Annual Report of Activities
October 1, 2017, to
September 30, 2018

Delta Operations for
Salmonids and Sturgeon (DOSS)
Technical Working Group
November 2018

Cover Photo: *Railroad bridge over Old River looking west towards Mount Diablo.*
Credit: *NMFS*

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Acronyms and Abbreviations

Term	Definition
BiOp	Biological Opinion
CDEC	California Data Exchange Center
CDFW	California Department of Fish & Wildlife
CNFH	Coleman National Fish Hatchery
CPUE	Catch Per Unit Effort
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWT	Coded Wire Tag
DAT	Data Assessment Team
DCC	Delta Cross Channel
DCT	Delta Conditions Team
DPS	Distinct Population Segment
DWR	California Department of Water Resources
EPA	Environmental Protection Agency
ePTM	Enhanced Particle Tracking Model
ESA	Endangered Species Act
FRH	Feather River Hatchery
FWS	U.S. Fish & Wildlife Service
I:E	Inflow-to-Export Ratio
IRP	Independent Review Panel
JPE	Juvenile Production Estimate
KLCI	Knights Landing Catch Index
LOBO	Long-term Operations of the CVP and SWP Biological Opinions
LSNFH	Livingston Stone National Fish Hatchery
MAF	Million Acre-Feet
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OMR	Net Tidal Flow Measurement in Old and Middle Rivers Combined
PTM	Particle Tracking Model
RBDD	Red Bluff Diversion Dam

Term	Definition
Reclamation	U.S. Bureau of Reclamation
RKM	River Kilometer
RPA	Reasonable and Prudent Alternative
RST	Rotary Screw Trap
SCI	Sacramento Catch Index
SWG	Smelt Working Group
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	Thousand Acre-Feet
TUCP	Temporary Urgency Change Petition
USGS	U.S. Geological Survey
VAMP	Vernalis Adaptive Management Program
WOMT	Water Operations Management Team
WY	Water Year

CHAPTER 1 BACKGROUND

1.1 Background

On 6/4/09, the National Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS) issued its Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project (CVP) and State Water Project (SWP, NMFS BiOp). The NMFS BiOp's reasonable and prudent alternative (RPA) Action IV.5 called for the formation of the Delta Operations for Salmonids and Sturgeon (DOSS) Technical Working Group. DOSS is a technical team that includes biologists, hydrologists, and operators with relevant expertise from member state and federal agencies (listed in Section 1.2) that provides advice to NMFS and to the Water Operations Management Team (WOMT) on issues related to fisheries and water resources in the Delta and recommendations on measures to reduce adverse effects of Delta operations of the CVP and SWP export facilities to salmonids and green sturgeon. Some key features in the DOSS "area of interest" are shown in Figure 1-1.

The purposes of DOSS are to:

1) Provide recommendations to WOMT and NMFS for real-time management of operations consistent with implementation procedures provided in the RPA.

2) Review annually project operations in the Delta and the collected data from the different ongoing monitoring programs.

3) Track the implementation of Delta RPA Actions IV.1 through IV.4.

4) Evaluate the effectiveness of RPA Actions IV.1 through IV.4 in reducing mortality or impairment of essential behaviors of listed species in the Delta.

5) Oversee implementation of the 6-year acoustic tag experiment for San Joaquin fish provided for in RPA Action IV.2.2.

6) Coordinate with the Smelt Working Group (SWG) to maximize benefits to all listed species.

7) Coordinate with the other technical teams identified in the RPA to ensure consistent implementation of the RPA.

1.2 Participants

The DOSS technical team includes participants from the following member agencies:

- United States Bureau of Reclamation (Reclamation)
- United States Fish & Wildlife Service (FWS)
- National Marine Fisheries Service (NMFS)
- California Department of Water Resources (DWR)
- California Department of Fish and Wildlife (CDFW)
- State Water Resources Control Board (SWRCB)

- United States Environmental Protection Agency (EPA)
- United States Geological Survey (USGS)

1.3 Summary of Key Delta RPA Actions

Key RPA actions relating to Delta operations are summarized below:

1. Delta Cross Channel (DCC) Gate Operations (IV.1.1 - IV.1.2)

- **Action IV.1.1**: Monitor and provide alerts to trigger changes in DCC operations to provide timely information for DCC gate operations that will reduce loss of emigrating Sacramento River winter-run Chinook (winter-run Chinook salmon, *Oncorhynchus tshawytscha*), Central Valley spring-run Chinook (spring-run Chinook salmon, *O. tshawytscha*), California Central Valley steelhead (CV steelhead, *O. mykiss*), and southern distinct population segment (sDPS) of North American green sturgeon *(*green sturgeon, *Acipenser medirostris)*.

- **Action IV.1.2**: Modify DCC gate operations to reduce direct and indirect mortality of emigrating juvenile salmonids and green sturgeon from October through June.

2. Old and Middle River (OMR) Flow Management (Action IV.2.3):

Reduce the vulnerability of emigrating juvenile winter-run, yearling spring-run, and CV steelhead within the lower Sacramento and San Joaquin rivers to entrainment into the channels of the south Delta and at the pumps due to the diversion of water by the export facilities in the south Delta. Enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the mainstem of the San Joaquin River for emigrating fish, including greater net downstream flows.

3. San Joaquin Inflow-to-Export (I:E) Ratio (Action IV.2.1):

Manage the inflow-to-export ratio to reduce the vulnerability of emigrating CV steelhead within the lower San Joaquin River to entrainment into the channels of the south Delta and at the pumps from diversion of water by the CVP and SWP export facilities in the south Delta. Enhance the likelihood of salmonids successfully exiting the Delta at Chipps Island by creating more suitable hydraulic conditions in the mainstem San Joaquin River for emigrating fish, including greater net downstream flows.

4. 6-Year Acoustic Tag Experiment (Action IV.2.2)

Reclamation and DWR shall fund a 6-year research-oriented action to assess the behavior and movement of outmigrating salmonids in the lower San Joaquin River, and to evaluate causes of mortality. The DOSS group shall conduct annual reviews of the study results and prepare a status review of the action at the end of the 6-year period to assess the success of Action IV.2.1 in increasing survival through the Delta for San Joaquin River basin salmonids but, in particular, steelhead. Based on the findings of the status review, DOSS will make recommendations to

NMFS, Reclamation, CDFW, DWR, and FWS on future actions to be undertaken in the San Joaquin River basin as part of an adaptive management approach to the basin's salmonid stocks.

5. Reduce Likelihood of Entrainment or Salvage at the Export Facilities (Action IV.3)

Reduce losses of winter-run and spring-run Chinook salmon, CV steelhead, and green sturgeon by reducing exports when large numbers of juvenile Chinook salmon are migrating into the upper Delta region, at risk of entrainment into the central and south Delta, and then to the export facilities in the following weeks.

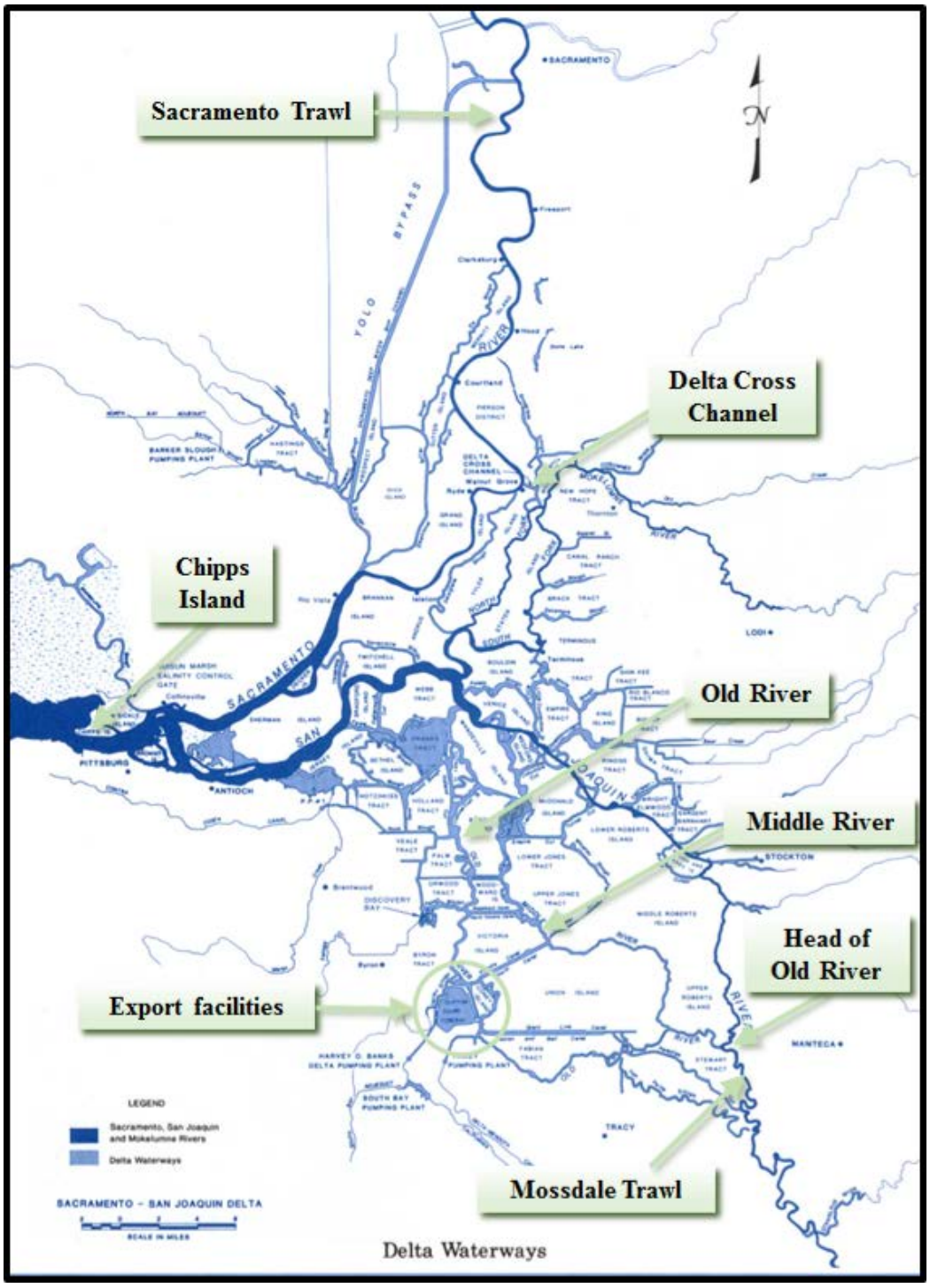

Figure 1-1. Delta map with DOSS-related points of interest including the locations of Chipps Island, the Delta Cross Channel, Old and Middle Rivers, the Head of Old River, the State and Federal export facilities, and the Mossdale Trawl in the lower San Joaquin River.

Chapter 2 SUMMARY OF DOSS DISCUSSIONS AND ADVICE/RECOMMENDATIONS

2.1 General Weekly Discussion Topics

- CVP and SWP operations
- Hydrodynamic conditions
- Delta fish monitoring, salvage, loss, and loss densities
- Hatchery releases
- DCC operations
- OMR flow management
- Coordination with other technical teams (e.g., Smelt Working Group)
- DOSS estimates of fish distribution
- Assessments of entrainment risk

2.2 Other Discussion Topics (as appropriate)

- Sampling effort at fish collection facilities
- I:E ratio
- Debris management at the fish collection facilities
- Interim winter-run juvenile production estimate (JPE)-based fish density triggers
- Tracking of acoustic-tagged Chinook salmon movement
- Coded wire tag (CWT) recoveries in Delta monitoring
- SacPAS website for migration modeling
- Tissue sampling at export facilities for genetic testing
- San Joaquin River Restoration Program (SJRRP) release of juvenile spring-run Chinook salmon
- Water Infrastructure Improvements for the Nation (WIIN) Act

2.3 Summary of WY 2018 RPA Action Implementation

RPA Action implementation during WY 2018 is described below. A daily summary of the controlling factors for CVP/SWP exports and DCC gate operations is provided in Appendix A.

2.3.1 DCC Alerts (Action IV.1.1)

RPA Action IV.1.1 describes two alerts that are signals that juvenile Chinook salmon may be migrating down the Sacramento River and indicate that DCC gate operations may need to be altered in the near future per the triggers in Action IV.1.2. In the 2009 BiOp, the first component of the first alert was triggered when there was capture of yearling-sized (>70 mm) spring-run Chinook salmon at the rotary screw traps (RSTs) in Mill Creek or Deer Creek. In October 2014[1], NMFS approved a request from Reclamation and DWR that the first component of the first alert based on fish monitoring be

[1] Implementation of the first component of the first alert was first modified during WY 2014. In August 2013, NMFS approved a request from Reclamation and DWR that, for October and November 2013, the first component of the first alert based on fish monitoring be replaced by a hydrologic criterion which triggers when mean daily flows are greater than 110 cfs in Deer or Mill creeks. Subsequently revised to the current 95 cfs threshold.

replaced by a hydrologic criterion which triggers when mean daily flows are greater than 95 cfs in Deer Creek or Mill Creek[2]. The two alerts in effect during WY 2018 were thus:

> First Alert: Mean daily flow in Mill Creek or Deer Creek (a) greater than 95 cfs, or (b) more than 50 percent higher than observed on the previous day.
>
> Second Alert: Flow greater than 7,500 cfs at Wilkins Slough and water temperatures are less than 56.3°F as measured at Knights Landing.

The alerts in Action IV.1.1 were tracked by DOSS from 10/1/17 through 11/30/17; the DCC gates were closed for the season on 11/24/17. During the period of October and November, the first alert was triggered on 10/1/17, and every day from 10/1/17 to 11/30/17 for flows greater than 95 cfs on Mill Creek. Flow data were not available for Deer Creek for the month of October 2017, but flows were above 95 cfs when the gage came back on line on 11/2/17 and remained above 95 cfs through 11/30/17. The second alert was triggered on 11/18/17, 11/19/17, 11/23/17, and 11/29/17. Note that the second alert is triggered only when both flow and water temperature components are satisfied. Appendix B summarizes the relevant daily flow and water temperature conditions during this period.

2.3.2 DCC Gate Operations (Action IV.1.2)

RPA Action IV.1.2 manages DCC gate operations to reduce the direct and indirect mortality of emigrating juvenile salmonids and green sturgeon. In October and November 2017, the criteria (based on water quality conditions and catch of older juvenile Chinook salmon at the Knights Landing RST, the Sacramento beach seines, or in the Sacramento Trawl) requiring DCC gate closure for fish protection were met on multiple occasions (Appendix B). The catch indices (CI) were exceeded on 11/21/17, 11/22/17, 11/24/17, 11/25/17, 11/28/17, and 11/29/17. On 11/21/17 and 11/22/17, the Action IV.1.2 triggers for closing the DCC during October 1-November 30 were exceeded for both the Knights Landing RST and the Sacramento beach seine catch indices (KLCI and Seine SCI) and the gates were required to be closed for three consecutive days. However, due to the expected increase in recreational boat traffic over the upcoming Thanksgiving Holiday (11/23/17) and the need to give recreational boaters notice 3 days prior to DCC gate closures, the DCC gates were not closed until 11/24/17 at 11 am. Although the gates were required to be closed for only 3 days, the SCI exceeded the second trigger threshold of 5 on 11/24/17 (CI of 6.9) and the gates were required to be closed for a minimum of 3 days or until the catch index was less than 3 older juvenile Chinook salmon per day for 2 consecutive days. Reclamation decided to keep the DCC gates closed for the remainder of November. Note that the KLCI and Seine SCI exceedances on 11/28/17 and 11/29/17 triggered DCC closures per the October 1-November 30 criteria in Action IV.1.2, but because the DCC gates were already scheduled to be closed through the end November and then closed on December 1 per the December 1-14 criteria, no further DCC action was required.

The DCC gates were closed on 12/1/17 per the requirement in Action IV.1.2, and did not open again until 5/25/18 for the Memorial Day weekend. Action IV.1.2 requires 14 days of gate closure for the May 21-June 15 period each year, which is usually implemented by opening the gates on Friday

[2] Based on the flow data reported for CDEC stations DCV (for Deer Creek) and MLM (for Mill Creek)

mornings and closing the gates on Mondays at noon during this period. From June 15-September 31, there are no RPA requirements for DCC gate operations and the Projects usually have the gates open throughout this period.

Appendix B summarizes the KLCI, the Seine SCI, and Trawl SCI for October and November 2017, and Appendix A summarizes DCC gate operations.

Note that due to a request by the California Department of Fish and Wildlife (CDFW), the DCC gates were closed weekdays from 10 am on Mondays through 10 am on Fridays for the period starting 9/18/17 and ending 11/17/17, to minimize straying of Sacramento River fall-run Chinook salmon. DCC gates were opened on weekends for recreational boating. See Section 2.4.7.

2.3.3 San Joaquin River Inflow-to-Export (I:E) Ratio (Action IV.2.1)

Action IV.2.1 is in effect during April and May of each year. The year type for the San Joaquin River Basin at the onset of RPA Action IV.2.1 on 4/1/18 was designated as "Critical" based on the March 2018 forecast, which required a 1:1 ratio of Vernalis inflow to combined CVP and SWP exports (I:E ratio), or minimum health and safety combined CVP and SWP pumping of 1,500 cfs, whichever was greater. However, on April 10, 2018, the classification of the water year type changed to "Below Normal" based on the April 2018 forecast, which required a 3:1 ratio of Vernalis inflow to combined CVP and SWP exports (I:E ratio), or minimum health and safety combined CVP and SWP pumping of 1,500 cfs, whichever was greater. Starting in early May 2018, a Water Infrastructure Improvement for the Nation (WIIN) Act action [Section 4001(b)(7)] was implemented that allowed additional exports to occur above the 3:1 required ratio to recover additional water released on the Stanislaus River by local irrigation districts (Oakdale Irrigation District and South San Joaquin Irrigation District) for transfer south of the Delta. See Section 2.4.5 for more details.

2.3.4 6-Year Acoustic Tag Experiment (Action IV.2.2)

The 2016 field season was the sixth and final year of the 6-year acoustic tag experiment. Action IV.2.2 requires that "at the end of the 6-year period, a status review of Action IV.2.1 shall be prepared by the DOSS group." Reclamation began releasing the final reports for the 6-year acoustic tag studies in June 2018 for study years 2011, 2012, and 2013. The final reports for the remaining years of the study are expected to be released in the fall of 2018. DOSS will wait for all 6 years of data to be analyzed and the reports finalized before conducting the review.

The Six-Year Steelhead Acoustic Telemetry Study annual (2011 to 2016) reports and supplemental information are being posted to the following web page: Reclamation Six-year Acoustic Telemetry Steelhead Study.[3]

[3] https://www.usbr.gov/mp/bdo/six-year-acoustic-telemetry-steelhead-study.html

2.3.5 Old and Middle River Flow management (Action IV.2.3)

The objective of this action is to reduce the vulnerability of emigrating juvenile winter run, yearling spring run, and CV steelhead within the lower Sacramento and San Joaquin rivers to entrainment into the channels of the south Delta and at the pumps because of the diversion of water by the export facilities in the south Delta. The action to manage Old and Middle River (OMR) flow at no more negative than -5,000 cfs is in effect from January 1 through June 15, or until the average daily water temperature at Mossdale is >72°F for 7 consecutive days in June, whichever is earlier. In WY 2018, temperatures at Mossdale ("MSD" station data reported on CDEC) did not satisfy the temperature off-ramp, and OMR flow restrictions were in effect through 6/15/18.

During the January 1 through June 15 Action IV.2.3 implementation period, several preliminary loss density triggers were exceeded for older juvenile Chinook salmon. Of the eight instances when the preliminary loss density trigger were exceeded (3/1/18, 3/2/18, 3/6/18, 3/25/18, 3/27/18, 3/28/18, 3/29/18 and 4/3/18), only one occasion (3/6/18) was confirmed as having a loss density trigger of genetically verified winter-run Chinook salmon that actually exceeded the threshold based on the results of the rapid genetic testing protocol. Daily fish loss triggers for wild steelhead were exceeded eight times during this period (4/2/18, 4/7/18, 4/14/18, 4/24/18, 5/5/18, 5/16/18, 5/22/18, and 5/23/18). On two occasions (4/7/18 and 4/24/18) the daily fish loss exceeded the second stage trigger for wild steelhead.

A summary of OMR limits in effect during WY 2018 and whether or not the limits were controlling exports is provided in Appendix A; a summary of observed OMR flows from December into June is provided in Appendix C. A summary of catch, salvage, loss at the CVP and SWP, and combined loss density during WY 2018 is provided in Appendix D (for Chinook salmon) and Appendix E (for CV steelhead).

2.3.6 Reduce Likelihood of Entrainment or Salvage at Export Facilities (Action IV.3)

The objective of RPA Action IV.3 is to reduce the loss of winter-run Chinook salmon, spring-run Chinook salmon, CV steelhead, and green sturgeon by reducing Project exports when large numbers of juvenile Chinook salmon are migrating into the upper Delta region and are at risk of entrainment into the south and central Delta. Exports are reduced based on established loss or loss-density triggers for Chinook salmon in the RPA action. During November and December (the months when this RPA action is in effect) of WY 2018, no loss or loss-density triggers were exceeded that required an action response under RPA Action IV.3. A summary of catch, salvage, loss at the CVP and SWP, and combined loss density during WY 2018 is provided in Appendix D (for Chinook salmon) and Appendix E (for CV steelhead).

2.4 Other Topics

2.4.1 Juvenile Production Estimate for Winter-Run Chinook Salmon

Action IV.2.3 (OMR flow management) includes a loss-density trigger based on the winter-run Chinook salmon juvenile production estimate (JPE). Per the DOSS advice from 12/26/17[4], the 2.5 fish/thousand acre-feet (TAF) and 5.0 fish/TAF triggers were implemented on an interim basis beginning on 1/1/18 and prior to NMFS' issuance of the brood-year 2017 JPE.

NMFS issued the JPE for brood-year 2017 winter-run Chinook salmon on 1/29/18[5]. The JPE for juvenile winter-run estimated to enter the Delta in WY 2018 (juveniles from brood year 2017) was 201,409 natural-origin fish, and the estimates for hatchery fish entering the Delta were 92,904 juveniles from Livingston Stone National Fish Hatchery (LSNFH) releases with an additional 90,924 from the juveniles released into Battle Creek that are the progeny of the adult captive brood stock fish held at LSNFH. The hatchery winter-run juveniles had unique CWT codes and the Battle Creek releases had an additional external mark (clipped left pelvic fin) to allow them to be readily distinguished visually from other hatchery Chinook salmon releases. The authorized incidental take for juvenile winter-run at the CVP and SWP fish salvage facilities has been established in the NMFS BiOp as 2 percent [based on length-at-date (LAD) criteria, which is actually approximately 1 percent genetically determined winter-run] of the estimated JPE. In WY 2018, Reclamation and DWR contracted with Cramer Fish Sciences to provide genetics-based run classification of unclipped juvenile Chinook salmon collected at the CVP and SWP fish salvage facilities (see Section 2.4.2, "Rapid Genetic Testing Protocol"). The use of genetic data to determine race of juvenile Chinook salmon observed at the CVP and SWP fish salvage facilities eliminates the uncertainty that was included in previous annual incidental take limits for winter-run. Therefore, the authorized level of incidental take (*i.e.*, reported as loss at the Delta fish facilities) under the ESA for the combined CVP and SWP fish salvage facilities for WY 2018 was set at **2,014 natural (non-clipped or wild)** winter-run (1% of the JPE). The incidental take for hatchery winter-run was set at **932 hatchery-produced** winter-run (1% of the LSNFH release expected to enter the Delta with an additional 3 fish representing the winter-run study fish from the hatchery production) and **909 hatchery-produced** winter-run released into Battle Creek from the adult captive brood stock. As in WY 2016 and WY 2017, the two stages of the JPE-based OMR triggers for WY 2018 RPA implementation were 2.5 fish/TAF and 5.0 fish/TAF (minimum density if the JPE-based OMR trigger is less than these densities).

[4] See agenda item 7 in the 12/26/17 DOSS notes, available at: December 26, 2017 DOSS notes
URLfor the above website:
https://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Delta%20Operations%20for%20Salmonids%20and%20Sturgeon/DOSS%20WY%202018/2017.12.26_final_doss_notes.pdf

[5] NMFS Brood year 2017 winter-run Chinook salmon JPE letter January 29, 2018
Website URL:
(https://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Delta%20Operations%20for%20Salmonids%20and%20Sturgeon/DOSS%20WY%202018/winter-run_juvenile_production_estimate__jpe__for_brood_year_2017_-_january_29__2018__1_.pdf)

2.4.2 Rapid Genetic Testing Protocol

Some of the action triggers in Actions IV.2.3 and IV.3 of the NMFS BiOp are based on loss or loss density of unclipped older juvenile Chinook salmon. Chinook salmon race classifications are made using LAD tables. Older juvenile Chinook salmon are those fish larger than the minimum winter-run size classification using the LAD criteria. Triggers for older juvenile Chinook salmon are primarily intended to protect natural-origin winter-run Chinook salmon, but also include natural-origin yearling spring-run Chinook salmon. Because genetic identification of race (especially for winter-run Chinook salmon) is more accurate than the classification based on LAD tables (which often result in false positive assignments), a pilot rapid genetic testing protocol was implemented in WY 2015 by DWR and Reclamation. The objective of the protocol was to process genetic samples collected from older juvenile salmonids as soon as feasible after a loss/loss density trigger for older juvenile Chinook salmon has been exceeded. Rapid genetic analysis was used to validate the race assignment based on the existing LAD table. The rapid genetic testing protocol has the capability of quickly determining, with a high level of confidence, whether a salvaged fish is a winter-run Chinook salmon or not (first probability selection tier) and then establishing a second and third tier of probabilities as to which race and watershed a Chinook salmon from the "non-winter-run" category belongs to. Determining the genetic identity of the fish could avoid or minimize the duration of export reductions triggered by the loss of fish falling within the older juvenile Chinook salmon size range that were not genetically winter-run or yearling spring-run Chinook salmon. For WY 2018, NMFS indicated that only fish determined as genetic winter-run would be used in determining the trigger exceedances, rather than including both genetic winter-run and yearling spring-run Chinook salmon in determining whether those trigger thresholds were exceeded.

Reclamation and DWR more formally implemented this procedure again during WYs 2016-2018, in coordination with the CDFW, FWS, and the NMFS. The procedure is intended to avoid (or minimize the duration of) export reductions resulting from loss of older juveniles that are not genetically listed Chinook salmon (i.e., winter-run or spring-run Chinook salmon). Action responses at the CVP and SWP export facilities to meet OMR requirements are initiated, if needed, when the older juvenile Chinook salmon trigger threshold is exceeded. However, if results of tissue genetic analysis indicate that the loss or loss density of genetically verified listed Chinook salmon (only genetic winter-run for WY 2018) did not exceed the trigger threshold, then changes in operations to comply with the OMR criteria required by the trigger exceedances will be cancelled. NMFS supported the use of this protocol with two additional conditions: 1) all unclipped Chinook salmon have tissue samples collected for subsequent analysis to correctly determine annual incidental take of listed fish, and 2) clarification that the annual incidental take limit of natural winter-run remains at 1% of the annual JPE (the original value of 2% of the JPE for incidental take assumes that there is a 50% misclassification of winter-run Chinook salmon based on the LAD tables; the ability to genetically verify fish as winter-run eliminates this uncertainty).

In addition to the use of the rapid genetic testing protocol for verifying the JPE-based juvenile winter-run loss density exceedances, DOSS has discussed expanding the use of the genetic testing of wild fish to include identifying genetic spring-run Chinook salmon young–of-year (YOY) and winter-run that fall below the LAD size criteria. Currently, winter-run that are smaller than the minimum winter-run LAD are not included in the rapid genetic testing protocol because they are not identified as older juveniles in the initial salvage screening using the LAD tables. This may lead to situations where entrainment of "true" winter-run into the facilities occurs, but salvage does not identify it as such. Thus, no operational changes arise to protect them from loss as they pass into the facilities.

In WY 2018, many winter-run may have been smaller in length than normal and fallen below the minimum LAD criteria for winter-run. Based on information gathered from the RBDD RST monitoring, a substantial fraction of the fish identified as YOY spring-run by LAD criteria were in fact genetic winter-run. This was determined by subsequent genetic testing of tissue samples gathered from spring-run sized fish collected at the RBDD RSTs and resulted in estimating that an additional 120,440 Chinook salmon that fell into the spring-run LAD category were in fact genetic winter-run. Under the current procedure of taking tissue samples from all wild Chinook salmon observed in salvage, but not running the samples until many months later, the true distribution and magnitude of winter-run salvage and loss is not known until well after the migratory period ends. Currently this information is provided in the annual incidental take report if the results of the genetic testing are available when the report is distributed. If all of the tissue samples have not been processed, then the report contains the results of the genetic testing of the tissue samples that have been processed up to that point. Following distribution of the annual incidental take report, NMFS reviews the genetic testing results. However, this precludes any operational changes that could have been made to increase protection for these fish. Utilizing genetic testing on a more frequent basis than only when exceedances of older juvenile Chinook salmon loss density criteria occurs would allow for a better, more accurate assessment of winter-run entrainment vulnerabilities at the Projects during their seasonal outmigration.

