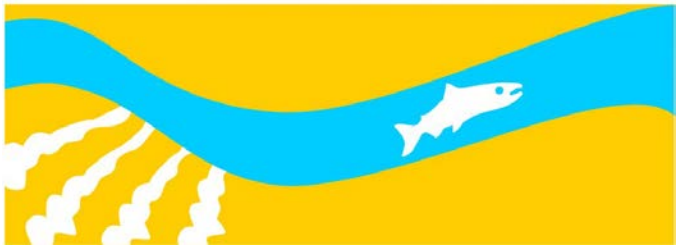
Study 45

Rotary Screw Trap Monitoring

Final
2014 Monitoring and Analysis Plan

SAN JOAQUIN RIVER
RESTORATION PROGRAM



November 2013

Fisheries Management Work Group STUDY WORKPLAN DETAIL CHECK LIST

Title: Rotary Screw Trap Monitoring

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Counties affected by Study: Fresno and Madera

I. Study Management

A. Study Description

1. History or Background

The following background description originates from the Fisheries Management Plan (SJRRP 2010). 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, 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. The Settlement establishes two primary goals: (1) Restoration Goal – To restore and maintain fish populations in "good condition" in the main stem 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, 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.

In response to the Settlement, the implementing agencies, consisting of the U.S. Department of Interior's Bureau of Reclamation (Reclamation) and U.S. Fish and Wildlife Service (USFWS), The U.S. Department of Commerce's National Marine

Fisheries Service (NMFS), California Department of Fish and Wildlife (CDFW), and California Department of Water Resources (DWR) organized a Program Management Team and associated Work Groups to begin work implementing the Settlement. The San Joaquin River Restoration Act was signed on March 30, 2009, giving the Department of Interior full authority to implement the SJRRP.

This study workplan, developed by the Fisheries Management Work Group (FMWG), describes rotary screw trap (RST) monitoring and juvenile trapping and transport activities.

a. General project background discussion

One of the Settlement's primary goals is to restore and maintain fish populations in "good condition" in the main stem 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. The FMWG has worked to meet this goal 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 being planned, and by conducting research and monitoring necessary to inform restoration actions. With several restoration actions planned for the reintroduction of Chinook Salmon, the need to monitor such activities is necessary to evaluate their effectiveness. One such opportunity would involve RST monitoring of juvenile Chinook Salmon naturally produced in the system, with the aim of providing descriptive information on the abundance, timing, size, and condition of these fish; from which it may be possible to make inferences about spawning success of released study fish during pilot-scale reintroduction efforts (i.e. trap and haul), while also providing a means to better inform future large-scale reintroduction efforts.

Preliminary, pilot-scale RST monitoring began in the spring of 2013 (March-June), with one RST operated near the SR 99 Bridge. During preliminary RST monitoring efforts, much information and experience was gained regarding the logistics of such a monitoring effort, including RST deployment, operation (cleaning, processing), and efficiency releases (fish marking, holding, releasing). However, further experience and site specific information at additional RST locations is needed before RST monitoring can begin in earnest, with the ultimate goal of providing descriptive information on the abundance, timing, size, and condition of juvenile Chinook Salmon naturally produced in the Restoration Area. Exploring suitable RST locations and optimizing trap efficiencies is a key first step for this monitoring activity, and may take several seasons under various river flow conditions to achieve. Further, using RSTs as effective methods to trap juvenile Chinook Salmon for transportation remains uncertain, with further evaluation into the practicality of such an approach necessary.

b. Why is the study necessary (context of settlement requirements, reintroduction efforts, interim flow information needs, etc.)?

The primary purpose of this study is to further evaluate the feasibility of using RSTs as well as to optimize RST efficiencies. In time, data obtained from this study will provide fundamental information concerning natural production in the system, and thus aid in future fisheries management decisions. Further it may be possible to make inferences about current rearing conditions in the river, survival of juveniles, and spawning success of released study fish, thus providing a means to better inform future reintroduction efforts. This coincides with the information gathering stage of salmon reintroduction as described in the SJRRP Chinook Salmon Reintroduction Draft (2013) document, which involves conducting fish studies using targeted species to inform the restoration process. Additionally, RST sites may also enhance juvenile migration studies by adding an additional acoustic or pit tag tracking location, and by adding a location to tag naturally produced fish.

The Program is also considering the feasibility of trapping (upstream reaches) and hauling (downstream reaches) juvenile Chinook Salmon prior to the completion of river restoration activities to help facilitate successful out migration in the interim; RSTs being a potential trapping method. Gaining juvenile trap and haul experience may be beneficial in the event that a juvenile salvage operation is ever needed.

2. Site Description

   a. Location of the study (include maps, geographic data, etc.)

