

# San Joaquin River Restoration Program Juvenile Salmonid Survival and Migration Preliminary Report – July 2011

## 1 2011 Juvenile Salmonid Survival and Migration Study

### 1.1 Introduction

The Fisheries Management Plan of the San Joaquin River Restoration Program (Program) (FMWG 2010) sets population goals for Chinook salmon (*Oncorhynchus tshawytscha*) to achieve the Restoration Goal for the Program. The Fisheries Implementation Plan (FIP) (FMWG 2010b) prioritized studies to address information needs to evaluate the Restoration Area for various fisheries needs. The FIP identified a study of juvenile salmonid migration and survival as a high priority for Interim Flows prior to the reintroduction of salmon, which is required by the Stipulation of Settlement by December 31, 2012 (NRDC vs. Rodgers 2006). Study 20.0 in Appendix A of the 2011 Agency Plan for the San Joaquin River Restoration Program proposed a study using acoustic telemetry to identify and characterize three limiting factors for juvenile Chinook survival through the Restoration Area: predation, entrainment, and physical habitat. Knowledge of these limiting factors will determine the best approach for initial reintroduction efforts; assist in developing habitat enhancement projects; and help prioritize actions for the reduction or elimination of predation, entrainment, and habitat impacts to survival.

The study was designed to provide information of survival of juvenile Chinook salmon during their spring downstream migration through the Restoration Area. Stationary telemetry receivers were deployed to assess survival through mining pits, at unscreened diversions, in bypasses, and the river channel in all available reaches (1-5) of the Restoration Area.

Preliminary results of the first year of acoustic tracking of juvenile Chinook salmon are described in this report. At the time of submission, July 7<sup>th</sup>, one final data download covering 2011 is still pending. In addition, these preliminary results do not include environmental data, including temperature and flow data during the study period. A final report will be submitted in the December Monitoring and Assessment Plan that will incorporate the environmental variables.

### 1.2 Methods

1. **Receiver Deployment.** Receiver deployment was based on the following criteria: potential to address appropriate limiting factors (predation, entrainment, habitat), ability to access deployment sites, and risk of vandalism. Receiver deployment followed the schedule and locations outlined in Table 1 below. Receivers were cabled

to existing woody vegetation and/or structures available on the bank using 3/8 inch stainless steel cable. Concrete block anchors were used to weight the receivers and buoys were cabled to the anchors on approximately 3 feet of cable. The receiver was attached to the cable using hose clamps and suspended in the water column.

Table 1. Receiver Deployment Locations in the San Joaquin River Restoration Area

Date Deployed	Site Name	River Mile	Description
4/21/2011	Hatchery		
3/23/2011	Above Lost Lake - 1	265	above lost lake
3/23/2011	Above Lost Lake -2	265	above lost lake
3/24/2011	River Bend North Channel	260	upstream of first mine pits - split channel
4/6/2011	Vulcan Property	258	upstream of first mine pits - split channel
3/24/2011	Above Hwy 41-1	256	downstream of first mine pits
3/24/2011	Above Hwy 41-2	256	downstream of first mine pits
3/24/2011	Scout Island	250	downstream of second mine pits
4/4/2011	Pashyan Camp -1	234	downstream of third mine pits
4/4/2011	Pashyan Camp -2	234	downstream of third mine pits
4/13/2011	Gravelly Ford - 1	228	downstream of sixth mine pits and upstream of chowchilla
4/13/2011	Gravelly Ford - 2	228	downstream of sixth mine pits and upstream of chowchilla
4/12/2011	Downstream Chowchilla Bypass -1	214	downstream of chowchilla
4/12/2011	Downstream Chowchilla Bypass -2	214	downstream of chowchilla
4/19/2011	Columbia	205	above Mendota Pool
4/19/2011	MP1 (Mendota Pool)	205	diversion @MP
4/19/2011	MP2 (Mendota Pool)	205	diversion @MP
4/19/2011	JBP1 (Mendota Pool)	205	James Bypass diversion @MP
4/19/2011	JBP2 (Mendota Pool)	205	James Bypass diversion @MP
4/5/2011	MPDS-1	204	downstream of MP
4/5/2011	Chowchilla Bypass	216b	DFG lease in Chowchilla
4/13/2011	Sand Sloug - 1	169	ESB connection to river
4/13/2011	Sand Sloug - 2	169	ESB connection to river
4/18/2011	East Side SS1	169b	ESB at Sand Slough
4/18/2011	East Side SS2	169b	ESB at Sand Slough
4/15/2011	Mariposa Bypass	148mb	fish in mariposa
4/15/2011	East Side Bypass Up (Below Mariposa)	147eb	Mariposa Bypass
4/15/2011	East Side Bypass Down (Below Mariposa)	147eb	East Side Bypass
4/20/2011	HFB1 (Hills Ferry)	118	End of Restoration Area
4/20/2011	HFB2 (Hills Ferry)	118	End of Restoration Area