At present, using the LAD tables, accurate separation of listed YOY spring-run Chinook salmon from fall-run Chinook salmon observed during salvage is not possible due to the broad overlap in the size distribution of the two runs, particularly after releases of fall-run hatchery fish occur. Because of this, there are no protective measures in place that are specifically designed to protect YOY spring-run from entrainment at the CVP and SWP fish salvage facilities. DOSS has discussed the need for, and the benefit of, utilizing genetic testing in the future to discriminate genetic fall-run from genetic spring-run. DOSS considers that a more frequent use of genetic testing of tissue samples may provide the information necessary to make operational changes during peak periods of YOY spring-run presence near the CVP and SWP fish salvage facilities. Furthermore, more frequent use of the rapid genetic testing protocol will provide a more accurate accounting of YOY spring-run salvage and loss in near real-time than is currently available at the CVP and SWP fish salvage facilities and that could provide a basis for making operational changes to protect listed spring-run. One large, unresolved issue is that the San Joaquin Restoration Program chose to use Feather River spring-run Hatchery stock for the reintroduction program, making differentiation of Sacramento Basin Feather River juvenile Chinook salmon from the reintroduced population difficult, and perhaps impossible for naturally-produced spring-run originating from the San Joaquin basin.

Genetic assignments from the rapid genetic testing protocol for WY 2018 are provided in the 2018 Incidental Take Report (Appendix F).

2.4.3 Spring-Run Surrogate Releases

Coleman National Fish Hatchery (CNFH) juvenile late fall-run Chinook salmon are used as surrogates for natural yearling spring-run emigrating from Deer, Mill, and Antelope creeks. These fish are 100% marked with a clipped adipose fin and a unique CWT code before release (Table 2-2). The CNFH late fall-run Chinook salmon are considered appropriate surrogates for yearling spring-run Chinook salmon because they are reared to a similar size to that of wild spring-run yearlings and, to the extent possible, released into the upper Sacramento River based on ambient turbidity and flow events that mimic natural storm events in spring-run Chinook salmon natal streams.

Table 2-2. Summary of all Water Year 2018 CNFH late fall-run Chinook salmon releases, including DOSS input to CNFH on the spring-run surrogate release timing, the dates of hatchery releases, and the number of fish released per release date.

Release Type	DOSS Input	Date Released	Number of Fish Released
Production Release	No DOSS input. When possible, the production release occurs coincident with a rainfall event.	1/5/18	520,000
First Surrogate Release	~3 days after the production release and coincident with a rainfall event.	1/8/18	79,000
Second Surrogate Release	Late December, ideally preceding (by ~3-7 days) a precipitation event and at least a week after the previous surrogate release.	1/19/18	72,000
Third Surrogate Release	Ideally preceding (by ~3-7 days) a precipitation event and at least a week after the previous surrogate release.	1/25/18	72,000

After each release, DOSS tracked the cumulative loss of each spring-run Chinook salmon surrogate group at the CVP and SWP fish salvage facilities in the south Delta to ensure the cumulative percent loss did not exceed the incidental take limit of 1.0% for each individual release group. Cumulative loss exceeding 0.5% of each individual release group would trigger an action response of export reductions as specified in RPA Action IV.3 or more positive OMR flow as specified in RPA Action IV.2.3. In WY 2018, loss of 0.016%, 0.000%, and 0.030% were observed for the first, second, and third spring-run Chinook salmon surrogate release groups, respectively (Table 2-3). Since the percent loss of each of the release groups was less than 0.5%, no action response based on the spring-run surrogate catch was triggered in WY 2018.

Table 2-3. Confirmed hatchery Chinook salmon loss at the SWP and CVP Delta fish salvage facilities.

CONFIRMED HATCHERY (ADIPOSE-FIN CLIPPED) CHINOOK SALMON LOSS AT THE SWP & CVP DELTA FISH FACILITIES as of 4/19/18

Release Date	CWT Race	Hatchery	Release Site	Release Type	Confirmed Loss	Number Released[1]	Total Entering Delta	% Loss of Number Released[2]	% Loss of Total Entering Delta[3]	First Stage Trigger	Date of First Loss[4]	Date of Last Loss[4]
12/21/2017	LF	Coleman NFH	Battle Creek	Production	35.68	297,370	n/a	0.012	n/a	n/a	1/23/2018	4/14/2018
1/5/2018	LF	Coleman NFH	Battle Creek	Production	130.62	519,791	n/a	0.025	n/a	n/a	1/31/2018	3/28/2018
1/8/2018	LF	Coleman NFH	Battle Creek	Spring Surrogate	12.99	78,786	n/a	0.016	n/a	0.5%	1/31/2018	3/26/2018
1/19/2018	LF	Coleman NFH	Battle Creek	Spring Surrogate	0	71,645	n/a	0.000	n/a	0.5%	*	*
1/25/2018	LF	Coleman NFH	Battle Creek	Spring Surrogate	25.68	84,922	n/a	0.030	n/a	0.5%	2/20/2018	3/8/2018
3/1/2018, 3/13/2018	W	Livingstone NFH	Sacramento River	Production	55.4	216,746	n/a	0.026	n/a	0.5%	3/22/2018	4/9/2018
12/21/2017	S	SJRRP	San Joaquin River	Experimental	13.16	1450	n/a	0.908	n/a	n/a	1/11/2018	3/13/2018
1/19/2018	S	SJRRP	San Joaquin River	Experimental	167.35	31184	n/a	0.537	n/a	n/a	3/14/2018	4/13/2018
1/26/2018	S	SJRRP	San Joaquin River	Experimental	253.16	49549	n/a	0.511	n/a	n/a	3/11/2018	4/13/2018
3/2/2018	S	SJRRP	San Joaquin River	Experimental	762	87115	n/a	0.875	n/a	n/a	3/30/2018	4/11/2018

UNCONFIRMED HATCHERY (ADIPOSE-FIN CLIPPED) CHINOOK SALMON LOSS AT THE SWP & CVP DELTA FISH FACILITIES, 2017/2018

Facility	Unknown CWT Loss[5]	Unread CWT Loss[6]	Unknown Hatchery Loss[7]	Acoustic Tag Loss[8]	Number of Unassigned CWTs[9]
SWP	296.14				
CVP	16.02				
TOTAL	**312.16**				

SWP and CVP adipose-fin clipped Chinook lost from 10/1/2017 through 4/19/2018.

[1]Number released with the adipose-fin clipped and a coded-wire tag (CWT).

[2]% Loss of Number Released = (Confirmed Loss/Number Released)*100.

[3]% Loss of Total Entering Delta= (Confirmed Loss/Total Entering Delta)*100.

[4]Date of first and last loss accounts for all CWT loss even those from special studies where salvage and loss=0.

[5]Adipose-fin clipped Chinook was observed during fish count, but tag code could not be determined (e.g., damaged tag, lost tag, no tag, or Chinook released).

[6]Adipose-fin clipped Chinook was collected during fish count and has not been processed yet.

[7]CWT has been read, but hatchery release information not yet available.

[8]Adipose-fin clipped Chinook released due to presence of sutures.

[9]CWT cannot currently be assigned to a salvage record with certainty since the CWT was lost and then found. CWT may be assigned to a salvage record if new information is available.

*** Information not yet available.**

DWR-DES Revised 4/20/2018
Preliminary data from DFW, DWR, FWS, and Reclamation; subject to revision.

2.4.4 Salvage Facility Operations

2.4.4.1 Large Chinook salmon salvaged at the DWR Skinner Fish Facility

In WY 2018, the salvage of Chinook salmon larger than 300 mm FL occurred twice, one large clipped (460 mm FL) and one large natural Chinook salmon (423 mm FL). Both were observed in salvage, at the Skinner Fish Protection Facility. The one large natural fish was expanded to four fish in the expanded salvage counts.

2.4.4.2 Predator/Debris Management Flushes at the DWR Skinner Fish Protection Facility

In WY 2018, the Skinner Fish Protection Facility operators decreased the number of days when secondary predator/debris flushes occurred (n = 52 days) that required interruption of normal salvage operations compared to WY 2017 (n = 73 days). The number of days that operators reduced the minimum count time (30-minute sample for 2 hours of water export) were less (n = 22 days) than in WY 2017 (n = 41 days) (Table 2.4).

During November and December of WY 2018, the frequency of secondary predator/debris flushes at the Skinner Fish Protection Facility increased to up to 7 days per week, Afterwards, these flushes occurred at a much lower rate (0 to 2 flushes per week) in 2018 compared to 3 or more flushes per week often seen in WY 2017.

The overall reduction in flushes that resulted in interrupted salvage operations and reduced count times were probably due to the lower export rates observed in 2018. Historically high export rates in WY 2017 were frequently associated with higher debris loads. Lower export rates also can provide more opportunities to schedule predator/debris flushes during non-export periods or allow alternating fish salvage between the two secondary channels. At higher export rates, the Skinner Fish Protection Facility operators must use both secondary channels to meet louver efficiency criteria. In May and June of 2018, export rates were much lower than at that time in 2017 and operators were better able to conduct salvage counts without needing to resort to reducing sampling times.
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Table 2-4. SWP flushes, salvage interruptions, count time variances and daily exports during WY 2018.

Summary of WY 2018 DOSS Table Results for SWP Flushes, Salvage Interruptions, Count Time Variances and Daily Exports

Prepared by Bob Fujimura on 8/19/18

		SWP reduced counts = percentage of time that routine salvage sample time were less than 30 min per 2 hours of salvage and export operations									SWP daily export in acre-feet								
DOSS Call Date	Reporting Period	Mo	Tu	We	Th	Fr	Sa	Su	Trend	Mean	Mo	Tu	We	Th	Fr	Sa	Su	Trend	Mean
10/23/17	10/15-22/17	0%	0%	0%	0%	0%	0%	0%	→	0%	744	534	442	623	621	533	1,421	↗	703
10/31/17	10/23-29/17	0%			0%	0%	0%	0%	→	0%	3,613	0	0	135	6,913	6,308	5,561	↗	3,219
11/7/17	10/30-11/5/17	17%	0%	0%	0%	0%	0%	17%	↗	5%	4,269	4,540	3,631	3,466	2,430	3,072	2,843	↗	3,464
11/14/17	11/6-12/17	0%	0%	0%	0%	0%	0%	0%	↗	0%	2,847	2,850	4,712	5,578	4,965	5,621	5,691	↗	4,609
11/21/17	11/13-19/17	0%	0%	0%	25%	0%	17%	0%	↗	6%	5,807	6,189	8,807	10,864	11,799	11,791	11,958	↗	9,602
11/28/17	11/20-26/17	0%	0%	8%	0%	0%	0%	0%	↘	1%	11,533	13,019	12,985	13,063	12,718	12,848	11,586	↗	12,536
12/5/17	11/27-12/3/17	0%	8%	0%	0%	0%	0%	0%	→	1%	13,874	14,728	13,259	13,616	13,674	12,800	12,708	↗	13,523
12/12/17	12/4-10/17	38%	21%	0%	0%	0%	0%	0%	↗	8%	12,626	12,040	12,670	13,496	10,733	10,895	10,807	↘	11,895
12/19/17	12/11-17/17	17%	0%	0%	0%	0%	46%	21%	↗	12%	10,446	9,414	6,441	7,772	7,787	5,604	5,936	↘	7,629
12/26/17	12/18-24/17	0%	0%	0%	0%	0%	0%	0%	↘	0%	5,925	6,316	5,815	5,471	5,182	4,858	4,949	↘	5,502
1/2/18	12/25-31/17	0%	0%	0%	0%	0%	0%	0%	→	0%	4,805	4,854	5,609	4,908	7,519	7,971	8,154	↗	6,260
1/9/17	1/1-7/18	0%	0%	0%	0%	0%	0%	0%	→	0%	7,271	7,776	8,546	7,736	6,572	7,036	6,304	↗	7,320
1/16/18	1/8-14/18	0%	0%	0%	0%	0%	0%	0%	→	0%	5,220	5,224	5,158	5,234	5,230	5,775	5,705	↘	5,364
1/23/18	1/14-21/18	0%	0%	0%	0%	0%	0%	8%	↗	1%	5,532	4,479	5,874	6,011	6,350	5,481	5,830	↘	5,651
1/30/18	1/22-28/18	0%	0%	0%	0%	0%	0%	0%	→	0%	5,474	5,478	6,081	5,516	5,910	5,450	5,274	→	5,598
2/6/18	1/29-2/4/18	0%	0%	0%	0%	0%	0%	0%	→	0%	5,037	5,726	7,112	6,001	6,902	6,324	7,200	↗	6,329
2/13/18	2/5-11/18	0%	0%	0%	0%	0%	0%	0%	→	0%	6,139	6,299	7,464	6,915	7,125	6,424	6,287	↗	6,665
2/20/18	2/12-18/18	0%	0%	0%	0%	0%	0%	0%	→	0%	3,446	473	3,622	3,097	2,770	2,257	1,830	↘	2,499
2/27/18	2/19-25/18	0%		0%	0%	0%	0%	0%	→	0%	392	0	809	1,226	2,106	1,761	1,235	↘	1,076
3/6/18	2/26-3/4/18	0%	0%	0%	0%	0%	0%	0%	→	0%	1,551	5,511	8,626	7,938	7,197	6,972	7,057	↘	6,407
3/13/18	3/5-11/18	0%	0%	0%	0%	0%	0%	0%	→	0%	7,258	6,550	6,633	5,149	4,325	3,713	3,927	↘	5,365
3/20/18	3/12-18/18	0%	0%	0%	0%	0%	0%	0%	→	0%	4,165	5,734	5,968	6,758	7,931	6,260	6,988	↘	6,258
3/27/18	3/19-25/18	0%	0%	0%	0%	0%	0%	0%	→	0%	7,706	7,233	7,791	7,631	7,523	7,598	8,532	↗	7,716
	3/26-4/1	0%	0%	0%	0%	0%	0%	0%	→	0%	8,454	9,645	11,169	7,959	12,697	11,336	6,605	↗	9,695
4/10/18	4/2-8/18	0%	0%	8%	0%	0%	0%	0%	↗	1%	6,092	7,316	8,974	9,037	9,146	9,584	8,784	↗	8,419
4/17/18	4/9-15/18	0%	0%	0%	0%	17%	0%		↗	3%	8,394	1,713	2,024	3,289	5,008	4,338	0	↗	3,538
4/24/18	4/16-22/18	0%	0%	0%	0%	0%	0%	0%	↗	0%	886	563	1,379	1,559	1,549	1,371	1,384	↗	1,242
5/1/18	4/23-29/18	0%	0%	0%	0%	0%	0%	0%	→	0%	1,386	1,373	1,381	1,364	680	495	527	↗	1,029
5/8/18	4/30-5/6/18	0%	0%	0%	0%	0%	0%	0%	↗	0%	1,010	1,713	1,206	1,695	1,751	2,099	1,791	↗	1,609
5/15/18	5/7-13/18	0%				0%	0%	0%	→	0%	175	0	0	0	799	1,822	2,464	↗	751
5/22/18	5/14-20/18	0%	0%	10%	0%	0%	0%	12%	↗	3%	2,037	2,680	2,367	444	2,122	2,740	2,551	↗	2,134
5/29/18	5/21-27/18	21%	25%	17%	0%	0%	0%	0%	↗	9%	2,171	2,177	2,834	2,202	2,200	2,184	1,170	↗	2,346
6/5/18	5/28-6/3/18	0%	0%	0%	0%	0%	0%	0%	↘	0%	1,167	1,526	1,349	1,371	2,601	2,235	2,224	↘	1,782
6/12/18	6/4-10/18	0%	0%	10%	8%	25%	0%	0%	↗	6%	2,228	2,257	1,893	2,217	2,138	1,309	1,491	↗	1,933

Yellow highlighted counts indicated dates secondary channel flushes occurred at SWP fish salvage facility during water exports.
Blue highlighted counts indicate dates when major interruptions (> 2 h) of fish salvage facility operations occurred during water exports
Tan highlighted count indicates reduced count due to daylight saving time change
Gray highlighted count indicates brief fish salvage facility interruption occurred

2.4.5 Water Infrastructure Improvement for the Nation Act

In December 2016, Congress passed and the President signed the Water Infrastructure Improvements for the Nation (WIIN) Act[6]. Subtitle J of the WIIN Act relates to California water issues and specifies certain operational changes to the way CVP and SWP water management occurs under the 2008 FWS and 2009 NMFS BiOps on long-term operations of the CVP and SWP. Sections 4001 ("Operations and Reviews"), 4002 ("Scientifically Supported Implementation of OMR Flow Requirements"), and 4003 ("Temporary Operational Flexibility for Storm Events") have the provisions most likely to affect implementation of the Delta actions in the RPA. In May 2018, CVP and SWP utilized Section 4001(b)(7) to adopt a 1:1 inflow to export ratio (I:E ratio) for a transfer of water from the Stanislaus River to south of the Delta. Additional exports of approximately 50 TAF occurred above the 3:1 required ratio to recover water released on the Stanislaus River by local irrigation districts (Oakdale Irrigation District and South San Joaquin Irrigation District) for transfer south of the Delta (Figure 2-1 for May 2018 flows and exports).

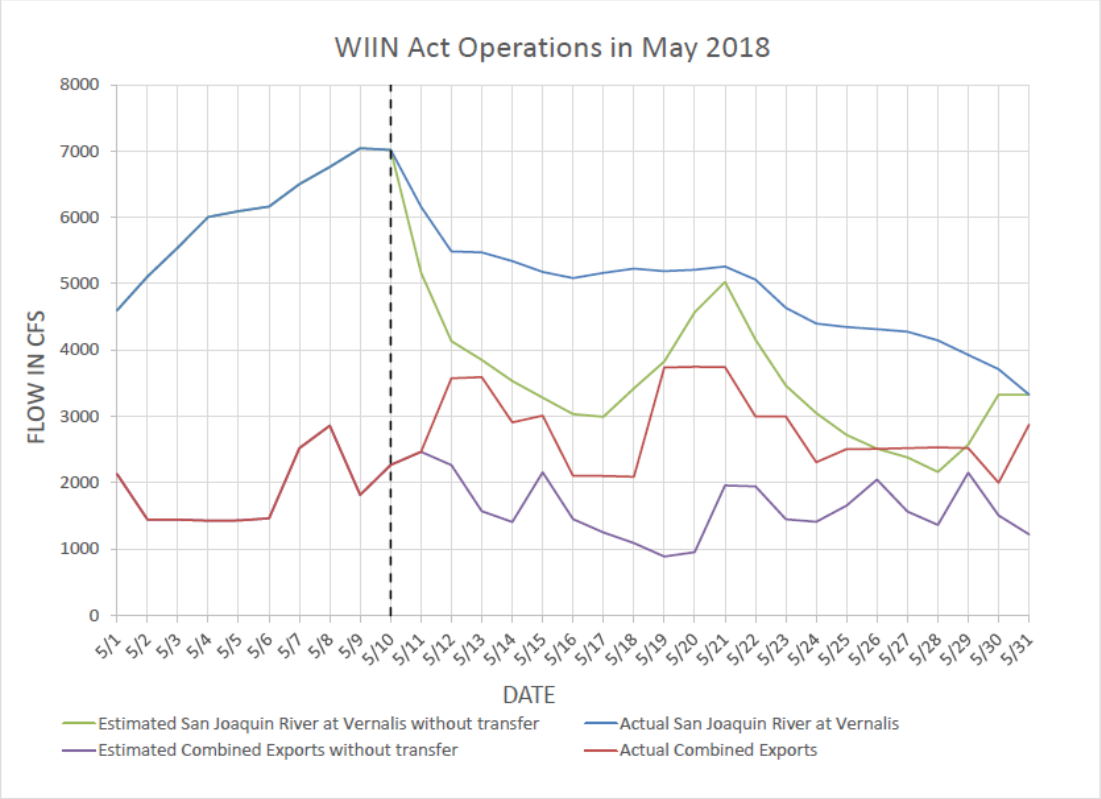

Figure 2-1. Estimated and actual flows in the San Joaquin River at Vernalis and estimated and actual combined Project exports with and without irrigation district water transfers under the WIIN Act for May 2018. The vertical dotted line indicates the start of irrigation districts water transfer on the Stanislaus River.

[6] Text of WIIN Act Bill - 114th Congress December 16, 2016. The "California Water" provisions are in Subtitle J, starting at Section 4001 (the "Enrolled Bill" version has a hotlinked table of contents). Website URL:https://www.congress.gov/bill/114th-congress/senate-bill/612/text

2.4.6 Smelt Working Group

SWG participants who also participated in the DOSS calls provided updates each week from SWG meetings, including advice and the status of any existing or pending determinations from FWS (for delta smelt) and CDFW (for longfin smelt). SWG meeting notes, advice, determinations, and other documentation can be found at: US Fish and Wildlife Service, Smelt Working Group weekly notes[7].

2.4.7 DCC Gate Operations to Reduce Coleman National Fish Hatchery Adult Fall-Run Chinook Salmon Straying

Due to drought and poor in-river conditions in 2013, 50% of CNFH brood year 2013 fall-run production were trucked to the Sacramento-San Joaquin Delta and San Francisco Bay net pen release sites, which resulted in a high level of adult spawner straying observed in the fall of 2016 when those juveniles returned as adults. In the following year 2014, 100% of the CNFH brood year 2014 fall-run production were trucked to San Francisco Bay and Delta net pen release sites and levels of adult spawner straying were anticipated to be higher in the fall of 2017. Based in part on the expected high stray rates, the FWS projected a return of 1,200 – 1,500 spawning pairs to CNFH, which would result in productions of less than half of the 12 million smolt production goal. Consequently, CDFW proposed an additional DCC gate closure as an adaptive measure to assist FWS in obtaining the 3,000 – 3,500 spawning pairs needed to reach the mitigation production goal.

CDFW transmitted a proposal to Reclamation on 9/5/17, to close the DCC gates earlier than required in the NMFS 2009 BiOp and RPA. This request was proposed as an adaptive management action because there are no regulatory requirements for the DCC gates to be closed during September and October. The proposal was accepted and implemented from 9/11/17 through 11/17/17. This closure, which overlapped with the upstream migration of CNFH fall-run, was implemented in order to reduce Sacramento River water olfactory cues through the DCC that may attract CNFH fall-run into the central Delta and San Joaquin tributaries and to assist Reclamation in reaching its annual CNFH mitigation goal of 12 million fall-run smolts for the operations of the CVP's Keswick and Shasta dams. Implementation of Action IV.1.2 of the NMFS 2009 BiOp began on 10/1/17 and continued through 6/15/18, which includes juvenile salmonid triggers that if exceeded, required closure of the DCC gates from October 1 to November 30. FWS and CDFW provided weekly updates on adult Chinook salmon migration and CNFH fall-run production to ensure CNFH fall-run mitigation would be balanced with the need to meet interior Delta water quality and other regulatory requirements. Starting on 9/18/17, the gates were closed through the week and open on weekends (Friday through Monday) for recreational boating. The gates were expected to be open from 11/18/17 through 11/30/17 and closed as of 12/1/17, but due to triggers exceeded for Action IV.1.2 on 11/21/17, the gates were closed as of 11/24/17, and Reclamation made the decision to keep the gates closed through the remainder of November. The gates remained closed from 12/1/17 until 5/25/18, per NMFS' RPA Action IV.1.2 and the requirements of D-1641. From 5/25/17 until 6/15/18, DCC gates were operated on a schedule that had them

[7] Web site URL: https://www.fws.gov/sfbaydelta/CVP-SWP/SmeltWorkingGroup.htm

closed Monday through Thursday of each week, and opened for weekends from Friday morning until Monday morning for recreational boaters.

The rationale for the CDFW's early fall closures not related to the RPA actions is based on Burau et al. (2007) which estimated approximately 45% of the flow measured at Freeport is redirected into the interior Delta through the DCC and Georgiana Slough, which then drains into the San Joaquin River near River Mile 22. When the gates are open, net water flow is conveyed into Snodgrass Slough and the Mokelumne River. Although this channel is heavily influenced by tides, tidal stage and river flow determine the magnitude and timing of flows that enter the DCC from the Sacramento River (Horn and Blake 2004). Maximum flows through the DCC occur during the incoming flood tide when increasing Sacramento River flows get redirected into the DCC. This redirection of Sacramento River water and associated olfactory cues is hypothesized to lead to significant straying of Sacramento River origin fish into central and south Delta tributaries.

As of 11/4/17, CNFH had spawned 1,419 pairs, which included spawned pairs from additional trapping efforts at Keswick Dam and CNFH crosses spawned at Nimbus Fish Hatchery. Including eggs from CNFH strays into the Nimbus Fish Hatchery and the additional spawning pairs trapped at Keswick Dam, the total estimated egg take was approximately seven million eggs. CNFH produced approximately 5,513,799 fall-run Chinook salmon for WY 2018, and preliminary analyses of adult returns into the Mokelumne Fish Hatchery implicate a reduction in straying into the south Delta compared to adult spawner straying rates in WY 2016.

Chapter 3 WY 2018 OPERATIONS SUMMARY

3.1 Water Year 2018

The final WY 2018 hydrologic year type in the Sacramento River basin and San Joaquin River basin were both classified as Below Normal based on the May runoff forecast. Both basins, however, started WY 2018 (based on the previous year's year type) as Wet. The Sacramento basin year type shifted to Above Normal based on the January 2018 forecast, to Below Normal based on the February 2018 forecast, to Dry based on the March 2018 forecast, and back to Below Normal based on the April 2018 forecast. The San Joaquin basin year type shifted to Dry based on the January 2018 forecast, to Critical based on the March 2018 forecast, and to Below Normal based on the April 2018 forecast.

A summary of WY 2018 operations and factors controlling CVP/SWP exports is provided in Appendix A; some summary operations charts are provided below in Figures 3.1, 3.2, 3.3, and 3.4.

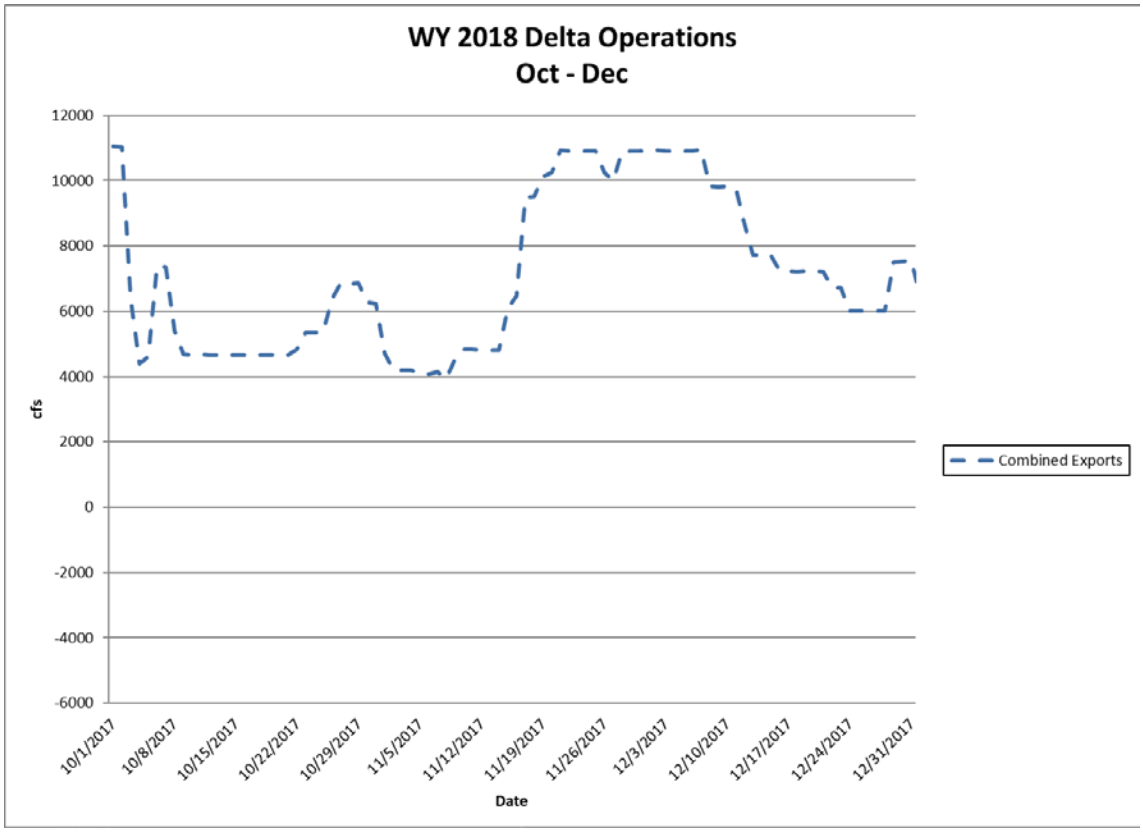

Figure 3-1. Combined exports at the CVP and SWP from October through December 2017.