Juvenile Chinook Salmon will be collected in Reaches 1 and 2 of the Restoration Area, with RSTs placed in two locations during near-term (Fiscal Year 2014) monitoring. RSTs will be installed in the following general areas: near the SR 99 Bridge (Fig. 1) and just downstream of the San Mateo Road crossing (Fig. 2). These sites were considered suitable for RST deployment and function in terms of (1) access to both banks of the river for anchoring, (2) structure for anchoring the cable system, (3) depth > 1/2 cone diameter, (4) velocities above 0.6 m/s, (5) coverage of channel width to maximize efficiencies, (6) ability to provide boat passage around traps, and (7) minimal vandalism opportunity. RST site locations will remain fixed each year unless changes in river conditions warrant the need to move them or if new RST sites are considered necessary for long-term study purposes.

If juvenile Chinook Salmon trap and haul is conducted, juveniles trapped in the downstream most RST will be held in live wells at the RST, for up to a week, until a sufficient number of juveniles has been trapped for transport and release at or downstream of Reach 5.

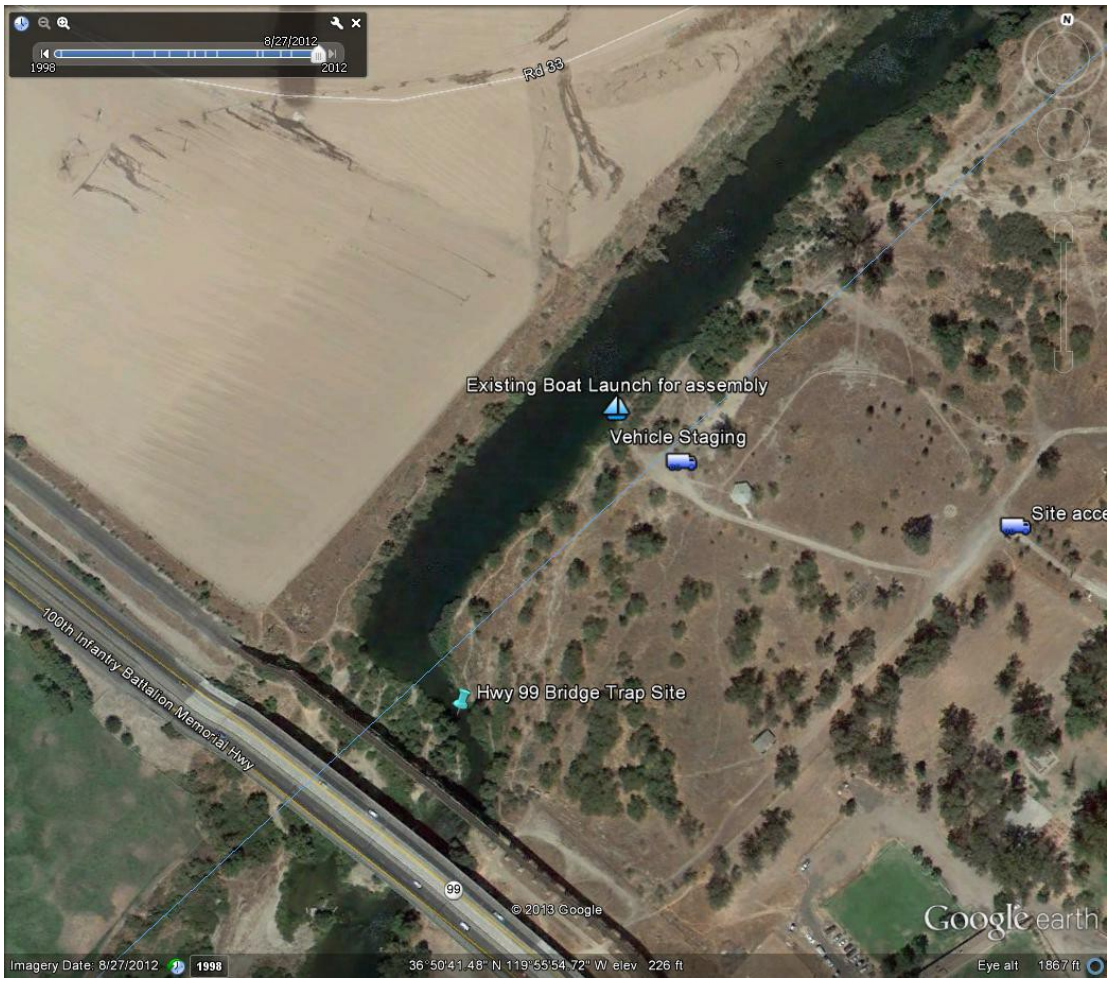

Figure 1. General Location for RST Deployment at SR 99

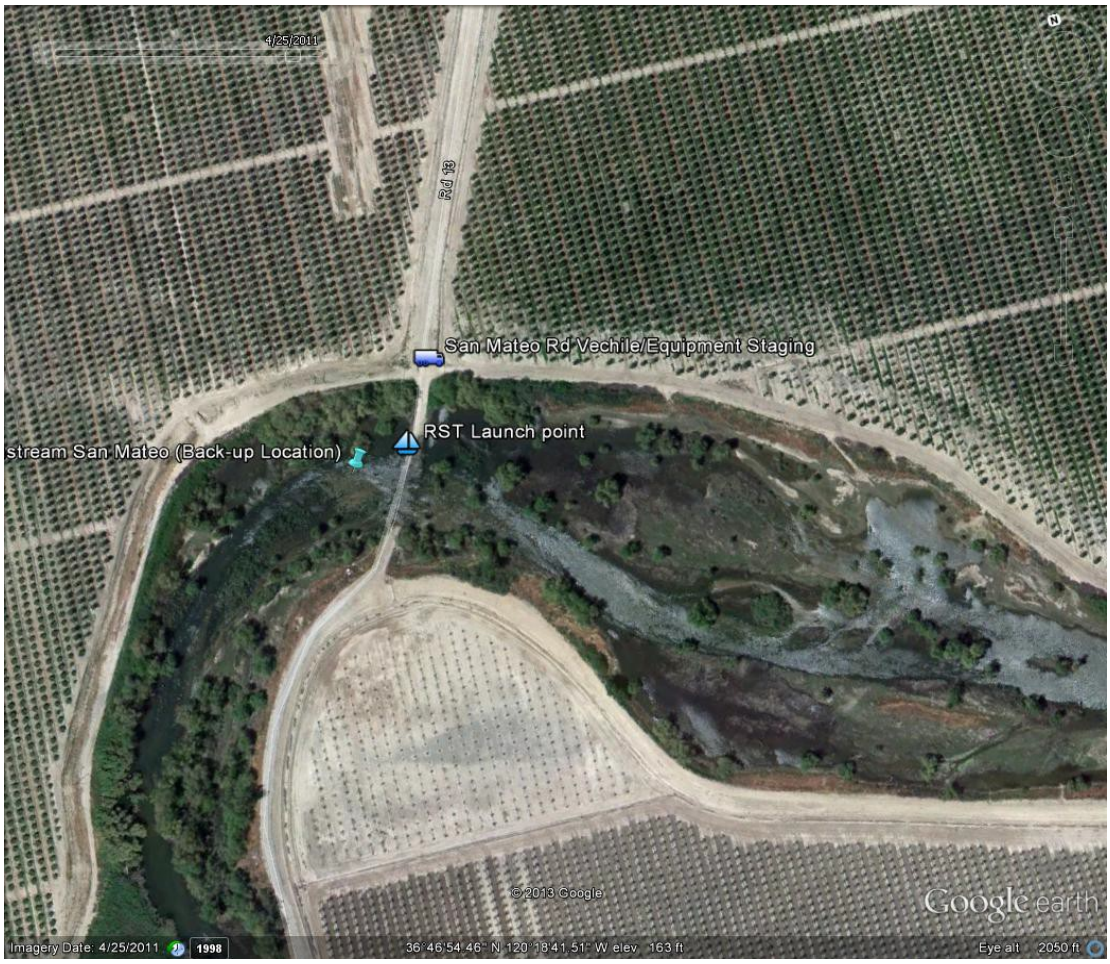

Figure 2. General Location of RST Deployment Downstream of San Mateo Road

a. Describe the environmental setting for the study

The Program will trap fish in Reaches 1 and 2 of the Restoration Area using RSTs, and if necessary (i.e. prior to the completion of river restoration activities) transport juvenile Chinook Salmon downstream to a suitable release location below any fish passage barriers. Reaches 3 and 4 of the Restoration Area do not contain suitable spawning or out migration passage for Chinook Salmon, therefore, only Reaches 1, 2, and 5 of the Restoration Area are included below. The following environmental setting descriptions are adapted from the Fisheries Management Plan (SJRRP 2010).

Reach 1

Reach 1 begins at Friant Dam and continues approximately 37 miles downstream to Gravelly Ford. The reach is divided into two sub-reaches, 1A and 1B. Reach 1A extends from Friant Dam to SR 99. Reach 1B continues from SR 99 to Gravelly Ford. Reach 1 is the principal area identified for Chinook Salmon spawning, but has been extensively mined for instream gravel. In addition, riparian encroachment, channels incision, and possible sedimentation of spawning grounds have occurred in Reach 1. Reach 1 presently supports continuous riparian vegetation, except where the channel has been disturbed by instream and floodplain aggregate mining.

