

San Joaquin River Restoration Adult Chinook Transportation Study 2012 Year 1 Report

Background

The Settlement (NRDC v. Rodgers et al 2006) required the reintroduction of salmon into the San Joaquin River “no later than December 31, 2012.” The Fisheries Management Work Group continues to work on reintroduction activities. A number of channel modification projects intended to improve habitat and passage conditions are being developed, requiring fisheries agencies to examine options allowing for reintroduction to commence while channel modification projects are still being planned. One option being explored is to trap and haul salmon around existing barriers and unsuitable habitat while channel modifications are still pending. This study will evaluate the feasibility of using trap and haul to transport adult Chinook salmon around existing barriers in the San Joaquin River to suitable holding and spawning habitat upstream.

In 1948 the Department of Fish and Game conducted an emergency trap and haul program on the San Joaquin River by erecting a temporary barrier weir at Hills Ferry (HFB) with a trapping and loading facility. Tank trucks transported adults to a suitable release site that would bypass the dry section of the river. A watertight collection tank and boom truck hoisted fish out of the trap and into transport trucks. Twenty to thirty fish at a time were hauled 18 miles upstream to where the river still flowed (Warner 1991). Currently the winter-run conservation program (USFWS) transports adult winter-run Chinook salmon to the Livingston Stone Conservation Facility for use in their captive rearing program, with great success. However, attempts to trap and haul Butte Creek adult spring-run Chinook salmon have had little success. The winter-run Chinook salmon trap and haul program uses a “fish elevator” to move the fish from below the Keswick dam to the transport truck. This allows fish to remain in water with no handling. Whereas, in Butte Creek fish were moved from the corral nets to the transport truck in dip nets. This required handling the fish, and didn’t allow fish to remain in water as they are moved to the transport truck.

Study Purpose

Study Goals

To capture and successfully relocate salmon to Reach 1 of the Restoration Area lost upstream from Hills Ferry Barrier. In addition to the primary goal, evaluate the feasibility of using trap and haul to transport adult Chinook salmon around existing barriers in the San Joaquin River to suitable holding and spawning habitat and develop protocols to successfully trap and haul adult salmon to achieve the restoration goal of reintroducing salmon in a timely manner.

Objectives

- Objective 1 assess the viability of trapping and hauling adult salmon
- Objective 2 assess spawning site selection of adults transported to Reach

- Objective 3 establish a long term plan for use of trap and haul activities
- Objective 4 assess success of streamside spawning and incubation
- Objective 5 produce offspring from trapped adults for use as study fish

Methods

Fyke Nets

Fish were trapped using fyke nets installed in four locations including upstream from the HFB, Mud Slough, Salt Slough, upstream from Highway 165 where Van Clief road terminates at the river (for approximate locations see maps below). Fyke nets were placed in the river as close to improved roads as practical to allow for the transport tank to be in close proximity. Fyke nets used in the mainstem river were constructed of two 150-foot-long, 6-foot tall, 1.5 inch #15 treated nylon wing walls funneled to a 6-foot by 6-foot collection box that leads to five, five-foot diameter fiberglass hoops with a 10-inch diameter funnel throats. Fyke nets set in the sloughs were similar in design except they were 4-foot tall with 1-inch square #21 treated nylon netting and 3.5-foot fiberglass hoops. These nets were installed in November and were removed by Mid-December with the exception of the Mud slough trap which was removed early due to high debris loads excessive velocities and weather conditions making the roads leading to the trap impassable.

Existing vegetation or t-posts were used to anchor the nets in the stream. Wing walls were extend to both stream banks and due to heavy vandalism caused by beaver and muskrat presence a small section near the shore on one side would be left open to allow the beavers/musk rats to pass. T-posts were used to stake off the terminal end of the trap with additional t-posts being placed along the wing walls for support as needed (approximately 5-15 t-posts per trap). T-posts were pounded in to a depth of 1-2 feet using hand tools and were reset on an as needed basis (a visual representation is given below in figure 1).

All fyke nets were checked every 24 hours, including weekends, and increased in frequency depending on conditions, such as peak migration, high flows, or excessive debris. Fall-run Chinook salmon were processed first and all other fish were released upstream from the fyke nets to decrease likelihood of multiple catches and in random locations to decrease predation. Fish were handled with care and within water to the maximum extent possible. The water levels were typically low enough so that portions of the hoop system are out of the water to accommodate species that require air.



Figure 1. Image of Fyke Net Checking for Days Catch

Processing and Transportation

Data collected from all trapped salmon include fork length, sex, condition score (i.e., good, poor) and adipose fin present/absent. In addition, tissue samples were collected, fish were tagged with a visible tag, and 34 were outfitted with acoustic tags with coded transmitters. Environmental data (water temp, conductivity, salinity, dissolved oxygen, were collected with a multimeter (i.e., hydrolab, ysi)) or at the gauging station closest to the activity.

Tagged fish were loaded streamside into a transport tank, using either dip nets or stretcher type cradles to carry them to the tank. The stretcher type cradles were the preferred method for loading as they minimized fish stress and movement. Further development of this equipment is planned for future operations. When dip nets were used fish will be kept in water until they are ready to be loaded into the tank. The transport tank was filled with river water or at the interim facility and checked to insure that water temperature was within 2°F and had 0.6-1.0 percent NaCl added to minimize stress. Transport water was obtained from the trapping location and baled into the tank using 5 gallon buckets. Dissolved oxygen in the transport tank was maintained at 8mg/L or more.