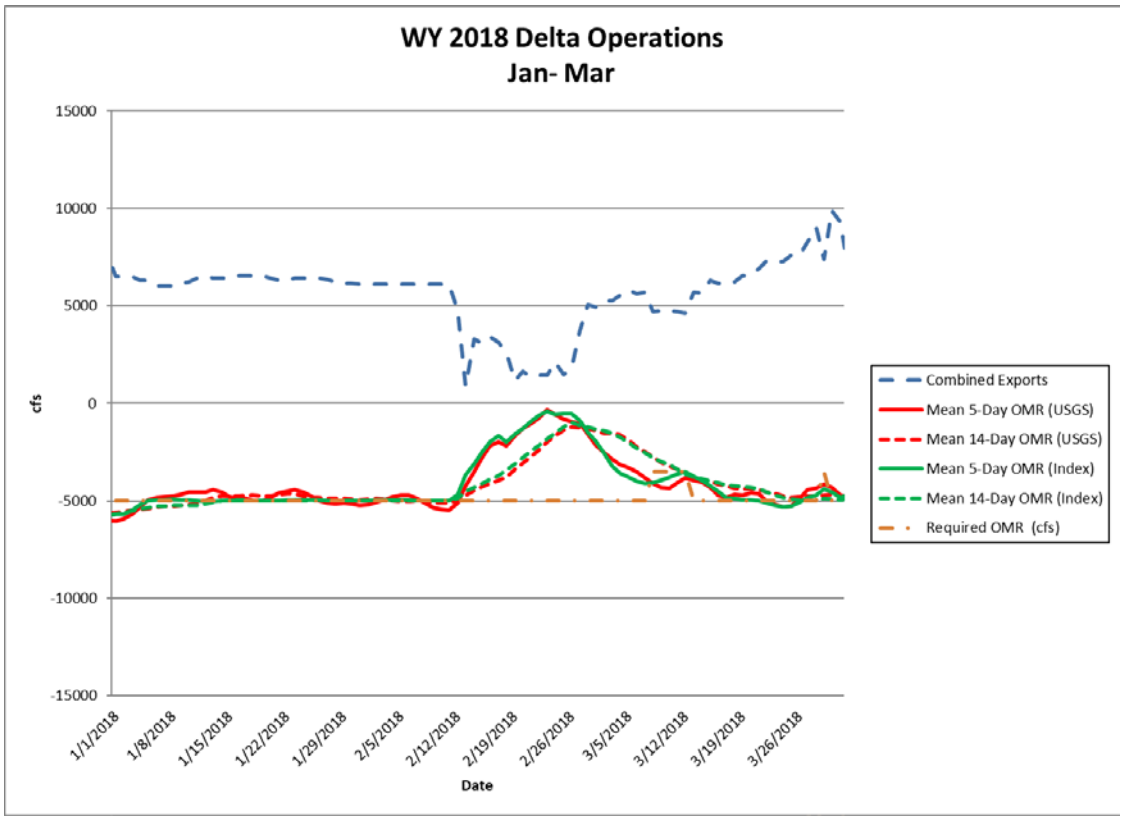

Figure 3-2. Combined exports at the CVP and SWP and Old and Middle river flows using the calculated index method and USGS gaged flows from January through March 2018.

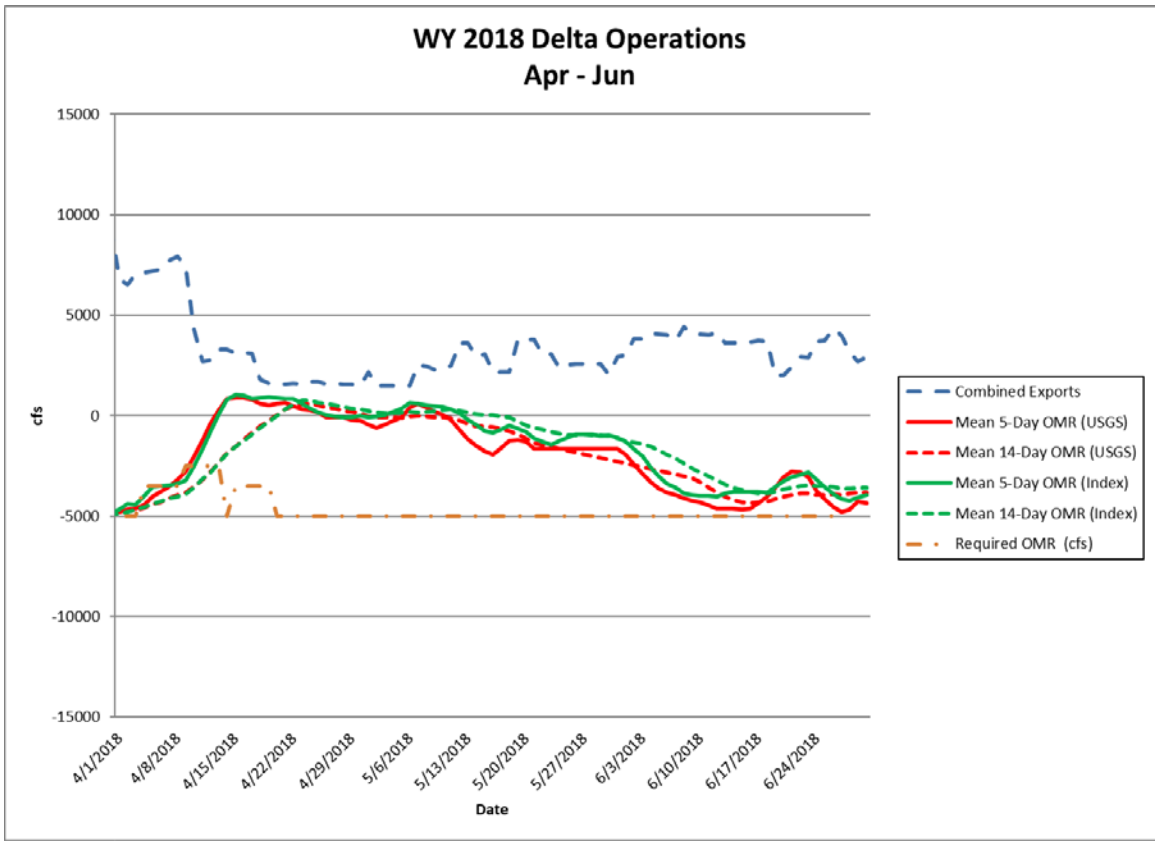

Figure 3-3. Combined exports at the CVP and SWP and Old and Middle river flows using the calculated index method and USGS gaged flows from April through June 2018.

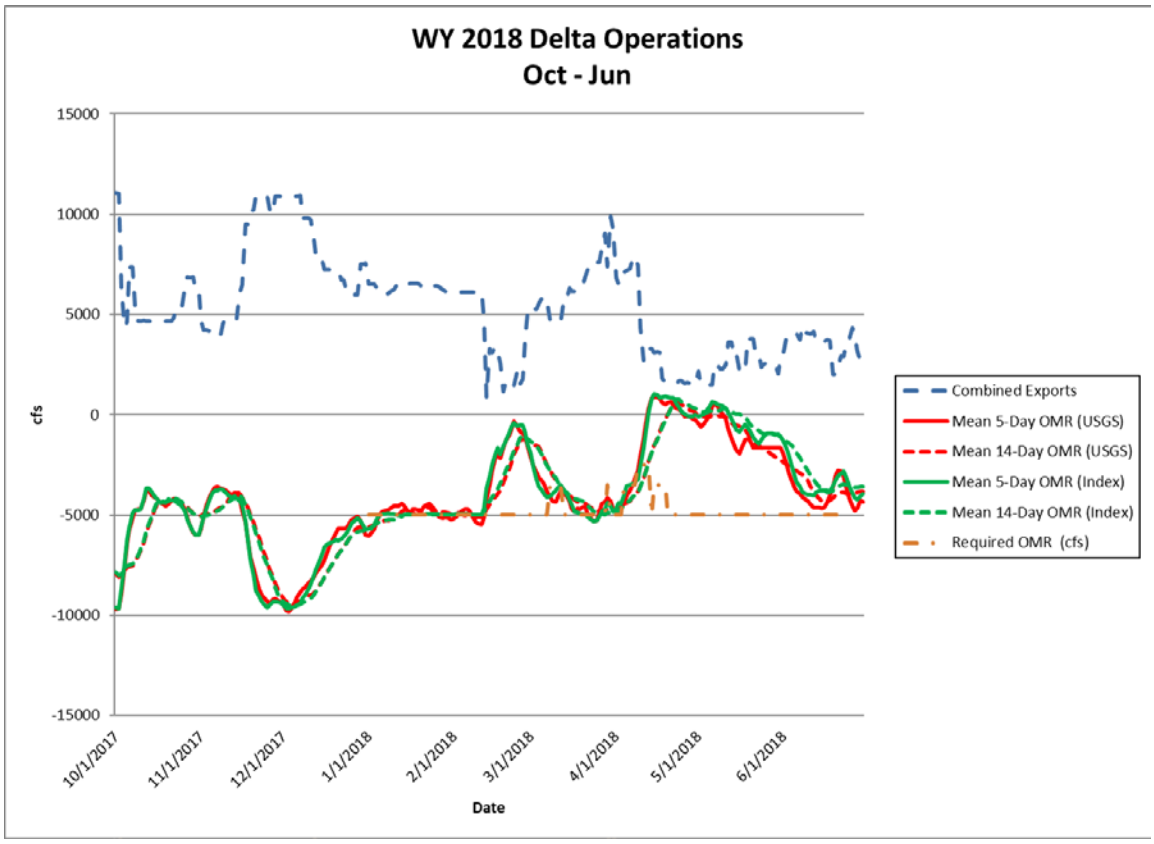

Figure 3-4. Combined exports at the CVP and SWP and Old and Middle river flows using the calculated index method and USGS gaged flows from October 2017 through June 2018.

Chapter 4 MONITORING ACTIVITIES

4.1 WY 2018 Incidental Take Report

The WY 2018 Incidental Take Report, included as Appendix F, is a document prepared by DWR and Reclamation that provides a detailed summary of incidental take during WY 2018 at the CVP and SWP fish salvage facilities in the south Delta.

4.2 WY 2018 Monitoring Summary

4.2.1 WY 2018 Overview

Section 11.2.1.3., "Reporting and Monitoring," of the 2009 RPA with 2011 amendments, provides specific guidelines for fish monitoring and reporting. From October to mid-June, DOSS meets weekly and reviews a suite of fish monitoring information, which is summarized in the DOSS notes[8]. Some key monitoring data include:

- Chipps Island Midwater trawls
- Sacramento River Kodiak trawls
- Beach seines
- Knights Landing rotary screw traps
- Tisdale rotary screw traps
- GCID rotary screw traps
- Mossdale Kodiak trawls
- Butte Creek Fyke and RST

In WY 2018, in addition to the location-specific monitoring datasheets posted online or distributed via e-mail, DOSS used two web-based tools to support our review of fish monitoring and hydrologic data:

- Bay Delta Live: Bay Delta Live website [9]
- Sacramento Prediction & Assessment of Salmon (SacPAS) website available at: SacPAS website [10]

Bay Delta Live includes a "DOSS Dashboard" (click on the "Fisheries" tab, then "Triggers and Indices" tab at the link given above) that summarizes monitoring catch and data over the past week, calculates and compiles recent catch indices and flow alerts relevant for DCC operations, and compiles recent hydrologic and water operations data (including salvage) for convenient review by the DOSS group.

[8] WY 2018 DOSS notes are available at: NMFS Weekly DOSS Notes WY 2018 . Website URL: https://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/ocapwy2018.html
[9] Bay Delta Live website URL: https://www.baydeltalive.com/djfmp
[10] SacPAS website URL: http://www.cbr.washington.edu/sacramento/

SacPAS is a web-based application that queries repositories of data from monitoring programs and integrates monitoring results in a single, publicly-accessible website. Real-time data were available for six out of the eight monitoring areas listed earlier in this section (RST data from GCID were not available in real-time).

Summary figures of winter-run Chinook salmon, spring-run Chinook salmon, and steelhead cohort monitoring at the six real-time areas are presented in Figures 4-1 through 4-3 below. In addition, fish monitoring data at the six real-time areas were plotted to track three categories of fish: unmarked older juvenile Chinook salmon, unmarked fry/smolt Chinook salmon, and unmarked steelhead. These figures plotted fish catch/passage from each monitoring area along with environmental variables associated with fish migration cues, including temperature (°C), flow (cfs), and turbidity (NTU/FTU). The additional figures can be found in Appendix G, Figure G-1 through Figure G-21. Collectively, the plots of data from the monitoring areas were used by DOSS to assess movement, timing, and distribution of fish from the upper Sacramento River to the Delta, from the San Joaquin River to the Delta, and the number of fish exiting the Delta. These assessments, along with other available data, were used to produce DOSS' weekly distribution estimates of listed salmonids and to determine the entrainment risk for the interior Delta and the CVP and SWP fish salvage facilities.

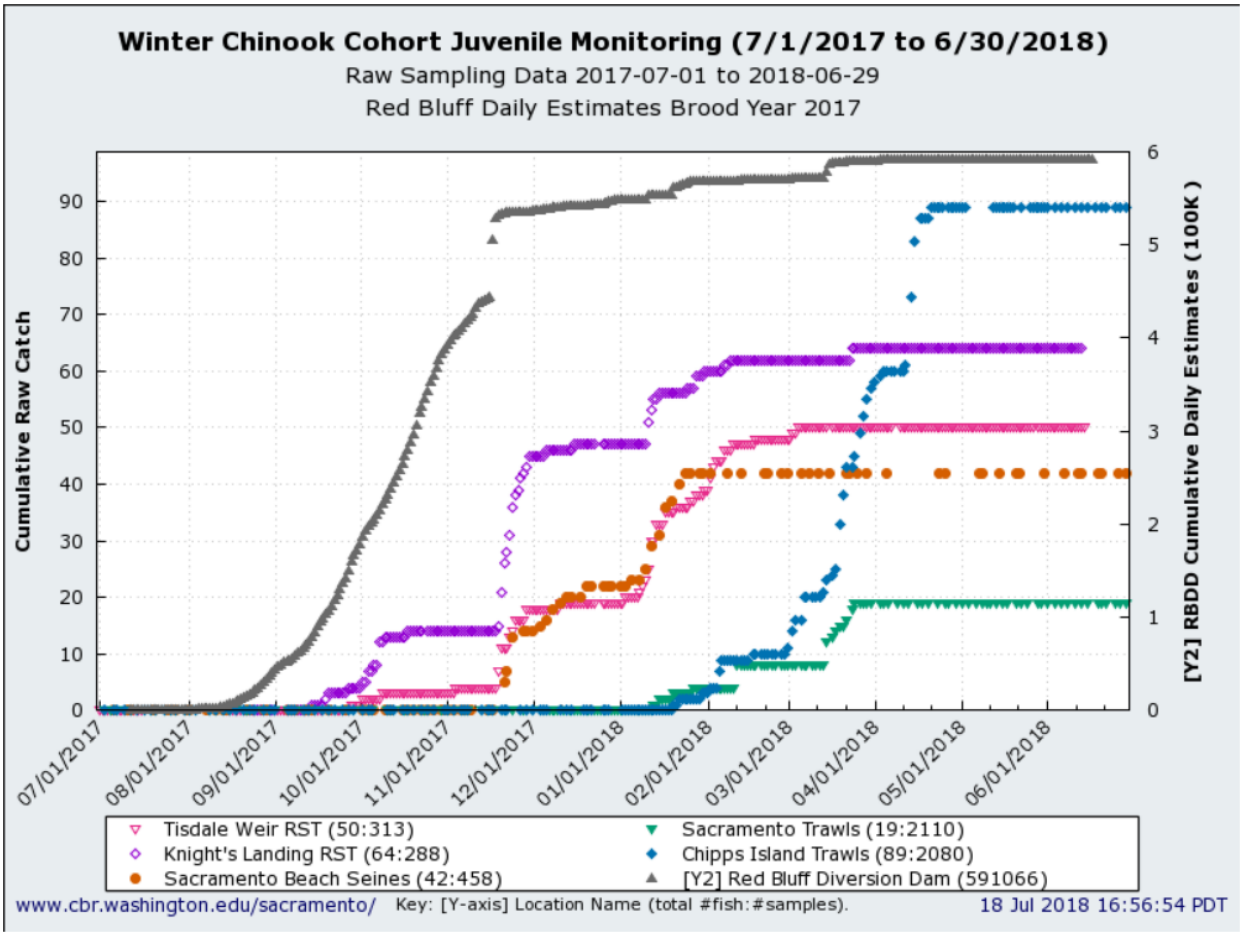

Figure 4-1. Cumulative catch of brood year 2017 juvenile winter-run Chinook salmon at six monitoring locations: Red Bluff Diversion Dam, Tisdale Weir, Knights Landing, Sacramento Beach Seine sites, Sacramento Trawl sites, and Chipps Island Trawl sites for Water Year 2018.

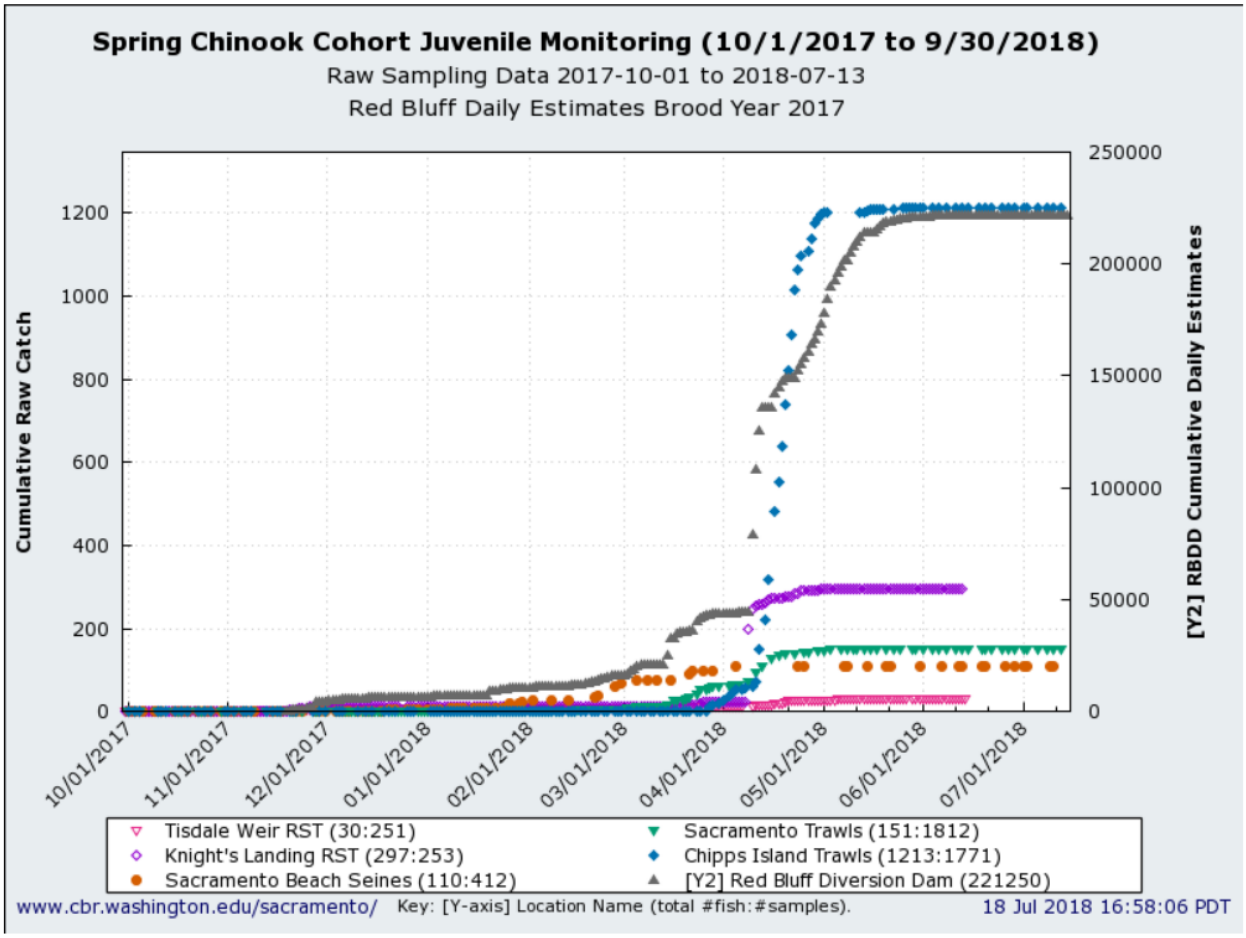

Figure 4-2. Cumulative catch of brood year 2017 juvenile spring-run Chinook at six monitoring locations: Red Bluff Diversion Dam, Tisdale Weir, Knights Landing, Sacramento Beach Seine sites, Sacramento Trawl sites, and Chipps Island Trawl sites for Water Year 2018.

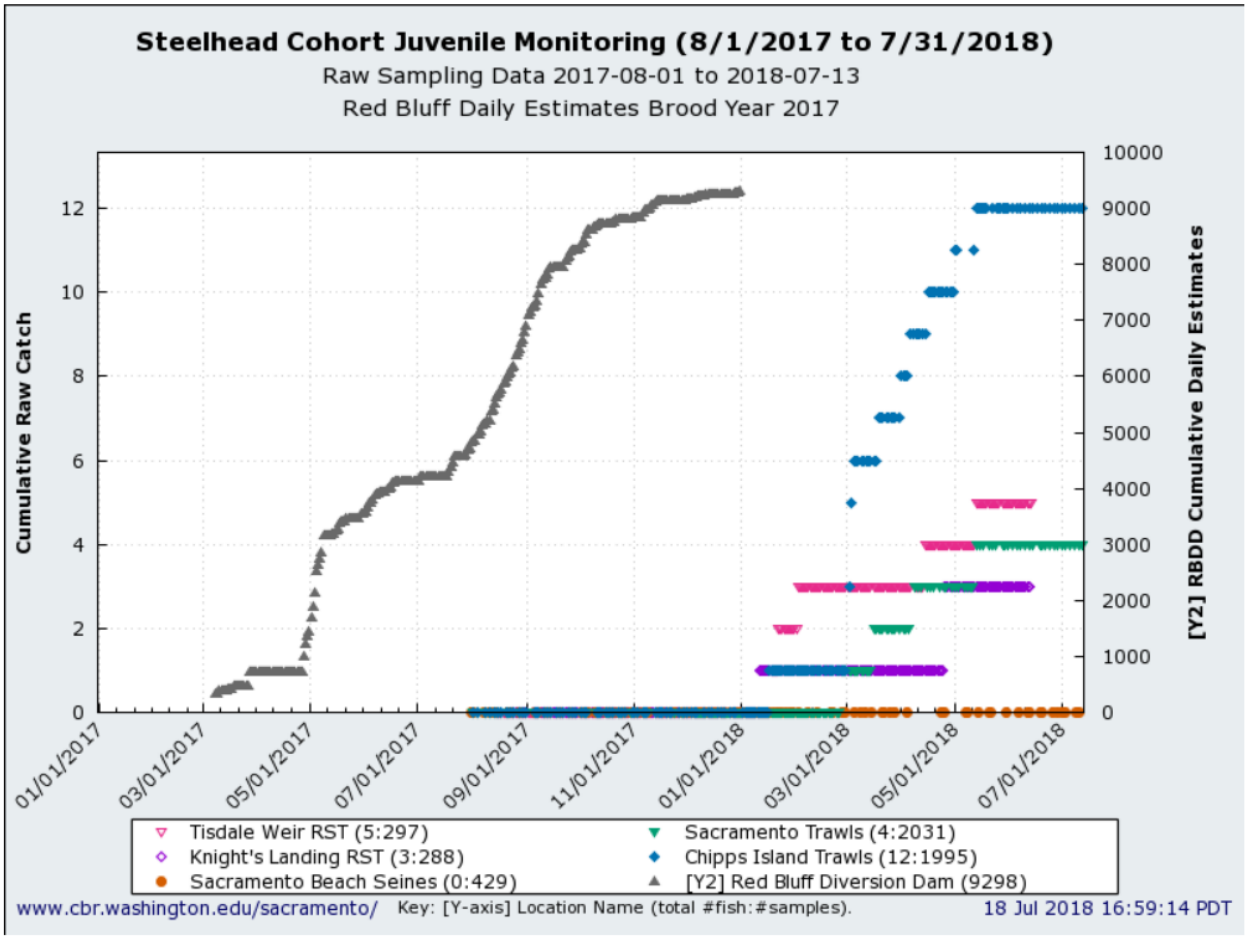

Figure 4-3. Cumulative catch of juvenile steelhead at six monitoring locations: Red Bluff Diversion Dam, Tisdale Weir, Knights Landing, Sacramento Beach Seine sites, Sacramento Trawl sites, and Chipps Island Trawl sites for Water Year 2018.

4.2.2 Acoustic tracking

During WY 2018, NOAA's Southwest Fisheries Science Center (SWFSC) shared with DOSS preliminary acoustic tracking results from a variety of releases of acoustic-tagged Chinook salmon in the Sacramento River watershed. The SWFSC, in conjunction with other state and Federal agencies, hosted a publically-accessible website that provided preliminary information in both tabular and graphic formats. Website available at: Central Valley Enhanced Acoustic Tagging Project website [11].

DOSS tracked the LSNFH release of acoustic-tagged hatchery winter-run Chinook most closely, since those fish served as "tracers" for the hatchery winter-run production release, a basis for one of the loss-density triggers in Action IV.2.3. Information on other releases was of interest mainly for information on travel times from the release point.

Unless noted otherwise, the preliminary results reported below represent daily tag detections at the telemetered acoustic receivers in the Sacramento River at the Tower Bridge and I-80/Hwy 50 Bridge in Sacramento and receivers farther downstream within Georgiana Slough. Two releases of hatchery winter-run Chinook salmon occurred; the first on 3/1/18, and the second one on 3/13/18. Both releases were made at the Bonnyview release site in Redding, California. See Tables 4-1 through 4-5 and Figure 4-4 for details of detections in the lower Sacramento River near the city of Sacramento. Data are preliminary and the tabulated results may change in light of future analysis of the acoustic tag receiver data. The website was last accessed on October 15, 2018, and no new updates have been made since the end of the field study in June 2018.

Table 4-1. Summary data for Acoustically-Tagged Hatchery Origin Winter-Run Chinook salmon.

Release Time	Number of Fish Released	Release Location	Release river kilometer (rkm)	Mean Length (mm)	Mean Weight (gms)
2018-03-01 17:50:00	361	Bonnyview_Release site	540.258	111.9	16.5
2018-03-13 18:00:00	239	Bonnyview_Release site	540.258	97.5	10.7

Table 4-2. Minimum Survival of Acoustically-Tagged Hatchery Origin Winter-Run Chinook Salmon to Tower Bridge (using CJS survival Model).

Release Group	Survival %	SE	95% lower C.I.	95% upper C.I.	Detection Efficiency (%)
All	23.2	1.8	19.9	26.9	85.6

[11] Central Valley Enhanced Acoustic Tagging Project website URL: https://calfishtrack.github.io/real-time/index.html

Release Group	Survival %	SE	95% lower C.I.	95% upper C.I.	Detection Efficiency (%)
2018-03-01 17:50:00	20.7	2.2	16.8	25.3	NA
2018-03-13 18:00:00	26.9	3.0	21.4	33.2	NA

Table 4-3. Detections for all release groups of Acoustically-Tagged Hatchery Origin Winter-Run Chinook Salmon combined.

General Location	First Arrival	Mean Arrival	Fish Count	Percent Arrived	rkm
Tower Bridge	2018-03-08 01:12:56	2018-03-15 18:12:13	119	19.83	172.000
I80-US 50 Bridge	2018-03-08 01:58:18	2018-03-18 02:57:08	104	17.33	170.748
Georgiana Slough	2018-04-19 13:38:35	2018-04-19 13:47:56	1	0.17	119.208

Table 4-4. Detections for the 2018-03-01 Release Group of Acoustically-Tagged Hatchery Origin Winter-Run Chinook Salmon.

General Location	First Arrival	Mean Arrival	Fish Count	Percent Arrived	rkm
Tower Bridge	2018-03-08 01:12:56	2018-03-15 13:24:40	70	19.39	172.000
I80-US 50 Bridge	2018-03-08 01:58:18	2018-03-15 12:47:22	63	17.45	170.748
Georgiana Slough	2018-04-19 13:38:35	2018-04-19 13:47:56	1	0.28	119.208

Table 4-5. Detections for the 2018-03-13 Release Group of Acoustically-Tagged Hatchery Origin Winter-Run Chinook Salmon.

General Location	First Arrival	Mean Arrival	Fish Count	Percent Arrived	rkm
Tower Bridge	2018-03-19 04:57:22	2018-03-28 20:27:46	49	20.50	172.000
I80-US 50 Bridge	2018-03-18 11:46:10	2018-03-27 15:15:04	41	17.15	170.748

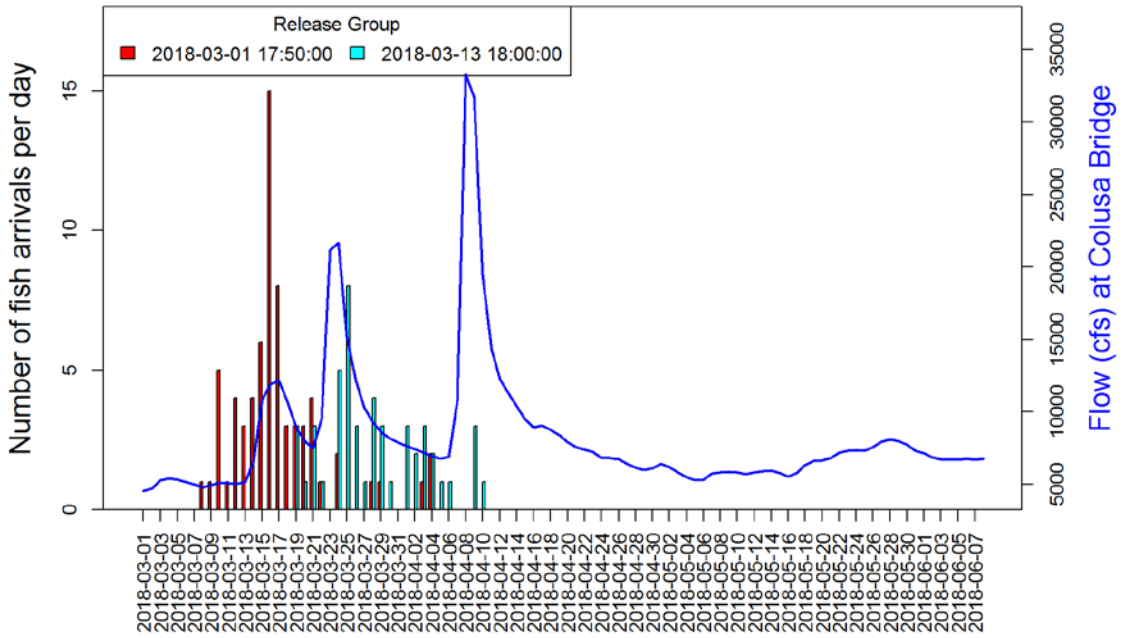

Figure 4-4. Detections of Acoustically-Tagged Hatchery Origin Winter-Run Chinook Salmon at Tower Bridge (downtown Sacramento) versus Sacramento River flows at Colusa Bridge.