Native fish species recently documented in Reach 1 include Sacramento Sucker (*Catostomus occidentalis*), Sculpin (*Cottus sp.*), Rainbow Trout (*Oncorhynchus mykiss*), Lamprey (*Lampetra*

sp.), Threespine Stickleback (*Gasterosteus aculeatus*) and Sacramento Pikeminnow (*Ptychocheilus grandis*). In addition to native fish, this reach also supports nonnative species such as Largemouth Bass (*Micropterus salmonides*), Spotted Bass (*M. punctulatus*), Striped Bass (*Morone Saxatilis*), Goldfish (*Carassius auratus*), Bluegill (*Lepromis macrochirus*), Green Sunfish (*L. cynanellus*), Pumpkinseed (*L.gibbosus*), Redear Sunfish (*L. microlophus*), Warmouth (*L. gulosus*), Bigscale Logperch (*Percina macrolepida*), Common Carp (*Cyprinus carpio*), Catfish (Brown and Black Bullhead, and White) (*Amerius sp*.), Channel Catfish (*Ictalurus punctanus*), Crappie (*Pomoxis sp.*), Golden Shiner *(Notemigonus crysoleucas)*, Brook Trout (*Salvelinus fontinalis)* and Western Mosquitofish (*Gambusia affinis*).

Reach 2

Reach 2 extends from Gravelly Ford (RM 229) to Mendota Pool (RM205). This reach is entirely sand bedded. At the downstream boundary, Mendota Dam marks the location where the river turns north and slope decreases. Reach 2 is divided into two sub-reaches that are separated by the Chowchilla Bifurcation Structure (RM 216). Sub-reach 2A begins at Gravelly Ford and extends downstream to the Chowchilla Bifurcation Structure. Sub-reach 2B begins at the Chowchilla Bifurcation Structure and extends downstream to the Mendota Dam. Both sub-reaches have confining levees protecting adjacent agriculture land, yet they have differing vegetation densities inside the levees. The backwater effect of Mendota pool has left much of sub-reach 2B with a dense but narrow ribbon of riparian vegetation. The upper third of sub-reach 2B and all of sub-reach 2A have little vegetation due to prolonged periods without water.

Native species recently documented in Reach 2 and adjacent sloughs included Sacramento Sucker (Catostomus occidentalis), Threespine Stickleback (Gasterosteus aculeatus), Prickly Sculpin (*Cottus aspur*), Hitch (*Lavinia exilicauda*), Sacramento Blackfish (*Othorodon microlepodotus)*, Sacramento Pikeminnow (Ptychocheilus grandis), Sacramento Splittail (*Pogonichthys macrolepidotus)*, Hardhead (*Mylopharodon conocephalus)*, and Tule Perch (*Hysterocarpus traskii)*. This reach, however, is dominated by nonnative species such as Largemouth Bass (*Micropterus salmonides*), Spotted Bass (*M. punctulatus*), Striped Bass (*Morone Saxatilis*), Goldfish (*Carassius auratus*), Bluegill (*Lepromis macrochirus*), Green Sunfish (*L. cynanellus*), Pumpkinseed (*L.gibbosus*), Redear Sunfish (*L. microlophus*), Warmouth (L. gulosus), Bigscale Logperch (Percina macrolepida), Common Carp (*Cyprinus carpio*), Catfish (Brown and Black Bullhead, and White) (*Amerius sp*.), Channel Catfish (*Ictalurus punctanus*), Crappie (*Pomoxis.sp*), American Shad (*Alosa sapidissima*), Threadfin Shad (*Dorosoma petenense*), Inland Silverside (Menidia beryllina), and other minnows and shiners.

Reach 5

Reach 5 of the San Joaquin River extends approximately 18 miles from the confluence of the Eastside Bypass downstream to the Merced River confluence. This reach receives flows from Mud and Salt sloughs, channels that run through both agricultural and wildlife management areas, consisting of flows that are dominated by agricultural return water. Reach 5 and the sloughs are typically composed of sandy substrate, steep banks with little to no vegetation, but occasionally have gradual sloping banks with only sparse grass cover. Woody riparian vegetation along the channel is sparse, but dominated by willow species. Habitat conditions for fish in Reach 5 have been substantially modified by levee/dike construction, agricultural encroachment, and water diversions. These changes have reduced the quality of floodplain habitat, as well as reducing the main channel habitat complexity and the quantity and quality of off-channel habitat.

Native species recently documented in Reach 5 and adjacent sloughs included Sacramento Sucker (*Catostomus occidentalis*), Prickly Sculpin (*Cottus aspur*), Hitch (*Lavinia exilicauda*), Sacramento Blackfish (*Othorodon microlepodotus*), Sacramento Pikeminnow (*Ptychocheilus grandis*), Sacramento Splittail (*Pogonichthys macrolepidotus*), Hardhead (*Mylopharodon conocephalus*), and Tule Perch (*Hysterocarpus traskii*). This reach, however, is dominated by nonnative species such as Largemouth Bass (*Micropterus salmonides*), Spotted Bass (*M. punctulatus*), Striped Bass (*Morone Saxatilis*), Goldfish (*Carassius auratus*), Bluegill (*Lepromis macrochirus*), Green Sunfish (*L. cynanellus*), Pumpkinseed (*L. gibbosus*), Redear Sunfish (*L. microlophus*), Warmouth (*L. gulosus*), Bigscale Logperch (*Percina macrolepida*), Common Carp (*Cyprinus carpio*), Catfish (Brown and Black Bullhead, and White) (*Amerius sp.*), Channel Catfish (*Ictalurus punctanus*), Crappie (*Pomoxis sp.*), American shad (Alosa sapidissima), Threadfin Shad (Dorosoma petenense), Inland Silverside (Menidia beryllina), and other minnows and shiners.

