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, 2022

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

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

FROM: Monica Gutierrez, Acting San Joaquin River Branch Chief, CCVO, West Coast Region

SUBJECT: 2022 (January 2022 – December 2022) 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. 2022. Technical Memorandum to Account for Reintroduced San Joaquin River Spring-Run Chinook Salmon per CFR 233.301(b)(5)(ii): 7.

Background

NOAA's 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 2022 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 CV 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 CV spring-run Chinook salmon release and monitoring plans for 2022.

In May 2013, a technical working 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 refers to 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 CV 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 CV 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. As the SJRRP continues 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 2021

No changes in water export quantities were experienced during the 2021 calendar year as a result of the juvenile NEP CV spring-run Chinook salmon produced by the SJRRP. In support of this

statement, Appendix A 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 Appendix A 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 2022

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. Given litigation on the ROD, recent reinitation of consultation for the Long-term Operations of the CVP and SWP, and the development of a proposed Interim Operations Plan for the reinitiation period, NMFS will re-evaluate whether issuance of a new Tech Memo is warranted under any new fish trigger methods.

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 SWP 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 (*O. tshawytscha*), 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 (i.e., Central Valley winter-run Chinook salmon).

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

1) be detected at the CVP or SWP Sacramento-San Joaquin Delta Fish Collection Facilities (CVP/SWP Facilities);

2) be in the same size range of juvenile winter-run Chinook salmon at the time of capture; and

3) contribute to exceeding 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 the California

[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

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 2022 calendar year will be reported to NMFS by the end of 2022. Additionally, genetic results will be reported to the Salmon Monitoring Team[4] throughout the 2022 calendar year to provide an accurate identification of Chinook salmon runs.

In 2022, 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 SJRRP'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 required DWR to develop a CV spring-run Chinook salmon Juvenile Production Estimate (JPE) Monitoring Plan. Development and implementation of a CV spring-run Chinook salmon JPE for the Sacramento River would help inform decision making. During calendar year 2022, the SJRRP will maintain communication with the CV spring-run Chinook salmon JPE technical team. Relevant information from DWR's JPE Monitoring Plan may be included in future Tech Memos.

Accounting Methodology

Physical Marking

All juvenile CV spring-run Chinook salmon released from the Salmon Conservation and Research Facility (SCARF) into the San Joaquin River as part of the SJRRP's reintroduction will be marked with an adipose fin-clip (ad-clipped) and coded wire tag (CWT). The CWT contains a code unique to the SJRRP's release groups so that these fish 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 ESA 4(d) protective regulations for West Coast

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

threatened salmonids (70 FR 37160, June 28, 2005; and 78 FR 79622, December 31, 2013). As a result, NEP CV spring-run Chinook salmon released for reintroduction by the SJRRP will not be counted toward any incidental take limits or cumulative, annual, or daily loss thresholds from any 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 2022 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 2022/2023. However, there may be several days during the juvenile monitoring season where sample collection for every fish may not be logistically feasible due to varying reasons. In situations where it is not feasible to sample every captured fish, then tissue samples will be taken from a subset of naturally-produced juveniles captured each day of RST monitoring. All tissue samples will be part of the parental inference analysis.

CVP/SWP Facilities

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 2022 to ensure that NEP CV 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.

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 2022 relative to juvenile CV spring-run Chinook salmon released from the SCARF 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. Under the 2019 Opinion, 2020 ITP, and any court-ordered operations, all unmarked Chinook salmon captured at the CVP/SWP Facilities would be genetically sampled in 2022, but the timelines and frequency for processing those genetic samples is uncertain at this time.

As mentioned above, the 2019 Biological Opinion and 2020 ROD are in active litigation, the biological opinion for the Long-term Operations of the CVP and SWP in reinitation of

consultation, and a proposed Interim Operations Plan has been developed for the reinitiation period. In addition, 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 and will re-evaluate whether issuance of a new Tech Memo is warranted under any new fish trigger methods.

Pilot Assessment

In addition to the methods described above, NMFS, in coordination with the SJRRP, developed an assessment to estimate the number of naturally-produced young-of-year (YOY) spring-run Chinook salmon that could be observed at the CVP/SWP Facilities. The two primary elements of this assessment are: (1) an analysis on migration timing to the CVP/ SWP Facilities, based on SCARF production releases in Reach 5 from 2016-2021; and (2) a conceptual method to calculate the estimated number of naturally-produced YOY CV spring-run Chinook salmon that may be observed at the CVP/SWP Facilities for the current calendar year. The methods for both elements of this assessment will be updated and refined over the years as the SJRRP gathers and synthesizes more fish monitoring data.

Appendix B contains detailed information on the results of the migration timing analysis. Based on the results of the analysis, it is estimated that the majority of naturally-produced YOY fish may be observed at the CVP/SWP Facilities from mid-March through mid- to late April 2022.

Appendix C contains detailed information on the conceptual methods and calculations for estimating the number of YOY fish that may exit the Restoration Area and be observed at the CVP/SWP Facilities in 2022. An accurate accounting of SJRRP fish is necessary to provide a complete characterization of SJRRP data progress and needs. While not complete, this conceptual JPE begins the development of that necessary piece of information. NMFS is open to suggestions from collaborating agencies and stakeholders in developing a scientifically robust metric in addition to or in place of this conceptual JPE.

Based on the results of this conceptual method, the estimated number of naturally-produced YOY fish that may be observed at the CVP/SWP Facilities is anticipated to be low in the spring of 2022.

It is important to note that annual circumstances significantly influence juvenile production. For example, annual variations in environmental factors, especially drier water year types, low flows, and high water temperatures, as occurred in 2021, can significantly reduce production because of poor habitat conditions. Additionally, the estimate of juvenile fish exiting the Restoration Area is generally anticipated to greatly increase once passage projects within the Restoration Area are completed. Furthermore, this conceptual method to estimate juvenile production is still under development and is expected to be updated as monitoring data becomes available. Thus, the estimated number of juveniles that may be observed at the CVP/SWP Facilities should be considered within the context of the numerous data gaps.

In summary, if naturally-produced, unmarked YOY spring-run Chinook salmon exit the Restoration Area, we expect them to be observed at the CVP/SWP Facilities primarily from March to April. Yet, the overall anticipated risk of naturally-produced, unmarked YOY spring-run Chinook salmon from the Restoration Area being observed at the CVP/SWP Facilities is estimated to be low for 2022.

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

2022 Planned Releases

Juvenile spring-run Chinook salmon from the SCARF are planned to be released into the San Joaquin River in spring 2022 as part of the SJRRP's reintroduction efforts. Some SCARF juveniles will be used in spring 2022 to help estimate the efficiency of the Mossdale trawls. All fish used in these experimental efficiency tests would be ad-clipped and marked with a CWT unique to the study, and thus clearly identifiable as SJRRP and study fish. Results from this efficiency test study will be reported in the 2023 Tech Memo.

In the summer of 2022, 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 may 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 2022. 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 may 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 2022, and any resulting juveniles would out-migrate as early as January 2023. Naturally-produced juveniles would not be physically marked.

Monitoring Plans and Additional Studies for 2022

Adults

Depending on funding, adult spring-run Chinook salmon that return in spring 2022 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 carcass and redd surveys in the fall/winter of 2022/2023 to estimate escapement of adult fish in Reach 1 and 2 and to estimate the number of redds, respectively. Results from these surveys will be presented in the 2023 Tech Memo.

Juveniles

Naturally-produced juvenile spring-run Chinook salmon will be monitored through Reach 1 to Reach 2 with RSTs to determine migration timing, life-stage diversity, survival, and size. The 2021-2022 RST monitoring season began in early November 2021 and 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 at least seven days. Full results of the 2021-2022 RST season will be reported in the 2023 Tech Memo.

For the 2022-2023 RST monitoring season, RST monitoring may begin in late-September or early October of 2022 to specifically target the yearlings out-migrating in fall 2022, but is dependent on funding and flows. RST monitoring will continue through June 2023, until water temperatures exceed the lethal temperature of 75°F, or until no salmonids are caught for a certain amount of time, which will be determined in coordination with the Fisheries Management Workgroup.

In addition to natural production, approximately 228,000 juvenile CV spring-run Chinook salmon from the SCARF will be released throughout the winter/spring of 2022/2023 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 Gravelly Ford[6]). 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

Flow and temperature 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.

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 2022 to discuss implementation of the 2022 Tech Memo and to develop the 2023 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 like to acknowledge the participants of the Tech Memo group for their review and feedback on this document. Additionally, NMFS would like to acknowledge and

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

[6] The Gravelly Ford RST location will replace the San Mateo RST location for the 2021-2022 sampling season.

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

thank Martin Gonzalez, an intern under the Hollings Preparatory Program, for all his work on compiling and analyzing the data and graphs used to help answer Question 4 within Appendix B.

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Appendix A: Accounting for Nonessential Experimental Population (NEP) of Central Valley (CV) spring-run Chinook salmon during 2021

Juvenile Releases and Recapture at Monitoring Sites and Central Valley Project and State Water Project Sacramento-San Joaquin Delta Fish Collection Facilities (CVP/SWP Facilities)

All juvenile CV 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 A1 provides a summary of the juvenile NEP CV 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 A2 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 winter-run Chinook salmon length-at-date range, while young-of-year (YOY) juveniles mostly fell into the CV spring-run Chinook salmon length-at-date range (Figure A1). Some YOY juveniles fell into the winter-run Chinook salmon length-at-date range (refer to Figure A1). However, since all yearlings and juveniles were fin-clipped and CWT'ed, these individuals were identified as NEP CV spring-run Chinook salmon released by the SJRRP and were not misidentified as juvenile Chinook salmon from other sources.

Table A1. Summary of juvenile NEP spring-run Chinook salmon releases made by the SJRRP in 2020-2021, and recaptures from each release group (YOY = Young-of-year). (CWT = Coded wire tag; SCARF = Salmon Conservation and Research Facility; CVP/SWP Facilities= Central Valley Project and State Water Project Sacramento-San Joaquin Delta Fish Collection Facilities; SJR = San Joaquin River)

Release Date	Lifestage	Release Location	No. Released / CWT # (from SCARF)	Mossdale Trawl	Beach Seines	Chipps Island Trawl	# Observed at CVP/ SWP Facilities	Notes
12/3/2020	Yearling	SJR at Hwy 140 (Reach 5)	4,593/ 06-05-22	0	0	0	6	Production release
12/3/2020	Yearling	SJR at Hwy 140 (Reach 5)	501/ 06-19-66	0	0	0	0	Production release
12/7/2020	Yearling	Scout Island (Reach 1)	200/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged

Release Date	Lifestage	Release Location	No. Released / CWT # (from SCARF)	Mossdale Trawl	Beach Seines	Chipps Island Trawl	# Observed at CVP/ SWP Facilities	Notes
12/8/2020	Yearling	Owl Hollow (Reach 1)	202/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
12/21/2020	Yearling	Scout Island (Reach 1)	175/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
12/22/2020	Yearling	Owl Hollow (Reach 1)	203/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
1/6/2021	Yearling	Scout Island (Reach 1)	201/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
1/7/2021	Yearling	Owl Hollow (Reach 1)	209/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
1/8/2021	Yearling	Scout Island (Reach 1)	168/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
1/9/2021	Yearling	Hwy 99 (Reach 1)	166/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
1/10/2021	Yearling	Owl Hollow (Reach 1)	338/ 06-05-22 or 06-19-66	0	0	0	0	RST efficiency test release fish; PIT tagged
1/26/2021	YOY	SJR at Hwy 140 (Reach 5)	53,690/ 06-22-05	0	0	0	68	Production release
3/2/2021	YOY	SJR at Hwy 140 (Reach 5)	118,041/ 06-18-10	0	0	0	89	Production release
3/22/2021	YOY	SJR at Hwy 140 (Reach 5)	1,650/ 06-23-46	0	0	0	4 (total for CWT #)	Released alongside UCD tagging study fish
4/6/2021	YOY	SJR at Hwy 140 (Reach 5)	1,650/ 06-23-46	0	0	0	See cell above	Released alongside UCD tagging study fish
Dec 2020-May 2021	YOY	Reach 1	26,000/ 05-14-68	0	0	0	0	RST efficiency test release fish
Total	Yearlings		6,956	0	0	0	6	
Total	Juveniles		201,031	0	0	0	161	

Table A2. Summary of juvenile NEP CV spring-run Chinook salmon that were observed at the CVP/SWP Facilities (Central Valley Project and State Water Project Sacramento-San Joaquin Delta Fish Collection Facilities) in 2020/2021. (CWT = coded wire tag; YOY = young of year; SJR = San Joaquin River)

Dates Observed	Facility	Release Life stage	Release date	Release location	CWT #	Total Observed
2/5 to 4/28/2021	CVP/ SWP	YOY	1/26/2021	SJR at Hwy 140	62205	68
2/9 to 4/14/2021	SWP	Yearling	12/3/2020 to 1/1/2021	SJR at Hwy 140 (Reach 5) or Reach 1	60522	6
3/17 to 4/26/2021	CVP/ SWP	YOY	3/2/2021	SJR at Hwy 140	61810	89
4/19 to 4/25/2021	CVP	YOY	3/22 & 4/6	SJR at Hwy 140	62346	4

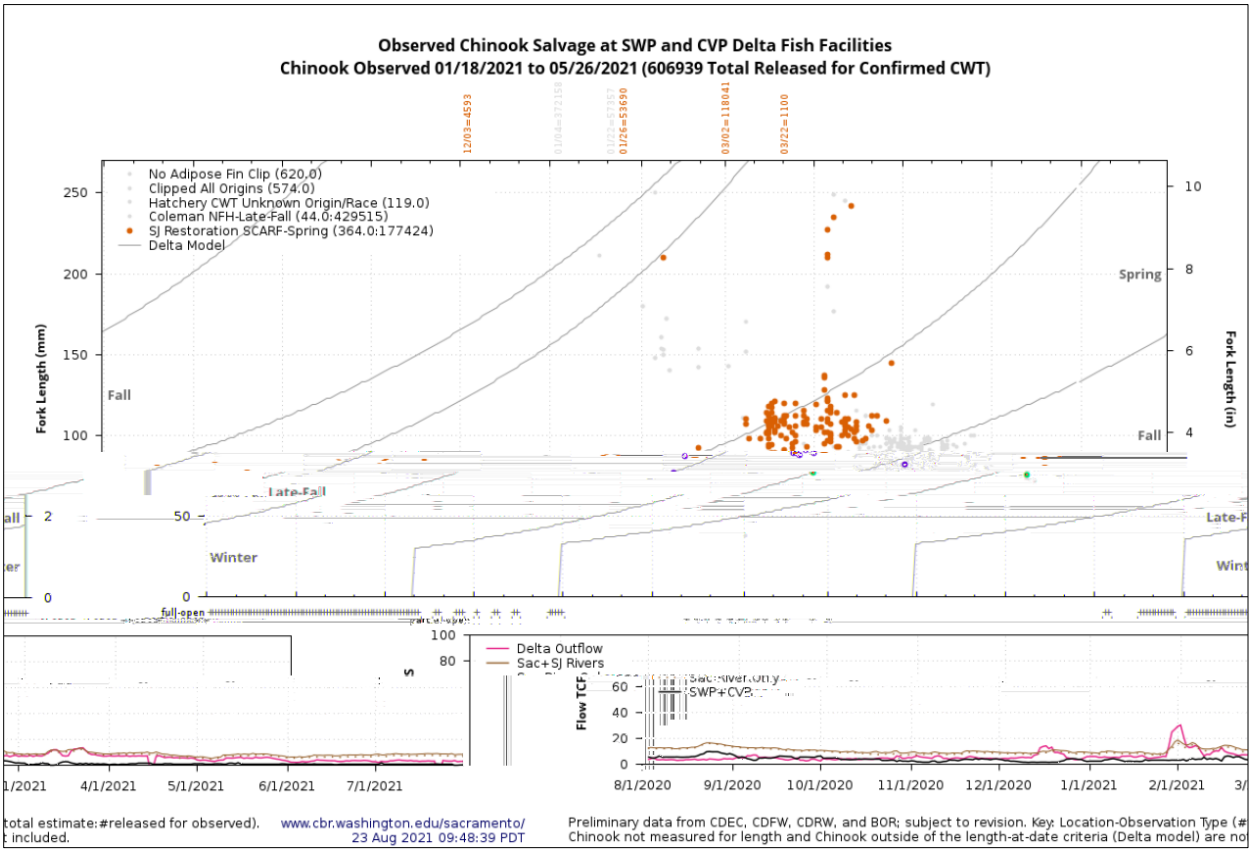

Figure A1. Observed Chinook salmon at SWP (Skinner Delta Fish Protective Facility) and CVP (Tracy Fish Collection Facility) Facilities from 8/1/2020 to 7/31/2021.