4.2.3 WY 2018 Monitoring Gaps

4.2.3.1 Red Bluff Diversion Dam Rotary Screw Traps

The majority of monitoring gaps at the RBDD RSTs during WY 2018 were due to high runoff events with concurrent heavy debris loading on the screens of the RST, high catches of hatchery Chinook salmon following upstream hatchery releases, or holidays. Table 4-6 lists the gaps in sampling at the RBDD RST.

Table 4-6. Biweekly sampling history during WY 2018 at the Red Bluff Diversion Dam Rotary Screw Traps during the period of weekly DOSS calls.

Biweekly Sampling Dates	Gap in sampling (days)	Date(s) of no sampling	Primary Reason for no Sampling
9/24-10/7	No gap		
10/8-10/24	No gap		
10/25-11/4	No gap		
11/5-11/18	No gap		
11/19-12/2	3 days	11/23, 24, 27	11/23-24—Holiday; 11/27-storm debris

Biweekly Sampling Dates	Gap in sampling (days)	Date(s) of no sampling	Primary Reason for no Sampling
12/3-12/16	No gap		
12/17-12/31	3 days	12/24-26	12/24-26—Holiday
1/1-1/14	4 days	1/1, 2, 7, 10	1/1-2—Holiday; 1/7—storm/limited personnel; 1/10—sample attempted but compromised
1/15-1/28	2 days	1/19, 21	1/19—storm event; 1/21—elevated fish numbers and debris loads (unable to obtain sample without negatively impacting fish)
1/29-2/11	No gap		
2/12-2/25	No gap		
2/26-3/11	No gap		
3/12-3/25	1 day	3/23	High flow event (>20 k flows) with elevated debris loads
3/26-4/8	3 days	4/5, 7, 8	4/5—compromised sample due to debris/cone stoppage; 4/7—High flow and heavy debris; 4/8—Hatchery release (~4 million FCS)
4/9-4/22	6 days	4/9, 14, 15, 16, 21, 22	All these dates cones were raised due to hatchery releases to lessen impacts
4/23-5/6	1 day	4/23	Cones raised due to hatchery releases
5/7-5/20	4 days	5/9, 15, 16, 17	5/9—staffing restrictions; 5/15-17—staffing restrictions
5/21-6/3	2 days	5/29, 31	Both of these days samples were attempted but compromised due to debris/flow conditions in the live box
6/4-6/17	No gap		

For the purposes of DOSS, RBDD RST data are used in conjunction with other downstream sampling sites to track movement of juvenile salmonids through the Sacramento River. While the monitoring gaps at RBDD occurred during the outmigration of ESA-listed salmonids, DOSS generally had information from RSTs downstream (GCID, Tisdale, or Knights Landing) and so had information to assess distribution of ESA-listed species in the Sacramento River. Because RBDD data are not used as the basis for any alert or trigger in the NMFS 2009 BiOp, no RPA implementation was impacted by sampling gaps at RBDD.

4.2.3.2 Glenn Colusa Irrigation District Rotary Screw Trap

Sampling at the GCID RST was suspended relatively frequently for much of WY 2018 (Table 4-7). Sampling gaps from October through April were primarily due to heavy debris or log jams in the RST. Sampling gaps in December and January and again in March and April were due to debris and hatchery releases of Chinook salmon.

Table 4-7. Number of days per month during WY 2018 that sampling was suspended at the GCID rotary screw trap.

Month	# Days without sampling	Dates of no/ reduced sampling	Primary reason
October	3	10/29-31	No sampling, no reason reported
November	11	11/1-10, 11/22	11/1-10 No sampling, no reason reported; 11/22 log jam
December	4	12/11, 12/24-12/26	12/11 annual fish screen inspection; 12/24-12/26 high volume of hatchery LFR Chinook salmon and debris
January	9	1/4 – 1/11, 1/13	1/4 -1/11 reduced sampling due to high catch of hatchery LFR Chinook salmon; 1/13 log jam in cone
February	0	No gaps	
March	21	3/4 -3/10, 3/13 – 3/27	3/4 – 3/11 and 3/13 -3/27 no sampling due to hatchery WR Chinook salmon releases
April	17	4/4-4/5, 4/6 -4/16, 4/21 – 4/25, 4/29	4/4 -4/5 log jams in cone; 4/6 – 4/16 high flows; 4/21 -4/25 hatchery FR Chinook salmon release; 4/29 Malfunction of RST
May	4	5/11, 5/13, 5/14, and 5/29	5/11 high winds and debris; 5/13 heavy debris; 5/14 heavy debris, FR hatchery Chinook salmon release
June	0	No gaps	
July	7	7/3 - 7/9, and 7/18	7/3 – 7/9 Debris; 7/18 log jam in cone
August	0	No gaps	
September	0	No gaps	

For the purposes of DOSS, GCID is used in conjunction with other sampling sites, both upstream and downstream, to track movement of juvenile fish movement through the Sacramento River. While the monitoring gaps at GCID occurred during the outmigration of ESA-listed salmonids, DOSS generally had some information from RSTs upstream (from RBDD) or downstream (Tisdale or Knights Landing) during at least part of the time the GCID RSTs were not sampling and so had information to assess distribution of ESA-listed species in the Sacramento River. Because GCID data are not used as the basis for any alert or trigger in the NMFS 2009 BiOp, no RPA implementation was impacted throughout this period.

4.2.3.3 Tisdale Rotary Screw Traps

Trapping at the Tisdale RSTs for the 2017-18 season began on 8/15/17. The cumulative sum of hours of trap operations during the season are presented in Table 4-8 using the information provided in the biweekly summary reports for the Tisdale RST. Website available at: Tisdale RST Biweekly Reports[12]

Table 4-8. Operations of the Tisdale Rotary Screw Trap for each biweekly reporting period during the 2017-2018 monitoring season.

Biweekly Reporting Date	Gaps in Monitoring (days)[13]	Cumulative Hours Sampled Per Biweekly Period	Percentage of Available Hours Sampled[14]
8/15 - 8/31/17	0	585	77.0
9/1 - 9/15/17	0	533	74.0
9/16 - 9/30/17	0	671	95.0
10/1 – 10/15/17	0	566.1	79.0
10/16 - 10/31/17	0	533.1	70.0
11/1 – 11/15/17	0	622	84.6
11/16 – 11/30/17	0	476.5	67.8
12/1 – 12/15/17	0	607	84.6
12/16 – 12/31/17	2 (12/24-12/25/17)	545.2	71.2

[12] The Tisdale Biweekly Reports are available at the following URL: http://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/SacramentoValleyTributaryMonitoring/MiddleSacramentoRiverSalmonandSteelheadMonitoring.aspx

[13] Gaps in monitoring days is determined by the lack of data for a given day (24 hour period). There are many days in which periods of non-sampling occur due to malfunctions or maintenance of the RSTs, and only partial sampling occurs for the rest of the 24-hour period. These were not counted as gaps in the monitoring.

[14] Sampling hours are estimated from the number of revolutions the trap made over the fishing period and the speed of rotation measured by field crews. The estimated sampling hours are divided by the number of hours between trap servicing and presented as a percentage of time sampled.

Biweekly Reporting Date	Gaps in Monitoring (days)[13]	Cumulative Hours Sampled Per Biweekly Period	Percentage of Available Hours Sampled[14]
1/1 -1/15/18	0	619.9	86.3
1/16 - 1/31/18	0	719.8	94.0
2/1 -2/15/18	0	628.4	87.2
2/16 -2/28/18	0	625.5	71.3
3/1 – 3/15/18	0	717.5	76.4
3/16 - 3/31/18[a]	1 (3/17/18)	715.5	60.1
4/1 – 4/15/18	2 (4/9 – 4/10/18)	621	58.5
4/16 – 4/30/18	0	334.1	45.0
5/1 -5/15/18	0	498.4	69.0
5/16 – 5/31/18	2 (5/19/18, 5/28/18)	460.7	62.8
6/1 – 6/15/18[b]	ND	ND	ND

[a] Traps were run at half cones for the period of 3/21 to 3/24/18
[b] As of 10/1/2018, the biweekly report for the period of 6/1 to 6/15/18 has not been posted to the website.

The biweekly monitoring reports state that stoppages of the Tisdale RST were due to trap malfunctions and/or maintenance of the traps, which reduced the total number of hours that the traps were actively fished.

The traps were pulled for the season on 6/14/18 due to high water temperatures not suitable for handling salmonids. For the purposes of DOSS, Tisdale RST data are used in conjunction with data at other sampling sites, both upstream and downstream to track movement of juvenile fish emigration through the Sacramento River. Because Tisdale data are not used as the basis for any alert or trigger in the NMFS 2009 BiOp, no RPA implementation was impacted throughout this period.

4.2.3.4 Knights Landing Rotary Screw Traps

Trapping at the Knights Landing RSTs was initiated on 8/25/17 and continued through the juvenile emigration period with only brief interruptions in monitoring primarily due to increases in river flow and heavy debris loading. The two days in December in which sampling did not occur did not impact the implementation of the NMFS BiOp, since the DCC gates were already closed. Likewise the 3 days in April did not affect DCC gate operations since they were already closed due to implementation of the NMFS BiOp and D-1641 requirements. The cumulative sum of hours of trap operations during the season are presented in the following table (Table 4-9) using the

information provided in the biweekly summary reports for the Knights Landing RST. Website available at: Knights Landing RST Biweekly Reports[15]

Table 4-9. Operations of the Knights Landing Rotary Screw Trap for each biweekly reporting period during the 2017 -2018 monitoring season.

Biweekly Reporting Date	Gaps in Monitoring (days)[16]	Cumulative Hours Sampled Per Biweekly Period	Percentage of Available Hours Sampled[17]
8/25 – 8/31/17	0	181.8	55.0
9/1 – 9/15/17	3 (9/3, 9/4, /9/5/17)	398.7	68.5
9/16/ - 9/30/17	0	606	84.7
10/1 – 10/15/17	0	615	84.8
10/16 – 10/31/17	0	615	87.0
11/1 – 11/15/17	0	562	78.2
11/16/ - 11/30/17	0	421	61.3
12/1 – 12/15/17	0	605	84.3
12/16 – 12/31/17	2 (12/24, 12/25/17)	477	71.1
1/1 – 1/15/18	0	640	89.0
1/16 – 1/31/18	0	585	76.0
2/1 -2/15/18	0	634	87.7
2/16 -2/28/18	0	537	87.0
3/1 – 3/15/18	0	525	73.0
3/16 – 3/31/18	0	449	59.3

[15] The Knights Landing RST Biweekly Report are available at the following URL: http://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyMonitoring/SacramentoValleyTributaryMonitoring/MiddleSacramentoRiverSalmonandSteelheadMonitoring.aspx:

[16] Gaps in monitoring days is determined by the lack of data for a given day (24 hour period). There are many days in which periods of non-sampling occur due to malfunctions or maintenance of the RSTs, and only partial sampling occurs for the rest of the 24-hour period. These were not counted as gaps in the monitoring.

[17] Sampling hours are estimated from the number of revolutions the trap made over the fishing period and the speed of rotation measured by field crews. The estimated sampling hours are divided by the number of hours between trap servicing and presented as a percentage of time sampled.

Biweekly Reporting Date	Gaps in Monitoring (days)[16]	Cumulative Hours Sampled Per Biweekly Period	Percentage of Available Hours Sampled[17]
4/1 – 4/15/18	3 (4/5, 4/6, 4/7/18)[a]	272 (full cone) 149 (half cone)	58.4
4/16 – 4/30/18	0	220	52.3
5/1 -5/15/18[b]	ND	ND	ND
5/16 – 5/31/18[b]	ND	ND	ND
6/1 – 6/15/18[b]	ND	ND	ND

[a] High flows on the Feather River on 4/5, 4/6, and 4/7/18 created a back-water flow condition at the Knights Landing RST location that prevented the traps from working correctly. No data were collected for these days.

[b] As of 10/1/18, biweekly reports have not been posted to the website for 5/1/18 through 6/15/18.

Monitoring was suspended on 6/14/18 due to observed daily average river water temperatures greater than 72°F that exceeded the safe handling range[18]. Because Knights Landing data are not used as the basis for any alert or trigger in the NMFS 2009 BiOp during June, this suspension of sampling for the season did not have an impact on the implementation of Action IV.1.2.

4.2.3.5 Delta Juvenile Fish Monitoring Program

FWS's Delta Juvenile Fish Monitoring Program (DJFMP) includes the Sacramento Trawl, Mossdale Trawl, Chipps Island Trawl, and beach seine sampling. For the purposes of DOSS, during October and November, the Sacramento Trawl and Sacramento beach seine data are used to calculate two of the catch indices that may trigger DCC gate closures under Action IV.1.2 of the NMFS 2009 BiOp. From December 1 through 15, the catch indices related to the Sacramento beach seines and the Sacramento trawl are used in determining whether the DCC gates should remain closed or potentially opened to alleviate water quality concerns as described under Action IV.1.2 of the NMFS 2009 BiOp. In WY 2018, the DCC gates remained closed during this period. DJFMP data are used throughout the year in conjunction with other upstream monitoring sites, to track the movement of juvenile fish emigration through the Delta. DOSS utilizes this information to help inform the discussion of the weekly fish distribution estimates.

During WY 2018, there were few instances in which DJFMP monitoring efforts were cancelled. These gaps in sampling typically were due to unsafe weather or river conditions that placed crews at risk or mechanical issues with vessels.

[18] The current protocol for monitoring programs at Knights Landing and Tisdale states: "To avoid stress to captured fish, no handling of fish will occur when daily average water temperatures are greater than 72°F. Instantaneous water temperatures will be monitored by staff as well to ensure handling of fish is only conducted when temperatures are 72°F or below. Fish monitoring activities will cease when daily water temperatures average 74°F or greater."

4.3 Review of DOSS's weekly distribution estimates

Since WY 2014, DOSS has provided weekly estimates of the distribution of ESA-listed salmonids based on review of the weekly fish monitoring data and other related data (e.g., hydrology, water temperatures, hatchery releases). These estimates, in combination with information provided from regional monitoring programs, are intended to give managers and stakeholders[19] an overview of salmonid distribution, and particularly to note when ESA-listed salmonids are present in the Delta. The assessment of salmonid distribution was categorized in three following geographic "bins" that add up to 100%: *Yet to enter the Delta (roughly above Knights Landing on the Sacramento River), In Delta,* and *Exited the Delta (past Chipps Island in the western Delta).* During each weekly call, members discussed the various factors influencing fish migration and reviewed monitoring data to estimate the percentage for each category.

DOSS weekly estimates for the proportion of salmonids in each of the three geographic bins are provided in Appendix H. Details about each week's estimates can be found in the associated DOSS notes[20].

DOSS has generated comparisons of the weekly DOSS estimates to comparable monitoring data. DOSS acknowledges that monitoring data are estimates of the fractional population passage at each monitoring location, and these comparisons have some complications based on the LAD run identification used to assign individuals to Chinook salmon run (*e.g.*, potential misclassifications of unmarked hatchery fall-run as wild YOY spring-run Chinook). Acknowledging those uncertainties, Figures 4-5 through 4-7 provide a visual comparison of the full season of DOSS weekly estimates and monitoring trends.

DOSS agreed to adjust high catch numbers (of natural-origin Chinook salmon) in monitoring data that are likely (in part) due to fall-run hatchery releases around that time. The average FL of many of the fall-run hatchery production releases was near the size range of YOY spring-run, so many of the larger-than-average individuals in the releases would fall into the spring-run size class (Table 4-10). High catch numbers were adjusted (see adjustment details in Appendix I) for natural-origin spring-run in all data sets (Knights Landing, Sacramento trawl, beach seines, Chipps Island trawl). DOSS agreed that adjusting catch numbers for natural-origin winter-run was not necessary, since the average FL of fall-run hatchery production was far enough from the size range of YOY winter-run that few of the larger-than-average individuals in the release should fall into the winter-run size class. In addition, no anomalously high winter-run catches were observed after large fall-run hatchery releases occurred. Adjustment was also not needed for the hatchery-origin winter-run Chinook salmon data, since those fish were identified based on the CWT or acoustic-tag (AT) codes, not the LAD criteria.

[19] For example, these weekly estimates were shared with both the Data Assessment Team (DAT) and Delta Conditions Team (DCT) stakeholder groups.
[20] DOSS notes available at: DOSS Meeting Notes. The website URL is: https://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/doss.html

Table 4-10. Summary of releases of hatchery-origin fall-run Chinook salmon during WY 2018. Yellow highlighted releases had the greatest potential to cause "apparent" spring-run catch because they (a) occurred at a location upstream of at least one of the key monitoring locations (Knights Landing RSTs, Sacramento trawl, Sacramento beach seines, Chipps Island trawl), and (b) included unmarked fish. For multiple-day releases, the spring-run LAD range listed is based on the first day of the release.

Date	Hatchery	Location	Average Fork Length (mm)	Marked Number Released	Unmarked Number Released	Total Number Released	Spring-run Length at Date Range at Knights Landing (mm)
1/19/2018	SCARF	San Joaquin River at Fremont Ford Bridge (Highway 140)		31,184	0	31,184	46-61
1/26/2018	SCARF	San Joaquin River at Fremont Ford Bridge (Highway 140)		49,549	0	49,549	48-64
3/2/2018	SCARF	San Joaquin River at Fremont Ford Bridge (Highway 140)		87,115	0	87,115	60-81
3/26/2018	FRH	Boyd's Pump	80	494,136	0	494,136	71-94
4/6/2018	CNFH	Battle Creek at Coleman NFH	72	989,436	2,970,546	3,959,982	76-102
4/13/2018	CNFH	Battle Creek at Coleman NFH	67	292,938	878,811	1,171,749	79-106
4/13/2018	MER	Sherman Island Net Pens		50,000	150,000	200,000	79-106
4/14/2018	MER	Sherman Island Net Pens		50,000	150,000	200,000	80-107
4/16/2018	FRH	San Pablo Bay Net Pens at Mare Island	80-85	125,000	375000	500,000	81-109
4/17/2018	FRH	San Pablo Bay Net Pens at Mare Island	80-85	125,000	375000	500,000	82-109
4/19/2018	MOK	Sherman Island Net Pens	85	112,500	337500	450,000	83-111
4/20/2018	CNFH	Battle Creek at Coleman NFH	66	95,518	286,550	382,068	83-111
4/24/2018	FRH	San Pablo Bay Net Pens at Mare Island	80-85	166,500	499,500	666,000	84-114
4/26/2018	MOK	Sherman Island Net Pens	85	112,500	337,500	450,000	87-116
4/27/2018	MOK	Sherman Island Net Pens	82	112,500	337,500	450,000	87-117
4/29/2018	FRH	San Pablo Bay Net Pens at Mare Island	80-85	162,500	487,500	650,000	88-118
4/30/2018	FRH	San Pablo Bay Net Pens at Mare Island	80-85	162,500	487,500	650,000	89-119
5/1/2018	FRH	San Pablo Bay Net Pens at Mare Island	80-85	162,500	487,500	650,000	89-120
5/2/2018	MOK	Coastside Fishing Club Net Pens in Pillar Point Harbor	94	240,000	0	240,000	90-121
5/2/2018	FRH	Elkhorn Boat Launch	85-89	252,452	757,353	1,009,805	90-121
5/3/2018	MOK	Sherman Island Net Pens	85	112,500	337,500	450,000	91-122
5/4/2018	MOK	Sherman Island Net Pens	82	112,500	337,500	450,000	91-122
5/9/2018	MOK	Coastside Fishing Club Net Pens in Pillar Point Harbor	100	240,000	0	240,000	94-126
5/10/2018	NIM	Lower American River (Jibboom)	92	167,554	502,902	670,456	95-127
5/10/2018	NIM	Lower American River (Sunrise)	84	167,681	503,340	671,021	95-127
5/11/2018	MOK	Sherman Island Net Pens	85	112,500	337,500	450,000	95-128
5/12/2018	MOK	Sherman Island Net Pens	82	112,500	337,500	450,000	96-129
5/15/2018	FRH	San Pablo Bay Net Pens at Mare Island	65-68	237,475	712,425	949,900	98-132
5/16/2018	MOK	Coastside Fishing Club Net Pens in Pillar Point Harbor	110	240,000	0	240,000	99-132
5/17/2018	MOK	Sherman Island Net Pens	95	112,500	337,500	450,000	99-133
5/18/2018	MOK	Mokelumne River Hatchery	82	200,000	0	200,000	100-134
5/18/2018	MOK	Woodbridge Dam	80	200,000	0	200,000	100-134
5/19/2018	FRH	Fort Baker, San Francisco Bay	68-70	165,178	495,535	660,713	101-135
5/19/2018	MOK	Sherman Island Net Pens	82	112,500	337,500	450,000	101-135
5/20/2018	FRH	Fort Baker, San Francisco Bay	68-70	82,589	247,768	330,357	101-136
5/21/2018	NIM	Conoco	85	162,557	488,109	650,666	102-137
5/22/2018	NIM	Mare Island	82	163,565	491,085	654,650	103-138

The weekly DOSS estimates of fish distribution based on monitoring data were determined as described in Table 4-11.

Table 4-11. Calculations and data sources used to generate estimates of population distributions based on monitoring data for comparison with the weekly DOSS estimates.

	Natural-origin spring-run Chinook	**Natural-origin winter-run Chinook**	**Hatchery-origin winter-run Chinook (CWT data)**	**Hatchery-origin winter-run Chinook (AT data)**
Yet to Enter the Delta	100% minus cumulative % Knights Landing RST catch		100% minus cumulative % Sacramento Trawl catch	100% minus cumulative % AT detection at Tower Bridge array
In Delta	Cumulative % combined Sacramento Trawl & beach seines catch minus cumulative % Chipps Trawl catch			Cumulative % AT detection at Tower Bridge array minus cumulative % AT detection at Chipps array
Exited the Delta	Cumulative % Chipps Trawl catch			Cumulative % AT detection at Chipps array

Figure 4-5 provides three ways to compare data to weekly DOSS estimates, based on (a) raw data, (b) adjusted data (high catch values adjusted only), or (c) adjusted data (all catch values adjusted during the entire date range when hatchery releases occurred). As mentioned earlier, winter-run data (Figure 4-6) showed no anomalously high values and, therefore, were not adjusted. Further details on the adjustments are described in Appendix I. Figure 4-7 shows hatchery winter-run data in comparison to weekly DOSS estimates. Approximately 216,746 hatchery winter-run Chinook salmon were released into the Sacramento River in Redding in early March (see Section 4.3 for details); all were marked with CWTs and clipped adipose fins, and a total of 600 were also acoustic-tagged. Data tables for CWT and acoustic-tagged are provided in Appendix J.

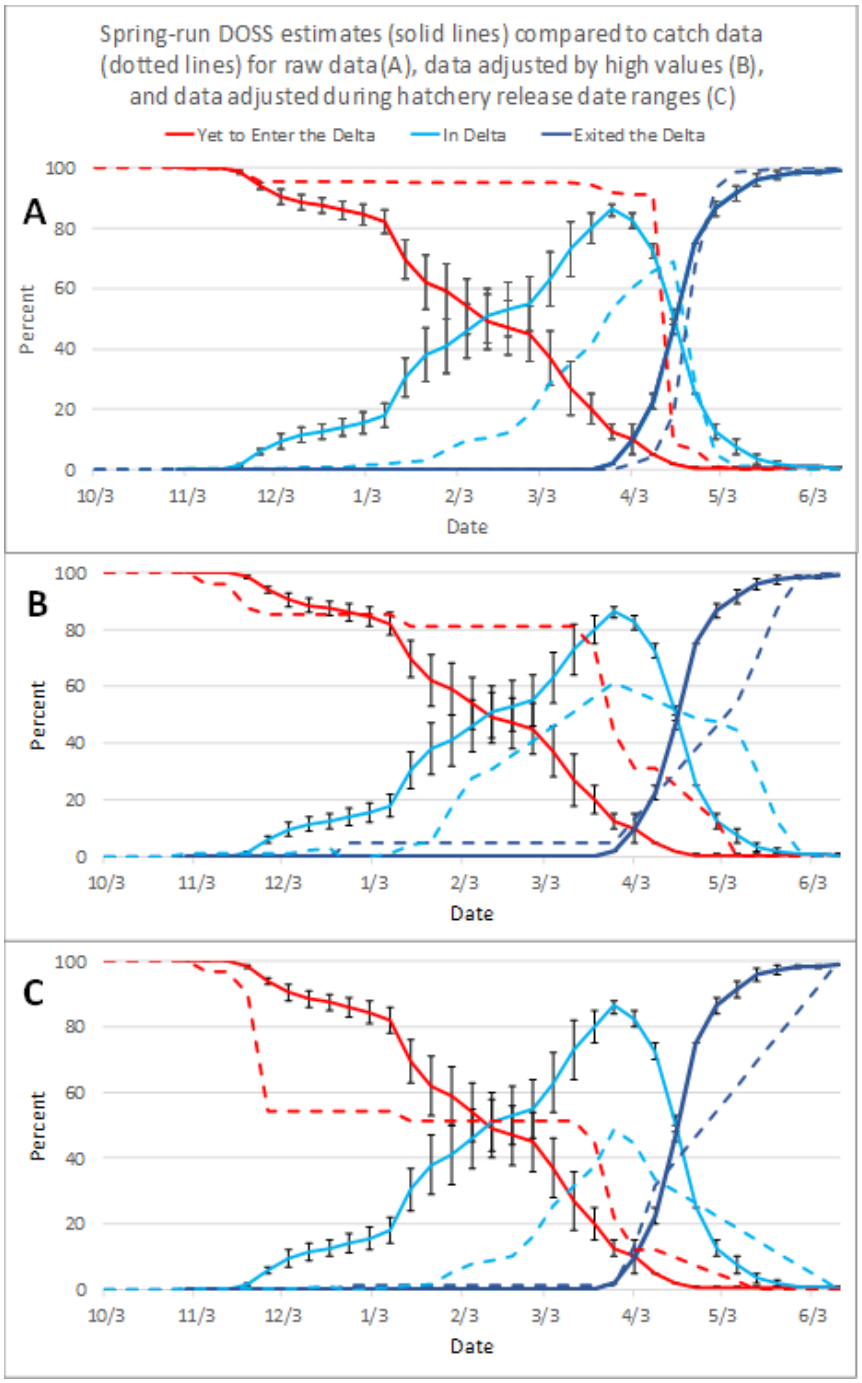

Figure 4-5. Spring-run weekly DOSS estimates compared to raw data (A), adjusted high values only (B), and adjusted hatchery release date range (C). The highest values were removed in p**anels B and C.** Red lines indicate "Yet to Enter the Delta", light blue lines indicate "In Delta", and dark blue lines indicate "Exited the Delta". Solid lines are weekly DOSS estimates and dashed lines are catch data.

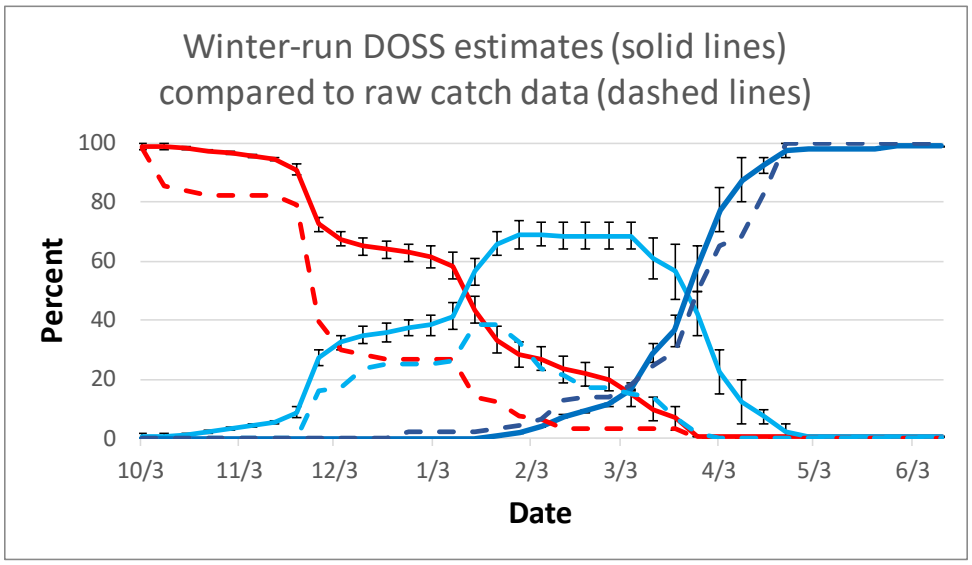

Figure 4-6. Winter-run weekly DOSS estimates compared to raw data. Data were not adjusted for hatchery influence since no high data numbers were observed. Red lines indicate "Yet to Enter the Delta", light blue lines indicate "In Delta", and dark blue lines indicate "Exited the Delta". Solid lines are weekly DOSS estimates and dashed lines are catch data.