2. Study purpose

    a. Statement of study goals

This study will further evaluate the feasibility of using RSTs while working to optimize trap efficiencies, with the eventual goal of studying naturally produced juvenile Chinook Salmon abundance, timing, size, and condition. Additionally, if considered necessary during channel modification and passage projects, to trap and transport juvenile Chinook Salmon around existing barriers in the Restoration Area to suitable habitat connected to the Pacific Ocean.

a. List the objectives of the study

- Assess the suitability of RST trapping locations
- Optimizing trap efficiencies at each study site
- Establish a long term plan for juvenile Chinook Salmon RST and trap-and- haul activities that will ultimately assess:
    - The abundance of naturally produced juvenile Chinook Salmon in the

Restoration Area

- Assess size/condition of juvenile Chinook Salmon at each trapping location
- Assess migration timing of juvenile Chinook Salmon

a. Study milestones. Identify products and timelines

- Begin additional RST trapping in 2014
- Release fall-run Chinook Salmon in Reach 1 starting in 2013
- Produce annual reports on finding and activities starting in 2013 and ending in 2027.
    - Initial studies will focus on feasibility of using RSTs

- Long-term studies will assess naturally produced juvenile salmon abundance, size, condition, migration timing, and trap-and-haul activities

- Develop a long-term strategy for the use of RSTs in a juvenile trap and haul operation. Completion date: October 2015

- Trapping/releases will occur within the time period of expected juvenile downstream migration (i.e. beginning in December of each year and ending in June of the following year). This study is expected to continue through 2026. Year one (2014) activities beginning in December 2013.

3. What are the management or policy implications of the study?

The initial years of the study may have long-term effects on the management of the species within the entire San Joaquin River system.

B. Study Organization and Responsibilities

1. Person(s) responsible (names, title, phone numbers, addresses, e-mail).

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2. Chain of command (if appropriate)

N/A

3. Collaborators (agencies, NGOs, academia, etc.) and contact persons: Is an MOU and/or contract already established with the collaborator(s)? CDFW, USFWS

4. Describe specific roles and responsibilities of all PIs on the project

Matt Bigelow and Pat Ferguson will be responsible for RST deployment and operation. Matt and Pat will be the lead for trapping and transportation of juveniles, but will assist with all aspects of the study and will also be responsible for draft and final reports and presentation of findings.

Michelle Workman will be responsible for USFWS RST equipment. Michelle will be the federal lead for trapping activities and will also be responsible for the trapping sections in the draft and final reports, and presentation of findings.

C. Study Design

Rotary Screw Traps

RSTs consist of a cone, supported on two pontoons, with interior baffles to trap and transfer fish to a live-box. Traps are usually positioned in the river thalweg and angled to catch the maximum amount of flow. The RST cone is lowered into fishing position with a single hand winch until the shaft is at the water's surface. A trap counter is installed on the cone and records the number of rotations the trap spins in a given sampling period.

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. Trap operation will begin in November or December to coincide with spawning times of adult spring-run and/or fall-run Chinook salmon in the Central Valley, 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.

The traps will be inspected daily for damage and improper wear. Field crews will inspect the live-box seal for any cracks and proper seating around the cone. The cone shaft and bushings will be inspected for cracks and wear. The cone mesh will be inspected for any punctures, and the access doors will be inspected for proper closure. The winch system will be inspected for proper function, as well as cable and pulley wear. The counter system will be inspected for proper function. The anchor points and cabling system for the traps will be inspected for faults. 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 PI's will be contacted before field crews leave the site.

The RSTs will be deployed at sites with suitable hydraulic conditions and reliable access, and will be positioned downstream of areas where Chinook Salmon spawn. The 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 (including floods) that may exist during a sampling season; (3) directly downstream of a riffle, as opposed to the downstream end of a pool; and (4) in the thalweg of the river channel, unless high discharge or flood conditions dictate the trap should be moved to a position with lower water velocities. Water velocities at trap sites where an 8-foot diameter RST is operated will not be less than 0.6 meters/second (2.2 feet/second) at the lowest discharge. Sufficient water velocities are 0.8 to 2 meter/second. 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 to 6 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, a low proportion of the total discharge may be sampled by the trap, and the trap may not collect juvenile Chinook Salmon in an efficient manner. In these locations, modifications to divert more flow into the trap cone may be needed and would possibly include hardware fence 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.

Processing and Transportation

Data collected from all trapped juvenile Chinook Salmon will include fork length, weight, fish condition/health score, and smolt index score. Additionally, tissue samples of adipose present juveniles will be collected, and some juveniles may be tagged with acoustic transmitters. Environmental data (water temperature, dissolved oxygen), will be collected with a multiparameter meter (i.e. Hydrolab, YSI) or at the gauging station closest to the activity. Additionally water velocity and trap function will be recorded at each trap check.

