UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Effective Date: January 15, 2021

MEMORANDUM FOR: Administrative Record for the Designation of a Nonessential Population of Central Valley Spring-run Chinook Salmon Below Friant Dam in the San Joaquin River, California (ARN: 151422-SWR2010-SA00361) and the Biological Opinion for the Reinitiation of Consultation on the Long-term Operation of the Central Valley Project and State Water Project (CVP/SWP Opinion; ARN: 151422-WCR2016-SA00300)[1]

TO: Cathy Marcinkevage, Assistant Regional Administrator, California Central Valley Office (CCVO), West Coast Region
A. Catherine Marcinkevage

THROUGH: Garwin Yip, Water Operations Branch Chief, CCVO, West Coast Region
Garwin YJ

FROM: Erin Strange, San Joaquin Branch Chief, CCVO, West Coast Region
Erin Strange

SUBJECT: 2021 (January 2021 – December 2021) Technical Memorandum Regarding the Accounting of San Joaquin River Spring-run Chinook Salmon at the Central Valley Project and State Water Project Sacramento-San Joaquin Delta Fish Collection Facilities

[1] Please cite as: NMFS. 2021. Technical Memorandum to Account for Reintroduced San Joaquin River Spring-Run Chinook Salmon per CFR 233.301(b)(5)(ii): 7.

Background

National Marine Fisheries Service (NMFS) has prepared this Technical Memorandum (Tech Memo) to fulfill the following three purposes:

1) Fulfill one of the requirements of the *Designation of a Nonessential Experimental Population of Central Valley Spring-run Chinook Salmon Below Friant Dam in the San Joaquin River, California* (70 FR 79622, December 31, 2013) to release an annual technical memorandum to:

   > "Calculate and document the proportionate contribution of Central Valley (CV) spring-run Chinook salmon (*Oncorhynchus tshawytscha*) originating from the reintroduction to the San Joaquin River and deduct or otherwise adjust for share of CV spring-run Chinook salmon take when applying the operational triggers and incidental take statements associated with the NMFS 2009 Biological and Conference Opinion on the Long-term Operations of the Central Valley Project and State Water Project (CVP/SWP Opinion) or subsequent future biological opinions, or Section 10 permits."

2) Present the methodology that will be employed in 2021 to identify reintroduced nonessential experimental population (NEP) CV spring-run Chinook salmon from the San Joaquin River when encountered outside the NEP reintroduction area and outline the deduction or adjustment for such reintroduced spring-run Chinook salmon in the operations of the Central Valley Project (CVP) and State Water Project (SWP) such that the reintroduction will not impose more than *de minimus* water supply reductions, additional storage releases, or bypass flows on unwilling third parties as defined in P.L. 111-11, Title X, section 10011(c)(1).

3) Outline the NEP spring-run Chinook salmon release and monitoring plans for 2021.

In May 2013, a technical work group consisting of fisheries agencies, water management agencies, and water users was first convened to provide input on the annual Tech Memo. In January 2014, NMFS issued the first Tech Memo, which was just prior to the San Joaquin River Restoration Program's (SJRRP) implementation of the reintroduction strategies of NEP CV spring-run Chinook salmon into the SJRRP Restoration Area (Restoration Area, the San Joaquin River from Friant Dam to the Merced River confluence). Since the issuance of the first Tech Memo, reintroduction strategies have been successful and spring-run Chinook salmon have returned to the San Joaquin River for the first time in over 60 years. As such, monitoring, scientific studies, and hatchery releases of spring-run Chinook salmon in the Restoration Area by the SJRRP has grown into a multi-faceted and dynamic effort based on an adaptive management process. Therefore, NMFS has determined the need to re-organize the Tech Memo in order to both efficiently address the three purposes of the Tech Memo (as stated above) and to present all relevant results of monitoring, research studies, and hatchery release information in a reader-friendly way. As the SJRRP progresses into the future, NMFS will continue to re-visit the format, organization, and content of the Tech Memo to ensure readability and purpose fulfillment.

Purpose 1: Accounting for NEP of CV spring-run Chinook salmon at the CVP/SWP Facilities during 2020

No changes in water export quantities were experienced during the 2020 calendar year as a result of the juvenile NEP spring-run Chinook salmon produced by the SJRRP. In support of this statement, Appendix A to this Tech Memo contains details of the relevant monitoring results, hatchery releases, calculations made, and the documentation of the proportionate contribution of the NEP CV spring-run Chinook salmon that originated from the Restoration Area. The information presented in the appendix has been coordinated with federal and state agencies and other interested parties involved in the implementation of the SJRRP.

Purpose 2: Methodology for accounting for NEP of CV spring-run Chinook salmon during 2021

For the previous Tech Memos (2020 and prior), the methodology for accounting for NEP CV spring-run Chinook salmon relied on rapid genetic testing. Each year, the SJRRP coordinated with the rapid genetic analysis efforts performed at the CVP/SWP Facilities to ensure that spring-run Chinook salmon produced from the SJRRP did not contribute to any loss density trigger exceedances that would warrant operational changes under the 2009 *Biological Opinion and Conference Opinion of the Long-Term Operations of the Central Valley Project and State Water Project* (herein referred to as the 2009 Opinion).

On October 21, 2019, NMFS issued the *Biological Opinion on Long Term Operation of the Central Valley and State Water Project*[2] (herein referred to as the 2019 Opinion) that superseded the 2009 Opinion. On February 18, 2020, the U.S. Bureau of Reclamation (Reclamation) adopted the 2019 Opinion by issuing its Record of Decision (ROD), which completed the environmental review and initiated operations defined by the ROD.

On March 31, 2020, the California Department of Fish and Wildlife (CDFW) issued an Incidental Take Permit (ITP), pursuant to the California Endangered Species Act, for the Long-Term Operation of the State Water Project in the Sacramento-San Joaquin Delta (herein referred to as the 2020 ITP).[3] The SWP will operate under the terms and conditions of both the 2019 Opinion and the 2020 ITP. Neither the 2019 Opinion nor 2020 ITP have operational restrictions or triggers based on salvage of naturally-produced CV spring-run Chinook salmon.

Both the 2019 Opinion and 2020 ITP have operational triggers based on salvage of hatchery and naturally-produced Sacramento River winter-run Chinook salmon. The single-year and cumulative loss thresholds for Sacramento River winter-run Chinook salmon, which are based on length-at-date criteria and historic loss from 2010-2018, are the same for both the 2019 Opinion and 2020 ITP. The 2020 ITP has an additional daily loss threshold for older juvenile Chinook salmon.

Therefore, to contribute to an operational trigger, an unmarked juvenile spring-run Chinook salmon produced from the SJRRP must navigate out of the Restoration area and:

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[2] Publicly available at: https://www.fisheries.noaa.gov/resource/document/biological-opinion-reinitiation-consultation-long-term-operation-central-valley

[3] Publicly available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Files/ITP-for-Long-Term-SWP-Operations.pdf

1) be detected at the CVP or SWP Facility;

2) be in the same size range of juvenile winter-run Chinook salmon or larger; and

3) contribute to exceeding either a daily loss threshold, single year loss threshold, or a cumulative loss threshold for winter-run Chinook salmon.