2020-2021 Rotary Screw Trap Monitoring Results

The SJRRP conducted rotary screw trap (RST) monitoring of juvenile Chinook salmon in the Restoration Area from October 3, 2020, through May 28, 2021.

RSTs were located at four locations in Reaches 1 and 2 (refer to Figure A2 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).

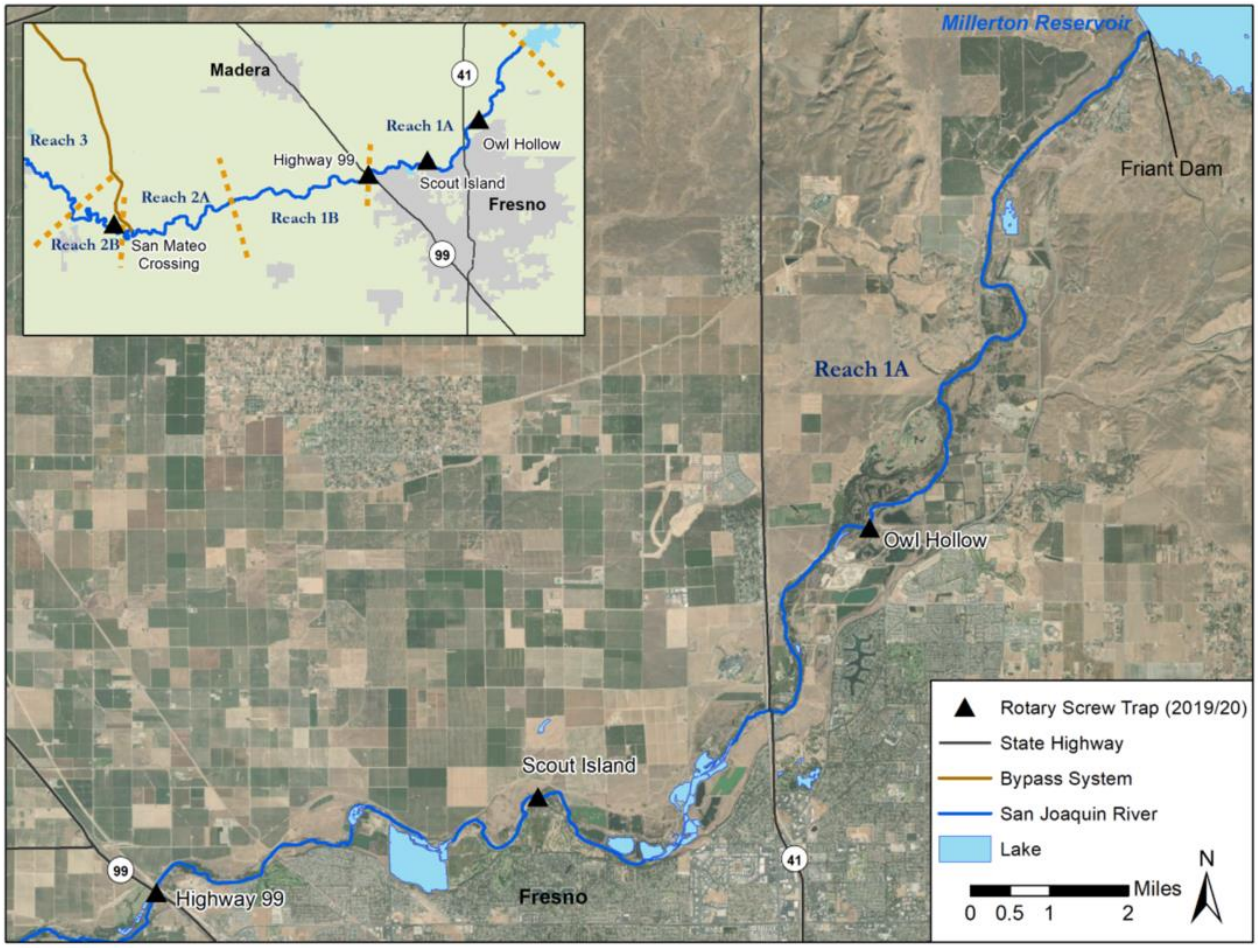

Figure A2. Map showing the RST monitoring locations (indicated by black triangles) within Reaches 1 and 2 of the SJRRP Restoration Area. Figure produced by Reclamation.

Sampling started at three traps (Scout Island, Hwy 99, and San Mateo) on October 3, 2020, in an attempt to capture any naturally-produced yearlings that might have been in the area (none were captured). Sampling started on November 1, 2020, at the Owl Hollow location. The sampling season concluded on April 30, 2021, at the San Mateo trap when water temperatures reached 24°C (75°F). Sampling concluded at the remaining three traps on May 28 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 only for fish >45mm in fork-length), and a tissue sample was collected for genetic analyses. After processing, fish were released downstream of the RST.

During times of high captures within an individual RST, 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 RST were counted but not further processed. This protocol only occurred once during the 2020-2021 monitoring season, on December 22 at the Owl Hollow RST.

Table A3 summarizes the RST catches by location and lifestage. Figure A3 and Figure A4 display the total catches and fork lengths of unmarked juvenile Chinook salmon caught in the RSTs. The smaller-sized group of fish (refer to Figure A4 and Figure A5) 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.

Table A3. Summary of RST catches from October 3, 2020, through May 28, 2021 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	1,059	22	1	0	1,082
Parr	11	0	0	0	11
Smolts	114	66	185	2	367
Yearlings	0	0	0	0	0
Total fish per RST location	1,184	88	186	2	1,460

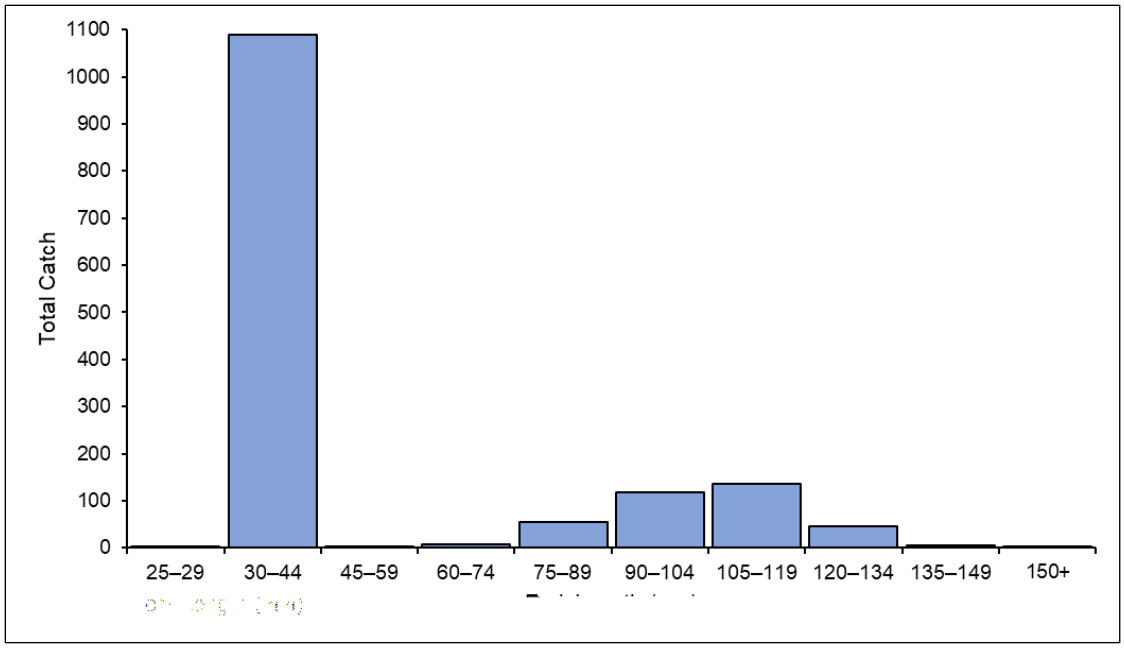

Figure A3. Total catch and fork lengths of unmarked juvenile salmon captured at RSTs in the San Joaquin River Restoration Area during the 2020/2021 sampling season. Figure produced by: Zak Sutphin, Reclamation.

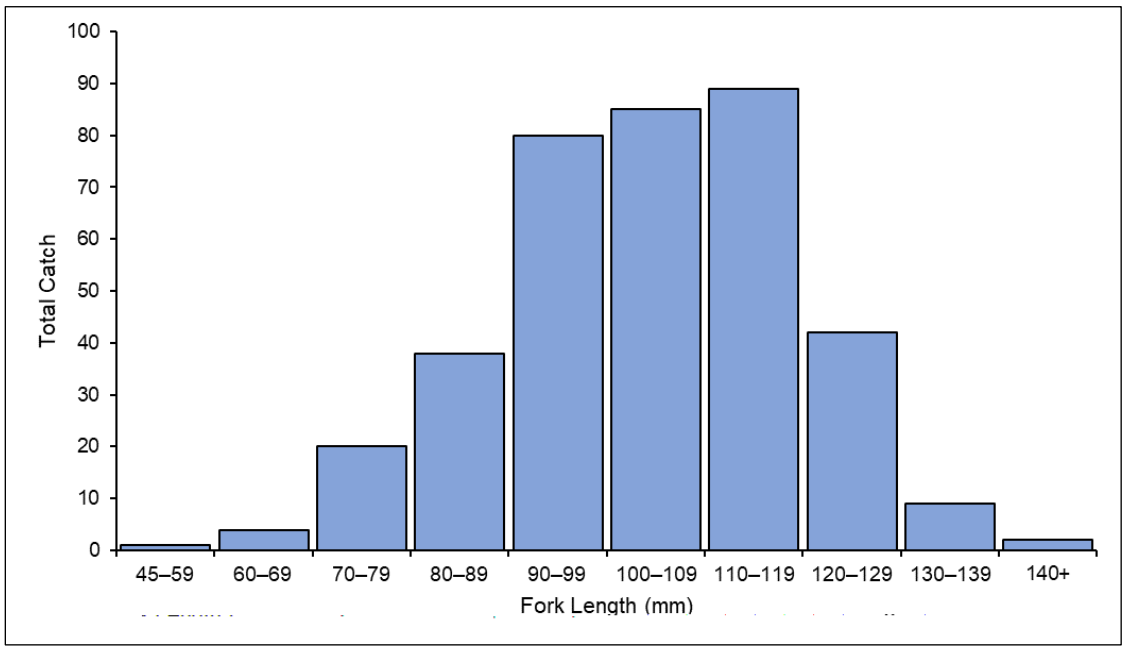

Figure A4. Subset of data displayed in Figure A3 that shows the total catch of unmarked juvenile salmon with fork lengths greater than 48 mm that were captured in the RSTs. Figure produced by: Zak Sutphin, Reclamation.

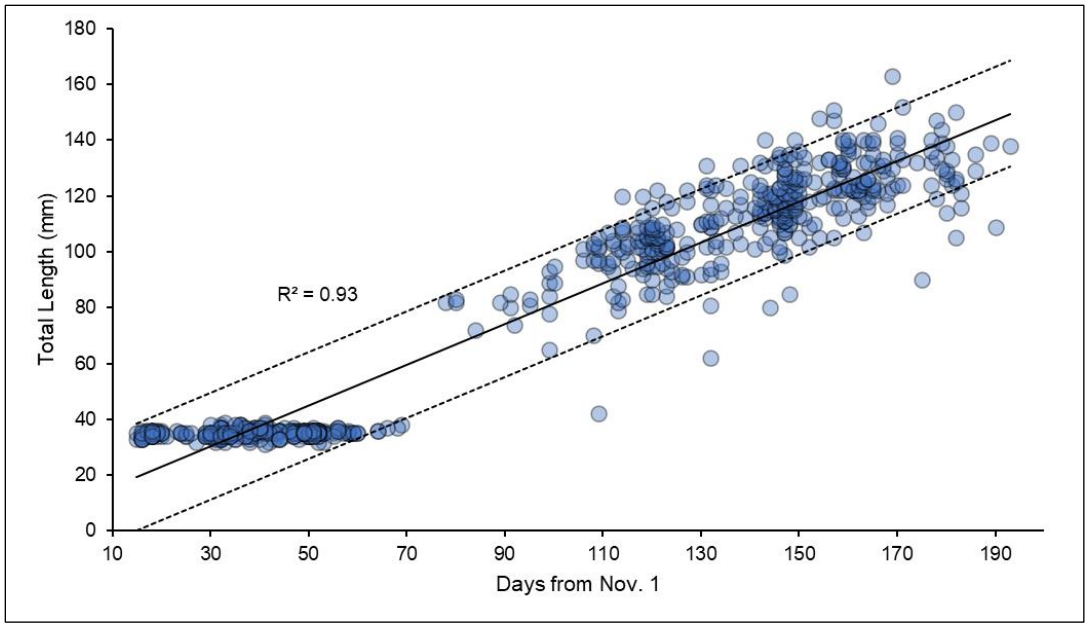

Figure A5. Linear regression (solid line) that shows the relationship between fork length (mm) and date of capture for juvenile salmon caught in the RSTs. The 99% confidence intervals are indicated by the dashed lines. R^2 is a measure of how well the linear regression model fits the observed values (blue 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.

