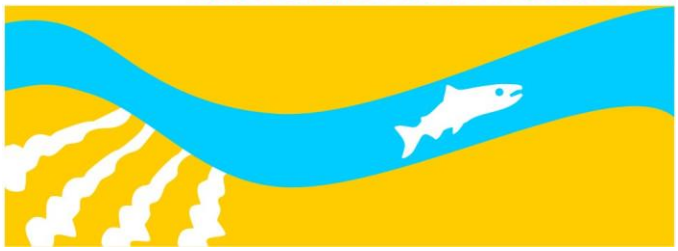
Study 54

Juvenile Chinook Salmon Trap and Haul

Final
2015 Monitoring and Analysis Plan

SAN JOAQUIN RIVER
RESTORATION PROGRAM



January 2015

Theme(s):

- Predation protection
- Entrainment protection
- Fish reintroduction
- Passage and transport

Related SIG Question(s):
RH-007: How long do fish rear in Reach 1 prior to migrating? Is this duration dependent on flow, temperature, or food? Does residence time influence survival rates with regard to the bottom of the river and smolt-to-adult return rates?

RH-009: Would control of Friant Dam release temperatures improve juvenile growth rates in Reach 1?

Questions regarding Passage and Transportation, and Reintroduction have not been developed to date.

1.1 Statement of Need

The San Joaquin River Restoration Program (SJRRP) Restoration Goal is to "restore and maintain fish populations in good condition in the main stem of the San Joaquin River (SJR) below Friant Dam to the confluence of the Merced River, including naturally-reproducing and self-sustaining populations of salmon and other fish." The SJRRP Fisheries Management Plan (FMP; SJRRP 2010) provides an adaptive management approach for the reintroduction of Chinook salmon (*Oncorhynchus tshawytscha*) and other fishes. Given the uncertainty associated with reintroduction of Chinook salmon and native fish to the San Joaquin River, and the complexity of the SJRRP, an adaptive management program is needed to ensure the SJRRP can be flexible in reaching its goals. The responses of translocated Chinook salmon and their progeny to physical factors such as streamflow, water temperature, and climate change are unknown. The ability to adaptively manage fish populations under challenging water constraints will allow SJRRP to use a variety of strategies and techniques to take action when unfavorable environmental conditions persist.

Chinook salmon were extirpated from upstream sections of the SJR following the construction of Friant Dam in the 1940's. Likewise, the river has undergone extensive changes following completion of the dam and because of its use to support Central Valley agriculture. Current restoration efforts by the SJRRP include the translocation of adult fall-run Chinook salmon into Reach 1 of the SJRRP Restoration Area to study spawning and rearing activities. Offspring of these salmon provide a unique opportunity to study the response of these fish to current river conditions. Furthermore, because river conditions remain largely unpassable downstream and are not conducive to juvenile

salmon survival, a trap and haul effort is proposed to transport fish downstream of these obstacles.

The purpose of the proposed action is to support the Settlement Restoration Goal by taking adaptive management actions to respond to unsuitable environmental and passage conditions in years when fish will not be able to emigrate on their own volition. The FMP (SJRRP 2010) identifies rearing and juvenile migration as a life stage to be supported for successful completion of the salmon life cycle. Outmigration of juvenile salmon is critical for survival to adulthood. Factors determining successful outmigration include suitable water temperatures, adequate and timely flow for downstream movement, and a passable watercourse, none of which are available in the lower portions of Reach 1 and other downstream reaches of the Restoration Area during low hydrologic water-year type and there may be no restoration pulse flow requirement. Low water conditions and water temperatures exceeding salmon thermal tolerance limits will cause physical and environmental barriers to downstream migration and result in lower salmon survival if no management actions are taken.

This effort will help to establish acceptable practices for capturing and transporting fish in subsequent low flow years when the SJR may not be contiguous throughout the Restoration Area. Data collected from these studies will help direct future management decisions regarding the restoration of a Chinook salmon population into this area of the SJR.