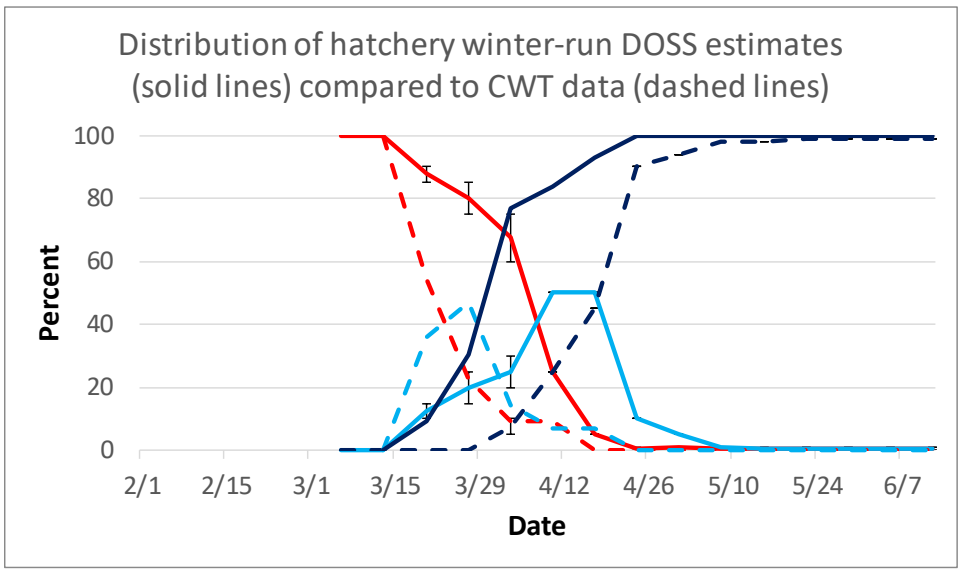

Figure 4-7. Hatchery winter-run weekly DOSS estimates compared to coded wire tag (CWT) data. Data were not adjusted since no high data numbers were observed and runs were identified by tag. Red lines indicate "Yet to Enter the Delta", light blue lines indicate "In Delta", and dark blue lines indicate "Exited the Delta". Solid lines are weekly DOSS estimates and dashed lines are catch data.

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Appendix A— Operations Summary Tables

GUIDE TO THE WY 2018 OPERATIONS TABLE

- The controlling factor in any blank cell is the same as the most recently listed controlling factor; factors are listed only when there is a change.
- Controlling factors for DCC operations are listed in regular text, within brackets.
- DCC gate status is listed as open "O" or closed "C" and will change based on the controlling factors for DCC gate operations.
- Controlling factors for Delta exports are listed in regular text.
- Conditions or requirements of note, but not controlling Delta operations (for example, D-1641 or NMFS BiOp requirements that go into effect at the beginning of a month), are listed in italicized text for informative purposes.
- The "Delta WQ" controlling factor generally refers to seasonal salinity management rather than specific water quality compliance location.

Date	Balance/Excess	Jones PP (cfs)	Clifton Court Inflow (cfs)	DCC Gate Status	USGS Tidally Filtered Mean 5-Day OMR (cfs)	USGS Tidally Filtered Mean 14-Day OMR (cfs)	Mean 5-Day OMR Index Calculation (cfs)	Mean 14-Day OMR Index Calculation (cfs)	Factor(s) Controlling Delta Operations
10/1/2017	E	4369	6672	O	-9694	-7946	-9623	-7838	FWS Action 4 Fall X2 Delta Outflow; *D-1641 Delta Outflow (4,000 cfs)*
10/2/2017	E	4355	6669	O	-9660	-8074	-9664	-8018	
10/3/2017	E	4370	1992	C	-8940	-8048	-8682	-7934	Available Operational Capacity; [DCC Gates -CDFW Request]
10/4/2017	E	4380	0	C	-7602	-7799	-7431	-7716	
10/5/2017	E	4385	233	C	-6456	-7609	-6283	-7509	
10/6/2017	B	4378	2996	O	-5702	-7560	-5593	-7478	FWS Action 4 Fall X2 Delta Outflow; [DCC Gates - Weekend operations]
10/7/2017	B	4372	2989	O	-5168	-7523	-4918	-7442	
10/8/2017	B	4389	998	O	-4760	-7336	-4739	-7273	
10/9/2017	B	4382	292	O	-4696	-7054	-4761	-7013	
10/10/2017	B	4384	289	C	-4700	-6759	-4720	-6679	[DCC Gates - CDFW Request]
10/11/2017	B	4390	291	C	-4262	-6371	-4174	-6259	
10/12/2017	B	4378	293	C	-3768	-5937	-3658	-5792	
10/13/2017	B	4366	292	O	-3800	-5519	-3676	-5416	[DCC Gates - Weekend operations]
10/14/2017	B	4364	297	O	-4012	-5136	-3856	-5061	
10/15/2017	B	4358	292	O	-4092	-4758	-4052	-4689	
10/16/2017	B	4357	294	O	-4232	-4433	-4241	-4322	
10/17/2017	B	4358	298	C	-4374	-4306	-4391	-4260	[DCC Gates - CDFW Request]
10/18/2017	B	4368	292	C	-4432	-4386	-4372	-4323	
10/19/2017	B	4372	297	C	-4530	-4448	-4347	-4369	
10/20/2017	B	4379	295	O	-4484	-4323	-4313	-4232	[DCC Gates - Weekend operations]
10/21/2017	B	4363	293	O	-4318	-4129	-4269	-4091	
10/22/2017	B	4348	492	O	-4198	-4106	-4271	-4093	
10/23/2017	B	4345	995	O	-4236	-4222	-4366	-4182	
10/24/2017	B	4355	991	C	-4270	-4294	-4454	-4274	[DCC Gates - CDFW Request]
10/25/2017	B	4368	991	C	-4446	-4389	-4549	-4366	
10/26/2017	B	4369	1998	C	-4754	-4481	-4850	-4516	
10/27/2017	B	4368	2488	O	-5140	-4584	-5220	-4644	[DCC Gates - Weekend operations]
10/28/2017	B	4359	2489	O	-5534	-4766	-5516	-4774	
10/29/2017	B	4372	2491	O	-5860	-4926	-5825	-4907	
10/30/2017	B	4286	1983	C	-6006	-5022	-6012	-4998	
10/31/2017	B	4251	1979	C	-5988	-5058	-5995	-5089	[DCC Gates - CDFW Request]
11/1/2017	E	2702	1995	C	-5680	-5030	-5600	-5083	*D-1641 Delta Outflow (4,500 cfs)*
11/2/2017	E	2706	1494	C	-5062	-4956	-5109	-5047	
11/3/2017	E	2712	1492	C	-4480	-4924	-4626	-5019	
11/4/2017	E	2701	1490	O	-4134	-4956	-4268	-4998	[DCC Gates - Weekend operations]
11/5/2017	E	2665	1424	O	-3836	-4929	-3906	-4959	
11/6/2017	E	2569	1493	C	-3642	-4818	-3800	-4881	[DCC Gates - CDFW Request]
11/7/2017	E	2653	1487	C	-3590	-4713	-3777	-4805	
11/8/2017	E	1833	2100	C	-3674	-4649	-3717	-4722	
11/9/2017	E	1848	2693	C	-3706	-4582	-3761	-4609	
11/10/2017	E	1830	2996	C	-3800	-4450	-3886	-4482	
11/11/2017	E	1830	2998	O	-3898	-4234	-4024	-4348	[DCC Gates - Weekend operations]
11/12/2017	E	1815	2992	O	-3970	-4038	-4164	-4212	
11/13/2017	E	1804	2996	C	-3902	-3897	-4188	-4070	[DCC Gates - CDFW Request]
11/14/2017	E	1804	2993	C	-3888	-3832	-4142	-3948	
11/15/2017	E	1807	4282	C	-4246	-3938	-4289	-4014	
11/16/2017	E	991	5491	C	-4776	-4131	-4521	-4138	
11/17/2017	E	3492	5996	C	-5360	-4352	-5302	-4454	
11/18/2017	E	3504	5991	O	-6194	-4633	-6219	-4767	[DCC Gates - Weekend operations]
11/19/2017	E	4121	5997	O	-7096	-4996	-7210	-5128	
11/20/2017	E	4239	5992	O	-7662	-5374	-7974	-5504	
11/21/2017	E	4238	6679	O	-8134	-5754	-8786	-5927	Available Operational Capacity
11/22/2017	E	4236	6661	O	-8674	-6138	-9048	-6357	
11/23/2017	E	4226	6665	O	-8986	-6519	-9316	-6751	
11/24/2017	E	4230	6665	C	-9126	-6899	-9473	-7123	[DCC Gates - NMFS Action IV.1.2]
11/25/2017	E	4225	6666	C	-9294	-7301	-9604	-7497	
11/26/2017	E	4238	5995	C	-9464	-7716	-9490	-7829	
11/27/2017	E	4225	5782	C	-9230	-8041	-9338	-8197	
11/28/2017	E	4214	6670	C	-9166	-8404	-9344	-8609	
11/29/2017	E	4223	6676	C	-9264	-8691	-9352	-8931	
11/30/2017	E	4221	6674	C	-9384	-8946	-9364	-9227	

12/1/2017	B	4228	6670	C	-9464	-9182	-9497	-9327	*D-1641 Delta Outflow (4,500 cfs)*
12/2/2017	B	4244	6673	C	-9794	-9326	-9677	-9432	
12/3/2017	B	4224	6670	C	-9828	-9379	-9676	-9489	
12/4/2017	B	4242	6671	C	-9642	-9398	-9623	-9520	
12/5/2017	B	4233	6670	C	-9392	-9396	-9563	-9504	
12/6/2017	B	4229	6673	C	-9114	-9339	-9480	-9482	
12/7/2017	B	4268	6677	C	-8866	-9284	-9413	-9466	
12/8/2017	B	4325	5491	C	-8700	-9227	-9146	-9373	FWS Action 4 Fall X2 Delta Outflow
12/9/2017	B	4324	5486	C	-8556	-9134	-8939	-9282	
12/10/2017	B	4325	5495	C	-8422	-9024	-8706	-9224	
12/11/2017	B	4238	5496	C	-8278	-8999	-8464	-9170	
12/12/2017	B	4218	4489	C	-8082	-8896	-8004	-8988	
12/13/2017	B	4234	3489	C	-7858	-8725	-7629	-8758	
12/14/2017	B	4231	3498	C	-7630	-8508	-7279	-8538	
12/15/2017	B	4229	3497	C	-7488	-8318	-6971	-8322	
12/16/2017	B	4255	2991	C	-7244	-8089	-6606	-8073	
12/17/2017	B	4236	2996	C	-6792	-7812	-6437	-7831	
12/18/2017	B	4225	2990	C	-6464	-7590	-6403	-7608	
12/19/2017	B	4230	2995	C	-6168	-7356	-6334	-7385	
12/20/2017	B	4239	2990	C	-5916	-7176	-6257	-7170	
12/21/2017	B	4228	2989	C	-5680	-6951	-6268	-6950	
12/22/2017	B	4215	2497	C	-5662	-6727	-6185	-6774	
12/23/2017	B	4211	2496	C	-5670	-6559	-6090	-6590	
12/24/2017	B	3518	2492	C	-5628	-6359	-5869	-6371	
12/25/2017	B	3509	2490	C	-5386	-6143	-5637	-6160	
12/26/2017	B	3505	2494	C	-5226	-5931	-5410	-6023	
12/27/2017	B	3512	2496	C	-5148	-5759	-5275	-5933	
12/28/2017	B	3516	2490	C	-5088	-5651	-5134	-5824	
12/29/2017	B	3519	3991	C	-5318	-5584	-5333	-5786	
12/30/2017	B	3532	4000	C	-5694	-5589	-5533	-5777	
12/31/2017	B	3545	3994	C	-6012	-5652	-5700	-5760	
1/1/2018	E	2731	3789	C	-6044	-5609	-5690	-5678	NMFS Action IV.2.3 (OMR -5000 cfs); *D-1641 Delta Outflow (4,500 cfs)*
1/2/2018	E	2721	3795	C	-5930	-5566	-5673	-5588	
1/3/2018	E	2722	3792	C	-5664	-5494	-5461	-5502	
1/4/2018	E	2726	3589	C	-5302	-5454	-5210	-5400	
1/5/2018	E	2723	3598	C	-4956	-5400	-5007	-5339	
1/6/2018	E	2718	3291	C	-4818	-5305	-4956	-5273	
1/7/2018	E	2725	3289	C	-4774	-5261	-4938	-5256	
1/8/2018	E	3536	2494	C	-4766	-5272	-4911	-5243	
1/9/2018	E	3541	2593	C	-4658	-5251	-4941	-5232	
1/10/2018	E	3557	2690	C	-4546	-5185	-4942	-5220	
1/11/2018	E	3550	2899	C	-4534	-5107	-4983	-5219	
1/12/2018	E	3546	2995	C	-4540	-4984	-5014	-5142	
1/13/2018	E	3545	2896	C	-4448	-4827	-5024	-5061	
1/14/2018	E	3545	2889	C	-4560	-4733	-5003	-4983	
1/15/2018	E	3549	2889	C	-4778	-4733	-4995	-4972	
1/16/2018	E	3550	2988	C	-4882	-4733	-4979	-4971	
1/17/2018	E	3546	2996	C	-4886	-4706	-4975	-4969	
1/18/2018	E	3548	2989	C	-4996	-4718	-4974	-4977	
1/19/2018	E	3554	2998	C	-5010	-4752	-5003	-4982	
1/20/2018	E	3553	2893	C	-4830	-4737	-4998	-4987	
1/21/2018	E	3540	2789	C	-4604	-4672	-4982	-4987	
1/22/2018	E	3529	2794	C	-4506	-4613	-4946	-4982	
1/23/2018	E	3525	2893	C	-4448	-4643	-4951	-4980	
1/24/2018	E	3532	2892	C	-4556	-4756	-4934	-4979	
1/25/2018	E	3540	2893	C	-4758	-4817	-4955	-4977	
1/26/2018	E	3538	2897	C	-4976	-4828	-4969	-4971	
1/27/2018	E	3537	2794	C	-5124	-4854	-4999	-4973	
1/28/2018	E	3538	2695	C	-5168	-4860	-5005	-4981	
1/29/2018	E	3538	2597	C	-5110	-4874	-5010	-4984	
1/30/2018	E	3546	2597	C	-5154	-4914	-5002	-4985	
1/31/2018	E	2720	3394	C	-5228	-4950	-5001	-4980	

2/1/2018	E	2705	3398	C	-5188	-4923	-4989	-4978	
2/2/2018	E	2724	3396	C	-5076	-4884	-4968	-4969	
2/3/2018	E	2720	3395	C	-4944	-4915	-4960	-4971	
2/4/2018	E	2721	3395	C	-4778	-4976	-4958	-4977	
2/5/2018	E	2710	3391	C	-4698	-5019	-4959	-4984	
2/6/2018	E	2728	3396	C	-4712	-5017	-4969	-4984	
2/7/2018	E	2731	3393	C	-4872	-4996	-4986	-4987	
2/8/2018	E	2722	3399	C	-5098	-5036	-4989	-4983	
2/9/2018	E	2717	3389	C	-5334	-5104	-4991	-4984	
2/10/2018	E	2725	3391	C	-5442	-5132	-4992	-4982	
2/11/2018	E	2726	3398	C	-5478	-5128	-4977	-4974	
2/12/2018	B	2727	1995	C	-5132	-5004	-4683	-4871	
2/13/2018	B	879	0	C	-4218	-4702	-3677	-4509	D-1641 Habitat Protection Outflow (11,400 cfs)
2/14/2018	B	1813	1491	C	-3494	-4485	-3108	-4308	
2/15/2018	B	1804	1296	C	-2761	-4265	-2506	-4096	
2/16/2018	B	1811	1599	C	-2175	-4092	-1970	-3904	
2/17/2018	B	1821	1296	C	-1982	-3946	-1654	-3690	
2/18/2018	B	1824	798	C	-2158	-3766	-1971	-3443	
2/19/2018	B	879	297	C	-1653	-3397	-1578	-3101	
2/20/2018	B	871	779	C	-1303	-3048	-1309	-2789	
2/21/2018	B	871	482	C	-1054	-2728	-932	-2456	
2/22/2018	B	873	590	C	-710	-2379	-627	-2132	
2/23/2018	B	872	590	C	-346	-1985	-408	-1806	
2/24/2018	B	872	1247	C	-571	-1658	-575	-1523	
2/25/2018	B	872	593	C	-827	-1387	-513	-1194	
2/26/2018	B	875	890	C	-920	-1224	-541	-976	
2/27/2018	B	876	2894	C	-1063	-1253	-902	-1141	
2/28/2018	B	873	4181	C	-1566	-1296	-1491	-1228	
3/1/2018	B	952	3993	C	-2120	-1429	-1933	-1318	
3/2/2018	E	1770	3491	C	-2535	-1515	-2590	-1416	D-1641 35% E/I 14-day Average
3/3/2018	E	1787	3496	C	-2871	-1541	-3234	-1540	
3/4/2018	E	1852	3691	C	-3133	-1601	-3597	-1722	
3/5/2018	E	1842	3988	C	-3295	-1883	-3800	-2022	
3/6/2018	E	1841	3794	C	-3490	-2210	-3997	-2278	
3/7/2018	E	2708	2989	C	-3828	-2506	-4125	-2556	
3/8/2018	E	2717	1991	C	-4102	-2753	-4054	-2764	NMFS Action IV.2.3 OMR (-3500)
3/9/2018	E	2728	2000	C	-4324	-3022	-3934	-2981	
3/10/2018	E	2731	1994	C	-4332	-3226	-3766	-3162	
3/11/2018	E	2732	1979	C	-4064	-3366	-3640	-3395	
3/12/2018	E	2724	1887	C	-3820	-3542	-3494	-3611	
3/13/2018	E	2734	2992	C	-3956	-3786	-3732	-3775	D-1641 35% E/I 14-day Average; *NMFS Action IV.2.3 OMR(-5000)*
3/14/2018	E	2693	2990	C	-4030	-3902	-3946	-3858	
3/15/2018	E	2807	3486	C	-4292	-4001	-4248	-3989	NMFS Action IV.2.3 OMR(-5000)
3/16/2018	E	2669	3492	C	-4694	-4137	-4523	-4086	
3/17/2018	E	2661	3495	C	-4814	-4236	-4816	-4176	
3/18/2018	E	2636	3591	C	-4684	-4340	-4887	-4236	
3/19/2018	E	2654	3899	C	-4696	-4402	-4971	-4276	
3/20/2018	E	2655	3899	C	-4580	-4391	-4935	-4324	
3/21/2018	E	3015	3899	C	-4638	-4426	-4988	-4394	
3/22/2018	E	3411	3893	C	-5026	-4566	-5119	-4556	
3/23/2018	E	3360	3893	C	-5182	-4646	-5251	-4706	
3/24/2018	E	3358	3898	C	-5310	-4751	-5295	-4822	
3/25/2018	E	3300	4293	C	-5260	-4818	-5283	-4910	
3/26/2018	E	3301	4298	C	-4886	-4807	-5085	-4962	
3/27/2018	E	3302	4995	C	-4448	-4741	-4848	-4954	
3/28/2018	E	3442	5590	C	-4346	-4759	-4715	-4981	
3/29/2018	E	3503	3896	C	-4148	-4700	-4369	-4865	NMFS Action IV.2.3. OMR(-3500)
3/30/2018	E	3508	6393	C	-4304	-4679	-4569	-4927	NMFS Action IV.2.3 OMR(-5000)
3/31/2018	E	3513	5793	C	-4702	-4767	-4842	-4971	

4/1/2018	E	3540	3290	C	-4810	-4786	-4677	-4879	NMFS Action IV.2.1 (I:E Ratio 1:1)
4/2/2018	E	3525	2997	C	-4672	-4751	-4383	-4771	
4/3/2018	E	3532	3492	C	-4616	-4713	-4439	-4688	
4/4/2018	E	2724	4393	C	-4412	-4598	-3968	-4563	NMFS Action IV.2.3. OMR(-3500)
4/5/2018	E	2711	4476	C	-4016	-4406	-3527	-4403	
4/6/2018	E	2712	4581	C	-3796	-4291	-3485	-4249	
4/7/2018	E	2715	4986	C	-3533	-4116	-3480	-4123	
4/8/2018	E	3434	4497	C	-3164	-3964	-3380	-4009	
4/9/2018	E	3430	3992	C	-2769	-3842	-3214	-3894	NMFS Action IV.2.3 OMR(-2500)
4/10/2018	E	3445	896	C	-2064	-3555	-2549	-3582	NMFS Action IV.2.1 (I:E Ratio 3:1)
4/11/2018	E	1814	895	C	-1207	-3170	-1659	-3157	
4/12/2018	E	979	1800	C	-382	-2771	-768	-2837	
4/13/2018	E	988	2294	C	271	-2330	77	-2349	
4/14/2018	E	986	2299	C	834	-1865	807	-1877	*NMFS Action IV.2.3 OMR(-5000)*
4/15/2018	E	2608	468	C	884	-1521	1033	-1543	*NMFS Action IV.2.3 OMR(-3500)*
4/16/2018	E	2622	494	C	889	-1184	988	-1239	
4/17/2018	E	2613	490	C	809	-833	851	-948	
4/18/2018	E	995	798	C	604	-539	897	-612	
4/19/2018	E	991	596	C	511	-248	920	-288	
4/20/2018	E	989	595	C	603	49	870	13	*NMFS Action IV.2.3 OMR(-5000)*
4/21/2018	E	989	592	C	644	307	829	300	
4/22/2018	E	989	599	C	467	463	823	554	
4/23/2018	E	990	590	C	336	570	611	754	
4/24/2018	E	990	697	C	276	588	362	751	
4/25/2018	E	991	697	C	148	533	144	657	
4/26/2018	E	992	589	C	-88	412	20	581	
4/27/2018	E	992	598	C	-66	343	-35	514	
4/28/2018	E	989	594	C	-102	236	-76	439	
4/29/2018	E	988	596	C	-199	201	-70	358	
4/30/2018	E	985	494	C	-233	133	1	304	
5/1/2018	E	986	1171	C	-452	-38	-90	245	
5/2/2018	E	988	491	C	-625	-96	-54	174	
5/3/2018	E	989	496	C	-442	-104	48	127	
5/4/2018	E	990	490	C	-253	-104	199	118	
5/5/2018	E	990	495	C	-73	-123	363	138	
5/6/2018	E	992	497	C	398	-63	639	180	
5/7/2018	E	1849	690	C	583	-8	587	165	
5/8/2018	E	1864	590	C	406	-58	534	189	
5/9/2018	E	1814	493	C	203	-85	487	241	
5/10/2018	E	1812	495	C	52	-73	430	285	
5/11/2018	E	1814	694	C	-186	-105	324	308	
5/12/2018	E	2612	997	C	-733	-234	119	235	
5/13/2018	E	2632	990	C	-1190	-412	-199	142	
5/14/2018	E	1859	1092	C	-1475	-528	-445	81	
5/15/2018	E	1867	1189	C	-1778	-547	-754	47	
5/16/2018	E	954	1200	C	-1929	-571	-866	18	
5/17/2018	E	954	1198	C	-1618	-654	-705	-34	
5/18/2018	E	955	1196	C	-1241	-765	-469	-97	
5/19/2018	E	2606	1195	C	-1212	-935	-654	-282	
5/20/2018	E	2602	1193	C	-1292	-1150	-812	-471	
5/21/2018	E	2594	1191	C	-1668	-1375	-1119	-592	
5/22/2018	E	1856	1197	C	No Data	No Data	-1278	-681	
5/23/2018	B	1849	1198	C	No Data	No Data	-1465	-794	D-1641 Habitat Protection Outflow (11,400 cfs)
5/24/2018	B	1848	506	C	No Data	No Data	-1259	-885	
5/25/2018	B	1852	688	C	No Data	No Data	-1097	-979	
5/26/2018	B	1862	689	O	No Data	No Data	-949	-973	[DCC Gates - NMFS Action IV.1.2; D-1641]
5/27/2018	B	1855	696	O	No Data	No Data	-941	-946	
5/28/2018	B	1868	693	O	No Data	No Data	-921	-964	
5/29/2018	B	1870	694	C	No Data	No Data	-999	-973	[DCC Gates - NMFS Action IV.1.2; D-1641]
5/30/2018	B	950	1092	C	No Data	No Data	-961	-1012	
5/31/2018	B	946	1968	C	-1659	No Data	-1098	-1113	*Last Day of NMFS Action IV.2.1 (I:E Ratio)*

6/1/2018	B	2722	280	C	-1925	No Data	-1285	-1237	
6/2/2018	B	2711	1093	O	-2433	No Data	-1641	-1316	D-1641 Habitat Protection Outflow (7,100 cfs); [DCC Gates - NMFS Action IV.1.2; D-1641]
6/3/2018	B	2715	1099	O	-2889	No Data	-2017	-1403	
6/4/2018	B	2715	1395	C	-3313	No Data	-2595	-1539	[DCC Gates - NMFS Action IV.1.2; D-1641]
6/5/2018	B	2669	1392	C	-3620	No Data	-3010	-1732	
6/6/2018	B	2646	1385	C	-3814	No Data	-3403	-1929	
6/7/2018	B	2649	1097	C	-3928	No Data	-3591	-2149	
6/8/2018	B	3310	1099	C	-4102	No Data	-3878	-2396	
6/9/2018	B	3293	798	O	-4212	-3116	-3958	-2614	[DCC Gates - NMFS Action IV.1.2; D-1641]
6/10/2018	B	3269	778	O	-4302	-3314	-3992	-2822	
6/11/2018	B	3261	772	C	-4454	-3573	-3985	-3024	[DCC Gates - NMFS Action IV.1.2; D-1641]
6/12/2018	B	3342	783	C	-4626	-3808	-4024	-3230	
6/13/2018	B	3318	295	C	-4616	-4007	-3865	-3434	
6/14/2018	B	3338	297	C	-4628	-4176	-3799	-3579	
6/15/2018	B	3374	268	C	-4684	-4299	-3776	-3711	*NMFS IV.2.3 OMR flow management restrictions lifted based on temporal offramp [No more DCC restrictions per NMFS BiOp or D-1641]*
6/16/2018	B	3369	296	O	-4624	-4356	-3773	-3785	[DCC Gates - Delta WQ]
6/17/2018	B	3372	368	O	-4340	-4326	-3770	-3855	
6/18/2018	B	3349	329	O	-4044	-4269	-3824	-3872	
6/19/2018	B	1629	368	O	-3579	-4162	-3540	-3768	
6/20/2018	B	1628	370	O	-3068	-4033	-3261	-3660	
6/21/2018	B	1630	796	O	-2766	-3941	-3063	-3597	
6/22/2018	B	1629	1295	O	-2812	-3866	-2943	-3521	
6/23/2018	B	1915	991	O	-3076	-3863	-2834	-3471	
6/24/2018	B	1922	1790	O	-3735	-3959	-3199	-3485	
6/25/2018	B	1922	1796	O	-4166	-3930	-3545	-3503	
6/26/2018	B	2737	1597	O	-4558	-3916	-3913	-3557	*FWS Action 3 OMR flow management restrictions lifted based on temperature offramp*
6/27/2018	B	2724	1270	O	-4794	-3929	-4137	-3619	
6/28/2018	B	2709	464	O	-4658	-3874	-4220	-3621	
6/29/2018	B	2689	0	O	-4286	-3817	-4065	-3589	
6/30/2018	B	2641	289	O	-4334	-3826	-3959	-3570	

Appendix B – Flows, water temperature, and catch indices related to Delta Cross Channel Operations per RPA Actions IV.1.1 and IV.1.2

First Alert in Action IV.1.1: Mill & Deer Creek flows

The first alert is triggered if the mean daily flow in Mill Creek or Deer Creek is (a) greater than 95 cfs, or (b) more than 50 percent higher than observed on the previous day. All flow data are from CDEC; station MLM for Mill Creek and station DCV for Deer Creek. Yellow-highlighted cells indicate conditions that triggered an alert.