In order to account for salmonids salvaged at the CVP/SWP Facilities, under Reasonable and Prudent Measure (RPM) 5(b)(ii) of the 2019 Opinion, Reclamation and Department of Water Resources (DWR) shall monitor the salvage and loss of salmonids by, in part, implementing "*tissue sampling programs from natural origin salmonids, and coded wire tag samples from adipose fin-clipped juvenile winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead and CV late-fall run Chinook salmon at the Tracy Fish Collection Facility and Skinner Delta Fish Protective Facility, for genetic analysis or tag removal/reading pursuant to appropriate sampling protocols and statistical power analyses*."

Furthermore, RPM 5(b)(ii)(a) states that Reclamation and DWR "*shall submit incidental take reports from Tracy Fish Collection Facility and Skinner Delta Fish Protective Facility by December 31 of each year, to include the genetic results of the tissue samples*"; and RPM 5(b)(ii)(b) states that Reclamation and DWR "*shall develop and submit for review and concurrence by NMFS a plan for tissue and whole fish or head processing and storage by December 31, 2020*."

Genetic results of the tissue samples from fish salvaged during the 2021 calendar year will be reported to NMFS by the end of 2021. Additionally, genetic results will be reported to the Salmon Monitoring Team[4] throughout the 2021 calendar year to provide an accurate identification of Chinook salmon runs.

In 2021, the SJRRP will continue to further investigate the use of genetic identification to account for San Joaquin River spring-run Chinook salmon detected at the CVP/SWP Facilities. Steps of this investigation include:

(1) Continuing to refine and learn from fish recovery and genetic testing at the CVP/SWP Facilities.

(2) Identifying and resolving (to the extent of the Program's control) potential issues with using genetic identification for meeting the *de minimus* requirement – process timing, chain of custody, and necessary agencies' commitments.

Of further interest to the SJRRP, the 2020 ITP requires DWR to develop a spring-run Chinook salmon Juvenile Production Estimate (JPE) Monitoring Plan by December 1, 2020. Development and implementation of a Sacramento River spring-run Chinook salmon JPE would help inform decision making to avoid the exceedance of operational thresholds. During calendar year 2021, the SJRRP will explore the feasibility of including relevant monitoring data from the SJRRP by coordinating with the spring-run JPE technical team.

Accounting Methodology

[4] Webpage for the Salmon Monitoring Team is here: https://www.usbr.gov/mp/bdo/salmon-monitoring-team.html

Physical Marking

All juvenile spring-run Chinook salmon released into the San Joaquin River as part of the SJRRP's reintroduction plan will be marked with an adipose fin-clip and coded wire tag (CWT). The CWT contains a code unique to the SJRRP's release groups so they can be distinguished from all other CV Chinook salmon release groups. In addition to an adipose fin-clip and a CWT, all yearling fish produced and released by the hatchery may be tagged with a passive integrated transponder (PIT) tag, depending on funding. SJRRP fish released and marked with an adipose fin-clip are exempt from take prohibitions under the final 4(d) protective regulations for West Coast threatened salmonids (70 FR 37160, June 28, 2005). As a result, reintroduced NEP CV spring-run Chinook salmon will not be counted toward any incidental take limits and trigger levels provided under all applicable ESA section 7 consultations or section 10 research permits for operation of the CVP/SWP Facilities.

Genetic Analysis

The SJRRP has established a parentage based tagging (PBT) procedure for the San Joaquin River Chinook salmon populations. PBT involves the annual sampling and genotyping of adult Chinook salmon returning to the Restoration Area; these data are being used to create a database of genotypes for future parentage assignment of their progeny. As such, all adult Chinook salmon captured in Reach 5 or recovered as a carcass returning to the Restoration Area in 2021 will be tissue sampled for genetic testing.

Efforts will be made to take a tissue sample from all naturally-produced (unmarked) juvenile Chinook salmon captured during Rotary Screw Trap (RST) monitoring in 2021/2022. However, there may be several days during the juvenile monitoring season where sample collection may not be logistically feasible due to varying reasons. In those situations, tissue samples will be taken from a subset of naturally-produced juveniles captured each day of monitoring. All tissue samples will be part of the parental inference analysis.

Genetic analysis is a more accurate method than the length-at-date method to distinguish SJRRP NEP CV spring-run Chinook salmon from other runs of Chinook salmon at the CVP/SWP Facilities. With the present operational triggers and length-at-date method to determine Chinook salmon run, the key concern is whether the NEP CV spring-run Chinook salmon would fall into the juvenile length-at-date criteria and inadvertently contribute to an operational trigger for winter-run Chinook salmon.

The SJRRP will coordinate with the genetic analysis effort at the CVP/SWP Facilities in 2021 to ensure that NEP spring-run Chinook salmon do not result in more than *de minimus* water supply reductions, additional storage releases, or bypass flows on unwilling third parties. Under the new 2019 Opinion and 2020 ITP, all unmarked Chinook salmon captured at the CVP/SWP Facilities would be genetically sampled in 2021, but the timelines and frequency for processing those genetic samples is uncertain at the time of writing this Tech Memo.

Calculation of incidental take and operational triggers

Incidental take calculations and adjustments to the incidental take estimates pursuant to the 2019 Opinion are unnecessary for 2021 relative to juvenile CV spring-run Chinook salmon released into the San Joaquin River because those fish will all receive an adipose fin-clip and CWT or PIT tag, which makes them readily identifiable upon capture. Any unmarked offspring of

naturally-spawned adults that survive and emigrate out of the Program Restoration Area, and are captured at the CVP/SWP Facilities, will be included in Reclamation's and DWR's genetic analyses and reported to NMFS.

Operational details under the 2019 Opinion are still in development, and DWR and Reclamation must maintain flexibility during the pandemic to ensure health and safety of field and laboratory staff. Therefore, NMFS will closely coordinate with Reclamation and DWR throughout the year.

Purpose 3: Planned releases and monitoring for NEP of CV spring-run Chinook salmon

2021 Planned Releases

Juvenile spring-run Chinook salmon from the Salmon Conservation and Research Facility (SCARF) are planned to be released into the San Joaquin River upstream of the Merced River confluence in spring 2021 as part of the SJRRP's reintroduction efforts. There is expected to be no translocation fish from the Feather River Fish Hatchery into the San Joaquin River.

In the summer of 2021, adult broodstock from the SCARF may be released into Reach 1. Although the exact numbers of adults released are not yet determined, these fish will have external tags, CWTs, adipose fin clips, and some will be acoustically tagged. The exact release location, date, number of release groups, and numbers of fish per release group are dependent on water year type, physical river conditions within the Restoration Area, and fish availability and size, which will not be known until early spring 2021. Target release timing, location, and numbers of fish per release will be identified and posted on the SJRRP's website when determined (http://www.restoresjr.net/).

The U.S. Fish and Wildlife Service (USFWS) will issue pre-release notifications via email correspondence to interested stakeholders and agencies approximately one week prior to fish release. A second notification will be made to the same email list immediately after the fish release. Release information will also be reported to the Regional Mark Processing Center website (https://www.rmpc.org/).

Additionally, the SJRRP is planning to monitor Reach 5 for returning adult CV spring-run Chinook salmon and capture/translocate them to holding and spawning habitat in Reach 1. If returning adults are captured, they will be marked with a PIT tag and/or Floy tag and will be genetically sampled prior to release. Up to 30 adults will be tagged with an acoustic transmitter, and all translocated adults will be released in Reach 1 or Reach 2. These adults and the SCARF broodstock releases are expected to spawn naturally in the Restoration Area in 2021, and any resulting juveniles would out-migrate as early as January 2022. Naturally-produced juveniles would not be physically marked unless they are captured and tagged in the RST monitoring.