Based on the condition of the fish, captured salmon were sorted for either release in Reach 1 or streamside spawning. Only live ripe fish, as evidenced by production of milt or eggs after palpation of the abdomen, were used for streamside spawning. In addition, both a male and female had to be present in the traps that day and both must be ripe to have been used for streamside spawning; otherwise they were released at Camp Pashayan.

Direct Releases

Fish were removed from the livewell with a large dip net and held in river with the dip net to allow fish to fully acclimate to the release water. Fish were given at least 5/10 minutes to acclimate and then were allowed to leave the net under their own volition. Mendota pool dam will serve as a downstream barrier and fish were tracked and monitored to determine movements, survival, disease, observe behavior, and spawning success. Fish that expired prior to release were disposed in river.

Receivers

Twelve single channel receivers capable of identifying coded transmitter tags were strategically placed to monitor fish movements throughout the San Joaquin River from downstream from Friant Dam, and various locations at spawning or passage points in the area down to just downstream from SR 99 Bridge. The receivers were moored using stainless steel cable anchored to the bank and weighted to the bottom using flat weights, or cement blocks (see Figure 4). Nearby structures or trees were used to anchor receivers. Receivers were suspended using a boat buoy to keep the receiver vertical in the water column. Receivers were installed in September and were retrieved by mid-January.



Figure 2. Vemco Receiver with Flat Weights and Buoy

Manual Tracking

Tagged fish were manually tracked using a portable hydrophone from a boat and from shore to determine the locations between receivers or specific locations within sections of the river. Visual surveys were conducted by boat to observe adults and redd locations, which were recorded utilizing GPS for future monitoring. Manual tracking and visual observations was conducted by a crew of two individuals

floating the river two days per week. Day one from Friant to just upstream from Highway 41 Bridge and day two from Highway 41 bridge to SR 99 Bridge. Adult carcasses were checked for retained eggs/milt and heads were to be retained for Coded Wire Tag (CWT) evaluation. However, there were no viable carcasses retrieved.

Streamside Spawning

Streamside spawning took place at the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) property near Friant Dam in a locked trailer. Fish were spawned on a 1:1 male to female ratio. Eggs were stripped from the female and prior to fertilization, the eggs will be assessed for abnormalities then good eggs were placed into a mixing tub. Milt was then extracted from males and placed directly into the mixing tub with eggs. Fertilized eggs were wrapped in wetted cheesecloth and placed in buckets to be disinfected with a 10 minute bath treatment containing 100 parts per million of free iodine. After disinfection eggs were placed in vertical incubation trays. Once eggs began to eye-up and were close to hatching they were moved to a screen submerged in water above the gravels with in a deep matrix spawning chamber. As the fish hatched they fell through the screen and moved into the gravel. After a few weeks in the gravel they would swim-up and then the current pull through an outlet to a swim-up tank where they were retrieved daily and then moved to a starter tank. In the starter tank fish would be placed on feed and held for up to a week before being moved out to the rearing pens in the river.

Rearing Pens

The rearing pens were 3' x 3' x 4' aluminum pens with 1/8" mesh panels and floated with two rotary screw trap pontoons. There were 8 pens total and the overall dimensions of the platform were 12' wide by 22' long with 3' of cage below the water surface. Each cage was outfitted with clock-driven belt-style fish feeders. Fish were fed daily approximately 4 to 6 percent of total body weight using a standard commercial salmon feed. Feed level was determined using BioGro, an Excel based fish feeding program developed by the University of Washington and used by the Oregon Department of Fish and Wildlife. The program calculates fish growth based on temperature units required to produce an inch of growth for each salmonid species. Feed was monitored to ensure that minimal amounts are left uneaten. The Program uses 840 temperature units for Chinook.

Pens were placed in the area below Friant Dam on the Madera County side of the river where boater traffic is prohibited and anchored using a combination of anchors/ tethers to existing vegetation. Fish were held up to a maximum density of 0.15 lb/ft³/in, based on literature and study results from earlier experiments with these pens. Daily, fish were monitored, fed and pens will be cleaned. Fish were held until they reach a size large enough for tagging. After which, fish were released in Restoration Area of the SJR. If some of the fish held in the cages were identified as needed for other studies (e.g., predator evaluation, telemetry, PIT tagging), they were held until they are large enough for the intended purpose. All fish were out of the pens by mid-May and the pens were pulled from the river at the end of May.

Results

Fyke Netting/Transportation

On November 5th the Department of Fish and Wildlife (DFW) and the Reclamation began setting fyke nets to capture adult fall run Chinook salmon. On the next day November 6th the first Chinook were captured at the Mud and Salt slough trap locations. Both locations captured 1 fish. By the end of the week both other locations (Hills Ferry and Van Clief Rd.) had begun to capture fish. The trapping went well for most of the season with the exception of the Mud slough trap. This trap was plagued by excessive debris, high velocities and road conditions leading to the trap proved to be too difficult to navigate leading to the early removal of the trap at this location. All other traps were removed by December 17th. There was also a brief period during this time in which all traps were removed to allow

crews a break during the Thanksgiving holiday. Nets were removed on November 21st and were reinstalled on November 26th



Note: Debris load causing net to sag near middle of wing walls.