2. **Technology.** Specific acoustic technology for the study was based on a number of criteria. Size and battery length of transmitter was considered. Juvenile Chinook salmon pose a unique constraint in their small size at emigration from freshwater to the ocean. A number of companies produce transmitters sized to fit these small fish and have varying specifications regarding battery length, ping rate, detection range of receivers, and frequency of tag used. VEMCO VR2W-180khz receivers and V-6 acoustic transmitters were used. VR2W-180 khz receivers have a detection range of approximately 75 m. V-6 tags weigh 0.65 grams in air and can be used on fish > 13.0g, to adhere to a maximum of 5% body weight tag burden (Adams et al 1998).
3. **Source Fish.** Juvenile fall run Chinook salmon from the Feather River Annex Facility were used in this study. Feather River fall run are the earliest returning fall run and provided the best opportunity to get fish to the appropriate size for acoustic tracking at the earliest date. On April 6, 2011 staff from the California Department of Fish and

Game and US Fish and Wildlife Service hand sorted approximately 1200 fish from the Feather River Annex Facility using 191 (5 gallon) buckets and dip nets. Buckets were filled 1/2 full with raceway water. Fish were counted by groups of 25 into the buckets and then hand carried to the transport tank for loading. The transport tank was filled with pumped water from the facility and temperature and dissolved oxygen were closely monitored. Dissolved oxygen was kept at or above saturation. Fish were transported from the Feather River facility to the San Joaquin Interim Conservation Facility located at the San Joaquin River Hatchery complex in a 500 gallon double-walled insulated aluminum tank (Aquaneering INC, San Diego, CA) equipped with two mechanical aerators (Fresh-flo Corporation, Sheboygan, WI) and pure oxygen gas supplied from pressurized cylinders through two ceramic micro-bubble diffusers (Point Four Systems, Coquitlam, BC). Four mortalities were attributed to transport and handling stress.

4. **Surgery and Fish Release.** Fish were held in circular tanks with a flow through water system in the San Joaquin Interim Conservation Facility from April 6<sup>th</sup> to April 18<sup>th</sup>. Fish tagging began on April 18<sup>th</sup>. All fish for tagging were anaesthetized using 50 mg/L for initial sedation and 15 mg/L for a maintenance solution during surgery. Fish were anaesthetized for 45 sec to 1 min max, then transferred to the maintenance solution for remainder of process. All fish were weighed, measured, adipose fin excised and coded wire tagged. A subset of 200 was surgically implanted with an acoustic transmitter. Transmitters were inserted through an approximate 1.5 cm incision into the peritoneal cavity of each fish just off the midline and anterior to the pelvic fins. The incision was made using a number 12 surgical scalpel blade and closed with 2 - 3 interrupted stitches using 5-0 nylon braided sutures. Approximately 50-75 acoustic tags and 300 coded wire tags were placed each day. Fish were separated into 4 holding groups to provide two replicates for each release location. Approximately 250 coded wire tagged only fish and 50 acoustic tagged fish were held in four separate tanks. All fish were tagged by noon on April 20<sup>th</sup> and releases were conducted in the afternoon of the 21<sup>st</sup>. All fish were held for a minimum of 24 hours, with some held maximum of 3 days. All fish tolerated sedation, surgery and recovery. Only one mortality was recorded from impingement during collection for release. Two acoustic tagged fish from each replicate were held back in the interim facility to monitor long-term survival from surgery and to assess actual tag life compared to tag life rating provided by VEMCO. As of the date of this report, July 7<sup>th</sup>, tags in the hatchery were still active.
5. **Receiver Downloads.** Deployed receivers recorded the identification number and time stamp from the coded acoustic transmitters as tags traveled within the detection range, estimated to be 75 m. Data were downloaded monthly in the field using a wireless personal computer interface. Data was appended in the office after monthly downloads. Data collection is still ongoing.
6. **Data Summary.** Data from receiver downloads was transferred from Excel to MS Access for analysis. Detection data was summarized separately from Below Friant releases and San Mateo Crossing releases. Total number of tags detected at the end of the Restoration Area (Hills Ferry Barrier) was characterized by length of transit time