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 in the RSTs 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 2020/2021 RST sampling season, which provided for efficiency testing for fish less than 55 mm fork length. Three groups of fry were CWT'ed and released at the Owl Hollow and Scout Island RST locations in December and January before typical ink/fin marking commenced. Furthermore, several groups of PIT-tagged yearling salmon (in addition to an ad-clip and CWT) were also released during January 2021 to account for trap efficiency in the event of the capture of 2019–2020 naturally-produced yearling salmon (refer to Table A1); however, capture of naturally-produced yearling salmon was not observed during 2020–2021 RST operations.

Efficiency tests were completed at four RSTs: Owl Hollow (n = 12, where n is the number of release groups), Scout Island (n = 11), Hwy 99 (n = 10), and San Mateo Crossing (n = 6),

resulting in the release of 26,000 externally marked YOY juvenile spring-run Chinook salmon into Reach 1 of the Restoration Area. Trap efficiency varied as a function of location with mean values (± 95 percent confidence interval) of: 16.7% (± 7.7%) at Owl Hollow; 10.5% (±5.8%) at Scout Island; 22% (± 6.7%) at Highway 99; and 24.2% (± 28.8%) at San Mateo. Currently, RST capture and efficiency data are being reviewed and analyzed. These data should be considered preliminary, and any significant changes or updates to these data will be presented in the 2023 Tech Memo.

2020-2021 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 and Delta. Specifically, the study goals include: 1) understanding survival and routing dynamics of fish during a range of water year types; and 2) to conduct pilot work on survivorship and routing of naturally-produced smolts.

The 2021 study occurred from December 2020 through August 2021. A total of 565 SCARF fish were tagged as part of the study, and 37 of those fish were held at the SCARF to conduct battery testing and monitor tag shedding. An additional 44 naturally-produced YOY fish caught in the RSTs were also tagged. All tagged SCARF fish were released at Fremont Ford, where the production releases typically occur. All tagged naturally-produced fish were released at Highway 99 Bridge in Reach 1. 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. Preliminary results indicate that 1 SCARF fish, and 0 naturally-produced fish were detected at Benicia Bridge. Additionally, 1 SCARF fish was detected at the SWP Facility. If available, final study results may be presented in the 2023 Tech Memo.

Adult Broodstock Releases in 2021

A total of 150 adult CV spring-run Chinook salmon broodstock raised at the SCARF were released by the California Department of Fish and Wildlife (CDFW) into Reach 1 of the San Joaquin River. Table A4 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 A4. Summary of adult NEP CV spring-run Chinook salmon released by the SCARF in 2021.

Release Date	Release Location	Number of Females	Number of Males	Total Released per Date
June 2021	Reach 1a	30	40	70
August 2021	Reach 1a	20	60	80
October 2021	Reach 1a	0	50	50
Total Released		50	150	200

Adult NEP CV Spring-run Chinook Salmon Returns in 2021

Trap and haul of adult CV spring-run Chinook salmon in Reach 5 were conducted from the week of April 11, 2021 to June 5, 2021. In total, 93 fish were caught, and of those, 74 were released into Reach 1, and 19 were mortalities or recovered carcasses. The carcasses of nine pre-spawn fish that were translocated into Reach 1 were recovered, leaving 65 translocated fish still alive within Reach 1. A full report of the effort will be available on the SJRRP website.

Redd and carcass surveys began on August 30, 2021. Preliminary data for redd/carcass surveys show that as of November 22, 2021, a total of 32 redds have been observed, and 40 carcasses (16 translocated from Reach 5 and 24 broodstock) have been observed.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
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Sacramento, California 95814-4700

Appendix B: Outmigration timing of juvenile nonessential experimental population (NEP) Central Valley (CV) spring-run Chinook salmon from the Restoration Area to the Central Valley Project and State Water Project Sacramento-San Joaquin Delta Fish Collection Facilities (CVP/SWP Facilities)

As part of the assessment to estimate the number of naturally-produced young-of-year (YOY) spring-run Chinook salmon that could be observed at the CVP/SWP Facilities, NMFS, in coordination with the San Joaquin River Restoration Program (SJRRP), evaluated outmigration timing data from six years (2016-2021) of Salmon Conservation and Research Facility (SCARF) YOY production releases in Reach 5. The primary assumption/hypothesis for this analysis is that SCARF juveniles have outmigration behaviors and timing that are similar to naturally-produced juveniles. All the fish data used in this analysis were gathered from publicly available data on SacPAS[1]. Only observed salvage data were used, and not calculated loss.

The purpose of this timing analysis is to produce an estimate of when naturally-produced YOY juveniles might be observed at the CVP/SWP Facilities. This timeframe estimate could then be used to help determine when naturally-produced YOY juveniles may potentially be observed at the CVP/SWP Facilities, during the current operational thresholds and triggers in Reclamation's proposed action and NMFS 2019 Biological Opinion (or subsequent operational requirements), and California Department of Fish and Wildlife's (CDFW) 2020 Incidental Take Permit (ITP; or any subsequent ITPs).

Four questions were outlined to help guide the timing analysis:

1) What is the timeframe that naturally-produced, YOY spring-run Chinook salmon originating from the SJRRP Restoration Area might be observed at the CVP/SWP Facilities?
2) Does the release date of the SCARF production fish affect migration timing to the CVP/SWP Facilities? For example, would release date affect the assumption that SCARF fish have similar outmigration timing as natural-produced juveniles?
3) Does RST data collected in Reaches 1 and 2 of the Restoration Area support the assumption that SCARF fish have similar outmigration timing as naturally-produced fish? For example, based on RST data, is it feasible for naturally-produced fish to be observed at the CVP/SWP Facilities at the same time as fish from the SCARF production releases?
4) Are there are any environmental variables that seem to influence outmigration timing of SCARF production releases and natural-produced juveniles between Reach 5 of the Restoration Area and the CVP/SWP Facilities?

[1] http://www.cbr.washington.edu/sacramento/

The results of the timing analysis are presented in the following graphs. These graphs and overall analysis may be updated and refined in subsequent Tech Memos as new data and/or monitoring occurs.

Question 1: What is the timeframe that naturally-produced, YOY spring-run Chinook salmon originating from the SJRRP Restoration Area might be observed at the CVP/SWP Facilities?

Figure B1 shows a clear pattern across the six evaluation years that the majority of SCARF fish are observed at the CVP/SWP Facilities from mid-March to mid- to late- April.

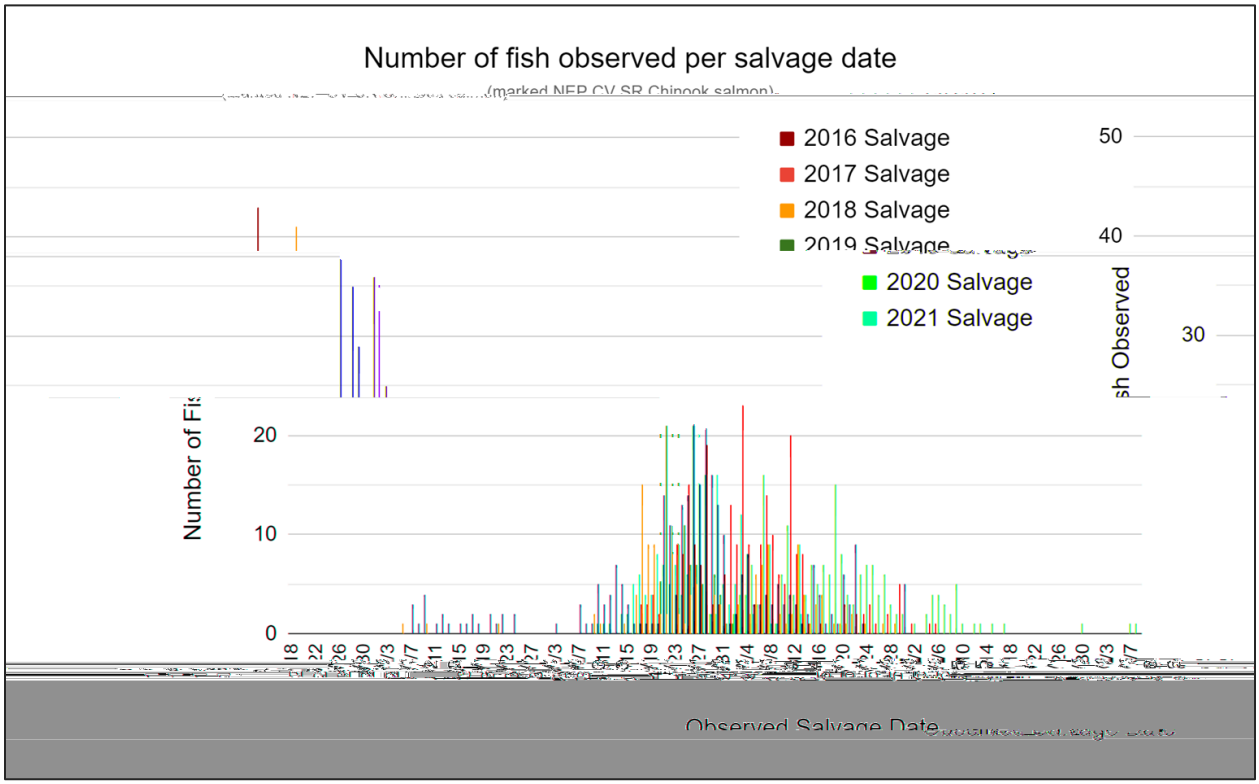


Figure B1. Graph showing the number of SCARF fish observed at the CVP/SWP Facilities by date across the evaluation years (2016-2021).

Question 2: Does the release date of the SCARF production fish affect migration timing to the CVP/SWP Facilities? For example, would release date affect the assumption that SCARF fish have similar outmigration timing as natural-produced juveniles?

Figure B2 shows that regardless of production release date, fish exhibit variability in outmigration timing. However, it seems that SCARF fish released later in the spring (i.e., in March or April, as seen in the second blue dotted line in 2018-2021) exhibit less variability in migration timing; whereas fish released earlier in the winter/spring (i.e., Jan or Feb, as seen in the first blue dotted line in 2018-2021), exhibit more variability in migration timing. Both Figures B1 and B2 suggest that release date of SCARF production fish affects the variability of

how long juvenile salmon rear in the San Joaquin River, but not the timeframe for when fish might be observed that CVP/SWP Facilities.

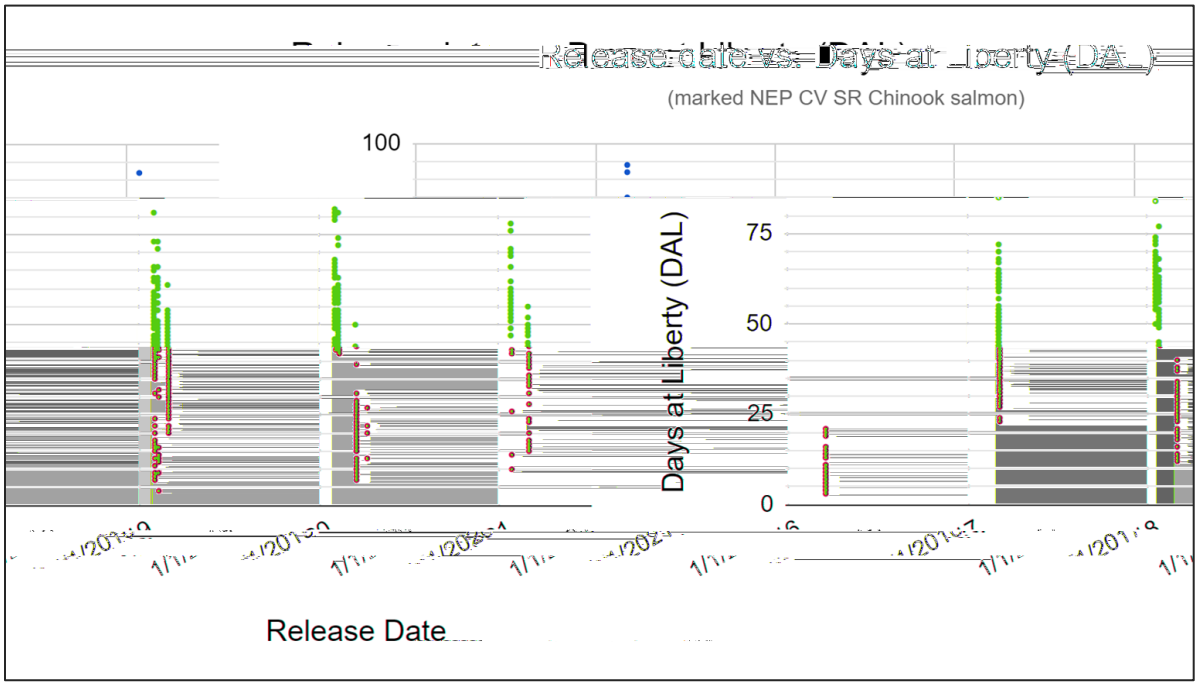


Figure B2. Graph showing the variability of outmigration timing (described as Days at Liberty, or DAL, which is the number of days between release in Reach 5 to observation at the CVP/SWP Facilities), in relationship with the release date of SCARF production fish for each year (2016-2021).

Question 3: Does RST data collected in Reaches 1 and 2 of the Restoration Area support the assumption that SCARF fish have similar outmigration timing as naturally-produced fish? For example, based on RST data, is it feasible for naturally-produced fish to be observed at the CVP/SWP Facilities at the same time as fish from the SCARF production releases?

Figure B3 shows that the majority of naturally-produced, YOY juveniles, specifically the fry lifestage, are captured during the months of November through December. These RST data suggest that it is feasible for some naturally-produced juveniles to migrate out of the Restoration Area and be observed at the CVP/SWP Facilities during the same timeframe as SCARF production fish. The assumption that SCARF production fish have outmigration behaviors and timing similar to naturally-produced fish could be supported by specific studies in the future, however Figure B3 suggests that this assumption is not unreasonable.