Figure 3. Fyke Net at Wolfson Road on Salt Slough Debris Being Cleaned by Crew

There were 115 Chinook captured in the fyke nets and 4 Chinook captured in nearby canals using dip nets. 119 total fish were captured and trans-located from the lower river to the release location of Camp Pashayan located just upstream from the State Route 99 Bridge with the exception of six (three males and three females) fish that were taken to Friant dam where they were artificially spawned. Along with these fish 59 unused male Chinook were hauled to the San Joaquin River in three separate loads of 14, 21, and 24 fish from the Merced River Hatchery and released at the Camp Pashayan site. A total of 172 salmon were placed in the river at Camp Pashayan. Of these 147 salmon were males and 25 were females.

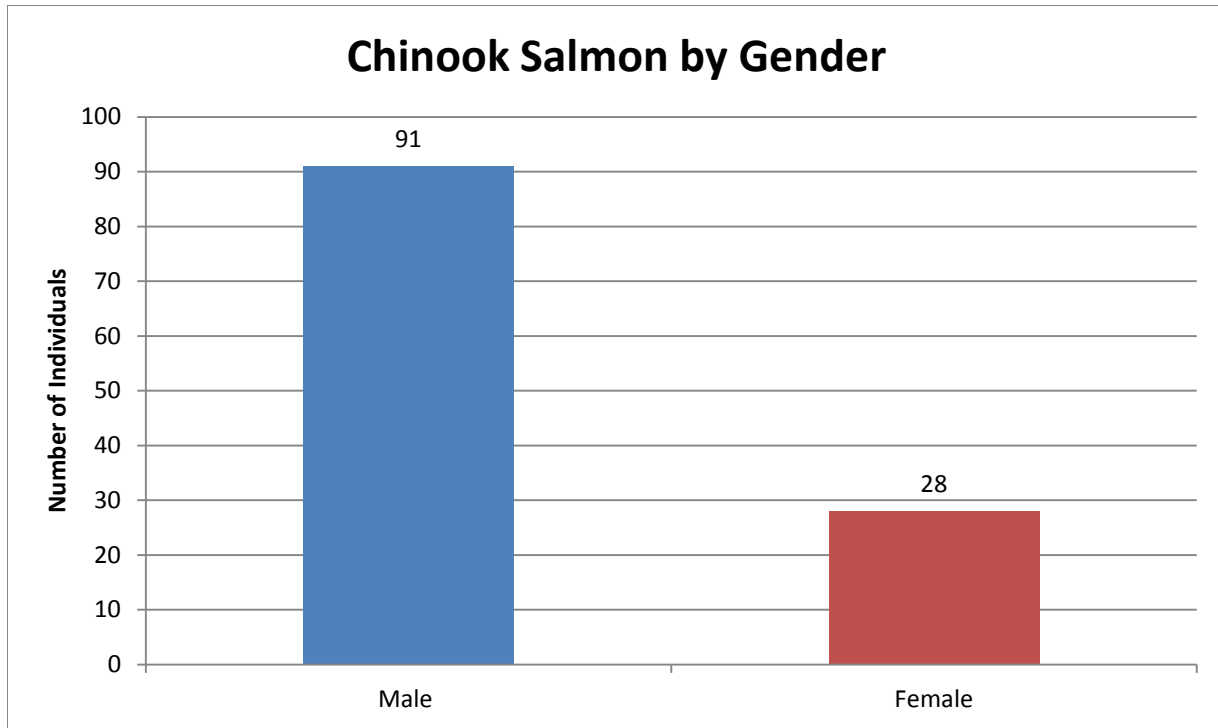


Figure 5. Total Number of Salmon captured by Gender

During the course of trapping and transportation there was some associated mortality (see Figures 6 and 7 below). The majority of transportation mortality occurred on November 10th with six salmon expiring during transport. It is unclear what the exact cause of the large number of deaths was, but is presumed to be lack of oxygen due to overcrowding. In addition to these fish, three others randomly expired throughout the process and were mainly fish that were considered to be in poor condition prior to transport. They were most likely overcome by high stress levels. There was also a small number of fish that were found expired in the nets. These fish were either in poor condition or had been gilled by the net.

