is operated will be no less than 0.6 meters/second (1.9 feet/second) at the lowest discharge. Under optimal conditions, the water velocities at trap sites will be 1.5 meters/second (4.9 feet/second), with the RST cone making a minimum of 5 rotations per minute (rpm) and a maximum of 13 rpm. Low stream gradients and water velocities may exist in some portions of the

river. Under these conditions, modifications to divert more flow into the trap cone may be needed and would possibly include guidance panels. Traps will be held in place with 6 millimeter diameter or thicker cable fastened to large, permanent structures on the bank. If possible, overhead cables will be used to secure traps. A safety cable will be attached to the rear of the trap, such that the trap will swing to shore if the other cables fail.

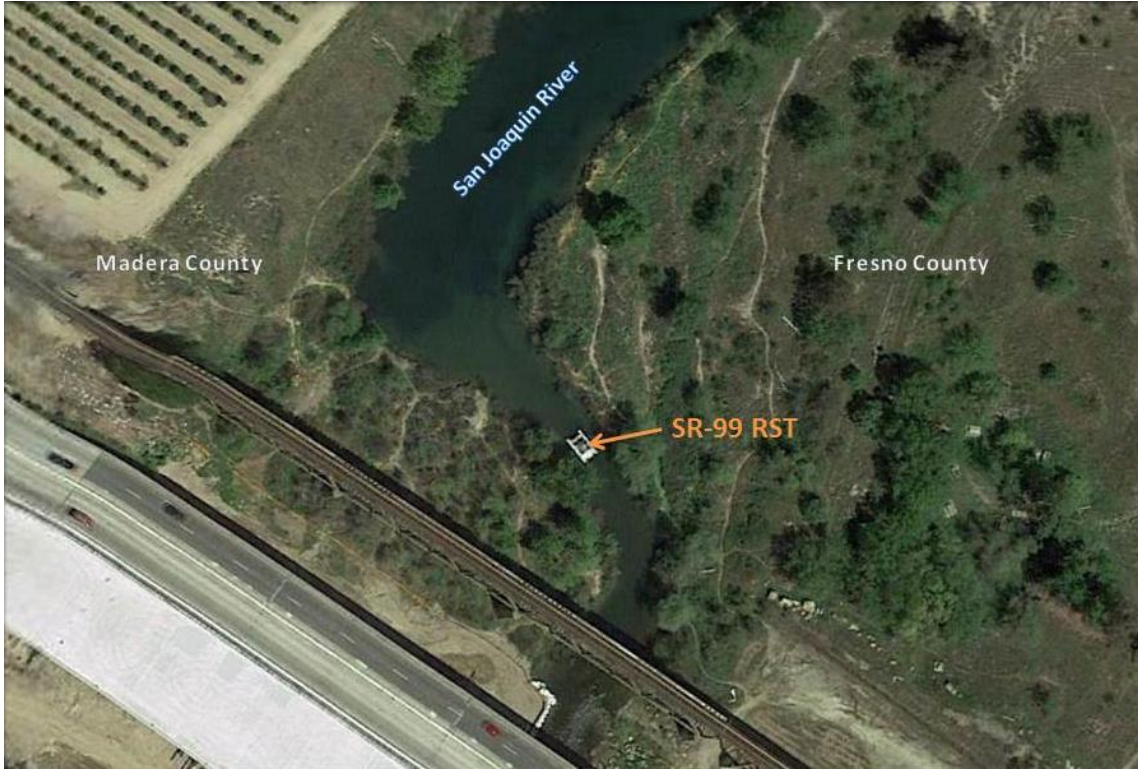


Figure 1. General location of SR-99 Rotary Screw Trap

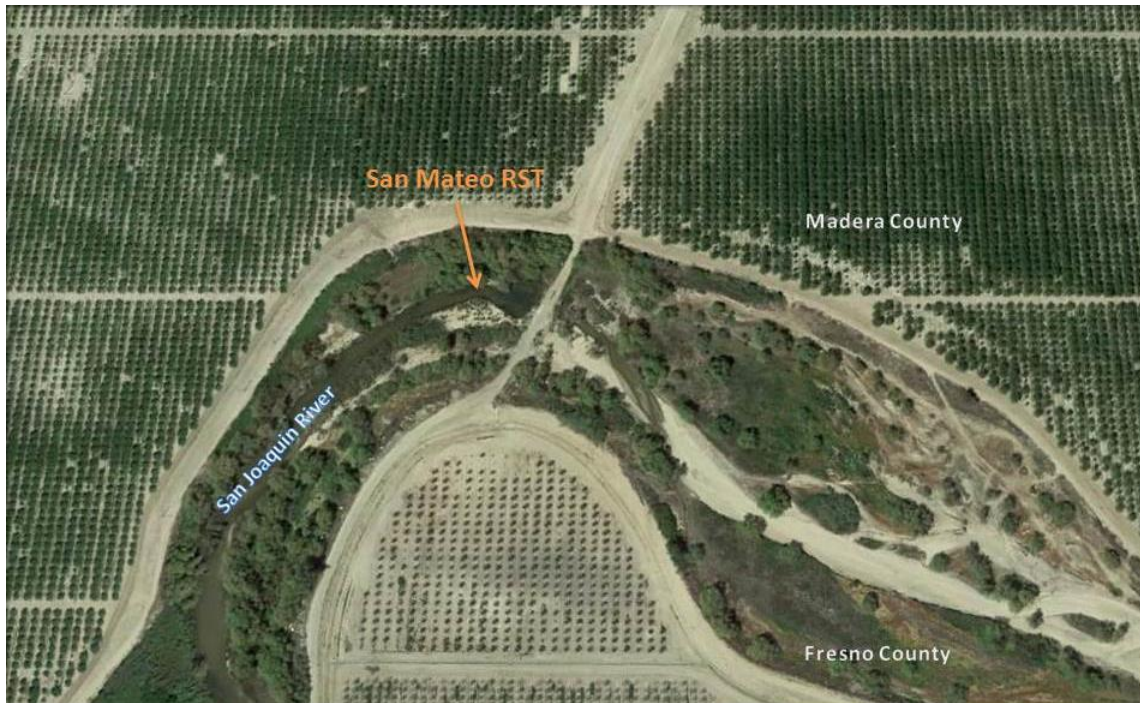


Figure 2. General location of San Mateo Rotary Screw Trap

1.4.2 Checking and Processing

RSTs will be checked a minimum of once a day, but as often as necessary to maintain a safe holding condition for fish and efficient operation of the trap. The frequency of trap checks will ultimately depend on the number of fish collected, level of instream flow, and debris loads. If mortalities greater than 2 fish or 2 percent of total catch are observed in a given day due to high debris loads, the RST cone will be raised out of the water until conditions are better suited for survival of fish (i.e., reduced winds or streamflow, improved weather conditions). If predation causes such mortality, a structural refuge will be installed inside the trap to reduce predation. The traps will be inspected daily for damage and improper wear to the cone, anchoring points, and overhead cable system. Field crews will check the live-box and processed any fish. The traps will be cleaned daily, with the cone, pontoons, and live-box being scrubbed and free of debris. Maintenance will be performed as inspections warrant such activities. Any problems with trap condition will be noted in the daily logbook. If problems cannot be addressed immediately, photos to document the issue will be captured and one of the Principal Investigators will be contacted.