	Mill Creek (MLM)		Deer Creek (DCV)*	
Date	mean daily flow (cfs)	change in mean daily flow	mean daily flow (cfs)	change in mean daily flow
10/1/2017	130	-1%	-	-
10/2/2017	130	0%	-	-
10/3/2017	130	0%	-	-
10/4/2017	130	0%	-	-
10/5/2017	130	0%	-	-
10/6/2017	129	-1%	-	-
10/7/2017	129	0%	-	-
10/8/2017	128	-1%	-	-
10/9/2017	127	-1%	-	-
10/10/2017	127	0%	-	-
10/11/2017	127	0%	-	-
10/12/2017	128	1%	-	-
10/13/2017	128	0%	-	-
10/14/2017	127	-1%	-	-
10/15/2017	127	0%	-	-
10/16/2017	127	0%	-	-
10/17/2017	126	-1%	-	-
10/18/2017	126	0%	-	-
10/19/2017	126	0%	-	-
10/20/2017	165	31%	-	-
10/21/2017	145	-12%	-	-
10/22/2017	139	-4%	-	-
10/23/2017	136	-2%	-	-
10/24/2017	131	-4%	-	-
10/25/2017	130	-1%	-	-
10/26/2017	129	-1%	-	-
10/27/2017	128	-1%	-	-
10/28/2017	127	-1%	-	-
10/29/2017	127	0%	-	-
10/30/2017	128	1%	-	-

*DCV data not available for the month of October.

	Mill Creek (MLM)		Deer Creek (DCV)	
Date	mean daily flow (cfs)	change in mean daily flow	mean daily flow (cfs)	change in mean daily flow
10/31/2017	128	0%	-	-
11/1/2017	125	-2%	-	-
11/2/2017	118	-6%	120	-
11/3/2017	120	2%	124	3%
11/4/2017	222	85%	245	97%
11/5/2017	162	-27%	227	-8%
11/6/2017	137	-15%	154	-32%
11/7/2017	130	-5%	146	-5%
11/8/2017	133	2%	144	-1%
11/9/2017	351	164%	385	167%
11/10/2017	218	-38%	263	-32%
11/11/2017	196	-10%	208	-21%
11/12/2017	162	-17%	176	-16%
11/13/2017	157	-3%	165	-6%
11/14/2017	228	45%	211	28%
11/15/2017	271	19%	238	13%
11/16/2017	843	211%	757	218%
11/17/2017	393	-53%	484	-36%
11/18/2017	258	-34%	303	-37%
11/19/2017	210	-19%	243	-20%
11/20/2017	288	37%	257	6%
11/21/2017	549	91%	479	86%
11/22/2017	329	-40%	312	-35%
11/23/2017	271	-18%	262	-16%
11/24/2017	270	0%	241	-8%
11/25/2017	231	-14%	220	-9%
11/26/2017	306	32%	255	16%
11/27/2017	586	92%	470	84%
11/28/2017	338	-42%	348	-26%
11/29/2017	270	-20%	282	-19%
11/30/2017	234	-13%	246	-13%
12/1/2017	213	-9%	226	-8%
12/2/2017	199	-7%	211	-6%
12/3/2017	211	6%	217	3%
12/4/2017	193	-9%	210	-3%

Second Alert in Action IV.1.1: Wilkins Slough flows and water temperature at Knights Landing

The second alert is triggered only if both components are met (Knights Landing water temperature less than 56.3°F and Wilkins Slough flows greater than 7,500 cfs). Wilkins Slough flow data are from CDEC station WLK. Knights Landing water temperature data are from the Knights Landing rotary screw trap datasheet posted by CDFW on the data access tab at: http://www.calfish.org/ProgramsData/ConservationandManagement/CentralValleyJuvenileSalmonandSteelheadMonitoring.aspx; the water temperature reported on each row was measured at the "Stop" time and date listed in that row. Yellow-highlighted cells indicate conditions that triggered an alert.

Wilkins Slough (WLK)		**Knights Landing (KL)**	
Date range	flow (cfs)	Date range	temperature (°F)
10/1-10/2	8,001-8,068	10/1	61
10/3-10/9	6,840-7,500	10/2-10/9	58-60
10/10-10/16	6,428-6,844	10/10-10/16	56-58
10/17-10/23	5,949-6,353	10/17-10/22	57-58
10/24-10/30	5,670-6,194	10/22-10/30	58-62
10/31-11/6	5,652-6,604	10/31-11/6	55-57
11/7-11/13	5,206-6,138	11/6-11/12	54-56
11/14-11/20	5,610-9,904	11/13-11/19	54-55
11/21-11/27	6,315-8,235	11/21-11/27	52-56
11/28-12/4	5,877-7,933	11/28-12/2	51-56

Action IV.1.2: Knights Landing Catch Index (KLCI) and Sacramento Catch Index (SCI)

The third alert (November 1-February 23) is triggered when KLCI or SCI >10, per Action IV.3, to reduce the likelihood of entrainment or salvage at the export facilities. When any catch index greater than 3, DCC closure action response is triggered, per Action IV.1.2 DCC Gate Operations. Red-highlighted cells indicate catch indices >3, green highlighted cells indicate catch indices <3.

Date	KLCI	Seine SCI	Trawl SCI	Day of Action Response (for triggers through 11/24/17)	Day of Action Response (for triggers through 11/25/17)
11/21/2017	4.1	5	0		
11/22/2017	4.8	3.4	0		
11/23/2017	2.1	No sampling	No sampling		
11/24/2017	2.4	6.9	0	1 (DCC closed ~10 am)	
11/25/2017	4.5	No sampling	No sampling	2	1
11/26/2017	1.3	No sampling	No sampling	3	2
11/27/2017	1.8	No sampling	0		3
11/28/2017	4.1	5	0		
11/29/2017	4.8	3.4	0		
11/30/2017	2.1	No sampling	No sampling		
12/1/2017	2.4	6.9	0		
12/2/2017	4.5	No sampling	No sampling		
12/3/2017	1.3	No sampling	No sampling		
12/4/2017	1.8	No sampling	0		

Appendix C – Old and Middle River Flows

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

December 2017

(*** Computed from available USGS Tidally Filtered Data)

Date	USGS Tidally Filtered OMR*** (cfs)		OMR Index Calculation (cfs)		
	Mean 5-Day	Mean 14-Day	Mean Daily	Mean 5-Day	Mean 14-Day
12/1/2017	-9460	-9180	-9890	-9930	-9,410
12/2/2017	-9790	-9330	-9520	-9850	-9,500
12/3/2017	-9830	-9380	-9470	-9680	-9,550
12/4/2017	-9640	-9400	-9140	-9570	-9,570
12/5/2017	-9390	-9400	-8850	-9370	-9,530
12/6/2017	-9110	-9340	-9010	-9200	-9,490
12/7/2017	-8870	-9280	-9530	-9200	-9,490
12/8/2017	-8700	-9230	-8210	-8950	-9,410
12/9/2017	-8560	-9130	-8380	-8800	-9,330
12/10/2017	-8420	-9020	-8200	-8670	-9,280
12/11/2017	-8280	-9000	-7880	-8440	-9,140
12/12/2017	-8080	-8900	-7300	-7990	-8,920
12/13/2017	-7860	-8730	-6100	-7570	-8,670
12/14/2017	-7630	-8510	-6960	-7290	-8,460
12/15/2017	-7490	-8320	-7040	-7060	-8,260
12/16/2017	-7240	-8090	-6090	-6700	-8,010
12/17/2017	-6790	-7810	-6240	-6490	-7,780
12/18/2017	-6460	-7590	-6250	-6520	-7,570
12/19/2017	-6170	-7360	-6420	-6410	-7,400
12/20/2017	-5920	-7180	-6220	-6240	-7,200
12/21/2017	-5680	-6950	-6090	-6240	-6,960
12/22/2017	-5660	-6730	-5940	-6180	-6,790
12/23/2017	-5670	-6560	-5740	-6080	-6,610
12/24/2017	-5630	-6360	-5150	-5830	-6,390
12/25/2017	-5390	-6140	-5060	-5600	-6,190
12/26/2017	-5230	-5930	-5120	-5400	-6,030
12/27/2017	-5150	-5760	-5470	-5310	-5,990
12/28/2017	-5090	-5650	-5140	-5190	-5,860
12/29/2017	-5320	-5580	-5990	-5360	-5,780
12/30/2017	-5690	-5590	-6170	-5580	-5790
12/31/2017	-6010	-5650	-6110	-5780	-5780

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

January 2018

(*** Computed from available USGS Tidally Filtered Data)

Date	USGS Tidally Filtered OMR*** (cfs)		OMR Index Calculation (cfs)		
	Mean 5-Day	Mean 14-Day	Mean Daily	Mean 5-Day	Mean 14-Day
1/1/2018	-6040	-5610	-5140	-5730	-5690
1/2/2018	-5930	-5570	-4990	-5690	-5600
1/3/2018	-5660	-5490	-5070	-5470	-5510
1/4/2018	-5300	-5450	-4870	-5210	-5410
1/5/2018	-4960	-5400	-4990	-5010	-5350
1/6/2018	-4820	-5310	-4860	-4960	-5290
1/7/2018	-4770	-5260	-4900	-4940	-5270
1/8/2018	-4770	-5270	-4940	-4910	-5260
1/9/2018	-4660	-5250	-5020	-4940	-5250
1/10/2018	-4550	-5190	-4990	-4940	-5230
1/11/2018	-4530	-5110	-5060	-4980	-5230
1/12/2018	-4540	-4980	-5060	-5010	-5150
1/13/2018	-4450	-4830	-4990	-5020	-5060
1/14/2018	-4560	-4730	-4910	-5000	-4990
1/15/2018	-4780	-4730	-4950	-4990	-4970
1/16/2018	-4880	-4730	-4990	-4980	-4970
1/17/2018	-4890	-4710	-5040	-4980	-4970
1/18/2018	-5000	-4720	-4980	-4970	-4980
1/19/2018	-5010	-4750	-5060	-5000	-4980
1/20/2018	-4830	-4740	-4930	-5000	-4990
1/21/2018	-4600	-4670	-4900	-4980	-4990
1/22/2018	-4510	-4610	-4860	-4950	-4980
1/23/2018	-4450	-4640	-5000	-4950	-4980
1/24/2018	-4560	-4760	-4970	-4930	-4980
1/25/2018	-4760	-4820	-5030	-4950	-4980
1/26/2018	-4980	-4830	-4980	-4970	-4970
1/27/2018	-5120	-4850	-5010	-5000	-4970
1/28/2018	-5170	-4860	-5030	-5000	-4980
1/29/2018	-5110	-4870	-5000	-5010	-4980
1/30/2018	-5150	-4910	-4990	-5000	-4980
1/31/2018	-5230	-4950	-4970	-5000	-4980

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

February 2018

(*** Computed from available USGS Tidally Filtered Data)

Date	USGS Tidally Filtered OMR*** (cfs)		OMR Index Calculation (cfs)		
	Mean 5-Day	Mean 14-Day	Mean Daily	Mean 5-Day	Mean 14-Day
2/1/2018	-5190	-4920	-4950	-4980	-4980
2/2/2018	-5080	-4880	-4930	-4960	-4970
2/3/2018	-4940	-4920	-4960	-4960	-4970
2/4/2018	-4780	-4980	-4990	-4960	-4980
2/5/2018	-4700	-5020	-4970	-4960	-4990
2/6/2018	-4710	-5020	-5000	-4970	-4990
2/7/2018	-4870	-5000	-5010	-4990	-4990
2/8/2018	-5100	-5040	-4970	-4990	-4980
2/9/2018	-5330	-5100	-5000	-4990	-4980
2/10/2018	-5440	-5130	-4980	-4990	-4980
2/11/2018	-5480	-5130	-4920	-4980	-4970
2/12/2018	-5130	-5000	-3540	-4680	-4870
2/13/2018	-4220	-4700	60	-3680	-4510
2/14/2018	-3490	-4490	-2140	-3100	-4310
2/15/2018	-2760	-4270	-1960	-2500	-4090
2/16/2018	-2180	-4090	-2230	-1960	-3900
2/17/2018	-1980	-3950	-1970	-1650	-3690
2/18/2018	-2160	-3770	-1530	-1970	-3440
2/19/2018	-1650	-3400	-180	-1570	-3100
2/20/2018	-1300	-3050	-610	-1300	-2780
2/21/2018	-1050	-2730	-350	-930	-2450
2/22/2018	-710	-2380	-460	-630	-2130
2/23/2018	-350	-1990	-430	-410	-1800
2/24/2018	-570	-1660	-1020	-570	-1520
2/25/2018	-830	-1390	-320	-520	-1190
2/26/2018	-920	-1220	-480	-540	-970
2/27/2018	-1060	-1250	-2260	-900	-1140
2/28/2018	-1570	-1300	-3390	-1490	-1230

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

March 2018

(*** Computed from available USGS Tidally Filtered Data)

Date	USGS Tidally Filtered OMR*** (cfs)		OMR Index Calculation (cfs)		
	Mean 5-Day	Mean 14-Day	Mean Daily	Mean 5-Day	Mean 14-Day
3/1/2018	-2120	-1430	-3220	-1930	-1390
3/2/2018	-2540	-1520	-3600	-2590	-1490
3/3/2018	-2870	-1540	-3720	-3240	-1610
3/4/2018	-3130	-1600	-4040	-3590	-1790
3/5/2018	-3300	-1880	-4390	-3790	-2090
3/6/2018	-3490	-2210	-4210	-3990	-2350
3/7/2018	-3830	-2510	-4240	-4120	-2630
3/8/2018	-4100	-2750	-3360	-4050	-2760
3/9/2018	-4320	-3020	-3470	-3930	-2980
3/10/2018	-4330	-3230	-3550	-3770	-3160
3/11/2018	-4060	-3370	-3340	-3590	-3380
3/12/2018	-3820	-3540	-3500	-3440	-3590
3/13/2018	-3960	-3790	-4550	-3680	-3760
3/14/2018	-4030	-3900	-4540	-3900	-3840
3/15/2018	-4290	-4000	-5060	-4200	-3970
3/16/2018	-4690	-4140	-4960	-4520	-4070
3/17/2018	-4810	-4240	-4970	-4820	-4160
3/18/2018	-4680	-4340	-4910	-4890	-4220
3/19/2018	-4700	-4400	-4960	-4970	-4260
3/20/2018	-4580	-4390	-4870	-4930	-4310
3/21/2018	-4640	-4430	-5230	-4990	-4380
3/22/2018	-5030	-4570	-5620	-5120	-4540
3/23/2018	-5180	-4650	-5570	-5250	-4690
3/24/2018	-5310	-4750	-5180	-5290	-4800
3/25/2018	-5260	-4820	-4820	-5280	-4910
3/26/2018	-4890	-4810	-4240	-5090	-4960
3/27/2018	-4450	-4740	-4440	-4850	-4960
3/28/2018	-4350	-4760	-4900	-4720	-4980
3/29/2018	-4150	-4700	-3440	-4370	-4870
3/30/2018	-4300	-4680	-5830	-4570	-4930
3/31/2018	-4700	-4770	-5560	-4830	-4970

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

April 2018

(*** Computed from available USGS Tidally Filtered Data)

Date	USGS Tidally Filtered OMR*** (cfs)		OMR Index Calculation (cfs)		
	Mean 5-Day	Mean 14-Day	Mean Daily	Mean 5-Day	Mean 14-Day
4/1/2018	-4810	-4790	-3630	-4670	-4880
4/2/2018	-4670	-4750	-3450	-4380	-4770
4/3/2018	-4620	-4710	-3720	-4440	-4690
4/4/2018	-4410	-4600	-3470	-3970	-4560
4/5/2018	-4020	-4410	-3400	-3530	-4400
4/6/2018	-3800	-4290	-3400	-3490	-4250
4/7/2018	-3530	-4120	-3410	-3480	-4120
4/8/2018	-3170	-3970	-3210	-3380	-4010
4/9/2018	-2770	-3840	-2620	-3210	-3890
4/10/2018	-2070	-3560	-50	-2540	-3580
4/11/2018	-1210	-3170	1030	-1650	-3150
4/12/2018	-380	-2770	1040	-760	-2830
4/13/2018	270	-2330	1010	80	-2350
4/14/2018	830	-1870	1010	810	-1880
4/15/2018	880	-1520	1060	1030	-1540
4/16/2018	890	-1190	810	990	-1240
4/17/2018	810	-840	350	850	-950
4/18/2018	600	-540	1250	900	-610
4/19/2018	510	-250	1140	920	-290
4/20/2018	600	50	780	870	10
4/21/2018	640	310	590	820	300
4/22/2018	470	460	330	820	550
4/23/2018	340	570	180	600	750
4/24/2018	280	590	-110	350	750
4/25/2018	150	530	-280	140	650
4/26/2018	-90	410	-10	20	580
4/27/2018	-70	340	70	-30	510
4/28/2018	-100	240	-30	-70	440
4/29/2018	-200	200	-90	-70	360
4/30/2018	-230	130	70	0	300

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

May 2018

(*** Computed from available USGS Tidally Filtered Data)

Date	USGS Tidally Filtered OMR*** (cfs)		OMR Index Calculation (cfs)		
	Mean 5-Day	Mean 14-Day	Mean Daily	Mean 5-Day	Mean 14-Day
5/1/2018	-450	-40	-470	-90	240
5/2/2018	-630	-100	240	-60	170
5/3/2018	-440	-100	480	50	130
5/4/2018	-250	-100	680	200	120
5/5/2018	-70	-120	890	360	140
5/6/2018	400	-60	910	640	180
5/7/2018	590	-10	-20	590	170
5/8/2018	410	-60	210	530	190
5/9/2018	200	-80	440	490	240
5/10/2018	50	-70	600	430	280
5/11/2018	-190	-110	380	320	310
5/12/2018	-730	-230	-1050	120	230
5/13/2018	-1190	-410	-1380	-200	140
5/14/2018	-1480	-530	-790	-450	80
5/15/2018	-1780	-550	-940	-760	50
5/16/2018	-1930	-570	-180	-870	20
5/17/2018	-1620	-650	-240	-710	-40
5/18/2018	-1240	-770	-200	-470	-100
5/19/2018	-1210	-940	-1710	-650	-280
5/20/2018	-1290	-1150	-1730	-810	-470
5/21/2018	-1670	-1380	-1710	-1120	-590
5/22/2018	-2150	-1570	-1030	-1280	-680
5/23/2018	-2760	-1820	-1130	-1460	-790
5/24/2018	-3410	-2170	-680	-1260	-890
5/25/2018	-3550	-2350	-920	-1090	-980
5/26/2018	-3260	-2280	-970	-950	-970
5/27/2018	-2910	-2180	-1000	-940	-950
5/28/2018	-2300	-2120	-1040	-920	-960
5/29/2018	-1620	-2120	-1070	-1000	-970
5/30/2018	-1470	-2190	-730	-960	-1010
5/31/2018	-1660	-2290	-1660	-1100	-1110

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

June 2018

(*** Computed from available USGS Tidally Filtered Data)

Date	USGS Tidally Filtered OMR*** (cfs)		OMR Index Calculation (cfs)		
	Mean 5-Day	Mean 14-Day	Mean Daily	Mean 5-Day	Mean 14-Day
6/1/2018	-1920	-2430	-1930	-1280	-1240
6/2/2018	-2430	-2550	-2820	-1640	-1320
6/3/2018	-2890	-2690	-2950	-2020	-1400
6/4/2018	-3310	-2780	-3620	-2600	-1540
6/5/2018	-3620	-2820	-3730	-3010	-1730
6/6/2018	-3810	-2800	-3900	-3400	-1930
6/7/2018	-3930	-2740	-3750	-3590	-2150
6/8/2018	-4100	-2880	-4390	-3880	-2400
6/9/2018	-4210	-3120	-4020	-3960	-2610
6/10/2018	-4300	-3310	-3900	-3990	-2820
6/11/2018	-4450	-3570	-3860	-3980	-3020
6/12/2018	-4630	-3810	-3950	-4020	-3230
6/13/2018	-4620	-4010	-3590	-3860	-3430
6/14/2018	-4630	-4180	-3700	-3800	-3580
6/15/2018	-4680	-4300	-3780	-3780	-3710
6/16/2018	-4620	-4360	-3850	-3770	-3790
6/17/2018	-4340	-4330	-3940	-3770	-3860
6/18/2018	-4040	-4270	-3860	-3830	-3870
6/19/2018	-3580	-4160	-2280	-3540	-3770
6/20/2018	-3070	-4030	-2380	-3260	-3660
6/21/2018	-2770	-3940	-2860	-3060	-3600
6/22/2018	-2810	-3870	-3340	-2940	-3520
6/23/2018	-3080	-3860	-3310	-2830	-3470
6/24/2018	-3740	-3960	-4100	-3200	-3490
6/25/2018	-4170	-3930	-4110	-3540	-3500
6/26/2018	-4560	-3920	-4700	-3910	-3560
6/27/2018	-4790	-3930	-4460	-4140	-3620
6/28/2018	-4660	-3870	-3730	-4220	-3620
6/29/2018	-4290	-3820	-3330	-4070	-3590
6/30/2018	-4330	-3830	-3580	-3960	-3570

Appendix D - Salmon Loss-Density Table

Chinook Salmon - Daily Summary Table

California Department of Fish and Wildlife - Results Subject to Revision

Prepared by: Geir Aasen **Report Date: 7/3/2018** **Report Time: 11:22 AM**

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT								
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED			LENGTH (FL mm)	RACE	OLDER JUV LOSS DENSITY
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS			
10/19/2017										1	1	**	460	U	
01/11/2018										2	8	5.76	198 - 220	S	
01/21/2018										1	4	2.54	83	W	
01/23/2018										2	5	3.45	150 - 226	LF	
01/31/2018				5	8	34.78							171 - 211	LF	
02/01/2018				1	1	4.33							151	LF	
02/02/2018				3	7	31.13							144 - 240	LF	
02/05/2018				1	2	8.88	1	4	3.19				170 - 171	LF,W	0.28
02/09/2018				1	4	17.84							188	LF	
02/10/2018	1	1	4.33										253	LF	0.37
02/11/2018				1	4	18.05							178	LF	
02/12/2018				2	3	12.78							154 - 200	LF	
02/13/2018				1	2	8.41							248	LF	
02/14/2018				1	1	4.33				1	4	3.52	178 - 183	LF	
02/15/2018				2	2	8.67							158 - 175	LF	
02/20/2018							2	8	7.15	1	4	3.88	38 - 193	F,LF,W	2.25
02/23/2018				1	2	8.77							190	LF	
02/25/2018				3	4	17.39							170 - 192	W	

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT								OLDER
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED			LENGTH	RACE	JUV LOSS
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	(FL mm)		DENSITY
02/26/2018										1	3	2.45	67	S	
02/28/2018				1	4	18.39							219	W	
03/01/2018	2	8	36.82	2	6	27.65							184 - 228	F,LF,W	
03/02/2018	3	6	27.03	8	11	48.65	3	12	9.02				30 - 245	F,LF,S,W	
03/04/2018							1	4	3.01				40	F	
03/06/2018	2	8	35.50										131 - 132	W	3.48
03/07/2018				1	4	17.82	1	4	2.76				40 - 202	F,W	
03/08/2018	1	4	17.47	1	2	8.81							103 - 169	F,LF	
03/09/2018	1	4	17.76				1	4	3.19				138 - 177	F	
03/10/2018	1	4	**							1	4	2.76	95 - 423	S,U	
03/11/2018							1	4	2.76	1	4	2.76	38 - 93	F,S	
03/12/2018							1	4	2.76	1	4	2.76	43 - 96	F,S	
03/13/2018										1	4	3.19	236	S	
03/14/2018							1	4	2.76	2	8	5.53	79 - 93	S	
03/15/2018							1	4	3.19	2	8	5.30	76 - 166	S,W	0.26
03/16/2018	1	4	16.74	4	7	29.74				3	12	8.71	47 - 140	F,LF,S	
03/17/2018				4	12	51.00				4	16	11.05	82 - 192	S,W	
03/18/2018				2	6	25.71				3	12	8.29	82 - 238	S,W	
03/19/2018	1	4	17.08							6	24	16.58	81 - 99	S	
03/20/2018				3	3	13.00	3	12	9.14	6	24	17.85	84 - 227	S,W	0.25

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT								
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED					OLDER JUV LOSS DENSITY
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	LENGTH (FL mm)	RACE	
03/21/2018	2	8	34.40	4	14	59.78				3	12	8.18	83 - 291	S,W	1.28
03/22/2018	2	6	26.96	1	1	4.33	5	20	13.38	5	20	13.38	88 - 161	S,W	2.27
03/23/2018	6	16	69.06	6	22	92.40	3	12	8.65	4	16	10.15	77 - 216	S,W	2.09
03/24/2018	2	8	35.47	2	4	16.69	3	12	7.96	2	8	5.07	79 - 150	S,W	1.52
03/25/2018	3	9	40.04				30	120	79.56	6	24	15.57	75 - 240	F,S,W	1.19
03/26/2018	16	32	132.93	5	13	54.04	76	304	194.90	21	84	53.63	54 - 191	F,LF,S,W	1.95
03/27/2018	45	154	643.76	8	26	109.09	112	448	284.17	37	148	94.57	37 - 240	F,LF,S	
03/28/2018	52	166	699.03	11	36	150.92	131	491	312.10	31	109	69.16	38 - 203	F,LF,S	
03/29/2018	23	70	294.93	6	14	58.46	154	616	393.15	7	28	17.76	37 - 211	F,S,W	0.59
03/30/2018	55	158	665.38	12	42	176.22	151	604	383.46	9	36	23.18	51 - 227	F,S,W	1.35
03/31/2018	45	112.5	472.54	3	10	43.32	86	344	218.89	5	20	13.03	58 - 166	F,S,W	0.49
04/01/2018	19	64	270.43	1	2	8.66	45	180	114.86	2	8	5.07	60 - 164	F,S,W	0.85
04/02/2018	20	54	227.92	1	2	8.88	33	132	83.73	5	20	13.38	67 - 191	F,S,W	0.68
04/03/2018	35	140	595.13	12	48	204.57	46	184	117.40	5	20	13.38	66 - 221	F,S	
04/04/2018	19	54	227.47	5	10	42.63	65	260	179.64	3	12	8.29	55 - 111	F,S	
04/05/2018	31	112	469.97	1	4	16.73	68	272	188.78	2	8	5.95	33 - 208	F,LF,S,W	1.23
04/06/2018	51	161.7	673.48				70	278.3	192.73				36 - 120	F,S	
04/07/2018	106	360	1514.47	1	4	16.44	86	344	238.51				58 - 123	F,S	
04/08/2018	92	262	1084.10	1	4	17.27	87	348	221.08	1	4	2.54	60 - 168	F,S,W	0.56
04/09/2018	61	192	809.41	5	18	78.12	104	416	265.25				63 - 124	F,S,W	

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT								
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED					OLDER JUV LOSS DENSITY
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	LENGTH (FL mm)	RACE	
04/10/2018	13	28	116.55				131	524	333.75	1	4	2.54	55 - 174	F,S,W	0.34
04/11/2018	81	146	613.25	2	8	34.02	55	220	165.88	2	8	6.01	64 - 107	F,S	
04/12/2018	21	50	208.57				31	124	101.92				60 - 111	F,S	
04/13/2018	57	210	876.71	2	8	34.62	22	88	71.90				64 - 109	F,S	
04/14/2018	61	196	817.22	1	1	4.33	25	100	81.70				66 - 165	F,LF,S	
04/15/2018							61	244	168.58				67 - 99	F,S	
04/16/2018	19	55	236.41				59	236	163.90				37 - 115	F,S	
04/17/2018	25	40	172.44				39	156	107.79				65 - 100	F,S	
04/18/2018	31	63	271.05				18	72	58.83				71 - 114	F,S	
04/19/2018	53	86	372.02				25	94	76.30				63 - 102	F,S	
04/20/2018	37	63	271.58	1	1	4.33	19	76	62.09				71 - 112	F,S	
04/21/2018	21	34	147.31				18	72	58.82				68 - 108	F,S	
04/22/2018	40	67	288.10				37	148	120.92				70 - 100	F,S	
04/23/2018	29	43	185.06				41	164	133.99				70 - 105	F,S	
04/24/2018	22	43	184.71				48	192	157.48				69 - 106	F,S	
04/25/2018	17	34	145.99				21	75	61.27				71 - 106	F,S	
04/26/2018	45	67	288.21				33	118	97.02				66 - 106	F,S	
04/27/2018	7	10	42.85				26	104	85.59				71 - 101	F,S	
04/28/2018	25	51	218.60				36	144	117.65				70 - 100	F,S	
04/29/2018	35	36	155.92	1	1	4.33	39	156	127.45				74 - 100	F,S	

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT								
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED					OLDER JUV LOSS DENSITY
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	LENGTH (FL mm)	RACE	
04/30/2018	55	74	319.09				21	84	68.63				74 - 100	F,S	
05/01/2018	89	122	527.61				27	108	88.24				70 - 106	F,S	
05/02/2018	112	246	1062.06				15	60	49.02				76 - 105	F,S	
05/03/2018	56	163	704.18				28	112	91.50				72 - 106	F,S	
05/04/2018	101	162	699.39				28	112	91.51				72 - 113	F,S	
05/05/2018	46	66	284.11				23	92	75.16				73 - 105	F,S	
05/06/2018	40	79	336.22				35	140	114.38				62 - 108	F,S	
05/07/2018	9	18	76.55				99	396	298.18				60 - 106	F,S	
05/08/2018							115	460	347.82				71 - 118	F,S	
05/09/2018							106	424	321.27				70 - 112	F,S	
05/10/2018							102	408	308.74				73 - 107	F,S	
05/11/2018	16	50	209.59				57	207	155.34				60 - 117	F,S	
05/12/2018	63	154	649.94				61	244	170.28				72 - 230	F,S,W	0.62
05/13/2018	43	80	339.39				45	180	127.33				69 - 124	F,S	
05/14/2018	69	146	615.90				41	164	124.30				74 - 122	F,S	
05/15/2018	37	73	328.31				32	128	98.77				65 - 249	F,S,W	0.68
05/16/2018	28	79	371.92				7	28	22.88				72 - 104	F,S	
05/17/2018	30	36	158.21				4	16	13.07				75 - 105	F,S	
05/18/2018	20	80	386.76				14	56	46.98				79 - 108	F,S	
05/19/2018	28	96	467.25				47	188	131.16				72 - 121	F,S	

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT								
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED					
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	LENGTH (FL mm)	RACE	OLDER JUV LOSS DENSITY
05/20/2018	36	130	628.44				36	144	100.76				74 - 128	F,S	
05/21/2018	10	44	213.09	1	4	20.97	59	236	165.17				73 - 122	F,S	
05/22/2018	11	46	221.04				15	60	45.10				81 - 100	F	
05/23/2018	5	19	89.46				13	52	39.60				83 - 120	F,S	
05/24/2018	3	12	57.50				10	40	30.07				85 - 100	F	
05/25/2018	1	4	19.08				11	44	33.07				80 - 98	F	
05/26/2018							29	116	88.73				81 - 103	F	
05/27/2018							26	104	79.71				80 - 105	F	
05/28/2018	6	24	115.75				31	124	94.23				75 - 105	F	
05/29/2018							25	100	76.19				78 - 103	F	
05/30/2018							4	16	13.69				79 - 104	F	
05/31/2018	5	10	49.60				3	12	9.80				87 - 105	F	
06/01/2018	4	16	78.27				20	74	51.73				81 - 108	F	
06/02/2018	2	8	38.21				12	48	33.17				78 - 100	F	
06/03/2018							5	20	13.82				81 - 97	F	
06/04/2018	2	8	38.21				6	24	16.58				80 - 99	F	
06/06/2018							6	24	16.58				78 - 95	F	
06/07/2018	3	9	42.56				2	8	5.95				84 - 104	F	
06/08/2018	3	12	59.19				16	64	40.94				82 - 110	F	
06/09/2018							6	24	15.22				82 - 100	F	

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT								
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED					
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	LENGTH (FL mm)	RACE	OLDER JUV LOSS DENSITY
06/10/2018	1	2	9.53				9	36	22.83				78 - 99	F	
06/11/2018							8	32	20.30				73 - 90	F	
06/12/2018							1	4	2.54				83	F	
06/15/2018							1	4	2.54				86	F	
06/20/2018							1	4	3.01				85	F	
Season total		**5572.2**	**23968.60**		**392.0**	**1677.32**		**13577.3**	**9665.84**		**738.0**	**487.23**			
Weekly total		**0.0**	**0.00**		**0.0**	**0.00**		**0.0**	**0.00**		**0.0**	**0.00**			

The table will only be updated with catch, salvage, loss, length, race, and loss density on dates when salmon were salvaged, although the report and "report date" will be updated each week day to indicate that the information is current.