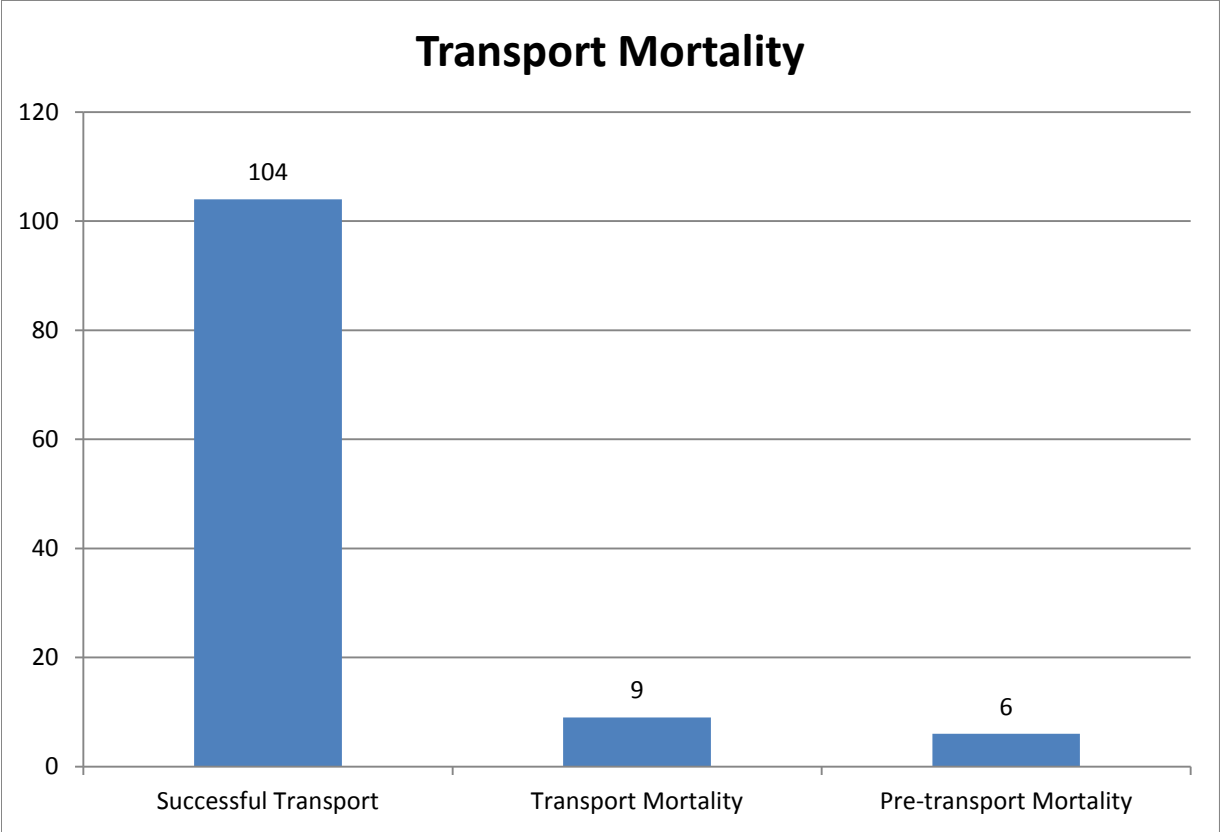


Figure 6. Total Mortality for Trapping and Transportation

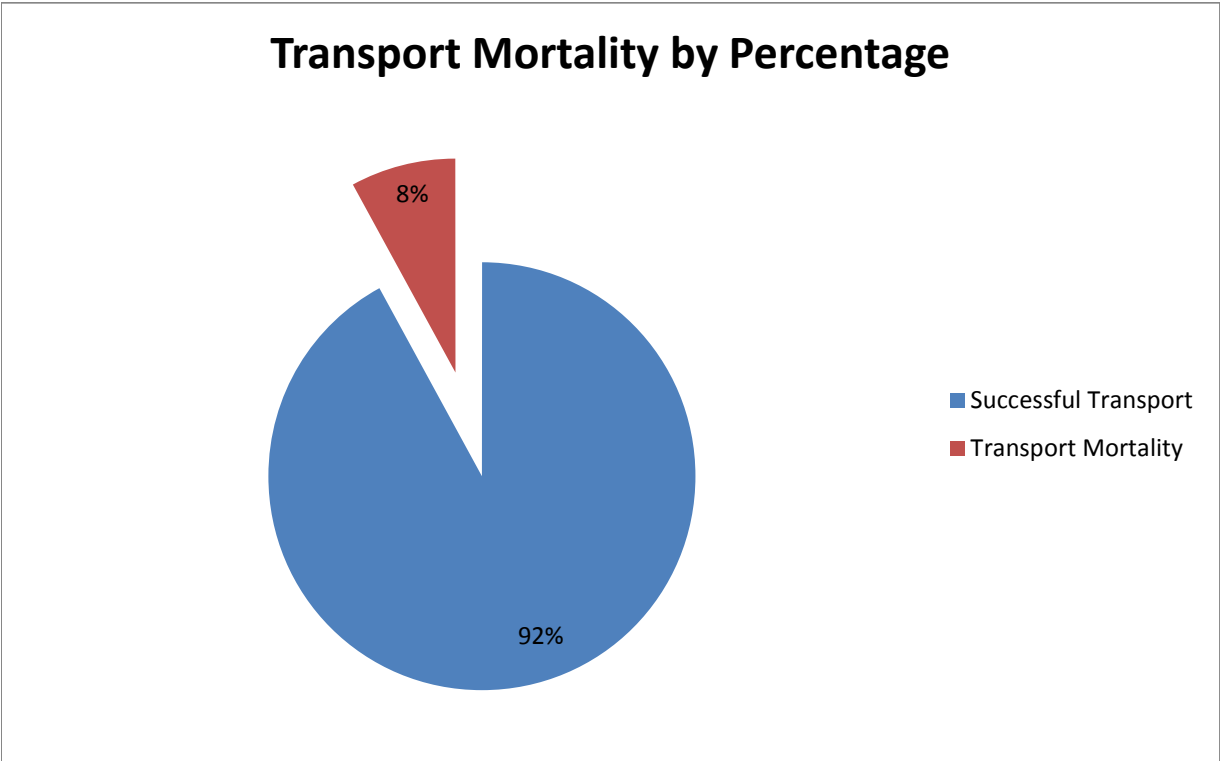


Figure 7. Percent Mortality of Transported Salmon

The trap placed directly upstream from Hills Ferry Barrier captured the most fish 69 total. The second most prolific trapping location was the Van Clief road trap capturing 36 followed by Salt slough with six then mud slough with four. In addition to the fyke netting effort nearby canals were canvased and salmon were found and four were captured using dip nets.