Monitoring Plans and Additional Studies for 2021

Adults

Depending on funding, adult spring-run Chinook salmon that return in spring 2021 may be monitored with a VAKI Riverwatcher camera with an attached trap in Reach 5 of the Restoration Area, if river conditions allow for the installation. If any adults are detected, they will be captured and moved to Reach 1 of the Restoration Area. Also, Reclamation plans to transport to

Reach 1 any adult spring-run Chinook salmon that are found during its monthly steelhead monitoring efforts in Reaches 4 and 5.

The SJRRP will conduct redd and carcass surveys in the fall/winter of 2021/2022 to estimate escapement of adult fish in Reach 1 and 2 and to estimate the number of redds. Results from these surveys will be presented in the 2022 Tech Memo.

Juveniles

Both hatchery-released and naturally-produced juvenile spring-run Chinook salmon will be monitored throughout Reaches 1 and 2 with a RST to determine migration timing, life-stage diversity, survival, and size. In an attempt to capture the entirety of the juvenile spring-run Chinook salmon migration timing, RST monitoring may begin in late-September or early October of 2021 to specifically target the yearlings out-migrating in fall 2021. RST monitoring will continue through June 2022, until water temperatures exceed the lethal temperature of 75°F (Figure 9 of the Fisheries Framework[5]), or until no salmonids are caught for seven days or more.

In addition to natural production, approximately 42,500 juvenile spring-run Chinook salmon from the SCARF will be released throughout the winter/spring of 2021/2022 to test RST capture efficiencies. Four RST monitoring locations within the Restoration Area were chosen based on redd locations and river access (Owl Hollow, Scout Island, Highway 99 Bridge, and San Mateo Avenue). RSTs at these sites will be operated when sufficient water velocities allow for adequate cone rotation and operations are safe for field personnel. NMFS has determined (based on previous discussions with participants of the Tech Memo group) that tracking the migration of juvenile spring-run Chinook salmon through the lower San Joaquin River, beyond the current monitoring efforts, has considerable value. Depending on funding priorities, UC Davis may continue to track juvenile spring-run Chinook salmon movement from Reach 5 of the Restoration Area to the south Delta.

Timeline

River conditions within the Restoration Area will dictate the implementation of fish releases and fisheries monitoring. The SJRRP will monitor river and weather conditions and may cancel or modify fisheries monitoring and/or fish release activities, depending on expected conditions in the system, funding priorities, or due to concerns for field staff health and safety.

The timing of juvenile NEP CV spring-run Chinook salmon migration from the Restoration Area to the Delta will be estimated from the capture of fish with CWTs that are recovered in 2021 from the Mossdale Trawl, Chipps Island Trawl, CVP/SWP Facilities, and other monitoring efforts[6]. UC Davis may continue the reach-specific survival study for juvenile CV spring-run Chinook salmon released into the lower San Joaquin River and south Delta in 2021.

[5] Fisheries Framework: Spring-run and Fall-run Chinook Salmon

[6] Data for juvenile salmonid monitoring that is conducted by entities external to the SJRRP is available here: https://www.fws.gov/lodi/juvenile_fish_monitoring_program/jfmp_index.htm

Final release of information of juvenile NEP CV spring-run Chinook salmon is available on the SacPAS website[7]. NMFS will hold monthly meetings starting February 2021 to discuss implementation of the 2021 Tech Memo and to develop the 2022 Tech Memo.

Acknowledgments

NMFS would like to acknowledge the SJRRP staff from USFWS, CDFW, and Reclamation for their contributions in collecting, summarizing, and providing the data used to produce this Tech Memo. NMFS would also like to acknowledge the participants of the Tech Memo group for their review and feedback on this document.

[7] SacPAS: Central Valley Prediction and Assessment of Salmon website is available here: http://www.cbr.washington.edu/sacramento/

Appendix A: Accounting for Nonessential Experimental Population (NEP) of Central Valley (CV) spring-run Chinook salmon during 2020

Juvenile Releases and Recapture at Monitoring Sites and the Central Valley Project and State Water Project (CVP/SWP Facilities)

All juvenile spring-run Chinook salmon released from the Salmon Conservation and Research Facility (SCARF) were marked with an adipose fin-clip and a coded wire tag (CWT) with numbers distinct to each release group. Table 1 provides a summary of the juvenile NEP spring-run Chinook salmon releases by the San Joaquin River Restoration Program (SJRRP), as well as recaptures for each release group at downstream monitoring sites and the CVP/SWP Facilities.

Table 2 provides a summary of juveniles that were observed at the CVP/SWP Facilities. Per protocol at the CVP/SWP Facilities, all adipose fin-clipped fish were sacrificed at the point of capture for CWT identification, unless there were visible sutures from acoustic tagging surgery, or a passive integrated transponder (PIT) tag was detected, in which case they were released alive.

Yearlings captured at the CVP/SWP Facilities fell into the fall/late-fall-run Chinook salmon length-at-date range, while young-of-year juveniles mostly fell into the spring-run Chinook salmon length-at-date range (Figure 1). A couple of young-of-year juveniles fell on the line with Sacramento River winter-run Chinook salmon length-at-date range (Figure 2). However, since those juveniles were fin-clipped and CWT'ed, these individuals were identified as NEP spring-run Chinook salmon released by the SJRRP and were not misidentified as juvenile Chinook salmon from other sources.

Table 1. Summary of juvenile NEP spring-run Chinook salmon releases made by the SJRRP in 2019-2020, and recaptures from each release group.

Release Date	Lifestage	Release Location	No. Released / CWT # (from SCARF)	Mossdale Trawl	Beach Seines	Chipps Island Trawl (CWT#)	No. at Facilities Observed (CWT#)	Notes
12/5/2019	Yearling	Reach 5: Hwy 140 crossing	9,229 / 60554 363 / 61447 49 / 61964	0	0	1 (60554)	64 (60554)	
12/12/2019	Juvenile	Reach 1: Owl Hollow & Scout Island	1,200 / 601080604	0	0	0	0	RST efficiency trials; two groups of 600 fish
1/6/2020	Juvenile	Reach 1: Owl Hollow & Scout Island	1,200 / 601080605	0	0	0	0	RST efficiency trials; two groups of 600 fish

Release Date	Lifestage	Release Location	No. Released / CWT # (from SCARF)	Mossdale Trawl	Beach Seines	Chipps Island Trawl (CWT#)	No. at Facilities Observed (CWT#)	Notes
1/23/2020	Yearling	Reach 5: Hwy 140 crossing	400 / 61446 300 / 61447 200 / 60554	0	0	0	0	The 200 fish with the same CWT # as the 12/5/2019 release group (06-05-54) were originally intended to be retained as broodstock fish however they were released because the SCARF did not have the space for them.
Jan.-May 2020	Juvenile	Reach 1 & 2	10,727 / 60555	0	0	0	1	RST efficiency test fish
Jan.-May 2020	Juvenile	Reach 1 & 2	9,106 / 60556	0	0	0	0	RST efficiency test fish
Mar.-May 2020	Juvenile	Reach 1 & 2	8,469 / 60557	0	0	0	0	RST efficiency test fish
2/3/2020	Juvenile	Reach 5: Hwy 140 crossing	49,677 / 60768	0	0	0	79	
2/10/2020	Juvenile	Reach 5: Hwy 140 crossing	53,089 / 60936	0	0	0	44	
3/16/2020	Juvenile	Reach 5: Hwy 140 crossing	32,052 / 60767 57,732 / 61441	0	0	0	36 (60767) 85 (61441)	
4/7/2020	Juvenile	Reach 5: Hwy 140 crossing	7,740 / 68020 2,769 / 61965	0	0	0	14 (68020) 4 (61965)	
Total	Yearlings		10,541				64	
Total	Juveniles		233,761				263	

Table 2. Summary of juvenile NEP CV spring-run Chinook salmon that were observed at the CVP/SWP Facilities in 2019/2020.