Multiple Chinook Salmon will be released for RST calibration testing. Calibration fish are used to determine the capture efficiency of the RST, which is needed to estimate population abundance and survival. Calibration releases will be made with marked fry-, parr-, and smolt-sized juveniles over the entire range of flow during each sampling period. Calibration releases will be made gradually in small groups between 0.25 and 0.5 miles upstream from the trap just after dusk. 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. Additional calibration 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 with multiple RST could require as many as 100,000 fish per RST per season.

Chinook Salmon transported for calibration studies or for release in lower sections of the river will be loaded streamside from cage pens held below Friant Dam or from the most downstream RST, respectively. Using either dip nets or water filled vessels, fish will be carried to a 150-gallon, 450-gallon, or 500-gallon transport tank; water filled vessels being the preferred method for loading. The transport tank will be filled with water at ambient river temperature. Transport water will be obtained from the cage pen location or downstream RST location either by bailing water into the tank using 5-gallon buckets or by pumping water into the tank using a screened portable pump. Dissolved oxygen in the transport tank will be maintained at 8mg/L or more.

Direct Releases

Once at the release location, transport water will be tempered within 2 °F of the receiving water by pumping or bailing river water directly into the transport tank until the desired temperature is reached. Juvenile Chinook Salmon will then be removed from the livewells with a large dip net and placed in small net pens until the ensuing nights calibration release. Net pens will be small structures, such as a closable collapsible laundry sac, that will be tethered to existing vegetation. Net pens will only be in the water during acclimation and will otherwise be stored in the transport vehicle. Juveniles that expire prior to release will be checked for disease or internal harm caused by handling. Juveniles that expire in transport will be chopped into quarters and disposed of in the river. Similarly, if juveniles capture in the most downstream RST are transported to lower sections of the river, transport water will be tempered within 2 °F of the receiving water and juveniles will be allowed to acclimate in net pens before release. Staff will then wade into the river to ward away predators before releasing juveniles in the river margin.

Methods

Setting Trap

1. Inspect stream for a long straight section of the thalweg, sufficiently deep to allow flow under the trap and livewell over all flow conditions, and consisting of streamside vegetation or permanent structures capable of anchoring a RST.

2. Identify appropriate anchoring locations and install appropriate cabling and highlines as dictated by conditions at each trap site and trap configuration. Ensure that the cabling configuration is appropriate for the site including safety considerations for potential recreational river users.

3. Transport RST to each site and assemble.

4. Anchor RST using 6 millimeter diameter or thicker cable to the base of stout trees (with the load distributed over the trunk) on each bank or affixed to bridge abutments, retaining walls, or bedrock. Where anchoring structures are unavailable, the RST will be anchored by burying 4- to 6-foot fence posts tied together with a steel cable or by driving a series of 6-foot fence post into the substrate in a triangular arrangement.

5. Once in the water, the RST will be walked into position where safe. Using hand winches or chainfalls the RST will be positioned in its fishing position by altering port and starboard attachment points either upstream or downstream and tightening or loosening bow cables as necessary until the RST is positioned; ensuring that cabling and winch configuration allows sufficient manipulation of trap position as river conditions change. In navigable waters, a small boat may be used to push the trap to a site where it can be secured in its final fishing position.

6. Install a safety cable from the downstream end of the RST pontoon to an anchor on the bank allowing the RST to swing to shore in the event of front cable failure. Mark all wires and cables anchoring the RST with brightly colored flagging and flashing lights as to be easily seen. Signage and/or buoys will then be placed both upstream and downstream of traps to instruct boaters on how to safely avoid the RST.

Checking RST

Cleaning the Live-box

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

2. Observe trap function and make sure it is operating properly.

3. Determining Trap revolutions per minute (RPM). a. Determine RPM as follows:

    i. 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.

    ii. Record the total time it takes for the cone to complete three rotations.

4. Scrub and clean exterior of cone with a brush.

5. Record water temperature, dissolved oxygen (DO), velocity, and record values on the data sheet.

6. Clear fish and debris from live-box making sure to keep hands and nets away from moving parts of the trap.

    a. Fill a bucket, with aerator, about 1/2 full of water.

    b. Scoop no more than 1/4 net full of debris at a time. With the net still in the water, scoop any visible fish out of the net with a smaller net to prevent injury to fish while gently emptying the contents onto the trap deck.

    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 (7–10 mg/L). Add cool water, frozen water bottles, or replace the water if it becomes too warm.

    f. If there are too many fish to hold in buckets or coolers 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, pit tag array's and thermographs are attached and free of debris.

Processing RST Catch

1. Sampled fish may be anesthetized before measuring by preparing Tricaine-S in a small bucket; fill water to line (15L) and add 0.75g of Tricaine-S stock solution. Test solution strength with a few fish; sedation should occur within 2–5 minutes. The solution may need slight adjustments depending on the size of fish, water temperature, and age of stock solution.