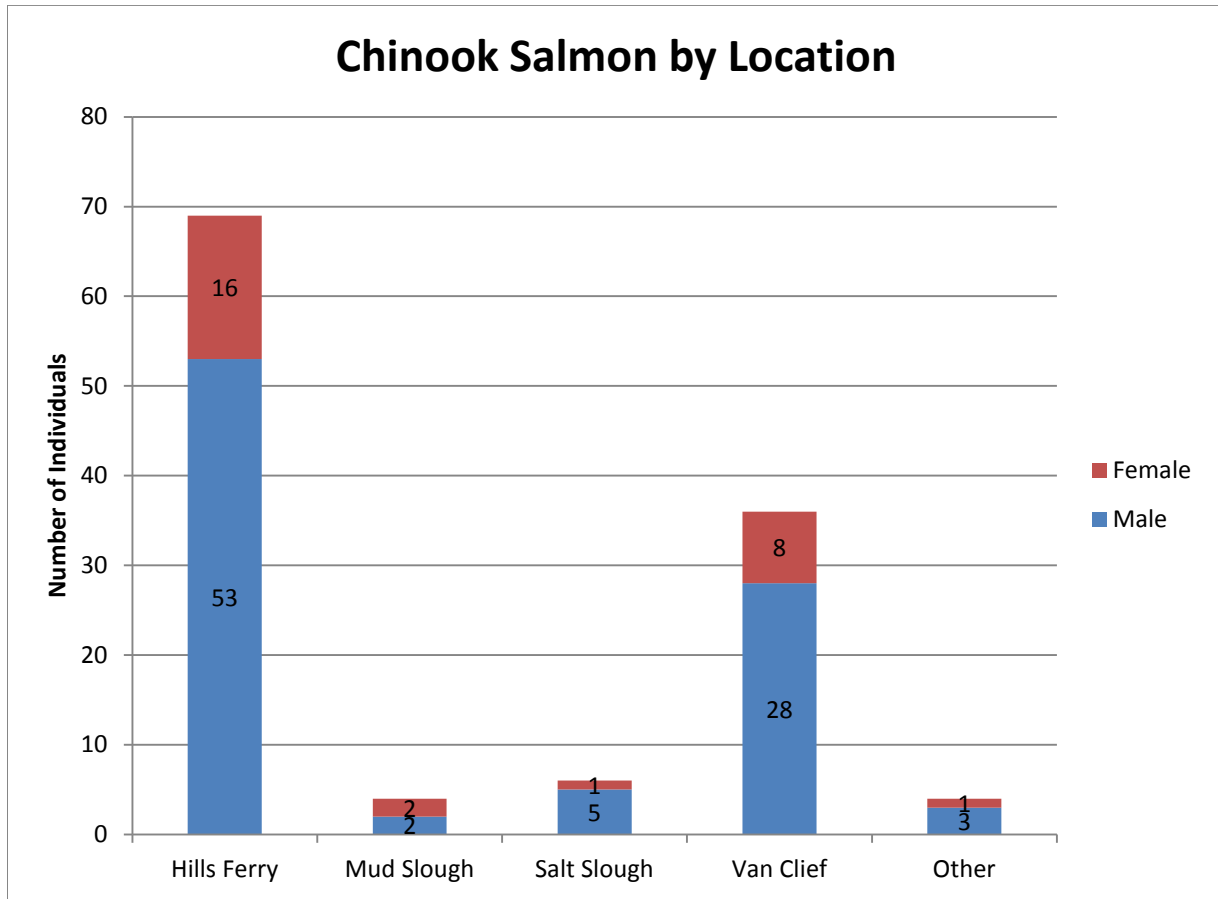


Figure 8. Capture Totals at Each Location by Gender

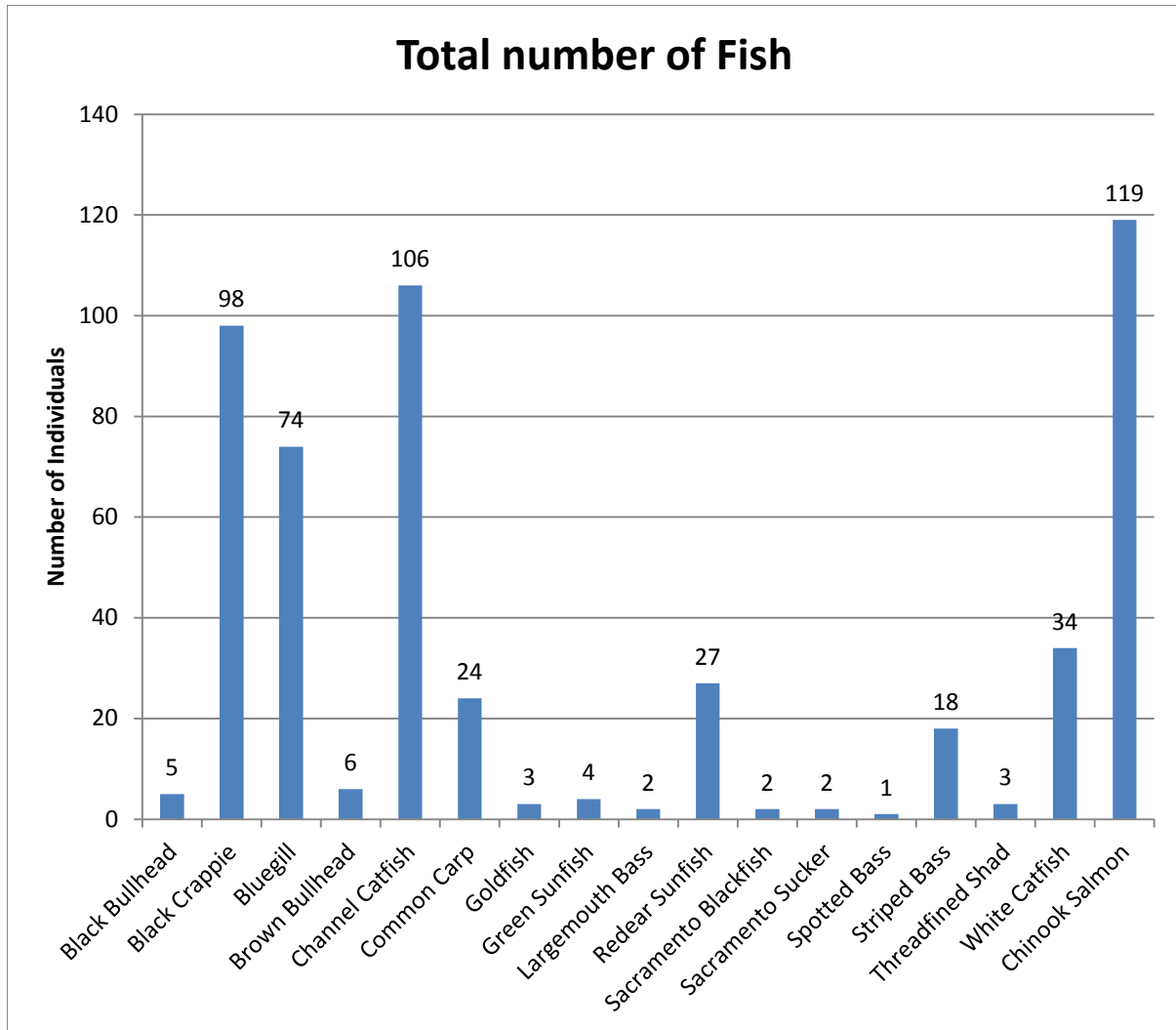


Figure 9. Combined Total of all Fish Captured at all Location by Species

During the course of fyke netting non target species were captured. As the chart above (Figure 9) indicates the target species was the most captured. However, there were many other species captured with sunfish and catfish being the next most captured fish. The low catch rate on other species was believed to be caused by low water temperatures causing a normal inactivity in these species that would decrease their movement during the trapping period compared to the migratory nature of the Chinook.

Mobile/Acoustic Tracking

Twelve Acoustic receivers were placed in the river prior to trapping activities and were recovered in early January. The receivers were distributed from just below SR 99 Bridge (River Mile (RM) 242.8) to Lost Lake Park (RM 265.5). There were seven receivers placed above the Highway 41 Bridge and five below. There were 34 Chinook tagged with acoustic transmitters and released at Camp Pashayn (RM 243.5). The receiver at the release location detected all 34 fish, while the downstream most receiver (RM 242.8) had the least number of fish detected at eight fish. Of the eight fish detected at RM 242.8 all but one tag #7378 were also detected throughout the receiver array. The Receiver at the upstream end of the array (RM 265.5) detected 26 of the 34 tags. The eight fish that were detected at the release location (RM 234.5) but, not detected at the upstream most receiver (RM 265.5) all were females and presumed to have

found a suitable location between these points for spawning. See Figure 10 below for map and locations of all receivers.