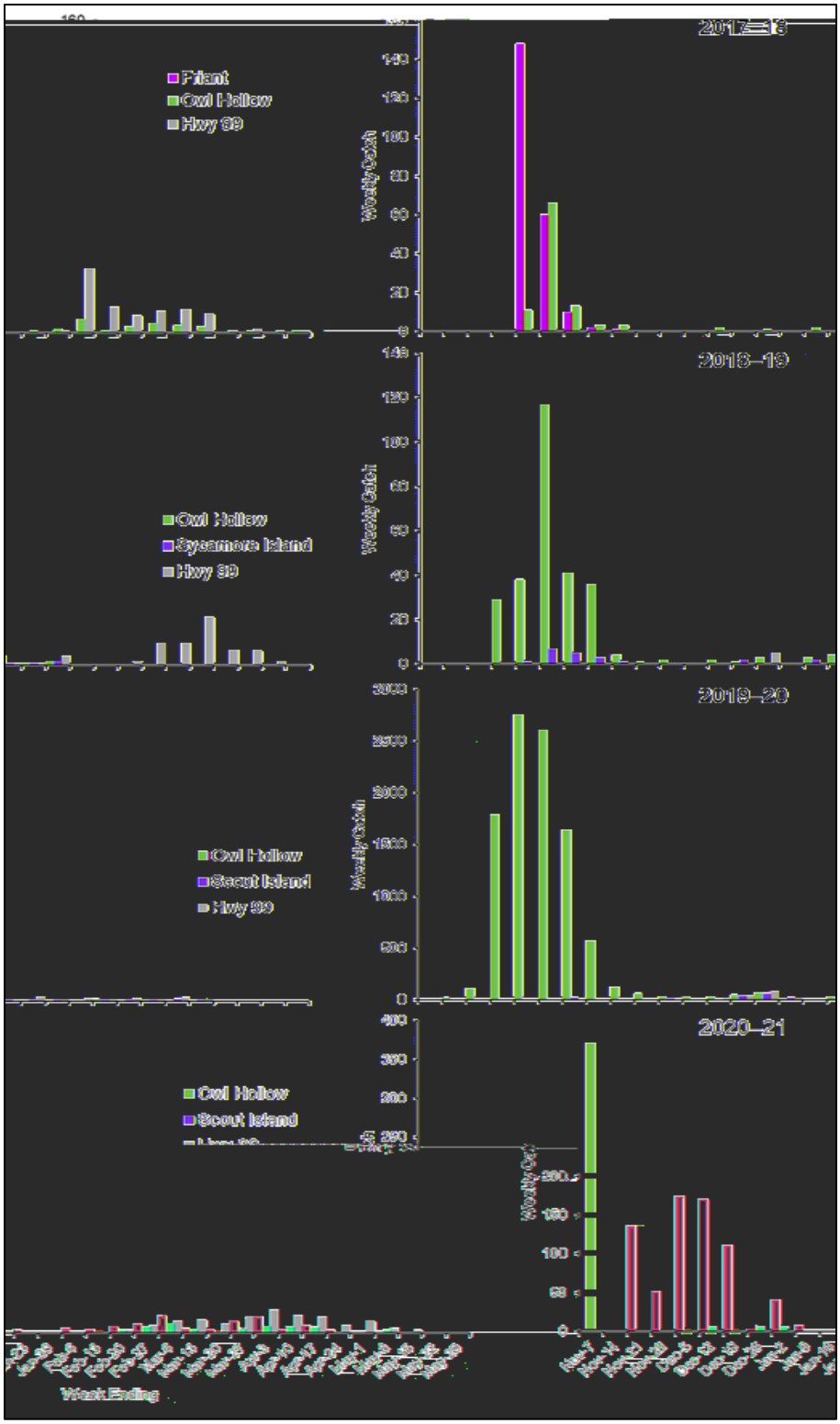


Figure B3. Graph showing the number of fish captured per date at the RSTs in Reach 1 for the monitoring years of 2017-2021. Graphs produced by Zak Sutphin of Reclamation.

Question 4: Are there are any environmental variables that seem to influence outmigration timing of SCARF production releases and natural-produced juveniles between Reach 5 of the Restoration Area and the CVP/SWP Facilities?

Question 4 is not as straight-forward as the previous questions, and could potentially involve confounding variables. While the timing analysis is being conducted, we can begin to form hypotheses regarding this question, and have a better understanding of what environmental variables might be influencing outmigration timing. In addition to fish data from SacPAS, environmental data were obtained from CDEC[2], and USGS[3].

The recent NMFS work shows the following relationships between fish observed in salvage and the following variables for 2016-2021:

1) San Joaquin River (SJR) flows (cfs) at:
    a. Fremont Ford gage (which is upstream of the confluence of the SJR and Merced River, and near where the SCARF production fish are released);
    b. Crow's Landing gage (downstream of the confluence of the SJR and Merced River);
    c. Maze Road Bridge gage (downstream of the confluence of the SJR and Tuolumne River);
    d. Vernalis gage (downstream of the confluence of the SJR and Stanislaus River); and
    e. Mossdale Bridge gage (just upstream of the split between the SJR and the head of Old River)
2) Inflows (cfs) at:
    a. Tracy pumping plant (CVP Export Facility); and
    b. Harvey O. Banks pumping plant (SWP Export Facility).
3) Daily maximum water temperature (degrees Celsius) at:
    a. Fremont Ford gage; and
    b. Vernalis gage

Flows at the different gages listed above were analyzed to determine if there was a relationship between fish observation at the CVP/SWP Facilities, and flows from the mainstem SJR, flows from any of the large tributaries to the SJR, or flows from the pumping intakes. Daily maximum water temperatures were analyzed because we hypothesized that fish may be biologically responding to the maximum water temperature experienced. However, other measures of water temperature could also influence timing and have yet to be explored. Water temperature was only analyzed at two locations because we assumed that temperatures would not differ significantly along the longitudinal gradient of the mainstem SJR. However, further analysis of water temperatures at different gages within the SJR is warranted to explore this assumption.

Graphs for the last six years (2016-2021) are presented in Figures B4, B5, and B6. NMFS did not complete statistical analyses on the relationships described above and therefore cannot make any definitive conclusions at this time. However, Figures B4-B6 can be used to formulate hypotheses

[2] California Data Exchange Center (CDEC): https://cdec.water.ca.gov/
[3] United State Geological Survey (USGS): https://waterdata.usgs.gov/nwis/rt

about what may be influencing outmigration timing between Reach 5 of the Restoration Area and the CVP/SWP Facilities.

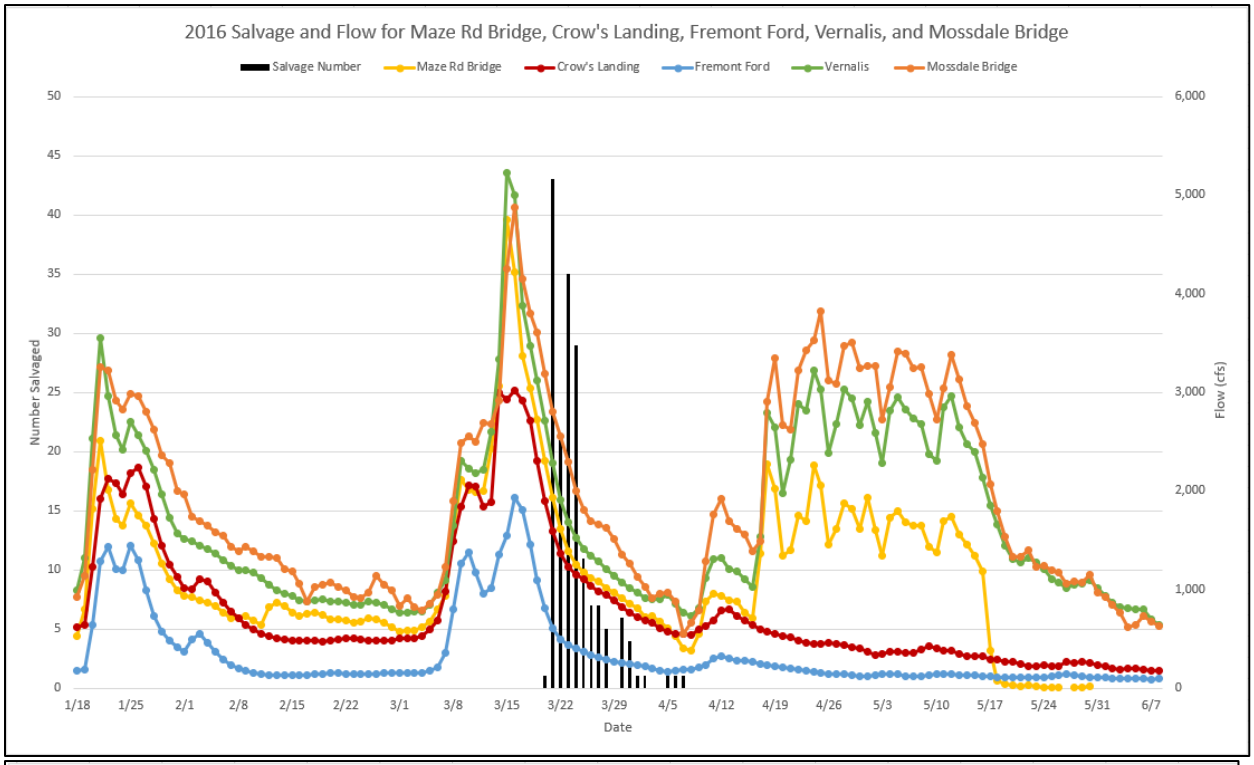
Based on all the graphs produced showing observed fish salvage and river flows, water temperature, and pumping flows, we hypothesize that the significance of environmental factors that were analyzed on outmigration timing differs between wetter and drier years. For example, we hypothesize that river flows and pumping rates could have less of an influence on migration timing in wetter years, and more of an influence in drier years. Water temperatures at different gages could also be further explored. It is possible that juvenile fish are rearing further upstream than Vernalis and thus may not be strongly influenced by water temperatures observed at the Vernalis gage. Smolt size could also possibly play a role in migration timing, in conjunction with flows and water temperatures. For example, out-migrating juveniles may reach a similar general size by mid-March through late April that helps to "trigger" out-migrating behavior. However, additional data analyses and targeted studies are necessary to explore these concepts and hypotheses.

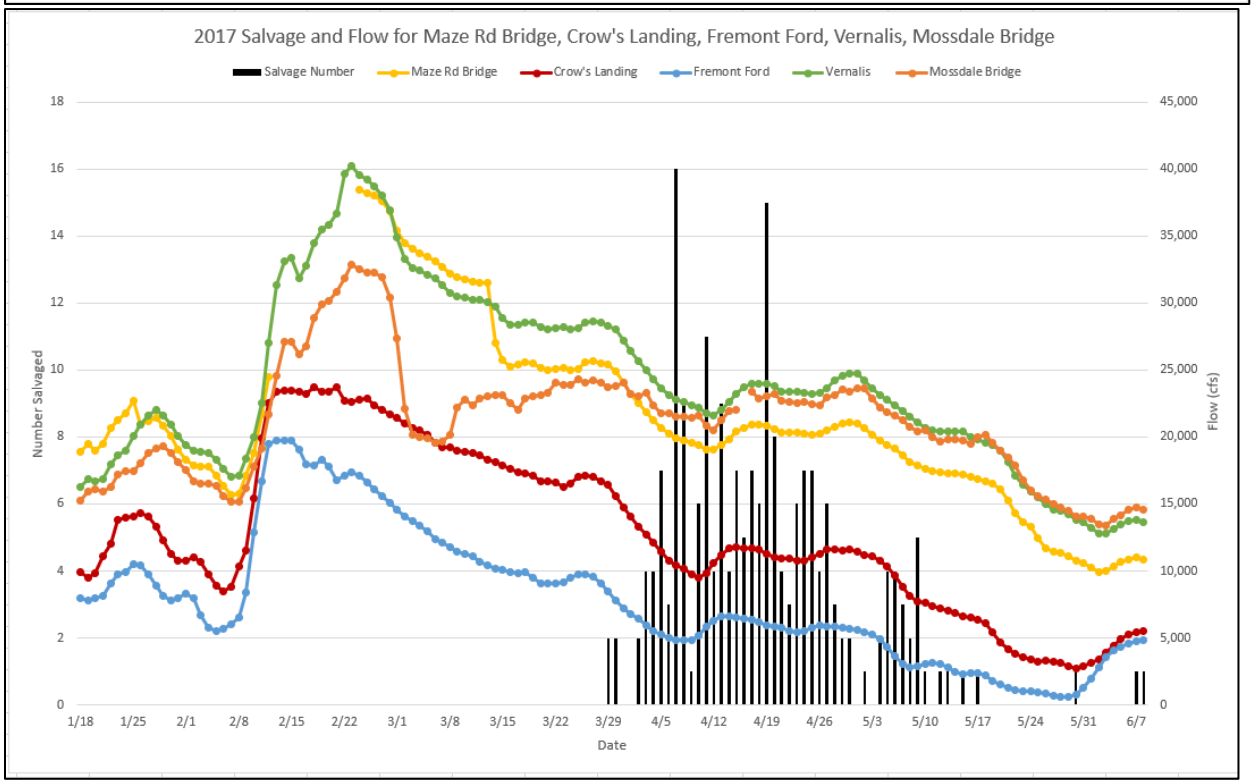
Summary

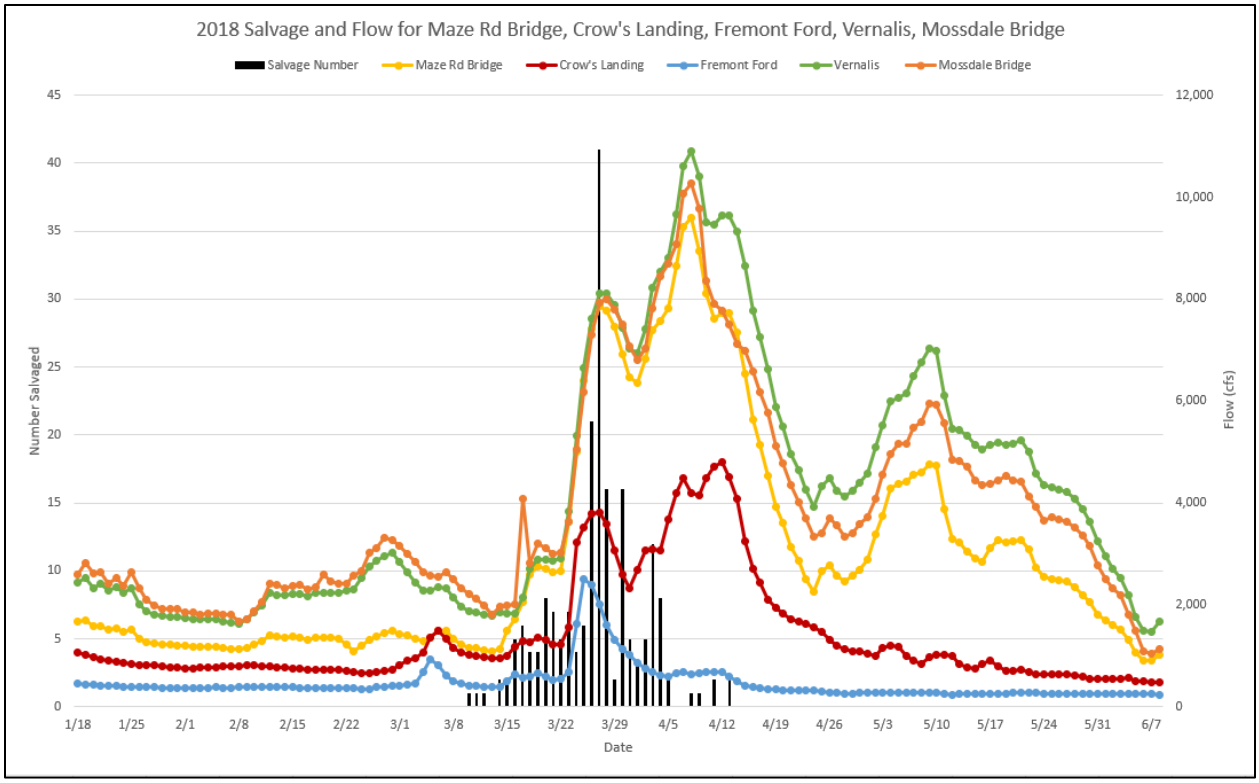
Overall, results of the outmigration timing analysis indicate that naturally-produced YOY juveniles are most likely to be observed at the CVP/SWP Facilities in March and April. The assumption that SCARF fish have similar outmigration behaviors as naturally-produced fish still needs further study, however, the results of this analysis indicate the assumption is not unreasonable. This assumption is further supported by outmigration timing of naturally-produced fish captured in the RSTs in Reaches 1 and 2.