Dates Observed	Facility	Release Life stage	Release date	Release location	CWT #	Total Observed
12/9 to 12/22/2019	CVP	Yearling	12/5/2019	Reach 5, Hwy 140 crossing	60554	64
3/17 to 4/25/2020	CVP/ SWP	Juvenile	2/3/2020	Reach 5, Hwy 140 crossing	60768	79
3/23 to 5/1/2020	CVP/ SWP	Juvenile	2/10/2020	Reach 5, Hwy 140 crossing	60936	44
4/15/2020	CVP	Juvenile	2/28/2020	San Mateo crossing; RST efficiency test fish	60555	1
4/1 to 5/5/2020	CVP/ SWP	Juvenile	3/16/2020	Reach 5, Hwy 140 crossing	60767	36
3/23 to 4/29/2020	CVP/ SWP	Juvenile	3/16/2020	Reach 5, Hwy 140 crossing	61441	85
4/27 to 5/4/2020	CVP/ SWP	Juvenile	4/7/2020	Reach 5, Hwy 140 crossing	61965	4
4/11 to 4/29/2020	CVP/ SWP	Juvenile	4/7/2020	Reach 5, Hwy 140 crossing	68020	14

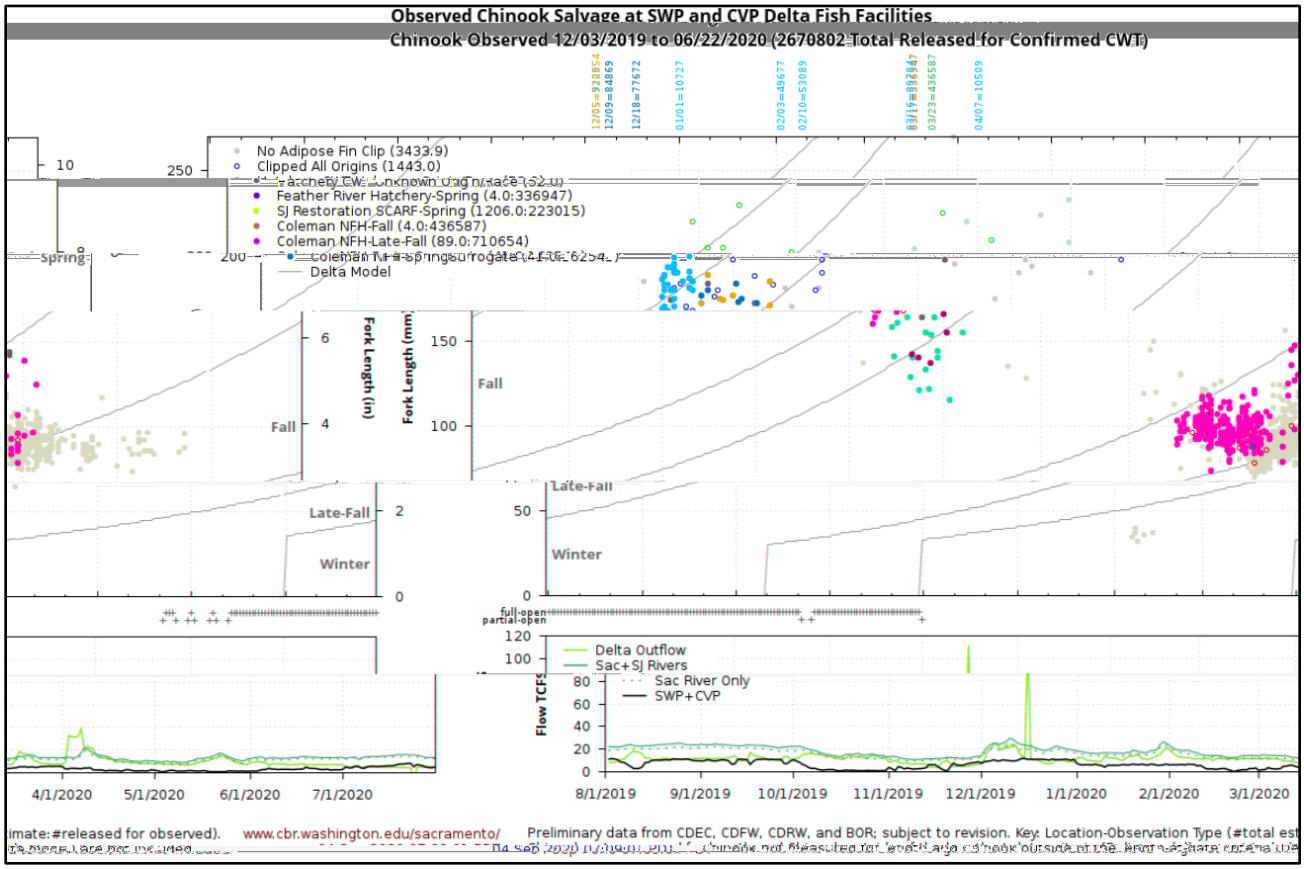

Figure 1. Observed Chinook salmon salvage at SWP (Skinner Delta Fish Protective Facility) and CVP (Tracy Fish Collection Facility) Facilities from 8/1/2019 to 7/15/2020.