1.2 Background

In 1988, a coalition of environmental groups, led by the Natural Resources Defense Council (NRDC), filed a lawsuit challenging the renewal of long-term water service contracts between the United States and the Central Valley Project Friant Division Long-Term Contractors. After more than 18 years of litigation of this lawsuit, known as NRDC et al. vs. Rodgers et al., 2006, a settlement was reached. The stipulation of the Settlement establishes two primary goals: (1) Restoration – to restore and maintain fish populations in "good condition" in the mainstem SJR below Friant Dam to the confluence of the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish and (2) Water Management – to reduce or avoid adverse water supply impacts on all of the Friant Division long-term contractors that may result from the Interim and Restoration Flows provided for in the Settlement.

The FMP (SJRRP 2010) provides an adaptive management approach for the reintroduction of Chinook salmon and other fishes. Adaptively managing fish populations under challenging water constraints will require the SJRRP to use a variety of strategies and techniques to take action when unfavorable environmental conditions persist, such as this year, which is projected to be another critical low water year. Because of anticipated hydrologic conditions, Reclamation is proposing to move captured juvenile fall-run Chinook salmon from rearing habitats in Reach 1 to downstream locations where they can migrate to the ocean. Under low flow scenarios, there may be a very low probability of juvenile Chinook salmon successfully migrating from rearing grounds downstream of

Friant to the Ocean, resulting in very low numbers of adults returning in subsequent years. Loss of brood years could significantly impact the success of the restoration effort. Low flow conditions on the SJR provide an opportunity to use fish weirs, rotary screw traps, and netting to capture out-migrating juvenile Chinook salmon for trap and haul to lower sections of the river. Under moderately low flows (600-1200 cfs), the techniques mentioned lose effectiveness and a more semi-permanent facility may be more successful at salvaging fish. The SJRRP will be investigating semi-permanent juvenile collection technology in the coming year to determine a cost-effective strategy and implementation in the near-term while flows and downstream passage are being developed. Juvenile trap and haul is not necessary under higher and contiguous flows as fish can move out on their own.

1.3 Anticipated Outcomes

The study will result in several outcomes:

1) To implement a trap and haul program to move juvenile Chinook salmon downstream of the Restoration Area to a location in the river that is connected in low flow years and no further migration barriers exist.

2) Improve salmon salvage efforts and evaluate whether alternative designs can improve salmon capture and survival from the previous study year.

3) Evaluate fish collection technique (i.e., weirs, rotary screw traps, and nets) efficiency using PIT tagged individuals released upstream of devices.

4) Monitor fish movements and losses in Reach 1 during low hydrologic water-year types where no flow pulses are available to cue juvenile salmon to downstream migration.

5) Investigate a semi-permanent fish collection facility for trap and haul under >500 cfs flows when the river is not connected.

6) Genetic analysis of sacrificed individuals to determine parentage and successful redds.

7) Stomach content analysis to determine food type and availability for juvenile Chinook salmon

1.4 Methods

Type of Study: Field

Reach(es): Reach 1 and 5

Several methods will be used to capture juvenile salmon during the winter/spring 2015 season. These include weirs, rotary screw traps, and entrainment-type nets. Fish weirs, porous barriers built across streams, have long been used to capture migrating fish in flowing waters (Hubert 1996). The use of temporary weirs is generally restricted to streams and small rivers because of construction difficulties in high flows, formation of navigation barriers, and the tendency of weirs to clog with debris. When feasible, however, weirs are generally regarded as the most accurate technique available to quantify escapement and downstream movement of salmon as they provide an absolute fish count (Cousens *et al.* 1982; Zimmerman and Zabkar 2007). Low flow conditions on the SJR provide the opportunity to use this technique to capture out-migrating juvenile Chinook salmon for trap and haul to lower sections of the river.

Weirs with traps will be temporarily installed across the river channel and enable monitoring and capture of passing fish. There are many different types of temporary weirs and they can be constructed from a range of materials. Due to reduced SJR flows and substrate considerations we have chosen to construct rigid weirs to capture downstream moving juvenile fish. This weir type consists of a fence and support structure; fences may be constructed from netting, fencing, pipes or metal pickets (Figure 1). These weirs are relatively easy to transport, construct, and dismantle, lending them beneficial for emergency salvage situations. However, fence weirs are difficult to maintain during high flows or in waterways with high debris loads as excessive water pressure can eventually cause their collapse. Weirs on the SJR will be constructed using marine plywood-frame wire mesh panels, supported by metal t-posts leading to a collection box. Fish enter the collection box through a V-shaped passageway that inhibits exit. Restrictive bars at the collection box entrance will allow smaller fish to enter and block larger fish (*i.e.*, predators). Collection boxes are specific to the type of fish that is being targeted and anticipated densities. Collection boxes will be 3'x 4' or larger, and may have redundant collection areas depending on site-specific river characteristics. Collection boxes will be checked for fish and weirs cleaned of debris daily. Weirs will be constructed near Highway 41, Scout Island, and Highway 145.