Data collected from captured juvenile Chinook salmon will include fork length, weight, and smolt index score. Additionally, tissue samples of adipose present juveniles may be collected. Environmental data (water temperature, dissolved oxygen), will be collected with a multiparameter meter (i.e. Hydrolab, YSI). Water velocity and discharge will be recorded at each trap check or at the gauging station closest to the activity.

Cleaning the Live-box

- 1) Record Location, Station, Gear Status, Recorder/Crew, and Date on the data sheet.

- 2) Observe RST condition and make sure it is operating properly.
- 3) Determining trap revolutions per minute (RPM) as follows:
 - a) As the RST cone spins, find a marker on the cone (e.g., counter bolt) to watch, and use a stopwatch to determine how many seconds it takes the cone to complete three rotations.
 - b) Record the RPM.
- 4) Scrub and clean exterior of cone with a brush.
- 5) Record water temperature, dissolved oxygen (DO), and velocity.
- 6) Clear fish and debris from live-box making sure to keep hands and nets away from any moving parts.
 - a) Fill a bucket with aerator, about 1/2 full of water.
 - b) Scoop out no more than 1/4 net full of debris at a time.
 - c) Carefully sort through the debris using a stick (or other probe).
 - d) Carefully find and remove all fish. Use a fine mesh net to scoop small fry and place them in a separate bucket from larger fish to prevent predation and/or cannibalism. Make sure fish are not overcrowded in buckets (< 25 small fish per bucket).
 - e) Make sure water temperature in bucket remains no more than 2°C greater than the river water temperature and DO remains within acceptable parameters (6 to 10 mg/L). Replace the water if it becomes too warm.
 - f) If there are too many fish to hold in buckets while processing, leave fish in the live-box and process fish in small batches.
 - g) Once the live-box is cleared, record Sample Time and Total Revolutions.
 - h) Make sure all acoustic receivers and/or thermographs are attached and free of debris.