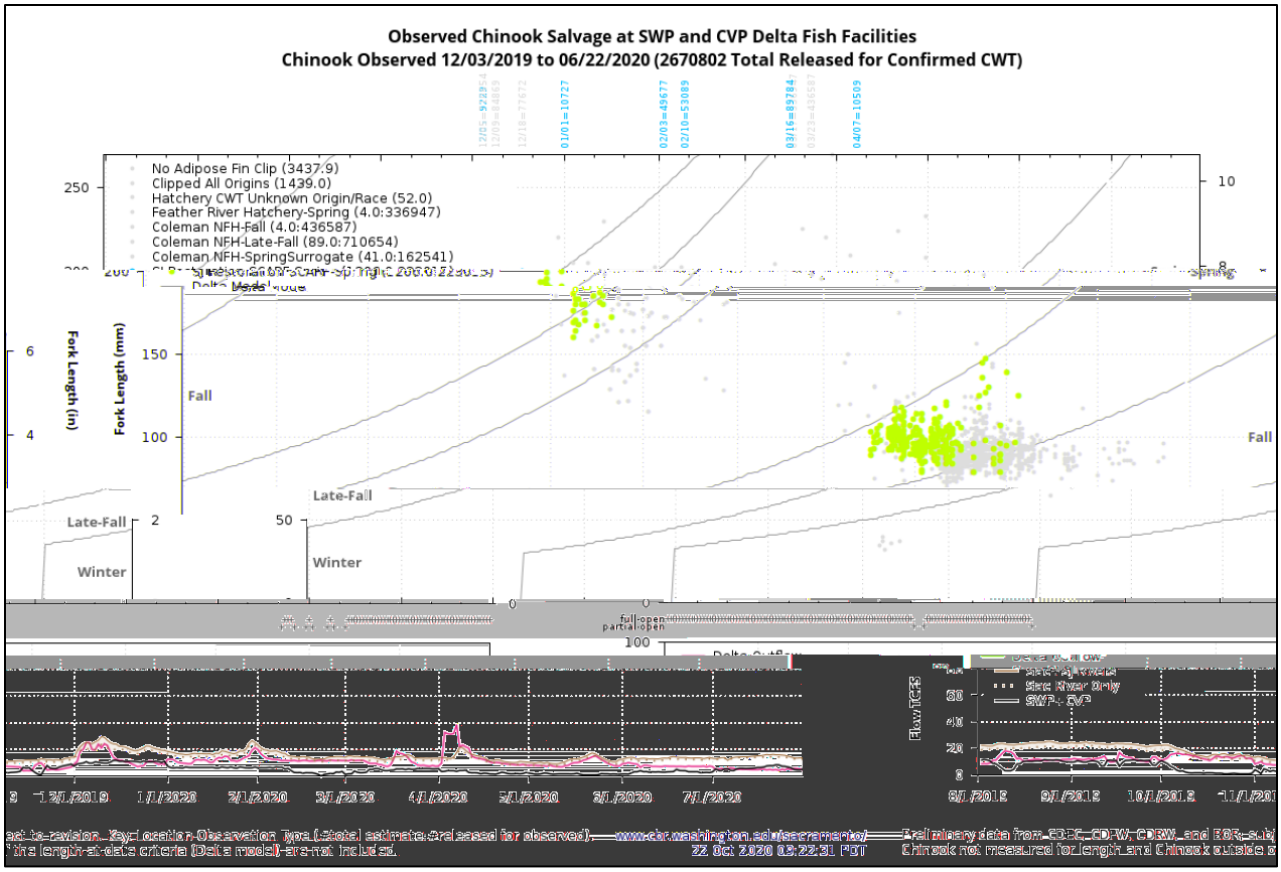

Figure 2. Observed NEP CV spring-run Chinook salmon salvaged at SWP (Skinner Delta Fish Protective Facility) and CVP (Tracy Fish Collection Facility) Facilities from 8/1/2019 to 7/15/2020.

2019-2020 Rotary Screw Trap Monitoring Results

The SJRRP conducted RST monitoring of juvenile Chinook salmon in the Restoration Area from November 8, 2019 through May 22, 2020.

RSTs were located at four locations in Reaches 1 and 2 (refer to Figure 3 for a map of locations):

1) Owl Hollow (river mile [RM] 258.6);
2) Scout Island (RM.250.17);
3) Highway 99 (Hwy 99; RM 243.1); and
4) San Mateo Crossing (RM 212.0).

Sampling started at the three Reach 1 traps (Owl Hollow, Scout Island, and Hwy 99) on November 8, 2019 to evaluate temporal emergence patterns. Sampling started on January 8, 2020 at the San Mateo location, prior to efficiency fish releases at Hwy 99. The sampling season concluded May 22 at all four locations in conjunction with decreasing salmon capture and increasing water temperatures. During the RST monitoring season, captured salmon were identified to life-stage, measured to length (fork length and total length in millimeters [mm]), weighed (nearest 0.1 gram [g]), and a tissue sample was collected for genetic analyses. After processing, fish were released downstream from the RST.

From late-November through December, there were periods of high capture rates in the RSTs, where an excess of several hundred salmon in an RST were captured each day. During this timeframe, only a subset of 90 individual juvenile salmon were processed each day in the manner described above, including tissue sample collection. The remainder of the fish captured in the RSTs were counted but not further processed.

Table 3 summarizes the RST catches by location and lifestage. Figure 4 and Figure 5 display the total catches and fork lengths of unmarked juvenile salmon caught in the RSTs. The smaller sized group of fish (refer to Figure 5 and Figure 6) are likely not progeny of NEP CV spring-run Chinook salmon (*e.g.,* fall-run Chinook salmon from the Salmonids in the Classroom Program, non-Chinook salmon species, or SCARF fish not related to broodstock progeny/natural returning spring-run fish). Verification of run-type and parentage will be assessed through genetic analyses.

In conjunction with daily monitoring efforts, mark and capture/recapture RST efficiency tests were completed to quantify juvenile salmon production and survival through the Reaches 1 and 2 of the Restoration Area. RSTs only sample a portion of the river, and thus do not capture all downstream migrating fish; therefore, RST efficiency estimates are necessary to extrapolate abundance estimates from totals of captured fish. Efficiency estimates also provide estimates of survival of marked fish that are released and recaptured at subsequent downstream RSTs. Unique combinations of ink colors and fin-tag locations allowed for recaptured fish to be identified to individual efficiency test release group. All fish released in the Restoration Area are required to be coded wire tagged prior to release, and all fish marked using the ink/fin method had a full-size CWT. Fish are not typically tagged with CWTs until they are 55 mm in fork length, precluding efficiency tests for fish under this size. However, half-size CWTs were available during the 2019/2020 RST sampling season, which allowed efficiency testing for fish less than 55 mm fork length. Two release groups of fish, that were under 55 mm in fork length, were completed in December and January at the Owl Hollow and Scout Island RSTs before typical ink/fin marking commenced.

Efficiency tests were completed at four RSTs: Owl Hollow (n = 11, where n is the number of release groups), Scout Island (n = 12), Hwy 99 (n = 12), and San Mateo Crossing (n = 6), resulting in the release of 21,746 externally marked juvenile spring-run Chinook salmon into Reaches 1 and 2 of the Restoration Area. Trap efficiency varied as a function of location with mean (± 95 percent confidence interval) values at Owl Hollow, Scout Island, Highway 99, and San Mateo, of 22.9 percent (± 4.4 percent), 12.4 percent (± 3.8 percent), 22.2 percent (± 6.2 percent), and 18.4 percent (± 8.6 percent), respectively. Currently, RST capture and efficiency data are being reviewed and analyzed. These data should be considered preliminary, and any significant changes or updates to this data will be presented in the 2022 Tech Memo.