The environmental variables that were analyzed thus far indicate that while the majority of naturally-produced YOY juveniles may be observed in the CVP/SWP Facilities in March and April, fish may move downstream earlier (i.e., January or February) with high flows. Preliminarily, outmigration timing seems to be influenced by flows in relation to the overall water year type, however additional years of data are needed to further evaluate this hypothesis. Further data analysis also needs to be done in order to determine patterns between outmigration timing and water temperatures, in conjunction with mainstem and tributary flows and water year type.

Figure B4. The following six graphs are for 2016 through 2021, and show fish observed in salvage and flows at Fremont Ford (blue line), Crows Landing (red line), Maze Road Bridge (yellow line), Vernalis (green line), and Mossdale Bridge (orange line) gages.






2018 Salvage and Flow for Maze Rd Bridge, Crow's Landing, Fremont Ford, Vernalis, Mossdale Bridge
Salvage Number
Maze Rd Bridge
Crow's Landing
Fremont Ford
Vernalis
Mossdale Bridge
Number Salvaged
Flow (cfs)
Date
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
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4/12
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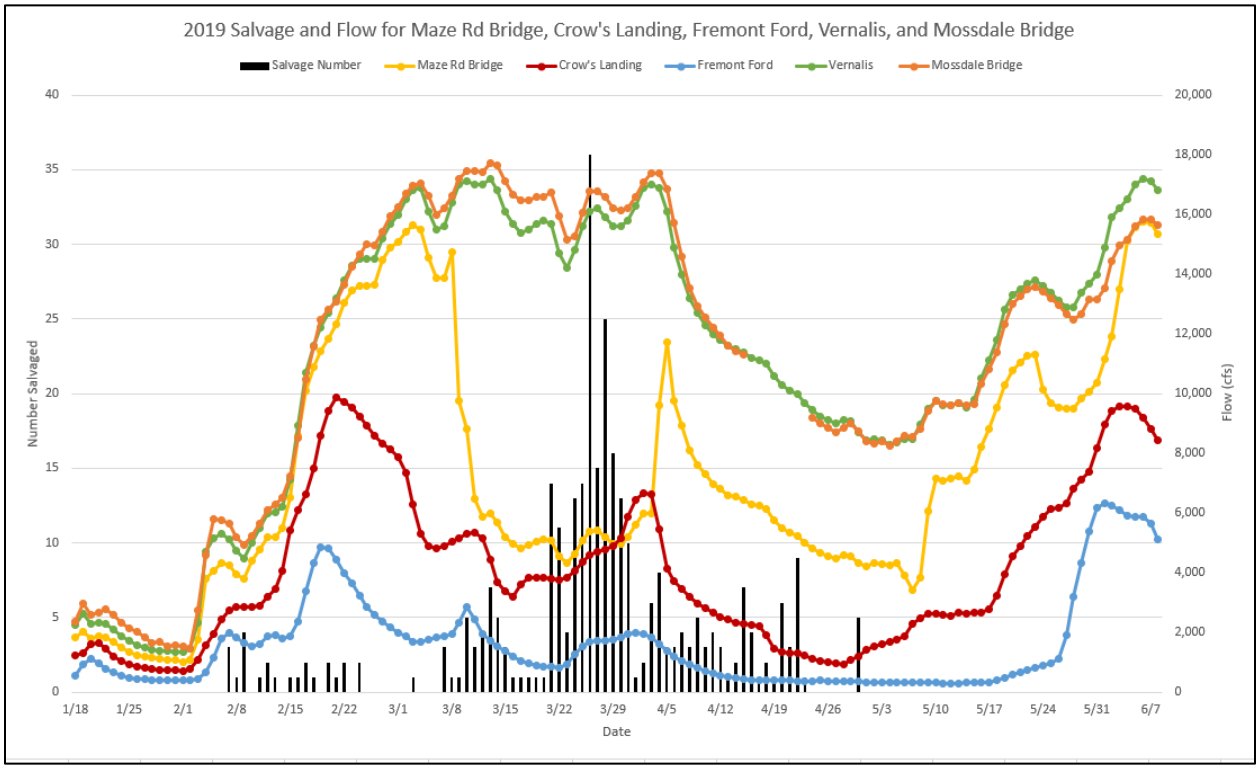
5/3
5/10
5/17
5/24
5/31
6/7


2019 Salvage and Flow for Maze Rd Bridge, Crow's Landing, Fremont Ford, Vernalis, and Mossdale Bridge
Salvage Number
Maze Rd Bridge
Crow's Landing
Fremont Ford
Vernalis
Mossdale Bridge
Number Salvaged
Flow (cfs)
Date
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
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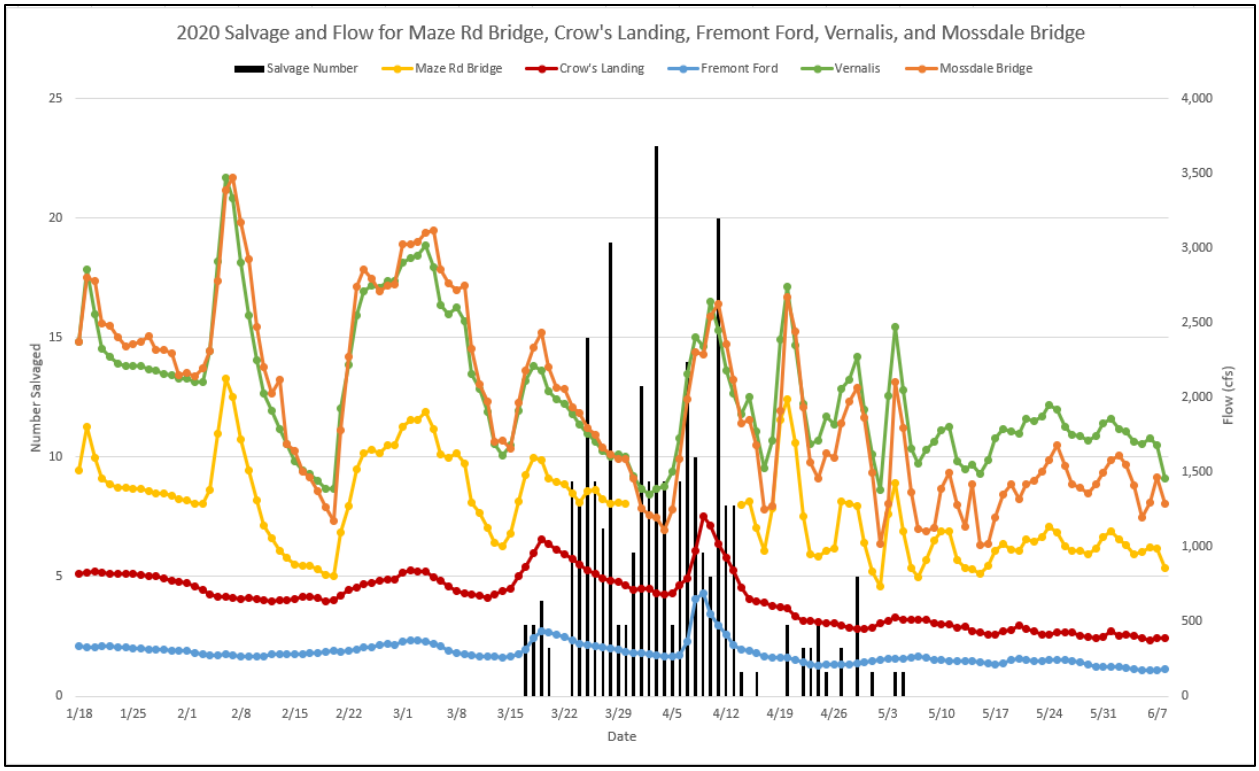
5/3
5/10
5/17
5/24
5/31
6/7