Non-clipped = adipose fin present; Clipped = adipose fin removed; Race: S = spring run, F = fall run, LF = late fall run, W = winter run.

U = Unknown race; fish was larger than any established race by length of the fish at date criteria (> 300 mm).

** Loss for large unknown race salmon is not included in this report.

***Since NON clipped salmon was not released, but kept for a study, a “1” was added to loss.

Older Juvenile Loss Density = daily combined (SWP+CVP) losses of older non-clipped juveniles /1000AF (SWP+CVP exports)

Older Juvenile Loss Densities were modified to reflect the results of the rapid genetic testing protocol for days in which the protocol was implemented. CDFW modified the initial Length-at-Date determination by the protocol results. Raw data is provided at the following web site by CDFW which includes the initial LAD determination and the modified coded wire tag or genetic determination results: ftp://ftp.dfg.ca.gov/salvage/Salmon_2018_06142018.csv

Appendix E - Steelhead Loss-Density Table

Steelhead - Daily Summary Table

California Department of Fish and Wildlife - Results Subject to Revision

Prepared by: Geir Aasen **Report Date: 7/3/2018** **Report Time: 1:06 PM**

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT							
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED			LENGTH (FL mm)	LOSS
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS		DENSITY
01/21/2018										1	4	2.72	185	
01/23/2018										1	1	0.68	230	
01/24/2018										1	4	2.72	228	
02/01/2018	1	4	17.32										250	1.52
02/06/2018										1	4	2.72	243	
02/08/2018	1	4	17.32							1	4	2.72	264 - 425	1.41
02/12/2018										2	8	5.44	211 - 245	
02/14/2018	1	4	17.32										280	2.40
02/21/2018							1	4	2.72				260	1.07
02/23/2018										1	1	0.68	246	
03/01/2018				3	10	43.30							201 - 256	
03/02/2018				8	17	73.61				1	4	2.72	208 - 487	
03/03/2018	1	4	17.32	15	46	199.18	1	4	2.72				190 - 270	1.91
03/04/2018				19	58	251.14							210 - 283	
03/05/2018	1	2	8.66	7	22	95.26				2	8	5.44	204 - 495	0.79
03/06/2018	1	2	8.66	9	32	138.56				1	4	2.72	190 - 256	0.85
03/07/2018				13	30.2	130.62				2	8	5.44	181 - 268	

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT							
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED			LENGTH (FL mm)	LOSS
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS		DENSITY
03/08/2018				3	9	38.97				1	4	2.72	211 - 242	
03/09/2018				1	2	8.66				1	4	2.72	235 - 274	
03/10/2018										1	4	2.72	260	
03/11/2018				3	3	12.99							238 - 331	
03/12/2018										3	12	8.16	204 - 480	
03/13/2018	1	4	17.32	2	3	12.99	4	16	10.88	2	8	5.44	210 - 360	2.53
03/14/2018	1	2	8.66	4	4	17.32	3	12	8.16				232 - 428	1.49
03/15/2018							1	4	2.72	1	4	2.72	229 - 253	0.22
03/16/2018	2	6.8	29.59	6	8.8	38.25	4	16	10.88	1	4	2.72	225 - 475	3.06
03/17/2018	1	4	17.32				5	20	13.60				262 - 283	2.68
03/18/2018	3	8	34.64	2	4	17.32	3	12	8.16	2	8	5.44	226 - 325	3.50
03/19/2018	6	16	69.28	1	4	17.32	7	28	19.04				227 - 406	6.81
03/20/2018	2	2	8.66	1	1	4.33	1	4	2.72				214 - 388	0.91
03/21/2018	1	2	8.66	3	8	34.64	4	16	10.88				220 - 264	1.42
03/22/2018	2	5	21.65				3	12	8.16	4	16	10.88	232 - 292	2.07
03/23/2018	6	20	86.60	2	6	25.98	7	28	19.04				224 - 301	7.45
03/24/2018	5	18	77.94	3	9	38.97	5	20	13.60				204 - 440	6.42
03/25/2018	4	10	43.30	6	16.3	70.72	4	16	10.88				149 - 428	3.59
03/26/2018	8	19	82.27	4	10	43.30	4	16	10.88	1	4	2.72	224 - 426	6.21

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT							
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED				
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	LENGTH (FL mm)	LOSS DENSITY
03/27/2018	6	20	86.60	3	10	43.30	2	8	5.44				215 - 370	5.68
03/28/2018	6	20	86.60	4	14	60.62				2	2	1.36	225 - 469	4.81
03/29/2018	7	16	69.28	3	8	34.64	1	4	2.72	4	16	10.88	207 - 335	4.83
03/30/2018	3	6	25.98	5	14	60.62							212 - 482	1.32
03/31/2018	9	22.5	97.43	10	20	86.60	2	8	5.44	1	4	2.72	209 - 435	5.62
04/01/2018	2	8	34.64	11	30	129.90	2	8	5.44	1	4	2.72	199 - 321	2.94
04/02/2018	8	28	121.24	2	4	17.32	3	12	8.16	2	8	5.44	219 - 402	9.89
04/03/2018	6	24	103.92	2	8	34.64	3	12	8.16	1	4	2.72	200 - 280	7.83
04/04/2018	5	18	77.94	6	20	86.60	2	8	5.44	3	12	8.16	209 - 461	5.80
04/05/2018	5	16	69.28	2	6	25.98	2	8	5.44	1	4	2.72	204 - 437	5.18
04/06/2018	6	9.5	41.14	3	10	43.30	4	16	10.88				210 - 275	3.58
04/07/2018	14	48	207.84	8	28	121.24	2	8	5.44				197 - 441	14.25
04/08/2018	7	26	112.58	3	6	25.98	2	8	5.44				221 - 460	7.57
04/09/2018	5	18	77.94	3	8	34.64	4	16	10.88	1	4	2.72	217 - 462	5.84
04/10/2018	9	13	56.29	11	18	77.94	4	16	10.88				215 - 440	7.86
04/11/2018	2	4	17.32	2	6	25.98	1	4	2.72				235 - 274	3.56
04/12/2018	1	4	17.32							1	4	2.72	243 - 318	3.31
04/13/2018	2	8	34.64										279 - 294	4.97
04/14/2018	3	12	51.96	3	9	38.97	2	8	5.44				226 - 335	9.12

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT							
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED			LENGTH (FL mm)	LOSS
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS		DENSITY
04/15/2018							3	12	8.16	1	4	2.72	210 - 288	1.58
04/16/2018				1	2	8.66				2	8	5.44	211 - 255	
04/17/2018				1	1	4.33	1	4	2.72				268 - 270	0.47
04/18/2018	2	3	12.99										219 - 226	3.87
04/19/2018							2	2	1.36	2	2	1.36	346 - 433	0.39
04/21/2018	2	4	17.32				1	4	2.72				213 - 331	6.01
04/22/2018	2	4	17.32	1	2	8.66							242 - 285	5.18
04/23/2018	1	2	8.66										231	2.59
04/24/2018	3	8	34.64										236 - 349	10.38
04/25/2018	1	1	4.33	1	1	4.33							238 - 265	1.29
04/26/2018	2	5	21.65										235 - 300	6.50
04/27/2018							1	4	2.72				271	1.03
04/28/2018							1	4	2.72				230	1.11
04/29/2018				1	1	4.33	1	4	2.72				224 - 270	1.09
04/30/2018							1	4	2.72				260	0.92
05/01/2018				1	2	8.66							246	
05/02/2018	1	4	17.32				1	4	2.72				243 - 288	6.33
05/03/2018	2	3	12.99										260 - 267	3.55
05/04/2018				2	3	12.99							219 - 235	

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT							
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED			LENGTH (FL mm)	LOSS
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS		DENSITY
05/05/2018	2	8	34.64				1	4	2.72				230 - 248	9.20
05/06/2018							1	4	2.72				296	0.72
05/07/2018	1	1	4.33				2	8	5.44				260 - 429	2.54
05/09/2018							1	4	2.72				282	0.76
05/10/2018							3	12	8.16				200 - 280	2.27
05/11/2018	1	4	17.32				1	4	2.72				259 - 275	4.56
05/12/2018	1	1	4.33				5	20	13.60				204 - 263	2.56
05/13/2018							4	16	10.88				232 - 267	1.42
05/14/2018	1	1	4.33				1	4	2.72				236 - 246	1.23
05/15/2018	3	4	17.32				3	12	8.16				229 - 431	3.99
05/16/2018	3	9	38.97										223 - 284	9.15
05/17/2018	1	1	4.33										230	1.85
05/18/2018							1	4	2.72				290	0.68
05/20/2018	2	6	25.98				1	4	2.72				234 - 262	3.72
05/21/2018							1	4	2.72				234	0.37
05/22/2018	4	18	77.94				1	4	2.72				215 - 370	13.77
05/23/2018	2	12	51.96				2	8	5.44				220 - 282	8.83
05/24/2018							1	4	2.72				240	0.46
05/26/2018	1	4	17.32				1	4	2.72				221 - 275	3.41

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT							
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED				
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	LENGTH (FL mm)	LOSS DENSITY
05/27/2018	2	2	8.66	1	4	17.32							267 - 453	1.79
06/01/2018	2	6	25.98				1	4	2.72				225 - 273	3.59
06/02/2018	1	4	17.32										275	2.28
06/10/2018							1	4	2.72				460	0.34
06/11/2018							1	4	2.72				260	0.33
Season total		**572.8**	**2480.37**		**538.3**	**2330.98**		**546.0**	**371.28**		**194.0**	**131.92**		
Weekly total		**0.0**	**0.00**		**0.0**	**0.00**		**0.0**	**0.00**		**0.0**	**0.00**		

The table will only be updated with catch, salvage, loss, length, and loss density on dates when steelhead were salvaged, although the report and "report date" will be updated each week day to indicate that the information is current.

Non-clipped = adipose fin present; Clipped = adipose fin removed

State Water Project loss = salvage x 4.33; Central Valley Project loss = salvage x 0.68

Steelhead Loss Density = daily combined (SWP+CVP) losses of non adipose clipped steelhead /1000AF (SWP+CVP exports)

Appendix F – 2017/2018 Salmonid and Green Sturgeon Incidental Take and Monitoring Report

Annual Incidental Take Monitoring Report will be posted on the DOSS website: http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/doss.html

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

DEPARTMENT OF WATER RESOURCES
DIVISION OF ENVIRONMENTAL SERVICES
3500 INDUSTRIAL BOULEVARD
WEST SACRAMENTO, CA 95691

October 19, 2018

Maria Rea
Sacramento Area Office
National Marine Fisheries Service
650 Capitol Mall, Suite 8-300
Sacramento, California 95814-4706

2017/2018 Salmonid and Green Sturgeon Incidental Take and Monitoring Report

Dear Ms. Rea:

Enclosed is the 2017/2018 *Salmonid and Green Sturgeon Incidental Take and Monitoring Annual Report*. This annual report is required under the 2009 National Marine Fisheries Service (NMFS) Final Biological Opinion and Conference Opinion on the Proposed Long-Term Operations of the Central Valley Project and State Water Project (2009 NMFS Biological Opinion). The enclosed report includes the following:

1. A summary of the incidental take of natural and hatchery winter-run Chinook salmon (*Oncorhynchus tshawytscha*), spring-run Chinook salmon (*O. tshawytscha*) surrogates, Central Valley steelhead (*O. mykiss*), and green sturgeon (*Acipenser medirostris*) at the State Water Project's John E. Skinner Delta Fish Protective Facility and the Central Valley Project's Tracy Fish Collection Facility.

2. A summary of the data acquired through the salmonid monitoring program for the lower Sacramento River and the Delta, along with a summary of the Delta hydrologic conditions.

If you have any questions regarding the report, please contact Farida Islam of the Division of Environmental Services' Office of Regulatory Compliance at (916) 376-9817.

Sincerely,

Dean F. Messer, Chief
Division of Environmental Services

Enclosure

cc:

Jeff Stuart
National Marine Fisheries Service
650 Capitol Mall, Suite 6066A
Sacramento, CA 95814-4706

Barb Byrne
National Marine Fisheries Service
650 Capitol Mall, Suite 6066A
Sacramento, CA 95814-4706

Harry Spanglet, Gail Kuenster and Chris Wilkinson
Department of Water Resources
3500 Industrial Blvd
West Sacramento, CA 95691

John Leahigh and Bryant Giorgi
Department of Water Resources
3310 El Camino Ave
Sacramento, CA 95821-9000

Laurence Kerckhoff
Department of Water Resources
1416 9th Street, Room 1104
Sacramento, CA 95814

Paul Fujitani
U.S. Bureau of Reclamation
3310 El Camino Avenue, Suite 300
Sacramento, CA 95821

Daniel Kratville
Department of Fish and Game
830 S Street
Sacramento, CA 95814

Felix Smith
Save the American River Association
4720 Talus Way
Carmichael, CA 95608

Rebecca Sheehan
Metropolitan Water District of Southern California
1121 L Street, Suite 900
Sacramento, CA 95814

2017/2018
SALMONID AND GREEN STURGEON
INCIDENTAL TAKE AND MONITORING REPORT

October 19, 2018

Prepared By

Farida Islam and Kevin Reece
California Department of Water Resources
Division of Environmental Services
West Sacramento, California

And

Elissa Buttermore
United States Bureau of Reclamation
Bay-Delta Office
Sacramento, California

2017/2018 SALMONID AND GREEN STURGEON INCIDENTAL TAKE AND MONITORING REPORT

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2017/2018 SALMONID AND GREEN STURGEON INCIDENTAL TAKE AND MONITORING REPORT

This annual report is required under the Terms and Conditions of the 2009 National Marine Fisheries Service (NMFS) Biological Opinion and Conference Opinion on the Proposed Long-Term Operations of the Central Valley Project and State Water Project (2009 NMFS Biological Opinion). This report summarizes the incidental take of Winter-run Chinook Salmon (*Oncorhynchus tshawytscha*), Spring-run Chinook Salmon (*O. tshawytscha*) surrogates, Central Valley steelhead (*O. mykiss*), and green sturgeon (*Acipenser medirostris*) at the State Water Project's (SWP) John E. Skinner Delta Fish Protective Facility and the Central Valley Project's (CVP) Tracy Fish Collection Facility (Delta fish facilities) for 2017/2018. This report also includes data from a wide geographic area including the salmonid monitoring program for the lower Sacramento River and the Delta (Figure, pg.16), and the hydrologic conditions in the Delta.

In addition to this annual report, the California Department of Water Resources (DWR) also conducted Data Assessment Team (DAT) meetings and reported the relevant data updates to the Delta Operations for Salmonids and Sturgeon technical working group (DOSS) during the 2017/2018 incidental take season. Preliminary analysis of the weekly data reports can be found in the weekly meeting notes that are posted on the DAT and DOSS websites:

DAT:
https://water.ca.gov/Programs/State-Water-Project/Operations-and-Maintenance/CALFED-Operations

DOSS:
http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/doss.html

In addition to those sites, during 2017/2018 season, fish monitoring data were reviewed from SacPAS website:
http://www.cbr.washington.edu/sacramento

Data Acquisition

DWR acquired data from the California Department of Fish and Wildlife (DFW), the United States Fish and Wildlife Service (USFWS), and other internal DWR and United States Bureau of Reclamation (Reclamation) divisions. At the time of the data acquisition, many of the agencies were still in the process of finalizing their data, therefore the data presented in this report are preliminary and subject to revision. DWR will add an addendum to this report if analysis of the finalized data leads to substantial changes to the results.

Methods for Measuring Incidental Take

Current Method

For this report, DWR quantified incidental take for the listed species to the nearest whole fish at each facility using the current methods described in the 2009 NMFS Biological Opinion. DWR estimated the incidental take of steelhead and green sturgeon based on salvage, and estimated the incidental take of Chinook Salmon based on loss using the procedures in DFW (2013). For implementation of the NMFS Reasonable and Prudent Alternative (RPA) Action IV.2.3, DWR also estimated daily loss of steelhead using the interim DOSS (2011) method, which expands for steelhead loss from salvage using Chinook Salmon expansion factors.

Alternative Methods

As presented in previous reports, there is still a high degree of uncertainty and poor documentation associated with the current methods used to estimate loss or incidental take of Chinook Salmon, steelhead, and green sturgeon. Reclamation is required to improve the quantification of loss by developing an alternative technique to quantify incidental take of listed anadromous species at the Delta fish facilities in compliance with Term and Condition 2a (T&C 2a) of the 2009 NMFS Biological Opinion. In the summer of 2013, Reclamation and DWR, with guidance from the interagency T&C 2a Technical Work Team (technical team), drafted Anonymous (2013) to describe the proposed modifications to the current methods for estimating loss. Anonymous (2013) was submitted for independent review and consideration at the 2013 Long-Term Operations Biological Opinions (LOBO) Annual Review, and was based on various documents prepared for the T&C 2a process. These documents include:

1) Jahn (2011), which describes an alternative technique for estimating point and confidence interval estimates of loss;
2) CFS (2013), which describes the most important terms in the modified Jahn (2011) loss equation for estimating loss and the contribution each term makes to the overall variance of loss; and
3) a two-year comparison of the Jahn (2011) method with the current methods for estimating incidental take, which is documented in the 2011/2012 and 2012/2013 incidental take and monitoring reports (see DWR and Reclamation 2012; DWR and Reclamation 2013).

However, the Independent Review Panel (IRP) for the 2013 LOBO review expressed concerns in their final report on the Jahn (2011) model for calculating point and confidence interval estimates of loss, which would also apply to the Anonymous (2013)

approach and to the current methods (see Anderson et al. 2013 for concerns). The IRP's concerns include using fixed survival values in the equation, not accounting for probable losses from zero salvage, and using the error propagation method for characterizing uncertainty (Anderson et al. 2013). To address these concerns, the IRP provided recommendations on how to improve the loss and uncertainty estimates, including using a Bayesian method to account for probable losses from zero salvage and using a Monte Carlo simulation for estimating loss and its uncertainty (see Anderson et al. 2013 for recommendations).

To move forward with some of these approaches from the IRP, technical team members will consider the IRP's suggestion to develop a different framework for calculating loss, which incorporates essential terms as random variables. Team members have also reviewed the various conceptual models for the SWP and CVP fish collection facilities that were presented by different agencies with technical expertise. Per the guidance of the technical team, DWR initiated a task order for the Contractor to complete various tasks that will help DWR and Reclamation to move forward with the 2013 recommendations from the IRP on T&C 2a. The task order consisted of five major tasks:

- Task 1: Complete Second Opinion Report on IRP Recommendations
  - The final copy of the second opinion report was received from the consultants on August 11, 2015 and was accepted by the technical team members

- Task 2: Provide Monte Carlo Script(s) from Teply and Ceder (2013) and Prepare Associated Report on Script(s).
  - No work was done on Task 2 yet as the technical team members have agreed to proceed with Task 3 instead.

- Task 3: Develop New Loss Method and Tool with Report.
  - Contractors have conducted the first workshop with technical team to review what the technical team needs for the new method and tool for estimating loss. The second workshop was conducted on October 8, 2015.

- Task 4: Complete Study Design Recommendation Report.
  - Contractors have recommended some additional studies during the first workshop and provided more as Task 3 progressed.

- Task 5: Project Management.
  - Contractor provided general project management, including coordination of staff, administrative support, and contract administration throughout the execution of the Task Order.

All the tasks have been completed under the task order during the year 2015/2016. Due to the shift in project management, the review process of the new Loss Method and

Tool developed by the consultants was delayed. DWR is still awaiting direction from Reclamation on how to proceed with the project. An analysis of the review will be included in the 2018/2019 incidental take report if it is available at the time of the report.

Observed Chinook Salmon Salvage

Figure 2 describes the observed Chinook Salmon salvage at the Delta fish facilities in 2017/2018 from normal salvage counts, special studies, and secondary flushes. However, Figure 2 does not include any Chinook Salmon whose run cannot be classified using the Delta model length-at-date criteria (LAD) (https://water.ca.gov/LegacyFiles/aes/docs/ValidatingLength-at-DateRunassignments.pdf) . This includes Chinook Salmon that are larger than the length-at-date criteria considered in the model, and any Chinook Salmon that were not measured for length. In 2017/2018, fork lengths were obtained for all Chinook Salmon salvaged at the Delta fish facilities. Total juvenile Chinook Salmon salvage was 19,137, with an expanded combined loss of 33,631. Overall, the number of sub-adults observed at Delta fish facilities were lower than the previous year. At CVP, 96 sub-adults of an undetermined run of Chinook Salmon were salvaged that fell outside of the length-at-date criteria (greater than 500 mm fork length) during 2016/2017 season and no sub-adults were observed during 2017/2018 season. At SWP, 6 sub-adults of an undetermined run of Chinook were observed during the 2016/2017 season and 4 sub-adults were observed during 2017/2018 season. All observed sub-adults were greater than 500 mm of fork length and therefore no loss was calculated for those fish.

Based on clarifications in DOSS (2013), DWR and Reclamation defined naturally-produced older juvenile Chinook Salmon as all Chinook Salmon with non-clipped adipose fins (non-clipped) greater than or equal to the minimum Winter-run length-at-date criteria using the Delta Model, and less than the maximum length-at-date criteria in the Delta Model. The Delta Model length-at-date criteria categorizes two different brood years of Winter-run Chinook Salmon in July, and for that month DWR and Reclamation used the minimum Winter-run length-at-date criteria for the older brood year.

Overall, the number of observed non-clipped older juvenile Chinook Salmon in 2017/2018 was substantially higher than in 2016/2017. In 2017/2018, the observed non-clipped older juvenile Chinook Salmon were salvaged between February and April, with most of salvage occurring during March 2018 (Figure 2). This is a departure from previous years when salvage generally occurred between December and May. There was no noticeable correlation between the number of non-clipped older juvenile salvage and export levels.

Interestingly, the overall number of observed hatchery Chinook Salmon at the Delta fish facilities was lower in 2017/2018 than in 2016/2017 even though the number of unclipped juvenile Chinook Salmon of Winter-run size was higher than the previous

year. As in year 2016/2017, the Coleman Hatchery late-fall-run brood year 2017 releases had the highest salvage out of all the hatchery fish observed in salvage. Also, the number of observed Spring-run Chinook Salmon from the San Joaquin River Restoration Program (SJRRP) was the highest among the released groups as it was also in 2016/2017 year.

Observed Chinook Salmon Genetic Run Assignment

For the 2017/2018 year, the Bureau of Reclamation (Reclamation) was leading the contract related to genetic analysis. During WY 2018, the daily older juvenile Chinook Salmon loss density threshold was exceeded on several days, with only one trigger event on 3/6/18 confirmed as a genetically Winter-run Chinook loss-density exceedance. Twelve percent (n = 6 fish) of the samples (n = 52 fish) taken during trigger exceedance events received a Winter-run genetic assignment that have been processed to date (Table 4). Forty-five of these samples were classified as Winter-run by LAD, but only six of these samples were confirmed to actually be Winter-run (87 percent false positive error rate; Table 4).

From the SWP, a total of 44 samples were obtained from LAD juvenile Winter-run sized Chinook Salmon. Genetic samples from 6 samples failed to provide reliable results, and 2, which arrived later in the season have not yet been analyzed. Confirmed loss of Winter-run for 2017/2018 was 70.94. If the 6 samples that failed, and the 2 awaiting analyses were all true Winter-run, total loss for the SWP would be 169.82.

A total of 27 samples were collected at the CVP that were classified as unclipped Winter-run Chinook based on LAD. Of these samples that have been analyzed (n=14), all were genetically fall-run. If the 13 samples that have not been analyzed were actually Winter-run Chinook, then the CVP Winter-run loss would be 42.25. The estimated combined CVP/SWP wild Winter-run loss could be as low as 70.94 or as high as 212.07. It is possible that some fish (that have not undergone genetic analysis yet) that were not categorized as Winter-run by the length-at-date model were actually Winter-run. Previous studies have demonstrated that few fish that are smaller than Winter-run LAD category are genetically Winter-run Chinook (Harvey et al. 2014).

Rapid Genetic Testing Protocol

Some of the action triggers in Actions IV.2.3 and IV.3 of the NMFS BiOp are based on loss or loss density of unclipped older juvenile Chinook Salmon. Chinook Salmon race classifications are made using LAD tables. Older juvenile Chinook Salmon are those fish larger than the minimum Winter-run size classification using the LAD criteria. Triggers for older juvenile Chinook Salmon are primarily intended to protect natural-origin Winter-run Chinook Salmon, but also include natural-origin yearling spring-run Chinook Salmon. Because genetic identification of race (especially for Winter-run Chinook Salmon) is more accurate than the classification based on LAD tables (which

often result in false positive assignments), a pilot rapid genetic testing protocol was implemented in WY 2015 by DWR and Reclamation. The objective of the protocol is to process genetic samples collected from older juvenile salmonids as soon as feasible after a loss/loss density trigger for older juvenile Chinook Salmon has been exceeded. Rapid genetic analysis was used to validate the race assignment based on the existing LAD table. The rapid genetic testing protocol has the capability of quickly determining, with a high level of confidence, whether a salvaged fish is a Winter-run Chinook Salmon or not (first probability selection tier) and then establishing a second and third tier of probabilities as to which race and watershed a Chinook Salmon from the "non-Winter-run" category belongs to. Determining the genetic identity of the fish could avoid or minimize the duration of export reductions triggered by the loss of fish falling within the older juvenile Chinook Salmon size range that were not genetically Winter-run or yearling spring-run Chinook Salmon. For WY 2018, NMFS indicated that only fish determined as genetic Winter-run would be used in determining the trigger exceedances, rather than including both genetic Winter-run and yearling spring-run Chinook Salmon in determining whether those trigger thresholds were exceeded.

Reclamation and DWR more formally implemented this procedure again during WYs 2016-2018, in coordination with the CDFW, FWS, and the NMFS. The procedure is intended to avoid (or minimize the duration of) export reductions resulting from loss of older juveniles that are not genetically listed Chinook Salmon (i.e., Winter-run or spring-run Chinook Salmon). Actions at the CVP and SWP export facilities to meet OMR requirements are initiated, if needed, when the older juvenile Chinook Salmon trigger threshold is exceeded. However, if results of tissue genetic analysis indicate that the loss or loss density of genetically verified listed Chinook Salmon (only genetic Winter-run for WY 2018) did not exceed the trigger threshold, then changes in operations to comply with the OMR criteria required by the trigger exceedances will be cancelled. NMFS supported the use of this protocol with two additional conditions: 1) all unclipped Chinook Salmon have tissue samples collected for subsequent analysis to correctly determine annual incidental take of listed fish, and 2) clarification that the annual incidental take limit of natural Winter-run remains at 1% of the annual JPE (the original value of 2% of the JPE for incidental take assumes that there is a 50% misclassification of Winter-run Chinook Salmon based on the LAD tables; the ability to genetically verify fish as Winter-run eliminates this uncertainty).