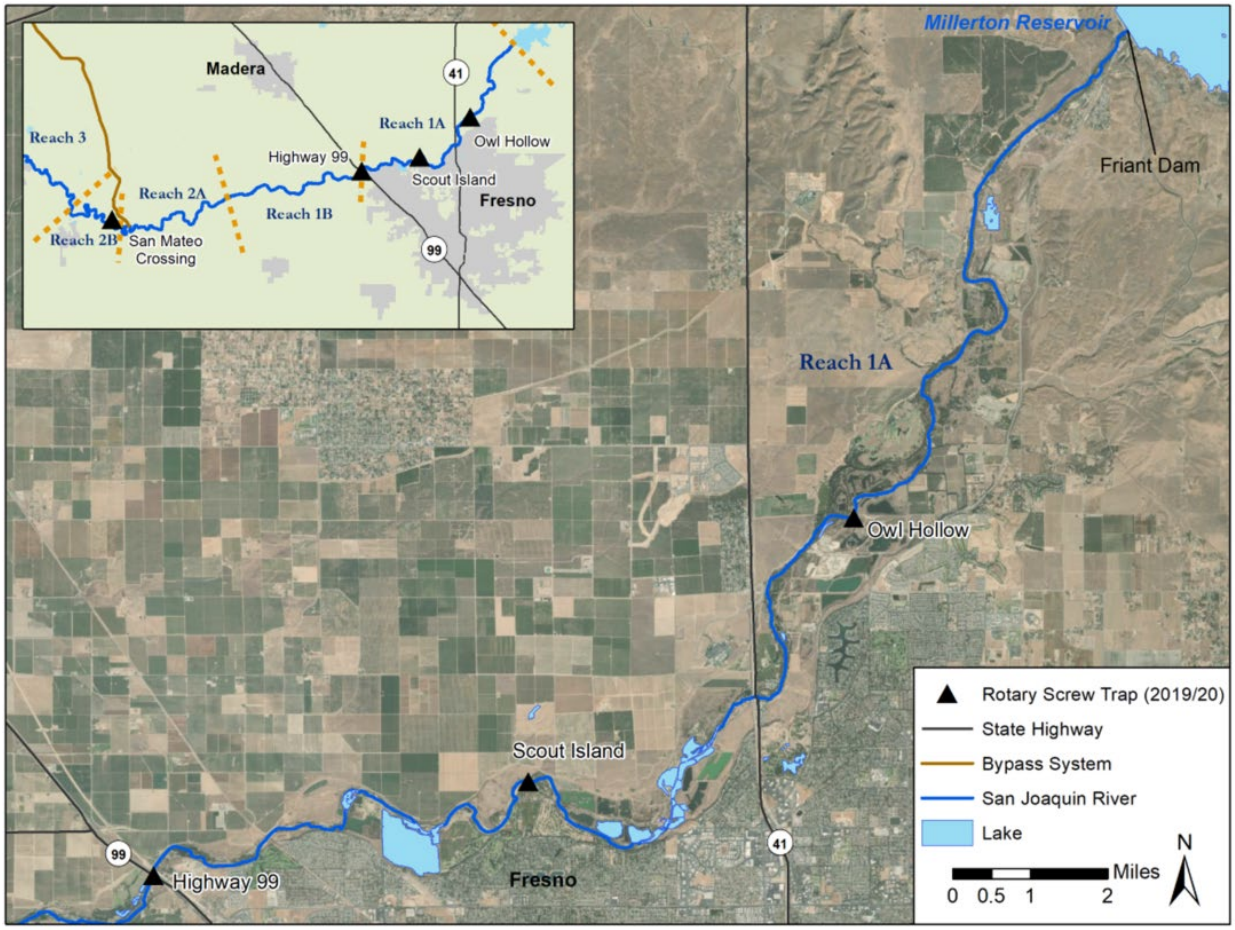

Figure 3. Map showing the RST monitoring locations (indicated by black triangles) within Reaches 1 and 2 of the SJRRP Restoration Area. Figure produced by Reclamation.

Table 3. Summary of RST catches from 11/8/2019 through 5/22/2020 by sampling location and lifestage.

Lifestage	Owl Hollow RST	Scout Island RST	Hwy 99 RST	San Mateo Crossing RST	Total fish captured per lifestage
Fry	9,647	54	4	0	9,705
Parr	74	8	5	0	87
Smolts	276	288	405	21	990
Yearlings	0	0	2	0	2
Not recorded	18	1	4	1	24
Total fish per RST location	10,015	351	420	22	10,808

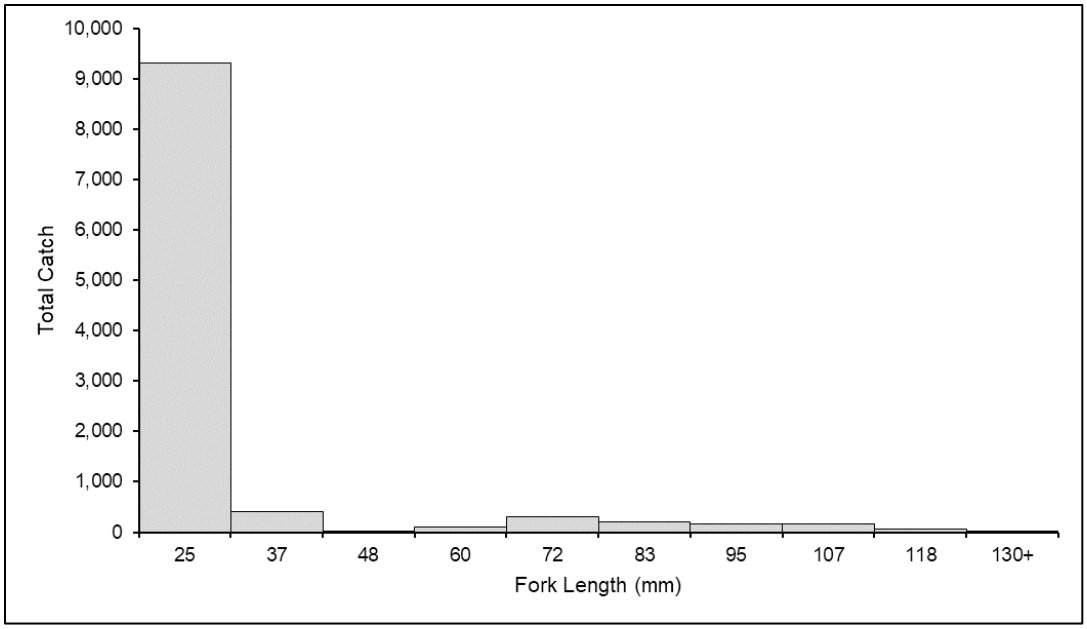

Figure 4. Total catch and fork lengths of unmarked juvenile salmon captured at RSTs in the San Joaquin River Restoration Area during the 2019/2020 sampling season. Figure produced by: Zak Sutphin, Reclamation.

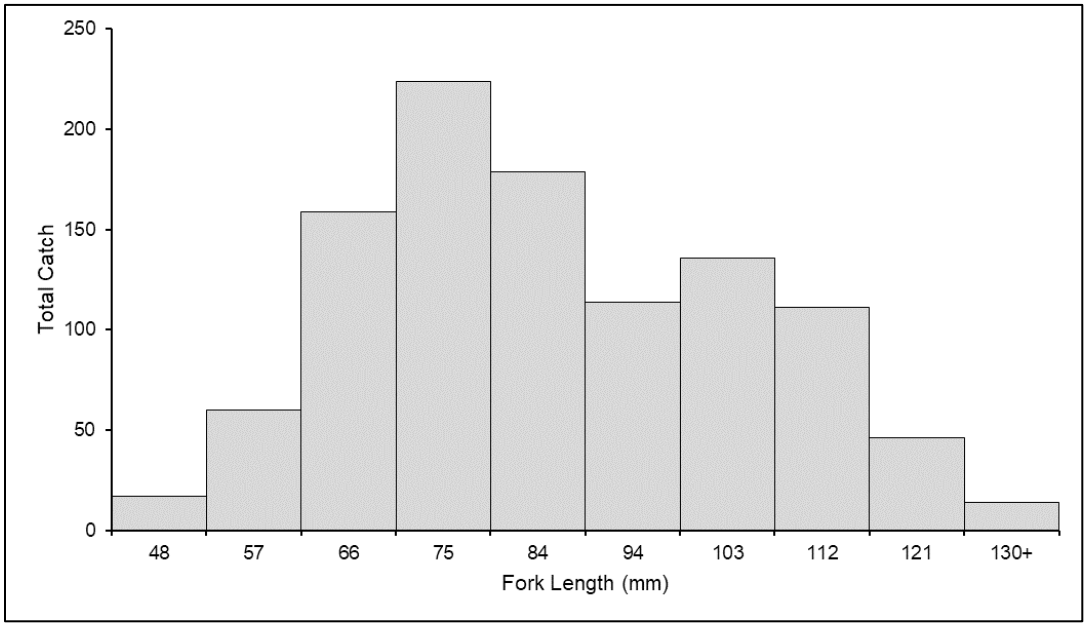

Figure 5. Subset of data displayed in Figure 4 that shows the total catch of unmarked juvenile salmon with fork lengths greater than 48 mm that were captured in the RSTs. Figure produced by: Zak Sutphin, Reclamation.