2. Fill at least 2 buckets (or coolers) 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. If there are large numbers of juvenile Chinook, randomly selected 50 Chinook juveniles to process (fork length, weight, fish condition/health score, 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 20 of all other species (fork length). All additional fish should be tallied under plus count.

4. If anesthetizing fish, add them to the measured Tricaine-S solution after it has been tested. Do not put more than about 10 fish in Tricaine-S at any one time.

5. Record 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. c. Record fish condition/ health on the data sheet.

6. Determine Smolt Index (SI)

Chinook Salmon Smolt Index

Smolt Index	Life Stage	Criteria
1	Yolk-sac Fry	▪ Newly emerged with visible yolk sac
2	Fry	▪ Recently emerged with sac absorbed (button up fry) ▪ Seam along mid-ventral line visible ▪ Pigmentation undeveloped
3	Parr	▪ 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	▪ 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

7. 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.

8. Photograph the 1st and 5th Chinook Salmon, then every 5th fish thereafter up to a total of 11 photographs (i.e., fish number 1, 5, 10, 15,…, 50).

9. 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. Record plus counts by lifestage when possible. If water temperature exceeds 20°C, do not take any measurements but record all fish as "plus counts."

10. After fish have recovered (i.e., swimming and reacting normally), Chinook Salmon and incidental fish may be released separately at pre-designated locations downstream from the traps. Clean the net pens each time you add or remove fish.

Trap Efficiencies

Photonic marks will be used to mark trap efficiency fish.

Photonic Dye Marking Procedure

1. Set up your location.

    a. Set up work station (including table, chairs and canopy).

    b. Start a new Marking Data Sheet and record: Date: Project Location; Crew; Observers (if present); Origin of Stock; GPS (Lat/Long); Release Code; Mark Applied; Holding Temp; Holding DO; and Start Time.

    c. Connect marking guns to tank and regulator.

    d. Attach marking dye hose and start flow.

    e. Use a wet plastic cutting board or similar device as a marking surface.

    f. Fill cooler 1/2 way with water, attach aerator, and up to 150 fish at a time.

    g. Mix Tricaine-S in half bucket (described above).

    h. Fill recovery buckets with water and add aerator.

2. Start marking

    a. Measure FL and determine SI; record values on backside of Fish Marking Data Sheet and place fish on plastic cutting board one at a time for marking. Repeat this step for all fish planned to be marked with that color.

    b. Apply the mark by starting with one pressure key turned out on the gun.

Lightly place the gun tip onto the appropriate fin and pull the trigger. Be careful, do not place tip and mark too close to the body or fin margin Turn out one key at a time to increase gun pressure; test before marking. If fin splits when marked, adjust gun pressure or position.

c. Count marked fish and place in recovery bucket; tally on data sheet (Mark Tally; note number of fish per tally mark).

d. If the gun jams, remove fish from Tricaine-S before trying to fix jam. Guns may be fixed by running clean water through them or reversing the tip. If this does not solve the problem after a few attempts, try using a different tip.

e. When approximately 75 marked fish have accumulated in recovery bucket, transfer fish to net pen.

f. After 200 fish have been marked mix new solution of Tricaine-S in 1/2 bucket, as it loses its effectiveness (and test).

g. After all fish have been marked, record your End Time and the total number of fish marked on the data sheet. Mortalities should be recorded on datasheet and subtracted from total count.

h. After all fish have been transferred to net pen, use a sharpie and some flagging to label the pen with date, mark applied, number of fish in pen, and expected release date.

3. Clean up

a. Carefully position net pen, seal and reinforce with zip ties. Review date, mark applied and number marked on the flagging for correctness.

b. Attach net pen to secure location (e.g., back of trap). Tie net pens so the water surface is about 1-2 inches below the underside of the plastic rim.

c. Clean and load up all supplies. Marking guns should be cleaned thoroughly with clean water and medical cleaner. NEVER put a gun back into its case with dye in it.

d. Field check data sheet(s) for completeness and correctness.

e. Return all supplies to storage.

f. Make sure equipment is ready to be used again.

Transportation

Transportation will take place in 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. Crews will begin each day by checking the upstream most RST first and working their way downstream, checking all RSTs. It is approximately 30 minute drive time between RST. If juvenile trap-and-haul is necessary, it is just over an hour to the release site form the downstream most RST location. If there are more fish in the RST than can be hauled with the tank, a direct trip to the release location will be made and remaining traps will be checked as needed, or a larger haul tank will be called and brought out.

Contingencies/Backups

A gas powered AC/DC generator will be available to operate aerators in the event of failure to the vehicle's electrical system.

In the event that the vehicle becomes immobilized, a towing company will be used to tow the vehicle to the release location, or if the tank is used on the 14-foot trailer, a backup vehicle will be used to complete the delivery.