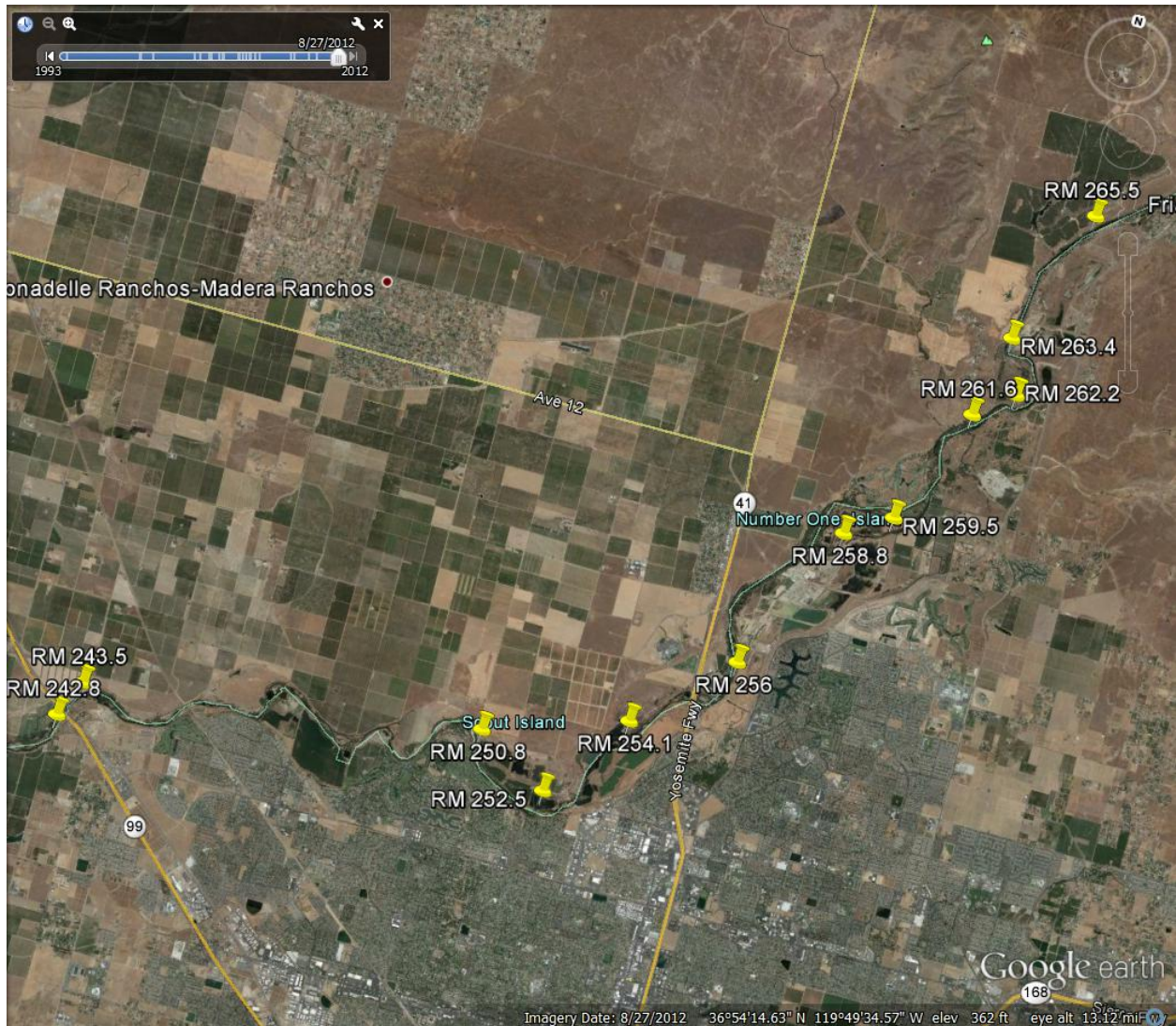


Figure 10 Receiver Locations by River Mile

Mobile tracking and redd surveys began on November 15th and occurred twice a week until December 20th with the survey area being broken into two reaches Reach 1 Road 206 Bridge downstream from Friant Dam down to Fort Washington Beach, Reach 2 was From Fort Washington Beach down to Camp Pashayan. There was one float made on December 20th downstream from Camp Pashayan three river miles downstream and then back Camp Pashayan to assess for any spawning activity that may have occurred below the release location.

On the first few floats kayaks were used and the VR-100 mobile tracker had the multi-directional hydrophone attached and was switched on an off to help maintain battery life but, also because it was hard to paddle and listen at the same time as the equipment was cumbersome. The following week the crews switched to a drift boat with one man paddling/navigating while the other was both looking for and listening for Chinook. Small numbers of detections were made using this method compared to the

stationary receivers. This method did, however, provide targeted detection capability between the stationary receivers.

Paired with this activity was assessment spawning and survival of the transported Chinook. The carcasses were not found in great numbers with only three being recovered during all floats. The spawning activity, however, saw greater detections and was first detected on November 27th by field crews working on riffle habitat assessments near RM 256. There were 11 potential redds identified during the mobile tracking and some additional site with bed disturbance that was unclear as to what or how it was created. In addition to the visual observation the mobile tracking data indicated that there may have been other locations where females may have spawned but, were not seen visually because of water depth and clarity.

Streamside Spawning

There were three attempts at spawning adults during this year's activities on November 14th, 27th, and the 28th producing 10,914 juveniles. Two of the spawns were very successful with survival to emergence near 93 percent while one complete spawn (November 27th) was lost due presumably to the male being expired for an unknown duration prior to spawning. More spawns may have occurred, however, during the week of the first spawn water temperatures began to rise and by November 16th the water temperatures were above those reported to have adverse effects on eggs. Since there was uncertainty as to how these temperatures would affect the eggs and their development it was determined that no additional spawning would occur until temperatures drop below those considered acceptable. After two weeks water temperatures had dropped some but were still near the unacceptable range yet, so were the detected temperatures in the adjacent river. At this time it was decided to continue spawning since the eggs in the trays would be receiving the same climatic conditions of those that were being experienced in the river and we wanted to know how they would survive and the first spawn showed little signs of mortality.