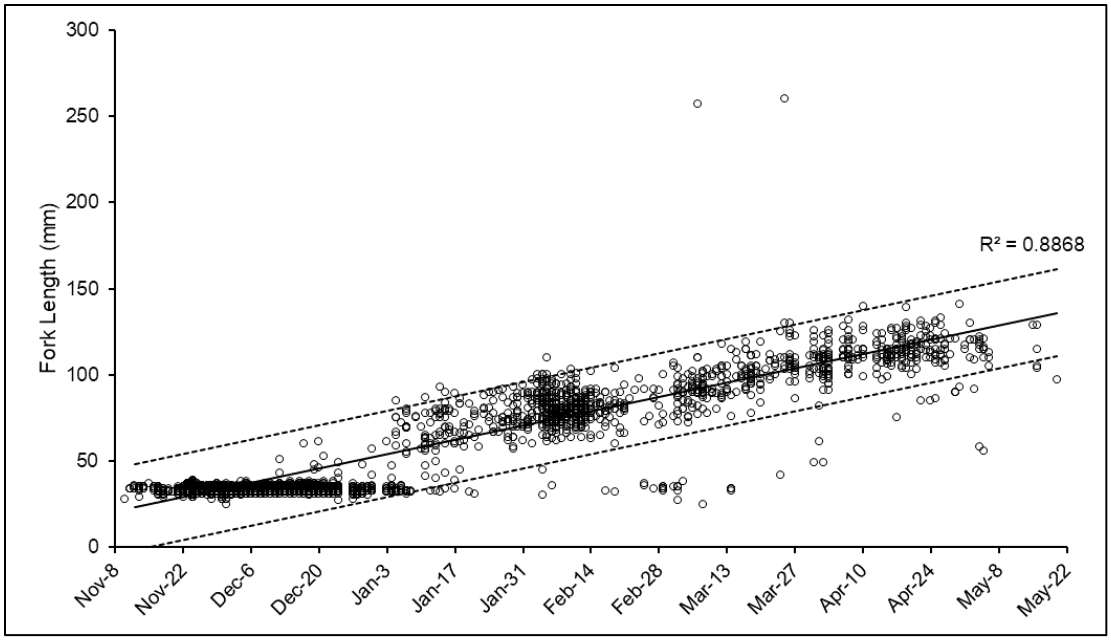

Figure 6. Linear regression (solid line) that shows the relationship between fork length (mm) and date of capture for juvenile salmon caught in the RSTs. The 99% confidence intervals are indicated by the dashed lines. R^2 is a measure of how well the linear regression model fits the observed values (dots), where a higher R^2 indicates a better fit. The linear regression was standardized to account for high numbers of fry/parr captured earlier in the sampling season (Nov- Dec). Figure produced by: Zak Sutphin, Reclamation.

Start of 2020-2021 Rotary Screw Trap Monitoring

In an attempt to capture the entirety of the juvenile spring-run Chinook salmon migration timing, additional RST monitoring will begin in late-September or early October of 2020 to specifically target the yearlings outmigrating in fall 2020. Results will be presented in the 2022 Tech Memo.

2019-2020 Telemetry Monitoring Results

A subset of juveniles were implanted with Juvenile Salmon Acoustic Telemetry (JSAT) acoustic tags as part of a movement study by UC Davis. The goal of the study was to pair habitat data with telemetry data to evaluate the link between broad scale habitat variability and survival of juvenile spring-run Chinook salmon in the San Joaquin River. All of the downstream monitoring efforts and south Delta fish salvage at the Tracy Fish Collection Facility (TFCF) and Skinner Delta Fish Protective Facility (SDFPF; collectively the CVP/ SWP Facilities) were informed of the presence of these fish and their CWT identifiers.

Starting on March 6, 2020, 800 juvenile spring-run Chinook salmon were tagged with acoustic transmitters. Of the 800 tagged fish, 350 tagged smolts were released near the Highway 140 Bridge at the downstream end of Reach 5 in the Restoration Area on March 16, 2020. A second group of 450 fish were released at: (1) Durham Ferry (350 fish) in the San Joaquin River below the confluence with the Stanislaus River, and (2) Franks Tract (100 fish) in the Delta on March 24, 2020. The 100 fish released in Franks Tract was part of a sub-study investigating movement

within and survival out of Franks Tract, a 3,000 acre flooded island located in the interior Delta. Telemetry data are currently being processed and survival estimates are pending. Based on preliminary data, four individuals out of 800 total survived to Benicia Bridge in the San Francisco Bay. Of the four fish detected at Benicia Bridge, two were from the group of fish released in Reach 5 of the Restoration Area, and two were from the Franks Tract release group.

Adult Broodstock Releases in 2020

A total of 285 adult spring-run Chinook salmon broodstock cultivated at the SCARF were released by CDFW into Reach 1 of the San Joaquin River. Table 4 summarizes the adult broodstock releases. All fish received external color-coded Floy tags with individual identification numbers, and all female and a subset of male fish were fitted with acoustic tags to track fine-scale movement. Genetic tissue samples of all broodstock adults were taken at the SCARF for use in the parentage database.

Table 4. Summary of adult NEP CV spring-run Chinook salmon released by the SCARF in 2020.

Release Date	Release Location	Number of Females	Number of Males	Total Released per Date
June 2020	Reach 1a	55	57	112
August 2020	Reach 1a	56	62	118
September 2020	Reach 1a	25	30	55
Total Released		136	149	285

Adult NEP CV Spring-run Chinook Salmon Returns in 2020

Table 5 summarizes all the adult spring-run Chinook salmon that were captured in Reach 5 from April 16, 2020 to May 23, 2020. In total, 57 fish were caught, and of those, 47 were released into Reach 1. Of the 47 fish released into Reach 1, 43 fish were acoustically tagged, and four were not acoustically tagged due to poor fish condition or high water temperatures. Figure 7 shows the monitoring and release locations for adult NEP CV spring-run Chinook salmon. A full report of the effort will be available on the SJRRP website.

Redd and carcass surveys began on August 31, 2020. Preliminary data for redd/ carcass surveys show that as of November 24, 2020, a total of 74 redds have been observed, and 48 carcasses (10 translocated from Reach 5 and 38 broodstock) have been observed.

Table 5. Adult Chinook salmon that were trapped and hauled from Reach 5 into Reach 1. Data were provided by Reclamation, USFWS, and CDFW. Each row represents an individual fish caught. ESBP stands for Eastside Bypass.