and release group origin. Data summary is preliminary as of this date as final downloads have not been conducted and receivers in the Mendota Pool area have not been downloaded due to high flows at the receiver sites. Final data from all receivers will be downloaded once all transmitters can be safely assumed to have expired and flows allow safe access to receiver sites. The preliminary data assessment compares the downstream of Chowchilla receiver (RM 214) to the below Mendota Pool receiver (RM 204)

### **1.3 Results**

Preliminary results of acoustic tracking are separated into Below Friant Release and San Mateo Crossing Release.

Results of Below Friant (RM 266) release include:

- 96 acoustic tagged fish were released in a group of 596 fish
- All acoustic tags from fish released Below Friant Dam were detected at least one time downstream of the release site.
- 46 acoustic tags from the Friant release group were detected at the end of the Restoration Area (Hills Ferry Barrier, RM 118)
- 39 acoustic tags were detected in the Chowchilla Bypass, with 31 of these detected at HFB.
- Transit time from Friant Release (RM 266) to Hills Ferry Barrier (RM 118) ranged from 4-35 days. Tags were detected in groups of 1-7 when detected.

Results of San Mateo Crossing (RM 212) releases include:

- 96 acoustic tagged fish were released in a group of 631 fish
- 31 of 96 acoustic tags from fish released at San Mateo Crossing were detected at least one time downstream of the release site (note: none of the receivers in and around Mendota Pool have been downloaded as of July 7<sup>th</sup>).
- 25 tags from the San Mateo Crossing release group were detected at the end of the Restoration Area (HFB, RM 118)
- Transit time from San Mateo Crossing Release (RM 212) to Hills Ferry Barrier (RM 118) ranged from 3 days to 33 days, and tags were detected in groups of 1-7 when detected.

### **1.4 Discussion**

Seventy-one out of the 192 acoustic tags placed in released fish were detected at the end of the Restoration Area. Transit times ranged from as few as 3 days from San Mateo Crossing and 4 days from Below Friant to 33 and 35 days respectively from San Mateo

Crossing and Below Friant. More tags were detected from the Above Friant release group than were detected from the San Mateo Crossing release group (46 v. 25).

This was the first year of a multi-year study. As such, detection resolution was better at some of the receiver locations than others. Even though 39 transmitters were detected in the Chowchilla bypass, only two transmitters were detected at Gravelly Ford, the last receiver upstream of the bifurcation structure. Additionally, only 3 detections occurred at the below Chowchilla receiver in the river channel (RM 214), even though 46 tags were detected at the end of the Restoration Area from the Below Friant release. Better resolution of detections around the flow split between the bypass and river channel is needed to assess fish migration routes during flood flows.

## 1.5 Conclusions and Recommendations

Preliminary data assessment provides information for the following recommendations:

- Some receiver locations should be moved to improve detection capabilities (Gravelly Ford, below Chowchilla)
- More receivers in the river between Mendota Pool and Sand Slough will help with resolution of results of survival and migration through those reaches.
- Additional receivers downstream of the restoration and into the Sacramento-San Joaquin River Delta boundary will improve resolution of final disposition of tagged fish.

## 1.6 References

Adams NS, Rondorf D, Evans S, Kelly J, Perry R (1998) Effects of surgically and gastrically implanted radio transmitters on swimming performance and predator avoidance of juvenile Chinook salmon (*Oncorhynchus tshawytscha*). *Can J Fish Aquat Sci* 55:781–787

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