Figure 1.–Temporary weir constructed at Scout Island (River Mile 250.1). Note the V-shaped opening facing upstream, designed to guide fish to the central collection box.

Rotary screw traps (Figure 2) are another type of device employed to sample a portion of juvenile salmon as they migrate downstream to the ocean. This type of trap has been used extensively in the Pacific Northwest to sample juvenile salmonids as they make their downstream migration. A rotary screw trap consists of a cone five to eight feet across suspended by pontoons that funnel fish into a collection box. The screw trap is anchored at a fixed point in the stream and spins with the flow as downstream moving particles are funneled into the collection box. The collection box is checked and cleaned at least once daily, more often if fish numbers and debris are high. Efficiencies for rotary screw traps are generally low at 3-10%, and are inversely related to flow. Reclamation has a 5-foot and 8-foot rotary screw traps that are anticipated to be installed at Ledger Island and downstream of Owl Hollow near the Vulcan Mine Pit.

Figure 2.–Rotary screw trap installed at Ledger Island (Near River Mile 262.3).

Lastly, Entrainment-type nets will be installed on the Donnie Bridge structure (Figure 3; RM 240.7) or another location that guiderails can be easily mounted. A total of four nets will be installed from the bridge allowing boat passage on the Fresno County side of the river. Nets measuring 6×3 ft are fixed to rigid frames that are guided in aluminum channel will be clamped to the existing bridge structure to raise and lower the nets. Depending on flow characteristics and debris load, the terminal end of each net will either be a mesh cod-end or a floating collection box. A zipper and grommets on the terminal end allows attachment in either scenario. Each net abuts the next, providing a 12-ft width across the river for sampling.

Figure 3.–Entrainment-type nets temporarily installed on Donnie Bridge (River Mile 240.7) using aluminum channel clamped to existing structure. Collection boxes are attached to the terminal ends of the nets and free-floating using net buoys.

Fish processing and transport

Collection boxes will be checked for fish and fish collection devices cleaned of debris daily. Fish will be netted and placed in 5-gallon buckets with lids to transfer them to a 300 gallon fish transport tank. Fish will be observed for suture marks (acoustically tagged fish) and wanded for PIT tags. Tagged fish will be released downstream of traps at all but the furthest downstream location for PIT tagged fish and always released for acoustically tagged fish. Fish will be transported in a 300-gallon tank filled with water collected from Reach 1 using a submersible pump. Salt (6‰) and Polyaqua will be added to transport tank water to alleviate osmotic imbalance and stress-related effects. Oxygen will be supplied and maintained at 8mg/L during transport. Visual inspections of fish and water quality will be made during transport to release site. Once at release location, the transport tank water will be tempered to within 2^0C of the receiving water by slowly transferring river water to the tanks. Once desired temperature is reached, fish will be netted and placed in 5-gal buckets and placed in a net pen. Any mortality during transport will be recorded, observed for physical damage, weighed, and measured.

Efficiency Tests

In order to evaluate the efficiency of the collection methods presented above, efficiency tests will be performed at the sampling locations. PIT tagged fish will be used to evaluate this efficiency. PIT tag antennas will be installed both upstream and downstream of all sample locations. This will allow biologists to determine whether

released fish were "experiment participants" (*i.e.*, if the fish swim upstream of the collection device, they are considered non-participants and cannot be included in the total numbers of fish used to evaluate the efficiency). Downstream PIT tag arrays will also determine how many fish pass and are not collected. Downstream arrays also determine the leakiness of weirs designed to catch all migrating fish. Numbers of fish used in the efficiency test will be determined by availability in March/April once they are at least 70 mm in length.

Sacrificed fish samples

Representative samples of collections will be provided to California Department of Fish and Wildlife for genetic analysis and stomach content analysis. Cost for genetic and stomach content analyses are not covered in this proposal estimate.