Date of Capture	Season Total	Capture Location	Total Length (mm)	Condition	CWT	General Comments
4/16/2020	1	ESBP	840	Good	N	
4/16/2020	2	ESBP	810	Poor	Y	

Date of Capture	Season Total	Capture Location	Total Length (mm)	Condition	CWT	General Comments
4/17/2020	3	ESBP	770	Good	Y	
4/18/2020	4	ESBP	826	Good	Y	
4/19/2020	5	ESBP	880	Mortality	Y	Released as yearling in March 2017 at Harmon Rd.
4/20/2020	6	ESBP	792	Good	Y	
4/20/2020	7	ESBP	758	Good	Y	
4/21/2020	8	Van Clief	688	Fair	Y	
4/21/2020	9	ESBP	782	Good	N	
4/22/2020	10	ESBP	745	Fair	Y	
4/23/2020	11	ESBP	810	Good	Y	
4/24/2020	12	Van Clief	850	Mortality	Y	Released as young-of-year in March 2017 at HWY 140.
4/25/2020	13	Van Clief	750	Good	Y	
4/26/2020	14	ESBP	640	Good	Y	
4/27/2020	15	ESBP	775	Good	Y	
4/27/2020	16	Van Clief	675	Good	Y	
4/29/2020	17	ESBP	810	Good	Y	
4/29/2020	18	ESBP	765	Good	Y	
4/30/2020	19	ESBP	790	Good	Y	
5/1/2020	20	ESBP	775	Fair	Y	
5/2/2020	21	ESBP	765	Good	Y	
5/2/2020	22	ESBP	853	Good	Y	
5/2/2020	23	ESBP	625	Fair	Y	Previously PIT tagged fish. Released as yearling in March 2019 at Hwy 140.
5/2/2020	24	ESBP	970	Good	N	
5/3/2020	25	ESBP	825	Good	N	
5/3/2020	26	ESBP	790	Good	Y	
5/4/2020	27	ESBP	745	Good	Y	
5/4/2020	28	ESBP	760	Good	Y	
5/4/2020	29	ESBP	853	Good	Y	
5/4/2020	30	ESBP	835	Good	Y	

Date of Capture	Season Total	Capture Location	Total Length (mm)	Condition	CWT	General Comments
5/5/2020	31	Van Clief	742	Good	Y	
5/5/2020	32	ESBP	712	Good	Y	
5/6/2020	33	ESBP Upstream	852	Good	Y	
5/6/2020	34	ESBP Upstream	648	Mortality	N	No CWT recovered
5/6/2020	35	Van Clief	731	Mortality	Y	Released as young-of-year in Reach 1 for RST efficiency testing in spring 2017
5/6/2020	36	Van Clief	762	Mortality	Y	Released as young-of-year in March 2017 at HWY 140.
5/7/2020	37	ESBP Downstream	805	Good	Y	
5/7/2020	38	ESBP Downstream	756	Mortality	Y	Released as young-of-year in March 2017 at HWY 140.
5/8/2020	39	ESBP Upstream	794	Good	Y	
5/8/2020	40	ESBP Downstream	909	Poor	Y	
5/9/2020	41	ESBP Upstream	809	Good	Y	
5/12/2020	42	ESBP Upstream	732	Good	N	
5/12/2020	43	ESBP Upstream	803	Mortality	Y	Released as young-of-year in March 2017
5/13/2020	44	Van Clief	730	Mortality	N	
5/14/2020	45	ESBP Upstream	502	Good	Y	
5/16/2020	46	Van Clief	779	Good	N	
5/16/2020	47	ESBP Upstream	752	Good	N	
5/16/2020	48	ESBP Downstream	708	Good	Y	
5/17/2020	49	Van Clief	507	Good	Y	
5/17/2020	50	Van Clief	830	Good	Y	
5/17/2020	51	ESBP Upstream	760	Mortality	Y	Released as young-of-year in March 2017 at HWY 140.
5/17/2020	52	Van Clief	592	Good	N	
5/18/2020	53	ESBP Upstream	625	Good	Y	Released as yearling in March 2019 at HWY 140.
5/19/2020	54	ESBP Upstream	759	Good	Y	

Date of Capture	Season Total	Capture Location	Total Length (mm)	Condition	CWT	General Comments
5/21/2020	55	ESBP Downstream	813	Mortality	Y	
5/22/2020	56	ESBP Upstream	822	Good	Y	
5/23/2020	57	ESBP Upstream	796	Good	Y	
Total Captures	**57**					
Total Live Released to Reach 1	**47**					

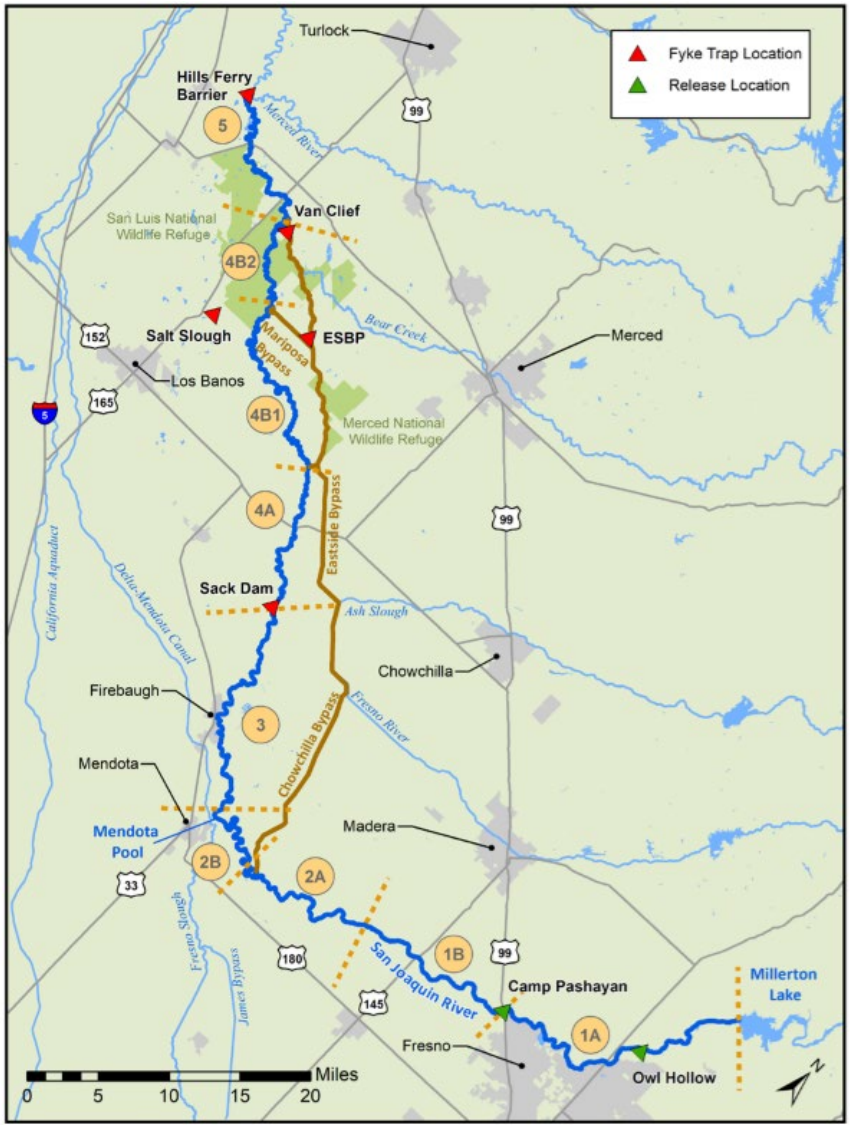

Figure 7. Map of the SJRRP Restoration Area showing adult NEP CV spring-run Chinook salmon monitoring locations in Reaches 4 and 5 (fyke trap locations indicated by red triangles), and release locations in Reach 1 (green triangles). Figure produced by Reclamation.