2020 Salvage and Flow for Maze Rd Bridge, Crow's Landing, Fremont Ford, Vernalis, and Mossdale Bridge
Salvage Number
Maze Rd Bridge
Crow's Landing
Fremont Ford
Vernalis
Mossdale Bridge
Number Salvaged
Flow (cfs)
Date
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
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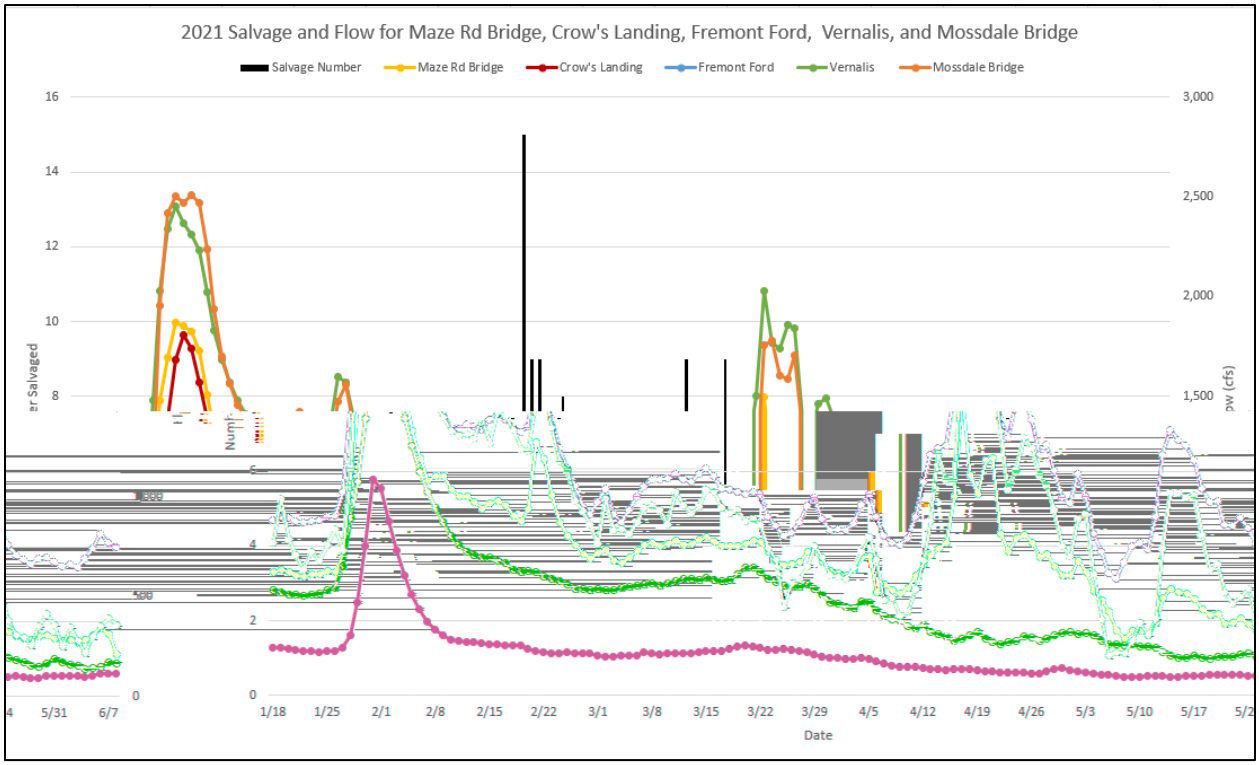
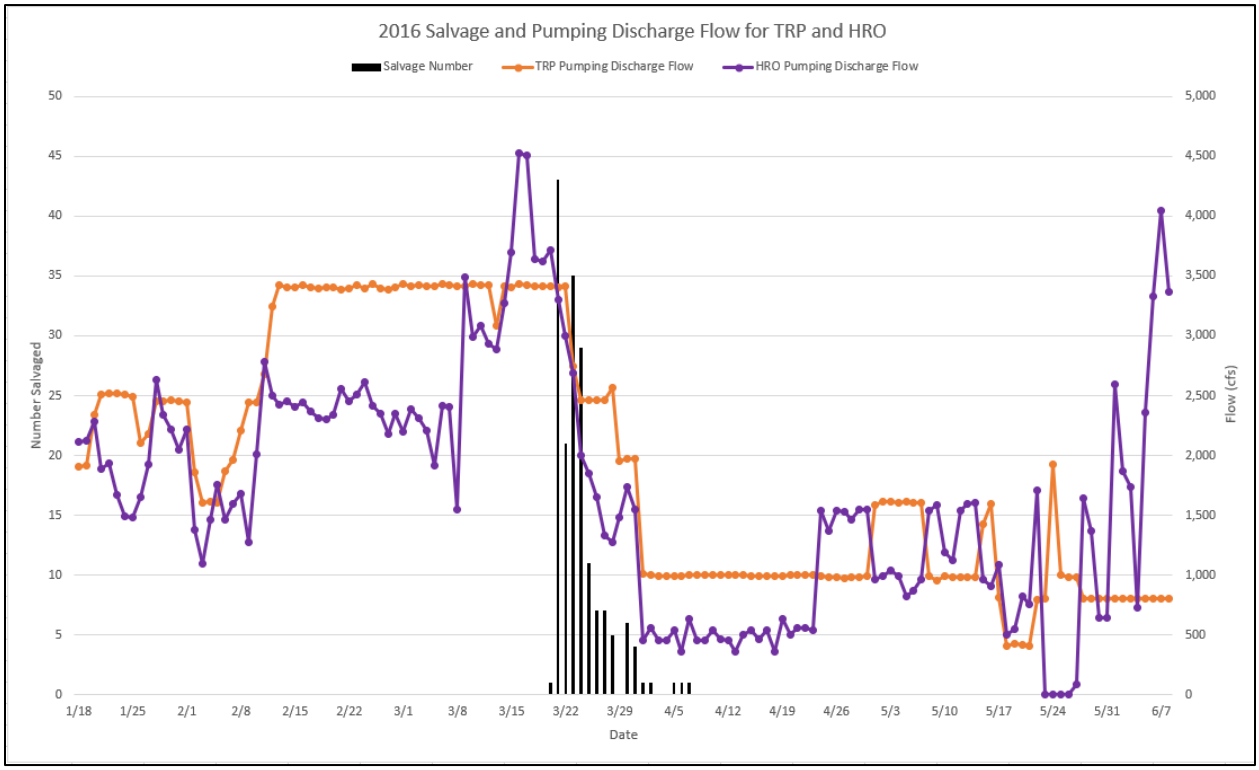
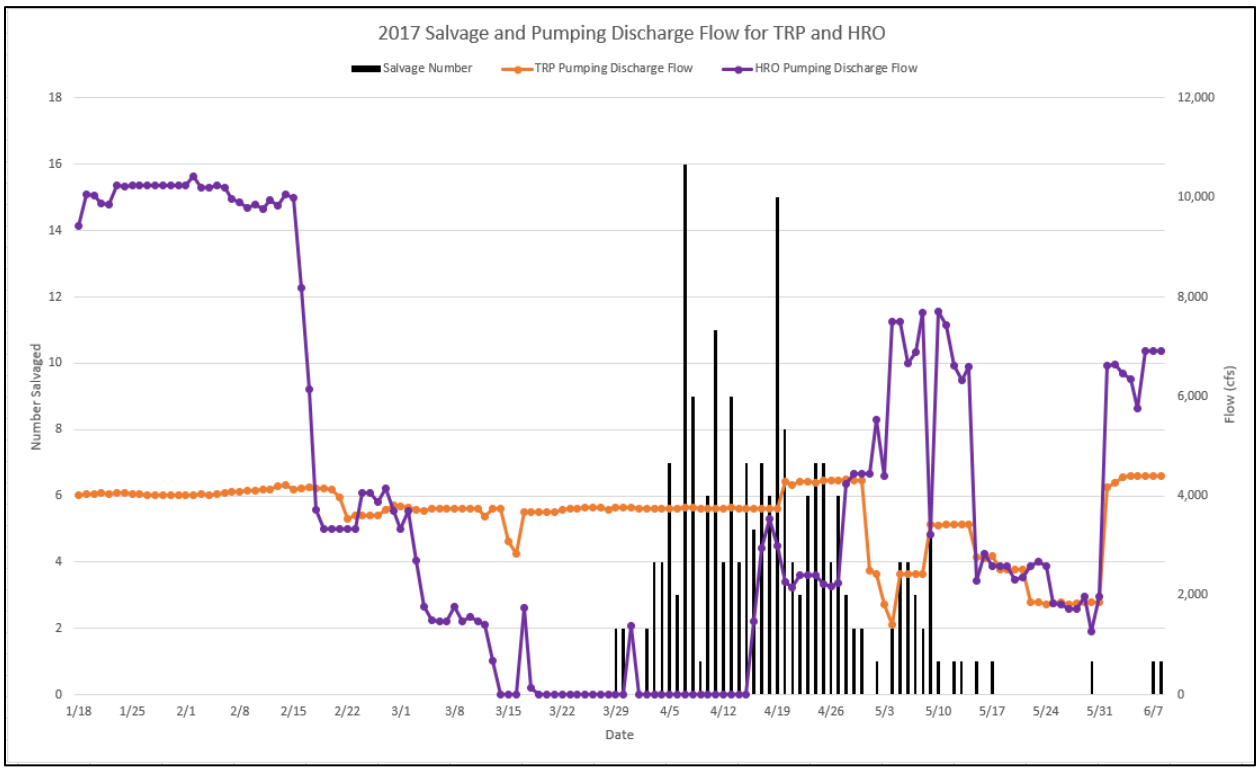
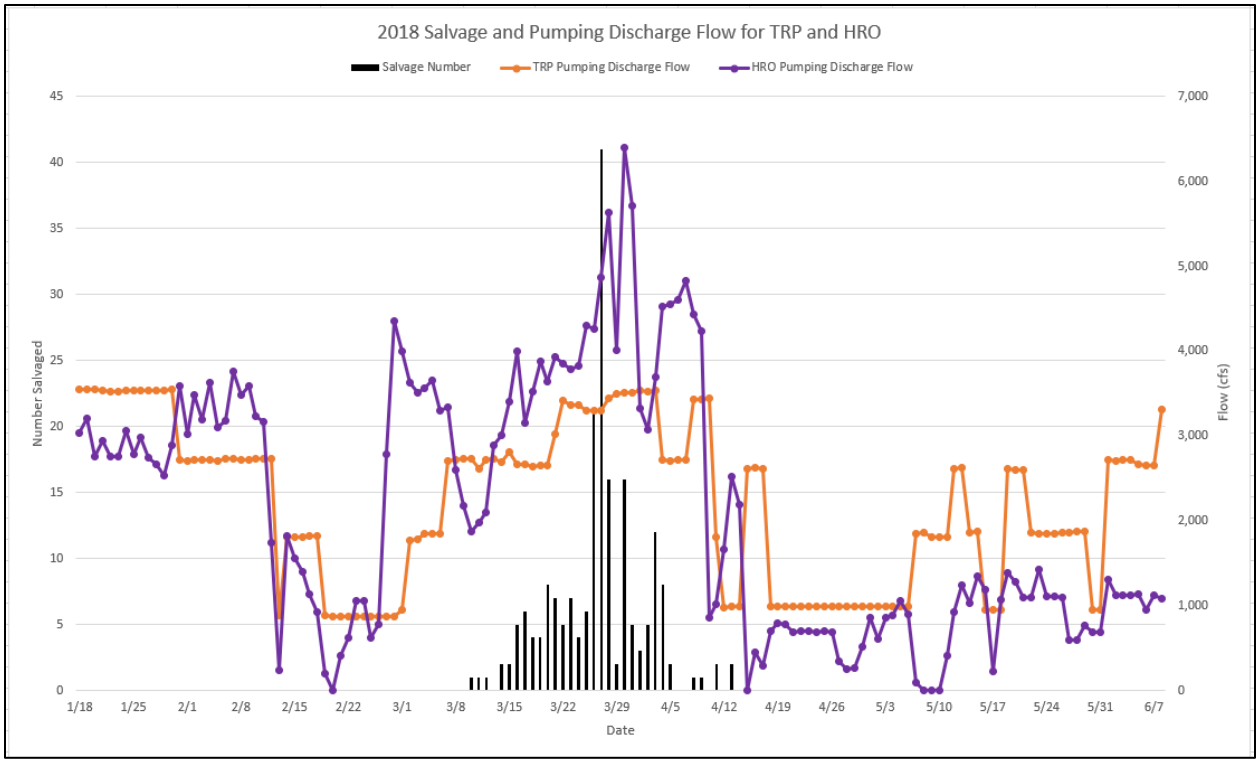

2021 Salvage and Flow for Maze Rd Bridge, Crow's Landing, Fremont Ford, Vernalis, and Mossdale Bridge
Salvage Number
Maze Rd Bridge
Crow's Landing
Fremont Ford
Vernalis
Mossdale Bridge
Date
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
5/10
5/17
5/31
6/7

Figure B5. The following six graphs are for 2016 through 2021, and show fish observed in salvage and export pumping flows at the CVP Facility (orange line) and the SWP Facility (purple line).






2018 Salvage and Pumping Discharge Flow for TRP and HRO
Salvage Number
TRP Pumping Discharge Flow
HRO Pumping Discharge Flow
Number Salvaged
Flow (cfs)
Date
0
5
10
15
20
25
30
35
40
45
0
1,000
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4,000
5,000
6,000
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1/18
1/25
2/1
2/8
2/15
2/22
3/1
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3/15
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5/3
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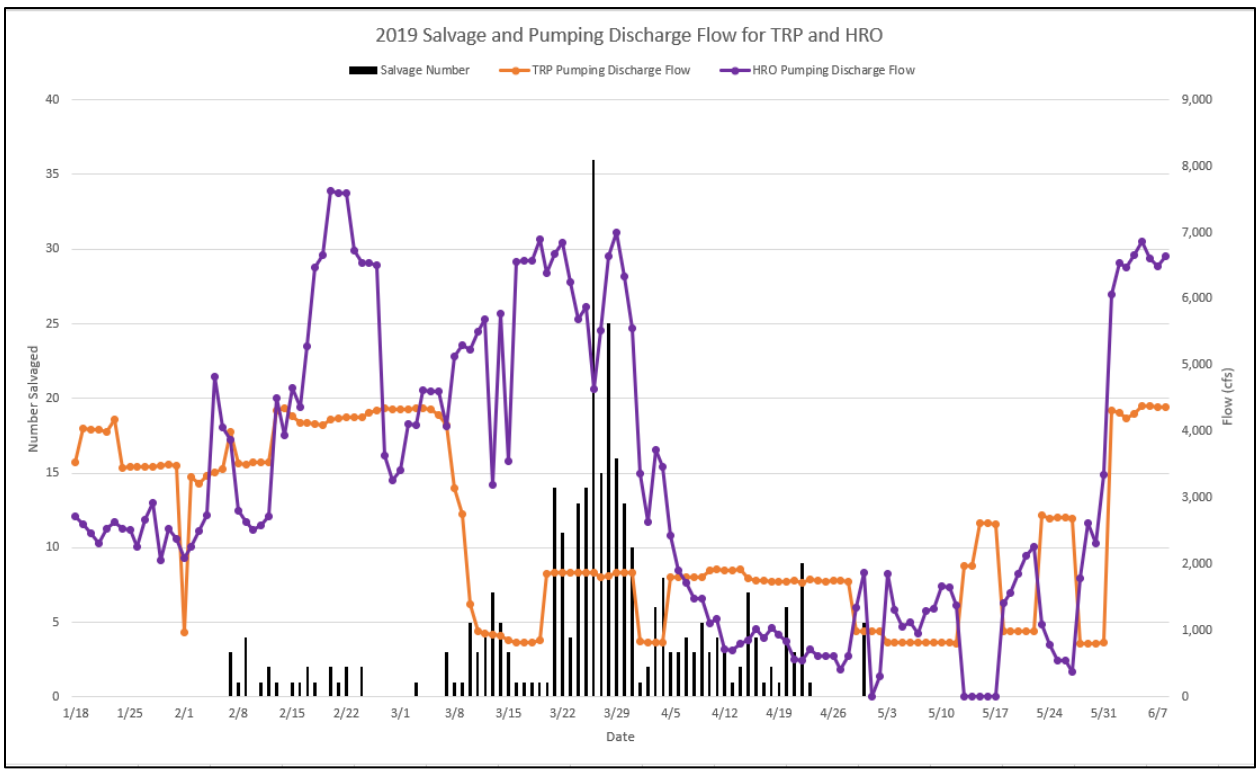
5/31
6/7


2019 Salvage and Pumping Discharge Flow for TRP and HRO
Salvage Number
TRP Pumping Discharge Flow
HRO Pumping Discharge Flow
Number Salvaged
Flow (cfs)
Date
0
5
10
15
20
25
30
35
40
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
1/18
1/25
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2/8
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3/15
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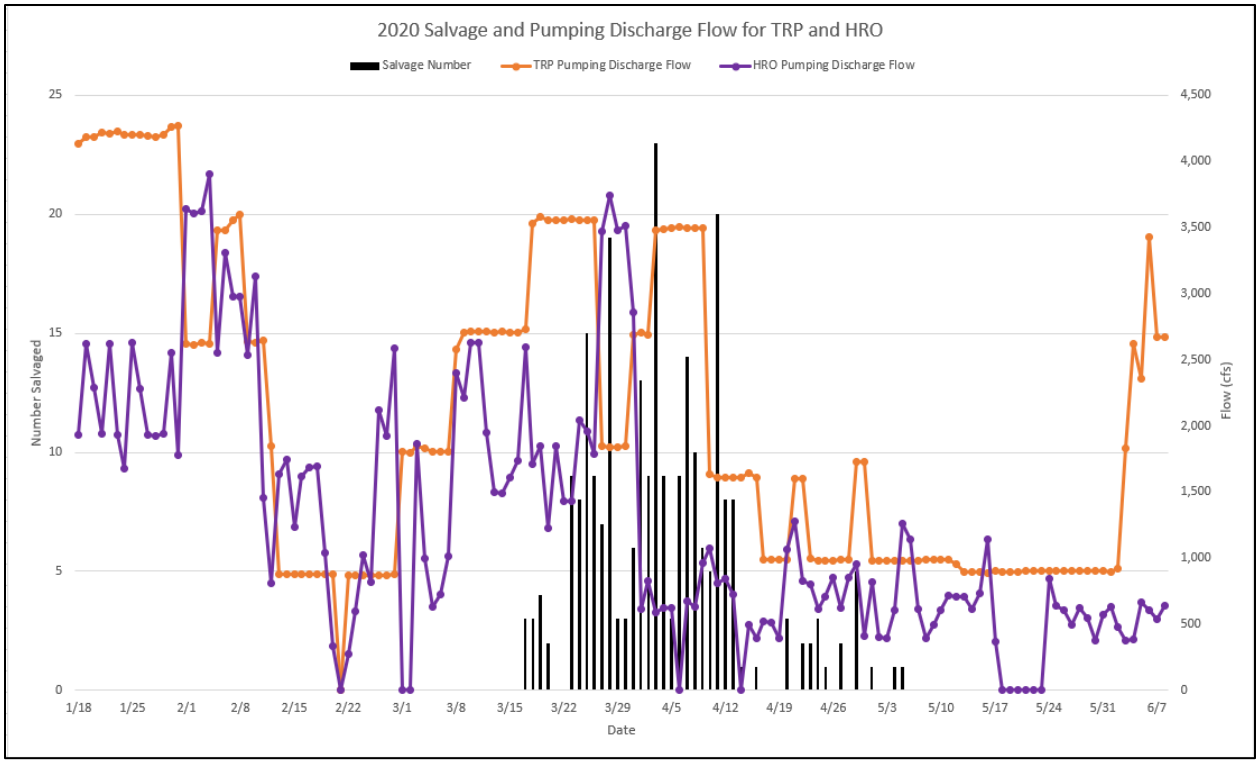