Timing of Study

February 15 – May 31, 2015 depending on Friant Dam releases and river temperatures. Potential to extend into June if water conditions and occurrence of fish permits.

Proposed Trapping Locations

1) Collection Weirs
    a. Within 1 mile downstream of Highway 41 Bridge*
    b. Scout Island
    c. Within 1.5 river miles upstream of Highway 145 Bridge*
2) Rotary Screw Traps
    a. Ledger Island, near RM 262.3
    b. Downstream of Owl Hollow, between RM 257-258
3) Entrainment-type netting
    a. Donnie Bridge

* locations to be selected in consultation with Program Landowner Coordinator

Locations are to be selected downstream of redds and in areas that will remain wetted during a Critical Low hydrologic water-year type. The above areas are being considered as they are in the lower extent of the river where thermal tolerances may be exceeded and salmon in areas upstream of trapping locations may over-summer below Friant Dam if water conditions permit.

Release Locations

Proposed release sites include the following and will be determined by water temperature, flow, and river connectivity.

A. Confluence of San Joaquin and Merced Rivers near Newman, CA (Private Property)
B. Confluence of San Joaquin and Tuolumne Rivers near Patterson, CA (River Partners)

Semi-permanent Collection Facility Design
Develop a multi-agency team to investigate a semi-permanent fish collection facility for trap and haul under >500 cfs flows when the river is not connected. Determine the feasibility and cost of collection structure and potentially have TSC hydraulic engineers develop designs. Cost for semi-permanent design and discussions are not covered in this proposal estimate.

Compliance considerations
CatEx (NEPA), Nationwide 5 (ACOE), Environmental Assessment (EA), State of California scientific collection permits, and other relevant permits will be obtained before starting this study.

1.5 Deliverables and Schedule

February 15	Begin installation of collection devices
February 16	Begin translocating captured to fish to release sites in Reach 5
March/April	Perform efficiency tests of collection devices
May 31 extending	End of collection period unless fish numbers and temperatures permit

Reclamation will provide a weekly catch update during the February 15– May 31 study period.

Reclamation will complete a summary report of trap and haul efforts by September 30, 2015. Analysis of data will be provided as well as a discussion of results and how they pertain to the SIG questions that require information. The final report will be made available on the SJRRP website.

1.6 Budget

The total cost estimate is $467,323 for 2015.

Construction								**Labor**	**Non-labor**
	Labor	10 sd	20	760	15200			**15200**	**6950**
	Supplies	laminate boards			5000				
		mesh			0				
		perforated plate			500				
		nets			0				
		aluminum guides			0				
		rubber			450				
		fastners			500				
		miscellaneous			500				
						22150			
Installation									
	Labor	40 sd (10 hour days)	40	950	38000			**39900**	**11827**
	Delivery	2 sd (10 hour days)	2	950	1900				
	Travel	airfare, hotel, perdiem etc			7327				
	Supplies	t-posts			2000				
		electric winches			2000				
		miscellaneous			500				
						51727			
Monitoring									
	Labor	212 sd (12 hour days)	212	1140	241680			**241680**	**43,212**
	Travel	airfare, hotel, perdiem etc			42,212				
	Supplies	miscellaneous			500				
		oxygen, salt, transport equip			500				
						284892			
Removal									
	Labor	30 sd (10 hour days)	30	950	28500			**28500**	**14374**
	Travel	airfare, hotel, perdiem etc			12224				
	vehicle/ gear return	2 sd (10 hour days)	2	950	1900				
	Supplies	miscellaneous			250				
						42874			
Project Management									
	Labor	15 sd	15	760	11400			**11400**	**0**
						11400			
Data Management / Report									
	Labor	15 sd	15	760	11400			**11400**	**0**
						11400			
Capture efficiency tests									
	Labor	30 sd	30	950	28500			**28500**	**14000**
	Supplies	PIT tags and array supplies			14000				
						42500			
								376580	**90363**
						$466,943.00			

1.7 Point of Contact / Agency Principal Investigator

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1.8 References

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Hubert, W.A. 1996. Passive capture techniques. Pages 157-192 in B.R. Murphy and D.W. Willis, eds. Fisheries techniques, 2nd edition. American Fisheries Society, Bethesda, MD.

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