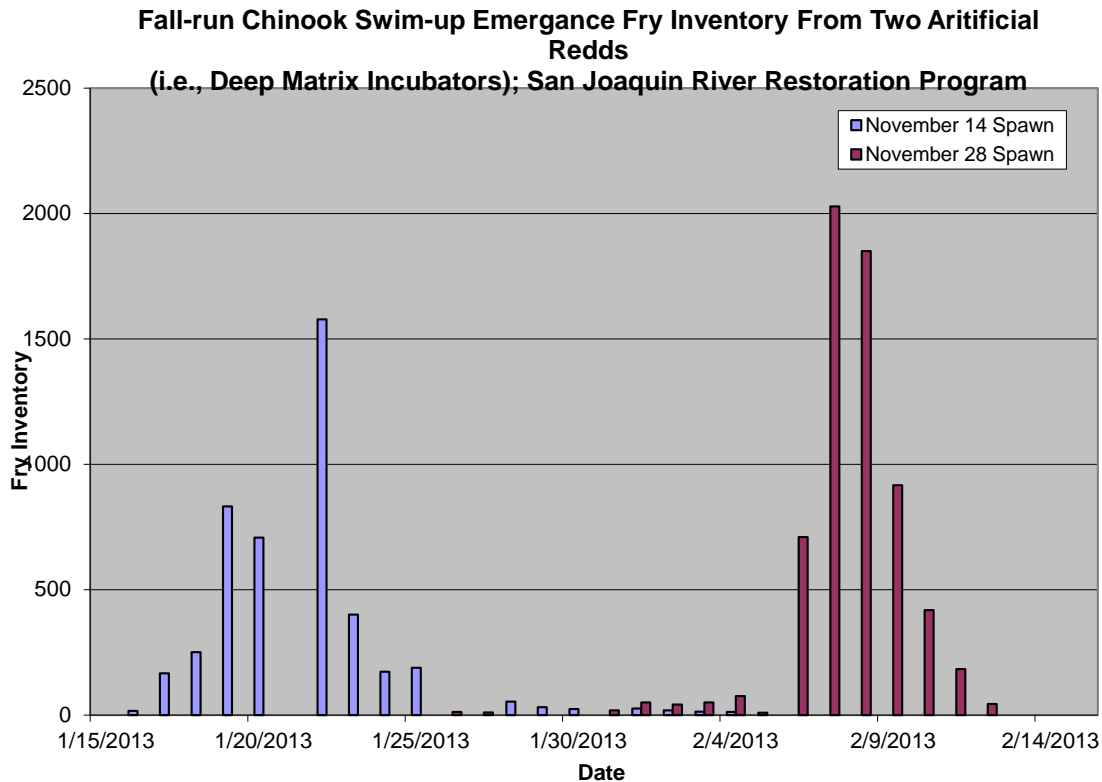


Figure 11. Fall-run Chinook Swim-up Emergence Fry Inventory From Two Artificial Redds (i.e., Deep Matrix Incubators); San Joaquin River Restoration Program

Holding/Rearing

Holding pens were placed in the river in mid-January and removed during the last week of May. Fish reared in cage pens were monitored daily; pens were cleaned, mortalities removed, and dissolved oxygen and temperature measured to assess conditions within the pens. In addition, fish were sampled from pens weekly to assess growth and condition by weighing and taking fork length measurements. During March fish from the Feather River Fish Hatchery were placed in the cages for later use by the program. Some of these fish were released after a week of holding however, some were held for up to five weeks.

During the course of rearing staff observed some fish swimming and behaving erratically and also noticed that these fish appeared to have bulging eyes. The first reported mortality of a juvenile fall-run Chinook salmon missing an eye, showing possible effects of GBD, began on April 6, 2013. Four additional mortalities were also observed on April 6th; however these fish did not show any outward symptoms of GBD. Low level losses (~0.1 - 0.2 percent/day) of juveniles began on April 10th, with most mortalities occurring in the upstream-most pen. Several moribund fish, possessing unilateral bulging eyes, were also reported swimming at the water surface on April 10th. Dissolved oxygen levels were measured as high as 133 percent in the upper-most cage pen on April 11, 2013. Fish pathologist from the California Department of Fish and Wildlife were requested to investigate the symptoms observed, making a site visit on April 17th. Fish symptoms reported to pathology include unilateral bulging eyes and bubbles under the skin on the operculum of one fish. Juvenile mortalities, exhibiting GBD symptoms, continued until May 4th with mortalities decreased substantially as releases from Friant Dam declined from flows greater than 1000 CSF to less than 400 CSF.

During pathology's visit five symptomatic fish were recovered from the upstream-most cage (Figure 1). Pathology found two of the fish exhibiting exophthalmia in the left eye, and one showing exophthalmia in the right eye. One additional fish examined displayed bilateral exophthalmia and the final examined fish had gas emboli in the skin on both sides of the caudal peduncle. Gas emboli were visible without aid in the exophthalmic eyes. Gas emboli could also be seen in the gills of the affected fish with the aid of a dissecting microscope.



Figure 12. Juvenile fall-run Chinook Salmon Exhibiting Exopthalmia and Emboli

A high volume of water (1,059 CFS) was observed being released from the base of Friant Dam during pathology's visit with significant velocity flowing from two large (6'-8' diameter) pipes that dropped 5 – 10 feet into the river; approximately 50 -100 meters above the cage pens. Pathology determined that this release is causing gas (nitrogen) supersaturation of the water flowing past the cage pens and is likely causing GBD in the exposed fish. Equipment to measure TDG was, however, not available during pathology's visit.

Discussion

The entire operations can generally be characterized as a success. There is, however, room for improvement there nearly 100 carcasses found in canals and drains upstream of our trapping locations. This indicates that fish were getting by in larger numbers and plans are underway to remedy this issue. In addition, there is uncertainty in what water temperatures will be annually and how that will affect the ability to carry out the streamside spawning aspect of the study. This study is planned to continue next year and for the foreseeable future.

References

- U.S. District Court, Sacramento Division. 2006. Stipulation of Settlement in *NRDC, et al., v. Kirk Rodgers, et al.* Available at: www.restoresjr.net.
- Warner, G. 1991. Remember the San Joaquin Chapter 5. IN: Lufkin, Alan, editor. *California's Salmon and Steelhead: The Struggle to Restore an Imperiled Resource*. Berkeley: University of California Press, c1991.

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