2020 Salvage and Pumping Discharge Flow for TRP and HRO
Salvage Number
TRP Pumping Discharge Flow
HRO Pumping Discharge Flow
Number Salvaged
Flow (cfs)
Date
0
5
10
15
20
25
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
5/10
5/17
5/24
5/31
6/7

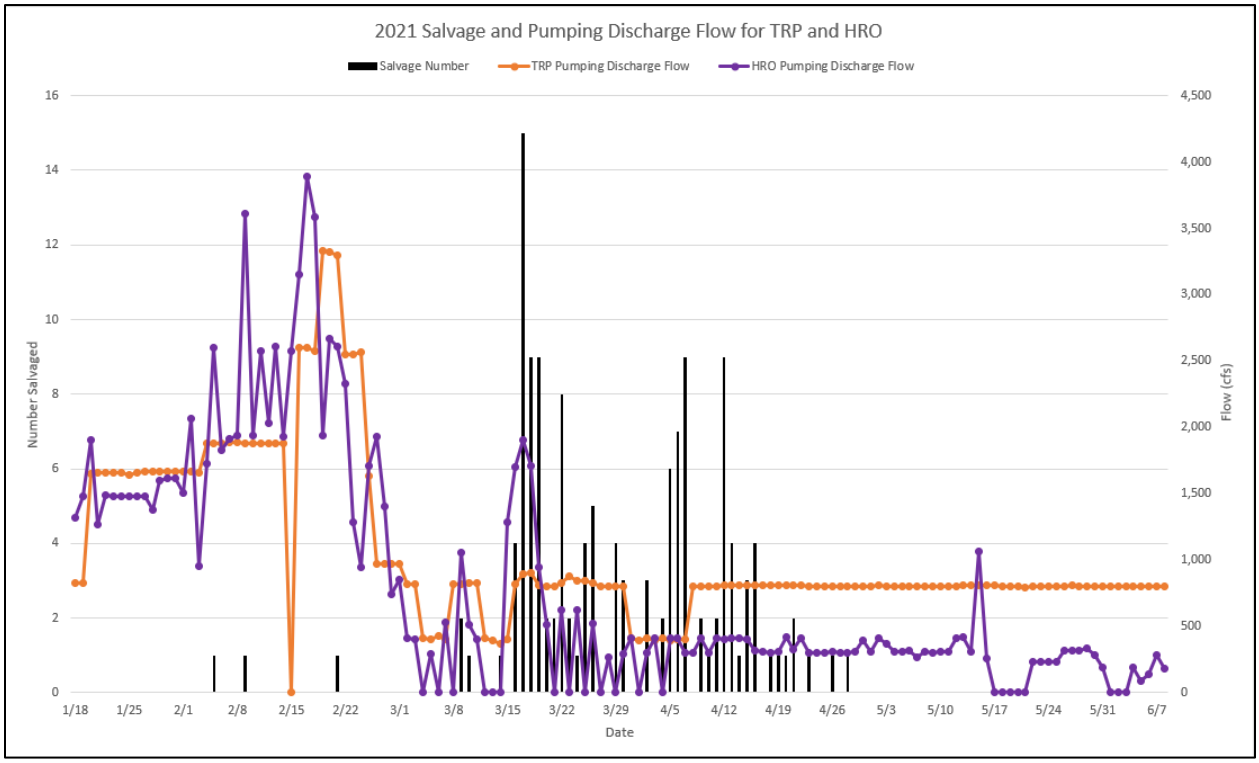
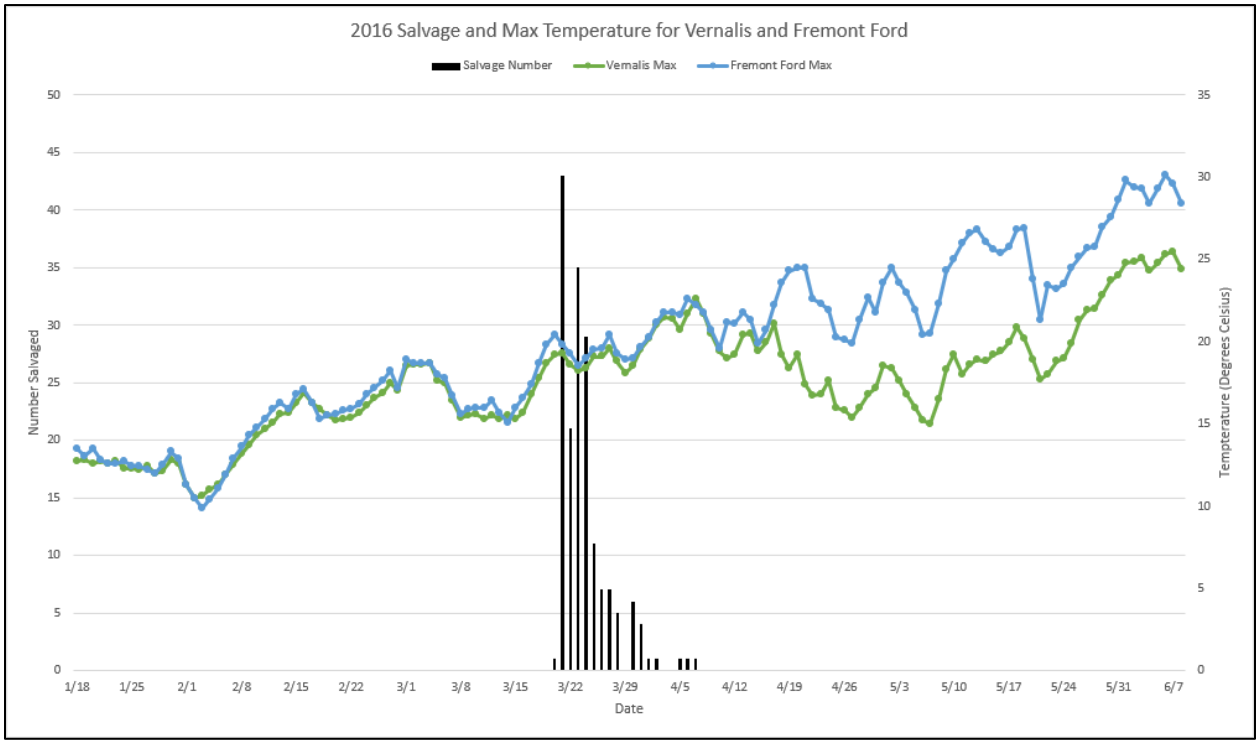
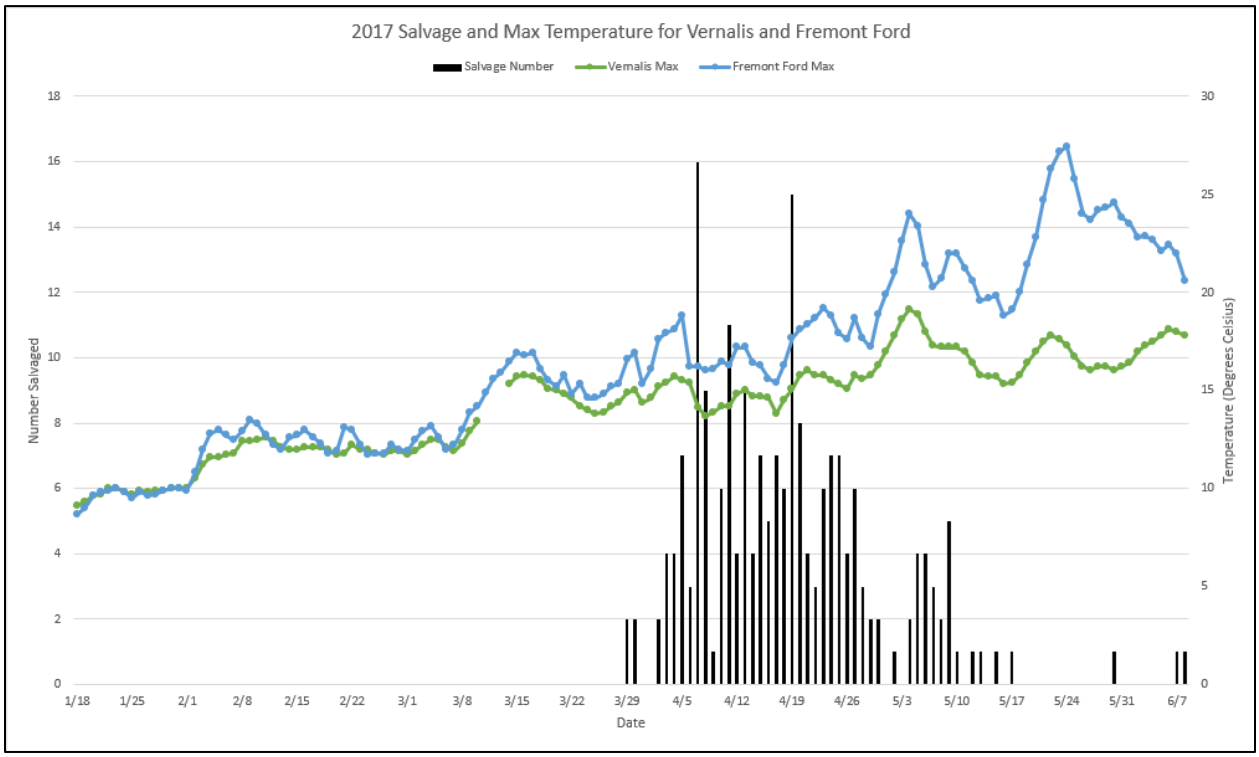
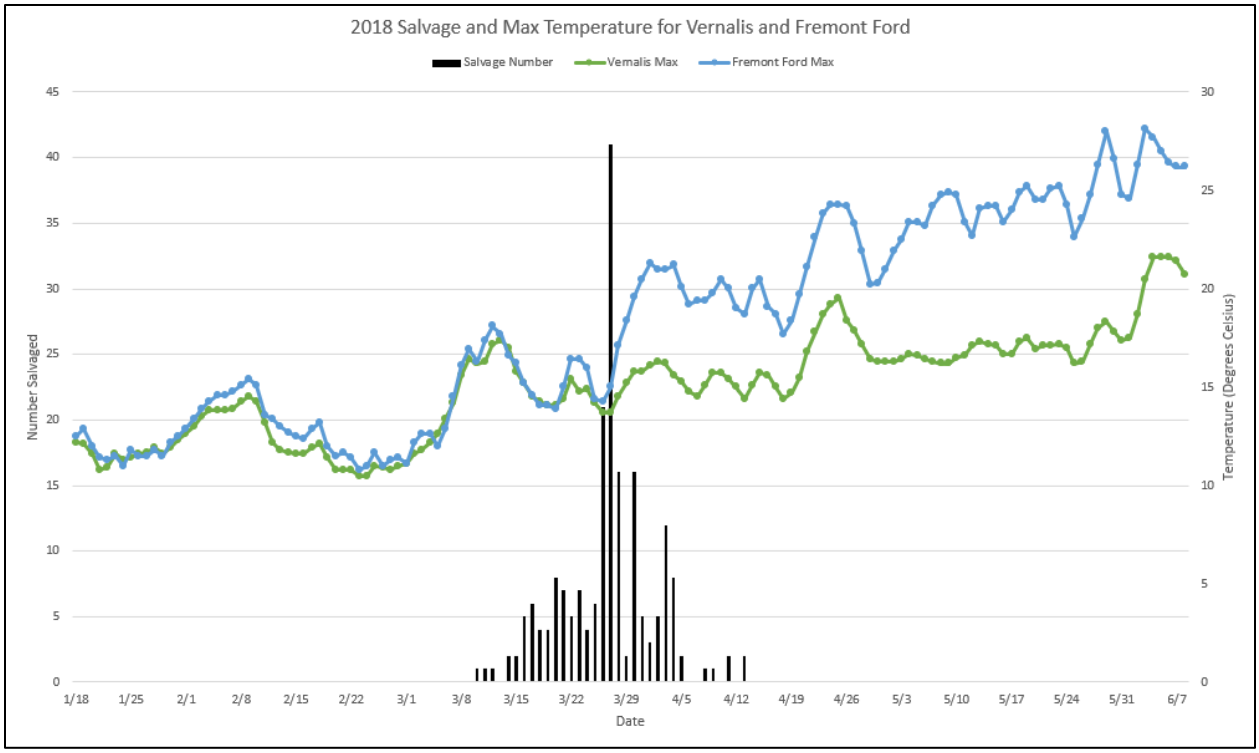
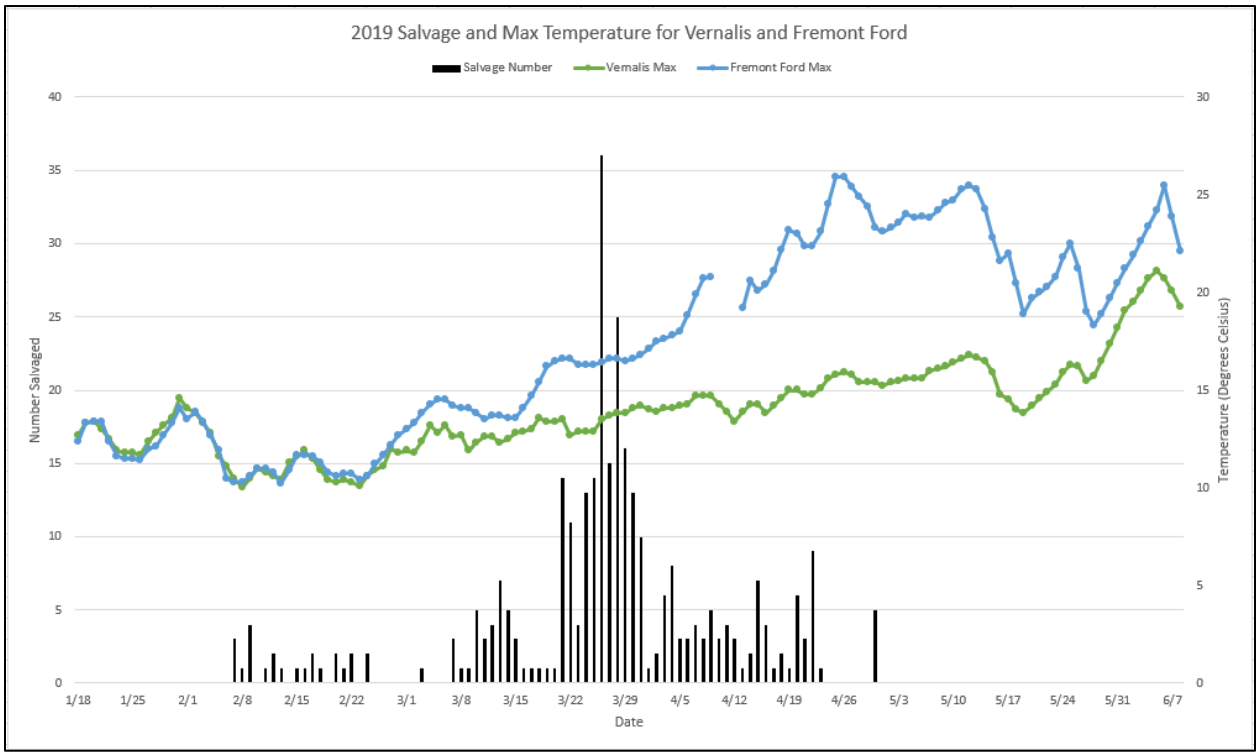