Processing RST Catch

- 1) Sampled fish may be anesthetized before measuring using CO₂ or other approved anesthetic.
- 2) Fill at least 2 buckets about 3/4 full of fresh river water for recovering fish. Use one bucket for juvenile Chinook and the other for all other species.
- 3) Fish condition/health
 - a) Observe fish carefully prior to sedation to identify potentially moribund fish.
 - b) Look for lesions (commonly across the back in a saddle shape), “black spot” disease, and any indications of hemorrhaging caused by RST operation.
- 4) If anesthetizing fish, add them to the approved anesthetic after it has been tested for concentration. Do not put more than about 10 fish in anesthetic at any one time.

- 5) If there are large numbers of juvenile Chinook, randomly selected 50 Chinook juveniles to process (fork length, weight, and smolt index score) as well as all yearlings while making sure to note natural produced juveniles to obtain tissue samples for genetic analyses. Process the first 10 of all other species (fork length).
- 6) Measure fork length (mm) and weight to the nearest 0.1g.
 - a) Fry should not be weighed as they are too small for an accurate measurement.
 - b) No need to weigh fish of other species.
- 7) Count the number of individuals of each species that exceeds the number measured, and record value in the Plus Count column associated with that species. If water temperature exceeds 20°C, do not take any measurements but record all fish as “plus counts.”
- 8) Determine Chinook salmon Smolt Index (SI) (see Table 1)
- 9) After fish have recovered (i.e., at least 30 minutes), release fish at pre-designated locations downstream from the traps.

Table 1-1. Smolt Index Criteria

Smolt Index	Life Stage	Criteria
1	Yolk-sac Fry	<ul style="list-style-type: none"> ▪ Newly emerged with visible yolk sac
2	Fry	<ul style="list-style-type: none"> ▪ Recently emerged with sac absorbed (button up fry) ▪ Seam along mid-ventral line visible ▪ Pigmentation undeveloped
3	Parr	<ul style="list-style-type: none"> ▪ Seam along mid-ventral line not visible ▪ Scales firmly set ▪ Darkly pigmented with distinct to slightly faded parr marks ▪ No (to slight) silvery coloration
4	Smolt	<ul style="list-style-type: none"> ▪ Parr marks highly faded or absent ▪ Bright silver or nearly white coloration ▪ Scales easily shed (deciduous) ▪ Black trailing edge on caudal fin ▪ More slender body

1.4.3 Trap Efficiencies

Calibration fish are used to determine the capture efficiency of the RST, which in turn is used in part to estimate population abundance. Efficiency releases will use marked fry-, parr-, and smolt-sized fall-run study fish over the entire range of flow conditions. Study fish will be tagged (CWT) and marked with brightly colored photonic dyes. Mark location/colors will not be used more frequently than every five days to ensure that release groups can be distinguished in trap captures. Marked study fish will be allowed to acclimate (i.e., at least 1 hour) to the river water before release by holding them in small net pens tethered to existing vegetation near the release site. Efficiency releases will be made gradually by drift boat in small groups (100-2,000 fish) approximately 0.25 mile upstream from the trap just after dusk. Efficiency studies will be needed whenever the trap location is changed or the channel morphology changes at the study sites. Trap calibration may require up to 2,000 fish per release. Multiple calibration releases for multiple RST could require as many as 100,000 fish per season.

1.4.4 Transportation

Transportation of juveniles will follow protocols described in the SJRRP Adult and Juvenile Salmon Transport SOP # SCF-TRN-001-03. Transportations will use a 150-gallon tank capable of holding up to 5,000 juveniles, a 450-gallon tank capable of holding up to 25,000 juveniles or in a 500-gallon tank capable of holding up to 30,000 juveniles. Juveniles will be loaded using either a dip nets or water filled vessels to carry them to the tank. Water filled vessels will be the preferred method for loading. If dip nets are used, fish will be kept in water until they are ready to be loaded into the tank. The transport tank will be filled with water at ambient river temperature with 0.6 to 1 percent NaCl to minimize stress. Transport water will be obtained from either the Interim Facility or trapping location. Dissolved oxygen in the transport tank will be maintained at 8 mg/L or more.

1.5 Deliverables and Schedule

Information on site suitability and trap efficiencies of deployed RSTs will be used to determine long-term monitoring site locations. Supplementary information on abundance, timing, size, and condition of these fish will also be collected during preliminary RST monitoring. Such efforts will provide a means to evaluate the success of the Restoration Goal while also providing information to better direct future restoration actions. An annual report of RST monitoring activities will be provided to the SJRRP at the end of each season.

Milestones (2014–2015):

December 15	RST Deployment
June 30	Removal of RST
July 31	Draft Report
August 31	Final Report

1.6 Point of Contact / Agency Principal Investigator

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1.7 References

- San Joaquin River Restoration Program (SJRRP). 2013. Adult and Juvenile Salmon Transport Standard Operating Procedures: SOP # SCF-TRN-001-03. March 2013.
- U.S. Fish and Wildlife Service (USFWS). 2008. Draft Rotary Screw Trap Protocol for Estimating Production of Juvenile Chinook Salmon.

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