If hauling the juveniles proves to be unsuccessful then juveniles will be released at the trapping location.

In the event that that there are more fish present in a trap than there is ability to haul using the 150-gallon tank when traps are checked, a call will be made to have the larger 500-gallon transport tank brought out to transport fish. If this does not remedy the problem then fish will be released downstream of the trap.

D. Study Resource Needs

1. Detailed budget (N/A)

2. Personnel needs

    a. Field activities

Two RSTs will be set and fished on a 24 hour basis, with traps checked 1-2 times daily. This will require a two man crew to check the trap, work up fish, and clean the trap. Approximately 1-3 hours per RTS (includes drive time) will be needed.

Transportation will take approximately 1.5 -2 hours one way (3-6 hours round trip. This will be done with a crew of two, loading, unloading and handling fish at each location. Additionally, there may be a need for multiple crews of transporters due to small sized transport tanks owned by the Reclamation and USFWS or if a vehicle is unavailable to pull the CDFW tank.

Tissue samples will be taken from all Salmonid species trapped and tissue will be sent to the CDFW Tissue Archive facility for processing.

Approximately three months of office time will be needed for data reduction, report generation and compliance/permitting annually.

    c. Travel (in-state and out-of-state)

CDFW – All travel will be in-state. A truck will be sent daily to process and maintain RSTs, and possibly transport Juvenile Chinook Salmon to reach 5. In the event that juvenile trap-and-haul occurs, this will be approximately 200 miles round trip.

    d. Temporary help (estimated number of hours)

An estimated 4-6 CDFW Temporary employees using approximately 174 hours per month from December through June will be needed. This results in a maximum of 7,308 hours total and a minimum of 4,872 hours.

3. Equipment needs

    a. All equipment listed will be needed for the duration of the study.

        - Trucks and transport tanks
        - Holding pens at both trapping and receiving locations
        - Rotary Screw Traps: two 8-foot and two 5-foot
        - Bucket aerators 10
        - Batteries
        - Hand held flow meter
        - Plastic tubs and buckets
        - Boats for trap deployment and daily trap checks (e.g. drift boat, john boat, kayaks)
        - Cable and anchors
        - Mobile tracking equipment
        - Waders and wading shoes
        - Dry suit
        - Warm clothes and rain gear
        - Personal Floatation Devices
        - Data boxes or data loggers in armored boxes w/data sheets, pencils and extra stylus
        - Dip nets
        - Small minnow nets
        - Tagging guns, extra needles, dye
        - Scissors for scale samples
        - Rite-in-the-rain paper
        - Tissue Sample Envelopes
        - Satellite/cell Phone in dry bag
        - First Aid Kit (one per vehicle)

- Tagging Schedule
- Trap Journal
- Transport Journal
- Phone # list to supervisors, office and crew members
- Phone # list to wardens
- Gaffs for Large Woody Debris and Small Woody Debris removal
- Measuring boards
- Gate keys or combinations
- Flashlights
- Extra nets, t-posts, post pounder, rope and shovel
- Tool Box for repairs(one per vehicle)
- Juvenile fyke nets
- Minnow traps
- Seine

b. Major Equipment (>$1000)

- Borrow or purchase a 1 ton truck capable of pulling a gooseneck trailer. A truck will be needed from December to June each year of the study.
- Pontoons for floating the cages

4. Coordination needs

CDFW will provide the transportation equipment and will provide the boat for accessing the RSTs and will provide staff to assist with all aspects of the study.

USFWS will provide equipment for operation of RSTs and acoustic receivers.

Access to release and trapping locations will be on CDFW owned lands or on land where access has been arranged. Gate codes will be given to the staff at the beginning of the study. The trapping locations will be on the river and will have drive-up access.

E. Compliance Considerations

1. Route study through FRRT for compliance considerations

F. Invasive Species

What measures will be taken to ensure field staff do not spread invasive plants or animals to new sites during the study? (HACCP plans)

The Department procedures to prevent the spread of Aquatic Invasive Species (AIS) will be used.

G. Due Dates and Products

1. Describe the timeline for the study, with due dates for deliverables, including drafts (this should relate to section I.A.2.c).

    - Monthly report on progress and trap catch will be generated and circulated through the program

    - Traps should be removed by July annually with a report expected in the fall of each year.

    - A summary of the first two years of data will be used to formulate a long-term plan for the use of RST and trap and haul activities on the program and will be due October, 2016.

H. References

San Joaquin River Restoration Program (SJRRP). 2010. Fisheries Management Plan. A Framework for Adaptive Management in the San Joaquin River Restoration Program. SJRRP Program Document.

San Joaquin River Restoration Program (SJRRP). 2013. Draft Chinook Salmon Reintroduction. SJRRP Draft Document.

U.S. District Court, Sacramento Division. 2006. Stipulation of Settlement in NRDC, et al., v. Kirk Rodgers, et al. Available at: www.restoresjr.net.