2021 Salvage and Pumping Discharge Flow for TRP and HRO
Salvage Number
TRP Pumping Discharge Flow
HRO Pumping Discharge Flow
Number Salvaged
Flow (cfs)
Date
0
2
4
6
8
10
12
14
16
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
5/10
5/17
5/24
5/31
6/7

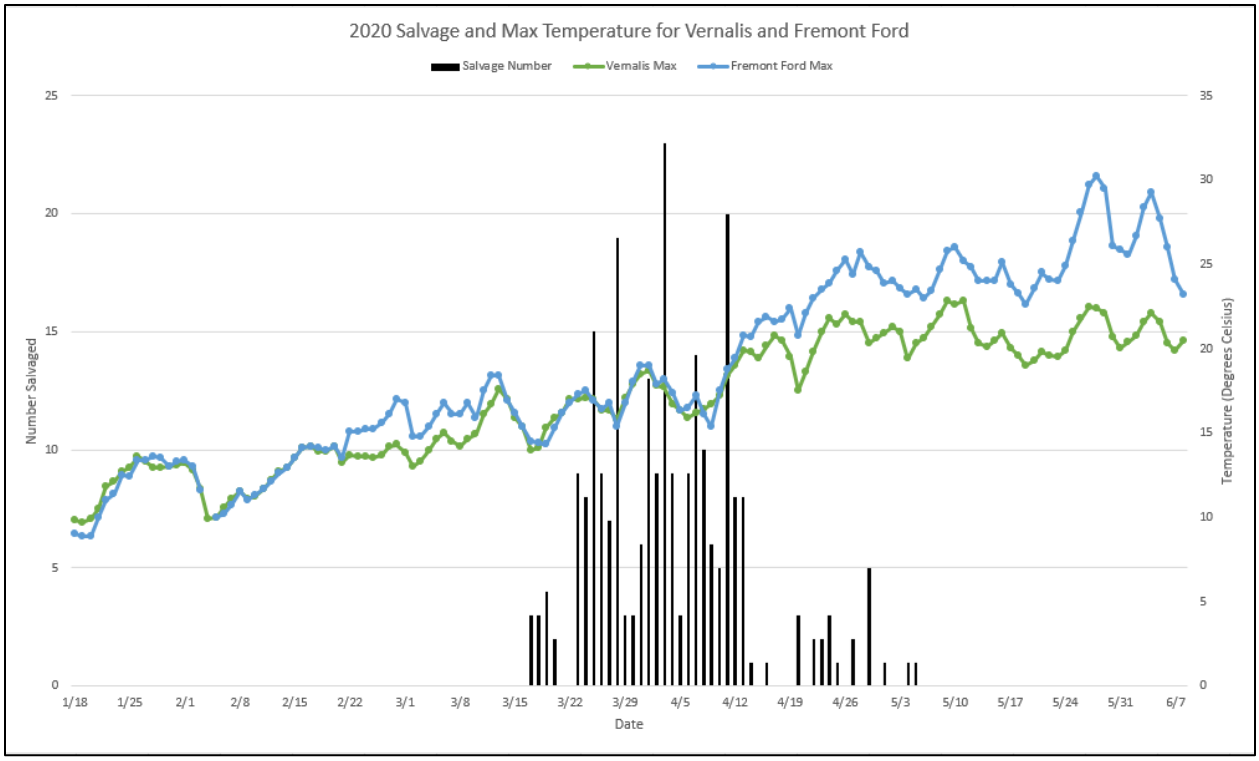
Figure B6. The following six graphs are for 2016 through 2021, and show fish observed in salvage and maximum daily water temperature at Vernalis (green line) and Fremont Ford (blue line).

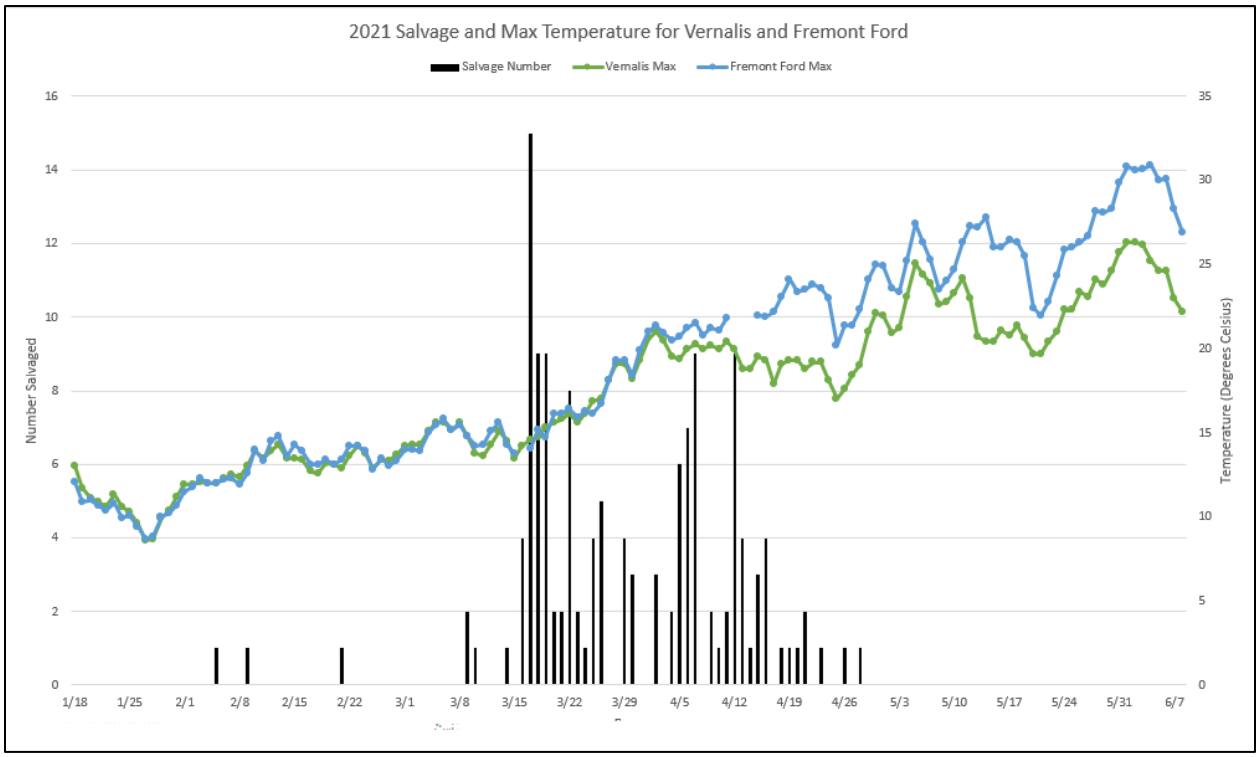





2018 Salvage and Max Temperature for Vernalis and Fremont Ford
Salvage Number
Vernalis Max
Fremont Ford Max
Number Salvaged
Temperature (Degrees Celsius)
Date
0
5
10
15
20
25
30
35
40
45
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
5/10
5/17
5/24
5/31
6/7


2019 Salvage and Max Temperature for Vernalis and Fremont Ford
Salvage Number
Vernalis Max
Fremont Ford Max
Number Salvaged
Temperature (Degrees Celsius)
Date
0
5
10
15
20
25
30
35
40
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
5/10
5/17
5/24
5/31
6/7


2020 Salvage and Max Temperature for Vernalis and Fremont Ford
Salvage Number
Vernalis Max
Fremont Ford Max
Number Salvaged
Temperature (Degrees Celsius)
Date
0
5
10
15
20
25
30
35
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
5/3
5/10
5/17
5/24
5/31
6/7


2021 Salvage and Max Temperature for Vernalis and Fremont Ford
Salvage Number
Vernalis Max
Fremont Ford Max
Number Salvaged
Temperature (Degrees Celsius)
0
2
4
6
8
10
12
14
16
0
5
10
15
20
25
30
35
1/18
1/25
2/1
2/8
2/15
2/22
3/1
3/8
3/15
3/22
3/29
4/5
4/12
4/19
4/26
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5/10
5/17
5/24
5/31
6/7

Appendix C: Conceptual method to estimate the number of naturally-produced, young-of-year (YOY), nonessential experimental population (NEP) Central Valley (CV) spring-run Chinook salmon from the Restoration Area to the Central Valley Project and State Water Project Sacramento- San Joaquin Delta Fish Collection Facilities (CVP/SWP Facilities)

As part of the assessment to estimate the number of naturally-produced YOY spring-run Chinook salmon originating from the San Joaquin River Restoration Program (SJRRP) Area that could be observed at the CVP/SWP Facilities, NMFS, in coordination with the SJRRP, developed the beginnings of a conceptual method to calculate the estimated number of naturally-produced YOY spring-run Chinook salmon that could be observed during the spring of each year. In the future, this conceptual juvenile production estimate (JPE) could be used to help determine how many naturally-produced YOY juveniles may potentially be observed at the CVP/SWP Facilities, under operational thresholds and triggers for the NMFS 2019 Biological Opinion (or subsequent operational requirements), and California Department of Fish and Wildlife's (CDFW) 2020 Incidental Take Permit (ITP; or any subsequent ITPs). The data used to produce any annual JPE, including this conceptual approach, will be provided by annual SJRRP monitoring and studies. Therefore, the annual estimate of production will be refined and updated each year as new data are available. The method used to calculate the conceptual JPE for NEP fish is loosely based on the methods used to calculate the winter-run Chinook salmon JPE[1], and was developed to accommodate the data available from the SJRRP. The development of a conceptual JPE sooner rather than later, helps in identifying data that is needed to produce a more robust estimate, and therefore where potential future monitoring efforts could be fruitful in advancing the development of a more accurate JPE.

Table C1 outlines all the components, numbers used, and any associated notes for each component of the conceptual JPE. The components used for this first opportunity to provide numbers for the conceptual JPE were presented to both the Fisheries Management Workgroup and the Tech Memo group prior to being presented in this appendix to the 2022 Tech Memo. Based on the results of the conceptual JPE calculations, the estimated number of naturally-produced YOY spring-run Chinook salmon that may be observed at the CVP/SWP Facilities in the spring of 2022 is anticipated to be low.

The results of the conceptual JPE for NEP fish are dependent on annual variations of environmental conditions, such as water year type, flows, and water temperatures. Thus, the results should be interpreted within the context of annual environmental conditions that returning adults, their eggs, and juvenile fish experience in a given water year. Additionally, the estimate of juvenile fish exiting the Restoration Area is generally anticipated to significantly increase once passage projects within the Restoration Area are completed. Furthermore, this conceptual method to estimate juvenile production is still under development and is expected to be updated

[1] Winter-run Chinook salmon JPE letter are publicly available here: https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/california-central-valley-water-operations-biological

as monitoring data becomes available. Thus, the estimated number of juveniles that may be observed at the CVP/SWP Facilities should be considered within the context of the numerous data gaps, and therefore will not be used to inform or influence operational thresholds or triggers related to CVP/SWP Facility operations.

Table C1. Table outlining the conceptual Juvenile Production Estimate (JPE) method and components, numbers used for 2022, and associated notes to explain the component and/or the number used.

JPE Component	Numbers for 2022	Notes
Reach 5 to Reach 1 Trap & Haul numbers	74	• 74 fish transported to Reach 1 (includes 9 post transport mortalities).
SCARF Broodstock number	200	• 50 females
Total known spawners	265	• Trap & haul numbers + broodstock
Estimated volitional returns to Reach 1	0	• Estimated from carcass survey data from Aug-Dec 2021. • Due to extreme drought conditions, there was no volitional passage to Reach 1; also the river was disconnected between Reach 5 and Reach 1 from July through November and early December 2021.
Total known + Estimated volitional returns	265	• Trap & haul +broodstock + volitional return estimate
Adult female estimate (AFE)	87	• Trap & haul(~50% =37) +broodstock (50) + volitional return estimate (0) • AFE of trap & haul fish is based on target estimate from the 2018 Fisheries Framework. • Will be revised as monitoring data become available.
AFE minus pre-spawn mortality (AFE-spawned)	74	• Used 15% target objective from the 2018 Fisheries Framework. • Will be revised as monitoring data become available. • AFE-spawned = AFE –(0.15*AFE)
Average annual fecundity	2,418	• Average annual fecundity of SCARF broodstock fish used as a surrogate for natural returns; usually known by Oct of each year.
Total viable eggs	178,932	• Total viable eggs= AFE-spawned* annual fecundity
Estimated egg-to-fry survival: Fry Production Estimate (FPE)	89,466	• Based on 50% target objective from the 2018 Fisheries Framework. • May be revised as emergence trap data across years become available, however, very preliminary data suggests the current survival rate to be lower than 50%.

JPE Component	Numbers for 2022	Notes
Fry-to-smolt survival rate estimate (SurvR2)	0.05	• Based on target survival rate from the 2018 Fisheries Framework. • Will be revised as monitoring data becomes available.
Estimated survival term: Reach 2 to Reach 5 (SurvR5)	0.05	• Based on target survival rate from the 2018 Fisheries Framework (same estimated as Surv2). • Will be revised as monitoring data become available.
Estimated survival term: Reach 5 to Delta (SurvDelta)	0.23	• Average survival rate of UC Davis tagged fish for 3 years (2017-2019) and applied to current year; it should be noted that this survival estimate is for years with higher flows and may not be representative for years with lower flows, as seen in 2020 and 2021. • Will be revised annually as study data become available. • For the purposes of this Tech Memo, survival to Delta is defined as fish observed at the CVP/SWP Facilities. May be revised as Mossdale Trawl efficiency estimates become available.
JPE= (FPE)*(SurvR2)*(SurvR5)*SurvDelta)	**51**	• Final number of naturally-produced YOY NEP spring-run Chinook salmon that may potentially be observed at the CVP/SWP Facilities. • Given the numerous data gaps within this initial JPE, there is low confidence associated with this number. Also, given drought conditions in 2021 (i.e., very low flows, and high water temperatures during adult holding, spawning, and egg incubation), the estimate is anticipated to be lower.