Winter-run Chinook Salmon

Winter-run Chinook Salmon Incidental Take

National Marine Fisheries Service (NMFS) provided the U.S. Bureau of Reclamation with the 2018 Juvenile Production Estimate (JPE) pursuant to the 2009 Biological Opinion on the long-term operations of the Central Valley Project (CVP) and the State Water Project (SWP) (Rea, 2018). The JPE is calculated each year to determine the

authorized level of incidental take for Winter-run Chinook Salmon, under section 7 of the Endangered Species Act (ESA), while operating the CVP/SWP Delta pumping facilities in each water year (NMFS 2009. In 2017, DFW estimated a total adult escapement of 1,155 Winter-run spawners to the upper Sacramento River, which is lower than the returns estimated in 2016 (1,546), and was significantly lower than the 10-year average of 2,802 adults. The methodology used in 2017 to calculate the annual Winter-run escapement (Cormack-Jolly-Seber Model) was the same as was used in 2016. The Cormack-Jolly-Seber model allowed for an estimation of a 90% confidence interval, which ranged from 109 to 1,888 fish. Based on the point estimate of escapement, NMFS calculated the juvenile production estimate (JPE) of natural (non-clipped) Winter-run Chinook Salmon entering the Delta in 2017/2018. NMFS took into consideration the recommendations of the Independent Review Panel (IRP) and the advice of the Winter-run Project Work Team (WRPWT) in calculating the number from the Winter-run 2017 brood year. Overall, NMFS has considered three methods (Juvenile Production Index (JPI) method and two alternative methods) for calculating JPE for 2017/2018. However, NMFS chose the JPI method to calculate the Winter-run JPE from brood year 2017 regardless of significant interest in alternative methods because of lack of documentation and peer review on those methods. According to 2018 JPE letter issued by NMFS, the members from WRPWT agreed on the interest to continue further study on the alternate methods and on the inclusion of the additional Winter-run genetically identified from those initially identified as spring-run using the river length-at-date criteria.

For the water year 2018, NMFS estimated that 201,409 natural-origin juvenile Winter-run Chinook Salmon would enter the Delta. Based on this JPE, the incidental take level from October 1, 2017, through June 30, 2018, for the Delta fish facilities was 2,014 non-clipped Winter-run Chinook Salmon, which is equal to 1% of the natural Winter-run production entering the Delta. For tracking incidental take, Winter-run Chinook Salmon are classified by genetic run assignment, following initial identification according to the Delta Model length-at-date criteria and the measurement of Winter-run Chinook Salmon incidental take is based on loss using the current loss equation from DFW (2013).

More detailed information on rationales provided by NMFS for this year's JPE estimation can be found at:
http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Delta%20Operations%20for%20Salmonids%20and%20Sturgeon/DOSS%20WY%202018/Winter-run_juvenile_production_estimate__jpe__for_brood_year_2017_-_january_29__2018__1_.pdf

Loss of Winter-run Chinook Salmon, based on the Delta Model length-at-date criteria, occurred at both Delta fish facilities for an expanded loss of approximately 591 fish at the SWP and approximately 80 fish at the CVP. The combined expanded loss of Winter-run sized Chinook Salmon was 671 for the season, approximately 33% of the permitted incidental take. Overall, the combined annual Winter-run sized Chinook Salmon loss,

based on length-at-date criteria, was higher than in the previous water year. The lowest loss in the past nine water years occurred in Water Year 2014/2015 (Figure 4, pg. 18). In 2017/2018, the daily combined older juvenile Chinook Salmon loss density trigger (NMFS RPA Action IV.2.3) was exceeded multiple times but on only one occasion was the trigger exceedance verified based on the rapid genetic analysis protocol and export reductions occurred for the protection of non-clipped Winter-run Chinook Salmon.

Hatchery Winter-run Chinook Salmon Incidental Take

On February 2, 2018, an estimated 212,270 Winter-run smolts from Livingston Stone National Fish Hatchery (LSNFH) were released into the Sacramento River at Caldwell Park near Redding, California, which was much larger than the 2017 release group of 141,922 Winter-run (from BY 2016). Based on preliminary release information and an updated survival term, NMFS estimated that 92,904 hatchery fish would enter the Delta. NMFS set the incidental take level at 1% of the total hatchery production entering the Delta, or 909 hatchery Winter-run Chinook Salmon from October 1, 2017, through June 30, 2018 and 909 hatchery Winter-run from the additional 90,924 Battle creek release group. The 2018 hatchery Winter-run take level was higher than in 2016/2017(582), which is reflective of the larger 2017/2018 release group. There was a confirmed loss of 0.026% from the LSNFH hatchery Winter-run Chinook Salmon at the Delta fish facilities. No loss occurred from the additional Battle Creek release group and n triggers were reached for this group.

Coded Wire Tagged (CWT) fish have been used for many years for investigating the fish behavior and survival rate Chinook Salmon after they are released from a hatchery. CWT fish are salvaged at the Delta Fish Facilities (SWP and CVP) are carefully handled, in accordance with the Standard Operations Protocol. On occasion, tag loss or damage does occur, and some tags are unreadable due to tag imperfections. On these occasions, the fork lengths of the CWT fish are recorded and the loss is calculated and recorded under the 'Unknown' category. For 2017/2018 year, the Unknown loss was estimated at 16.02 at CVP and reported as 'Unknown CWT Loss'. (Table 2, pg. 34). At SWP, the Unknown loss for 2017/2018 was estimated as 296.14 (Table 2, pg. 34). The combined Unknown CWT loss at both facilities for the season was 312.16 (Table 2, pg. 34).

Spring-Run Chinook Salmon

Under the 2009 NMFS Biological Opinion, NMFS uses hatchery-reared subyearling Late Fall-run Chinook Salmon as surrogates for yearling Spring-run Chinook Salmon emigrating from the upper Sacramento River and tributaries into the Delta. According to NMFS, these late Fall-run Chinook Salmon are used as surrogates because they are generally released and begin their smoltification and emigration and passage through the Delta at approximately the same time, and at a similar size, as wild Spring-run. The

Coleman National Fish Hatchery (CNFH) releases a percentage of the total CNFH Late Fall-run Chinook Salmon production as these surrogate release groups.

In water year 2017/2018, CNFH released three groups of Late Fall-run Chinook Salmon uniquely marked as Spring-run Chinook Salmon surrogates into Battle Creek: 1) 78,786 on 1/8/2018, 2) 71,645 on 1/19/18, and 3) 84,922 on 1/25/17. In addition to these surrogate releases, CNFH also released a total of 216,746 Late Fall-run Chinook Salmon into Sacramento river on 3/1/18 and 3/13/18. On 12/21/17, 297,370 Late Fall-run were released into Battle Creek and 519,791 Late Fall-run were again released there on 1/5/18. Prior to these releases, DOSS provided input to the CNFH on the release schedule of the Spring-run Chinook Salmon surrogates based on the information that the production release would occur during the first significant precipitation event sometime between November and late December. However, DOSS also noted that the 1st surrogate release should occur about 3 days after the production release and also should coincide with a rainfall event. DOSS provided the guidance to release the second surrogate group during late December, at least a week after the previous group and ideally preceding a precipitation event, and to release the third group after a similar number of days between the first and second releases. A summary of more specific inputs provided from DOSS to CNFH is described in the annual DOSS report (2018).

Measuring Incidental Take

The incidental take level for the combined operation of the Delta pumping plants is equal to 1% of any individual CNFH Late-Fall Chinook Salmon surrogate release group. Measurement of incidental take for each surrogate release group is based on loss using the current loss equation from DFW (2013). However, there are occasions when the hatchery of origin for the CWT Chinook Salmon could not be confirmed due to lost, missing, or damaged tags, or due to the accidental release of CWT fish. For this reason, the actual loss could be higher than what is confirmed in Table 3. For the 2017/2018 season, the total Unknown loss due to Damaged Tags or Tags Not Found was 312.16 (Table 2, pg. 35). As mentioned previously, the Unknown loss is for the entire season and was not necessarily correlated with any one released group.

First Surrogate Release Group and Incidental Take

The first Spring-run Chinook Salmon surrogate hatchery group of approximately 78,786 CNFH Late Fall-run Chinook Salmon was released on January 8, 2018. A total confirmed loss of 12.99 was estimated from this group from the fish salvaged at the Delta fish facilities (Table 1, pg.34). The percent loss was calculated to be 0.016%, which was below the exceedance level according to NMFS BiOp.

Second Surrogate Release Group and Incidental Take

On January 19, 2018, CNFH released the second Spring-run Chinook Salmon surrogate hatchery group of approximately 71,645 Late Fall-run Chinook Salmon into Battle Creek. Interestingly, no confirmed loss occurred from this group as there was no salvage observed from this group. The percent loss was calculated to be 0%, which was obviously well below the exceedance level according to NMFS BiOp.

Third Surrogate Release Group and Incidental Take

On January 25, 2018, CNFH released the third Spring-run Chinook Salmon surrogate hatchery group of approximately 84,922 Late Fall-run Chinook Salmon into Battle Creek (Table 1, pg. 34). A total confirmed loss of 25.68 was estimated from this group from the fish salvaged at the Delta fish facilities (Table 1, pg. 34). The percent loss was calculated to be 0.030%, which was well below the exceedance level according to NMFS BiOp.

Fry/Smolt Chinook Salmon Loss

The combined expanded loss of fry/smolt Chinook Salmon salvaged between October 2017 and July 2018 was approximately 32,956, which is much lower than the previous few years' salvage (Figure 6, pg.20). Using the Delta Model length-at-date criteria, DWR and Reclamation defined fry/smolts as all non-clipped Chinook Salmon smaller than the minimum Winter-run length-at-date criteria. The Delta Model length-at-date criteria categorizes two different brood years of Winter-run Chinook Salmon in July. For this month, DWR and Reclamation used the minimum Winter-run length-at-date criteria for the older brood year.

Most of the fry/smolt Chinook loss occurred during April and May, unlike in the previous few years when fry/smolt Chinook Salmon were salvaged earlier in the season, starting mid-December. The annual loss in 2017/2018 was lower than 2015/2016 season.

Chinook Salmon Monitoring in the Sacramento River and the Delta

The Delta Juvenile Fish Monitoring Program (DJFMP) conducted by USFWS operates under the auspices of the Interagency Ecological Program (IEP). The DJFMP has been conducting juvenile salmon monitoring in the Delta since the early 1970s with the goals of gaining information on potential management actions that could improve the survival of juvenile salmon rearing and migrating through the Delta, and to document non-salmonid temporal and spatial distributions. For the USFWS Sacramento River and Delta surveys, DWR and Reclamation separated non-clipped older juvenile Chinook

Salmon from fry/smolts using the Frank-Fisher Model (Fisher, F.W, CDFW) which categorizes two different brood years of Winter-run Chinook Salmon in July and August. DWR and Reclamation used the minimum length of the dominant brood year of a reporting period for categorizing older juveniles and fry/smolts.

Spring-Run Chinook Salmon Surrogate Monitoring

The USFWS conducted a midwater and Kodiak trawl survey on the Sacramento River at Sherwood Harbor to gauge the relative abundance and timing of juvenile Chinook Salmon entering the Delta. Based on the data received early September, USFWS recovered 3 surrogates from the first surrogate release, 0 surrogates from the second release group, and 0 surrogates from the third release group (Figure 7, pg.21). The number of recovered surrogates was similar to the previous year. The surrogate catch occurred during December of 2016 to early January 2017, which coincided with the catch of older juvenile Chinook Salmon at the Sacramento trawl.

In addition, a midwater trawl survey was conducted at Chipps Island, which is the most downstream trawl survey location in the legal Delta. USFWS recovered surrogates at Chipps Island for a catch of 16 surrogates from the first surrogate release, a total of 7 from the second surrogate release in February, and 10 surrogates for the third surrogate release. The total numbers of recovered surrogates were lower in 2017/2018 compared to the previous year. An opposite trend has been observed when 2016/2017 numbers were compared to 2015/2016. The timing of recoveries at Chipps Island for all three surrogate releases was consistent with the timing of older juvenile Chinook Salmon catch at Chipps Island.

Due to the staff shortage, the catch data from FY 2018 was still awaiting the final QA/QC read at the time this report was being prepared and these results should be considered preliminary.

Hatchery Winter-Run Chinook Salmon Monitoring

Recoveries of hatchery Winter-run Chinook Salmon from LSNFH in the Delta monitoring trawls were higher than in 2016/2017. Between mid-March and late April of 2018, the USFWS recovered 4 hatchery Winter-run Chinook Salmon from LSNFH. A total of 20 hatchery Winter-run Chinook Salmon from LSNFH were recovered in the Kodiak trawl and 40 hatchery Winter-run Chinook Salmon from LSNFH were recovered in the Chipps Island midwater trawl (Figure 8, pg. 21). Overall recoveries were higher than the previous water year where USFWS caught 0 hatchery Winter-run Chinook Salmon in the Sacramento Trawls and 4 hatchery Winter-run from LSNFH in the Chipps Island trawl. Additionally, a total of 4 hatchery Winter-run from LSNFH were recovered from Enhanced Delta Smelt Monitoring Survey.

Central Valley Steelhead

Steelhead Incidental Take

Between October 2017 and July 2018, the CVP had a total catch of 138 non-clipped steelhead, and the SWP a total of 197, (Figure 13, pg. 28). Comparing the numbers salvaged at each facility individually, unlike the previous year, the number of salvage was similar at each fish facility. Interestingly, in 2016/2017 year, SWP salvaged almost twice as many as CVP. The number of steelhead salvaged at both facilities were significantly higher than previous year. On multiple occurrences, DWR and Reclamation reported the exceedance of steelhead daily loss triggers from January to June 2018 for more restrictive Old and Middle River flow limits (Figure 9, pg. 24) to NMFS. The daily steelhead loss triggers were calculated by multiplying combined exports in TAF on a given day by either 8 fish/TAF or 12 fish/TAF. The overall seasonal salvage for hatchery steelhead was higher than in the past nine water years (Figure 14, pg.29).

The SWP and CVP total expanded salvage of non-clipped steelhead was approximately 546 and 572, which is well below the incidental take level of 3,000 fish for the water year (Figure 9, pg. 24). The annual salvage of non-clipped steelhead for 2017/2018 greatly increased from 2016/2017, when it was 65 (Figure 9, pg. 24). The SWP and CVP salvage of hatchery (adipose fin clipped) steelhead significantly increased in 2017/2018 compared to the previous year. From October 2017 to July 2018, the CVP salvaged a total of 194 and the SWP salvaged a total of 583 for a combined total annual salvage of 732 steelhead (Figure 10, pg. 25), which is much higher than the total of 43 in 2016/2017.

Green Sturgeon Incidental Take

The incidental take level for green sturgeon remained at 74 fish for water year 2018 and is based on historical salvage. In the 2017/2018 period, no Green Sturgeon was observed at the State Water Facility. There was 1 Green Sturgeon observed at the state facility in the previous water year (2015/2016). No Green Sturgeon were observed at the Federal Facility during the water year during 2017/2018 and 2016/2017.

Delta Hydrology

In California, lower-than-average precipitation and snowpack have been observed during Water Year 2018. According to the California Data Exchange Center, precipitation data as of June 14, 2018 measured 9% of the normal for this date in the Northern Sierra area, 0% for Central Sierra, and 0% for Southern Sierra. It was very different during the previous year when the California Department of Water Resources measured the statewide snowpack to be at 190% of normal for the date of May 31, 2017. On April 7, 2017, Governor Jerry Brown issued Executive Order B-40-17 which officially ended the drought state of emergency, which started on January 17, 2014. More information on the history of drought and current hydrology of 2018 can be found

at https://water.ca.gov/News/Current-Conditions .

Overall, average exports for Sacramento River and San Joaquin River were both higher during October to December 2017 and lower during January to July 2018 than they were in 2016/2017. Water year 2017/2018 was classified as a “below normal” water year type for the Sacramento Valley, and for San Joaquin Valley. Table 3 on page 35 shows a monthly average summary of SWP and CVP exports, Sacramento and San Joaquin River flows, and Delta outflow.

Modeled volumetric water fingerprints derived from the Delta Simulation Model 2 (DSM2) at Clifton Court Forebay (SWP) and at the Jones Pumping Plant (CVP) are presented in Figures 16 and 17(DWR Division of Operations and Maintenance). Overall, these fingerprints show that most of the water from the SWP during the 2017/2018 year was split between the San Joaquin River and the Sacramento River, while the majority of SWP water came from the San Joaquin River in the previous year. In 2017/2018, water at CVP was split between the Sacramento and the San Joaquin Rivers (Fig 17, pg. 33 but 2016/2017, the majority of CVP water came from the San Joaquin River.

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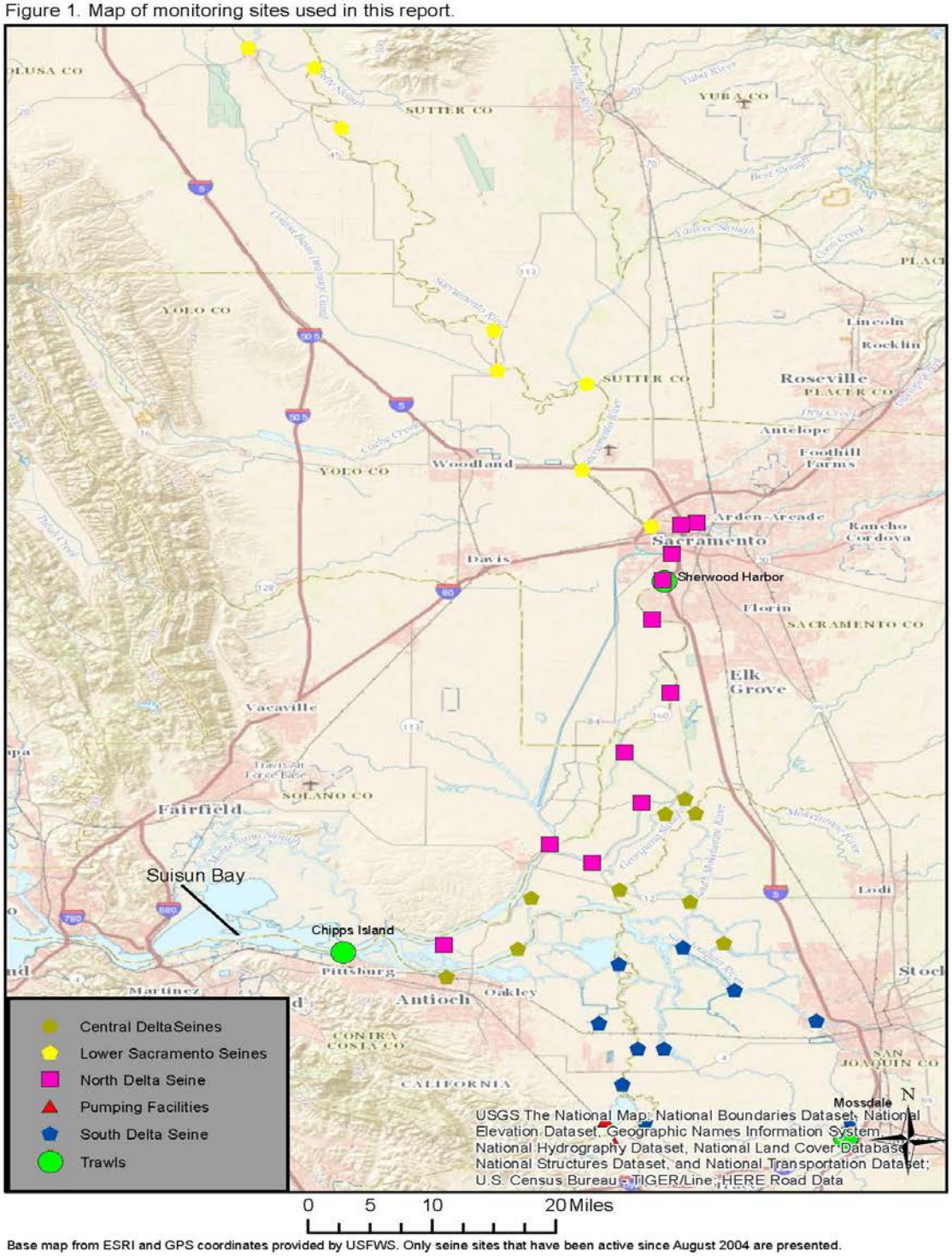
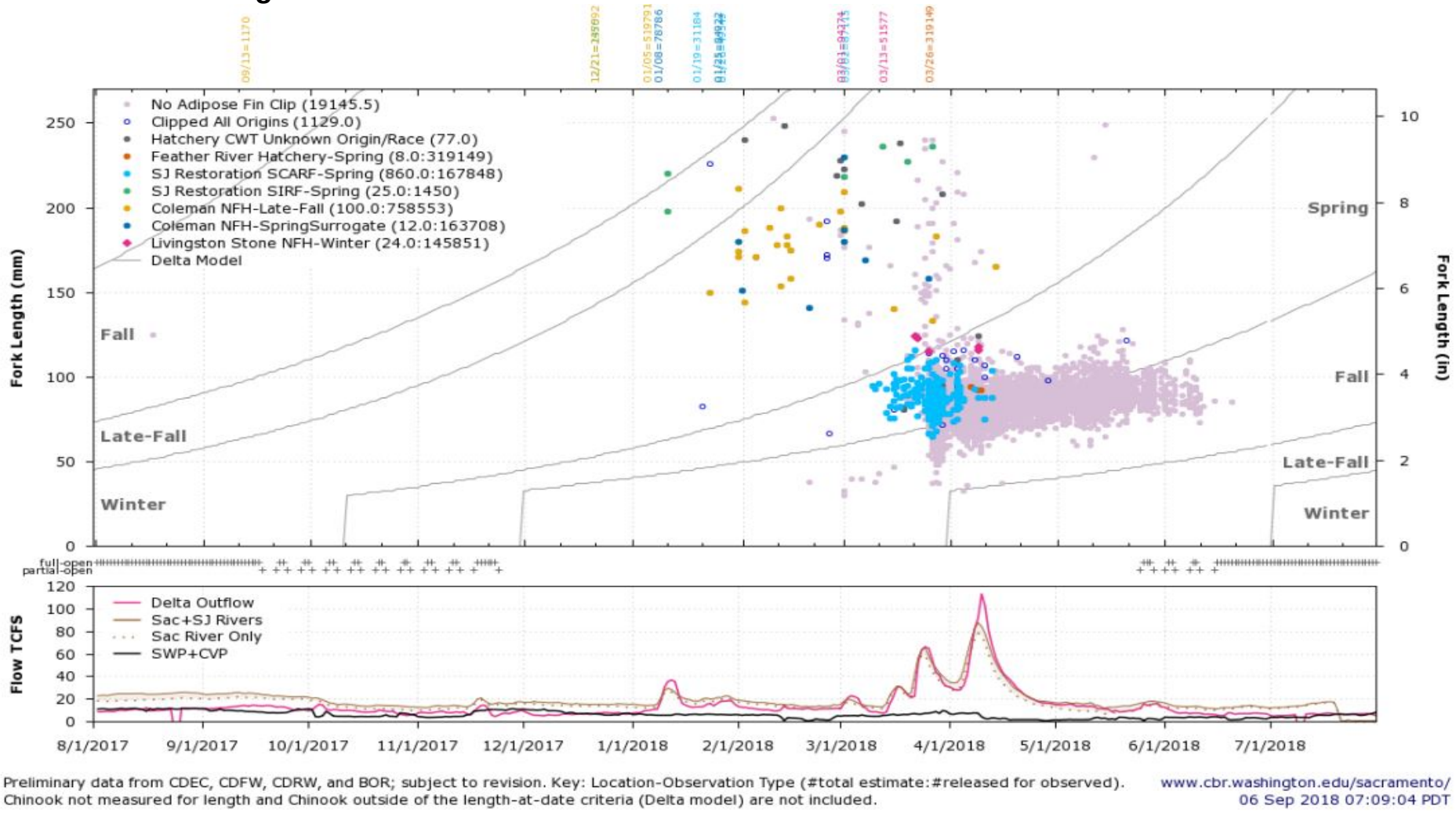
List of Figures

Figure 1. Map of monitoring sites used in this report.



Base map from ESRI and GPS coordinates provided by USFWS. Only seine sites that have been active since August 2004 are presented.

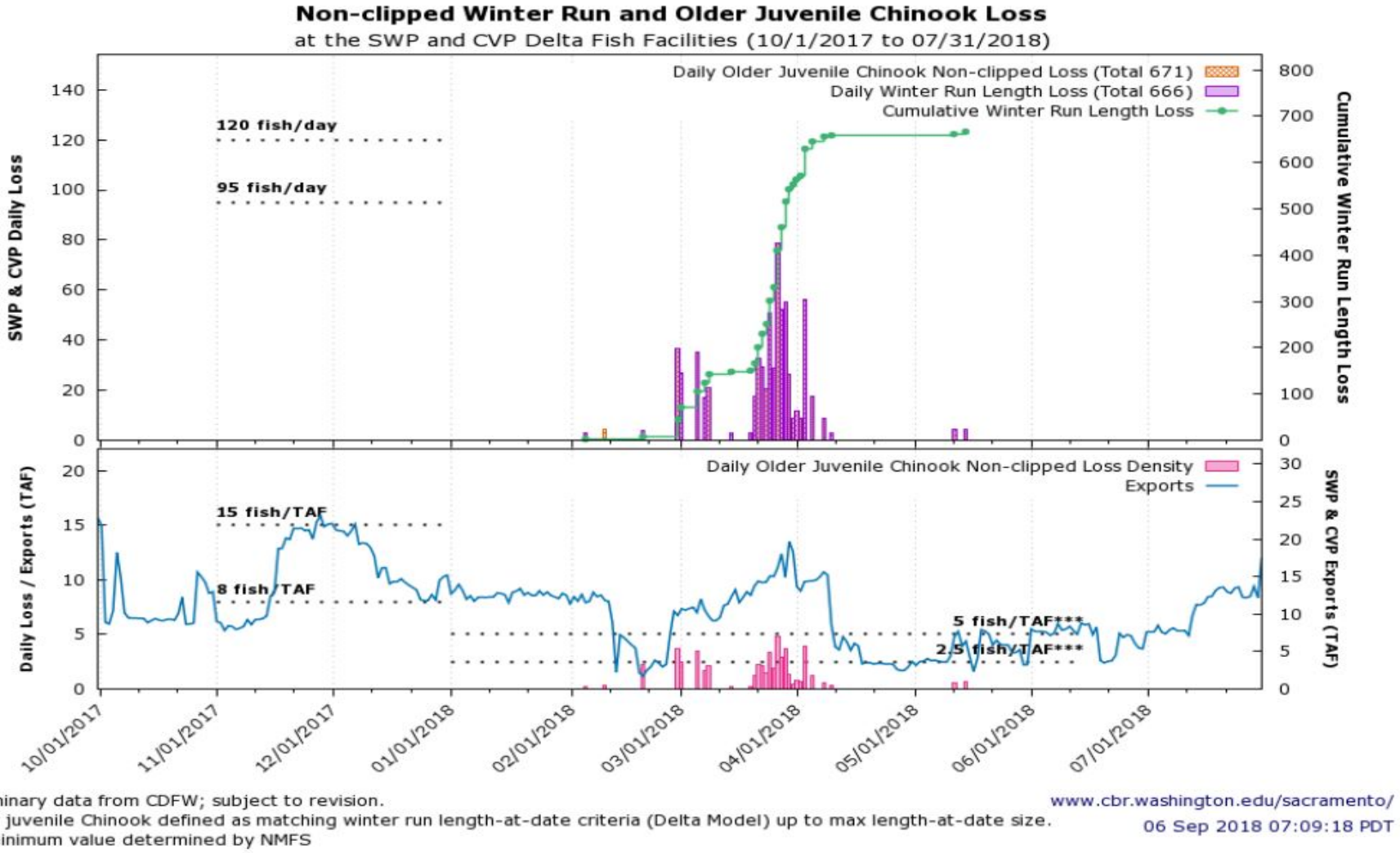
Figure 2. Observed Chinook Salmon salvage at the Delta fish facilities, with Delta hydrology, August 1, 2017, through July 31, 2018. Chinook Salmon race/run designation is based on Delta model length-at-date criteria and Coded Wire Tag recoveries.



Preliminary data from CDEC, CDFW, CDRW, and BOR; subject to revision. Key: Location-Observation Type (#total estimate:#released for observed).
Chinook not measured for length and Chinook outside of the length-at-date criteria (Delta model) are not included.

www.cbr.washington.edu/sacramento/
06 Sep 2018 07:09:04 PDT

Figure 3. Daily loss and loss density of non-clipped Winter-run length and older juvenile Chinook Salmon at the Delta fish facilities using the current loss equation (DFW 2013), October 1, 2017, through July 31, 2018.



Preliminary data from CDFW; subject to revision.
Older juvenile Chinook defined as matching winter run length-at-date criteria (Delta Model) up to max length-at-date size.
***minimum value determined by NMFS

www.cbr.washington.edu/sacramento/
06 Sep 2018 07:09:18 PDT

Figure 4. Non-clipped Winter-run length Chinook Salmon loss at the Delta fish facilities from October to June using the current loss equation (DFW 2013), water years 2008 through 2018.

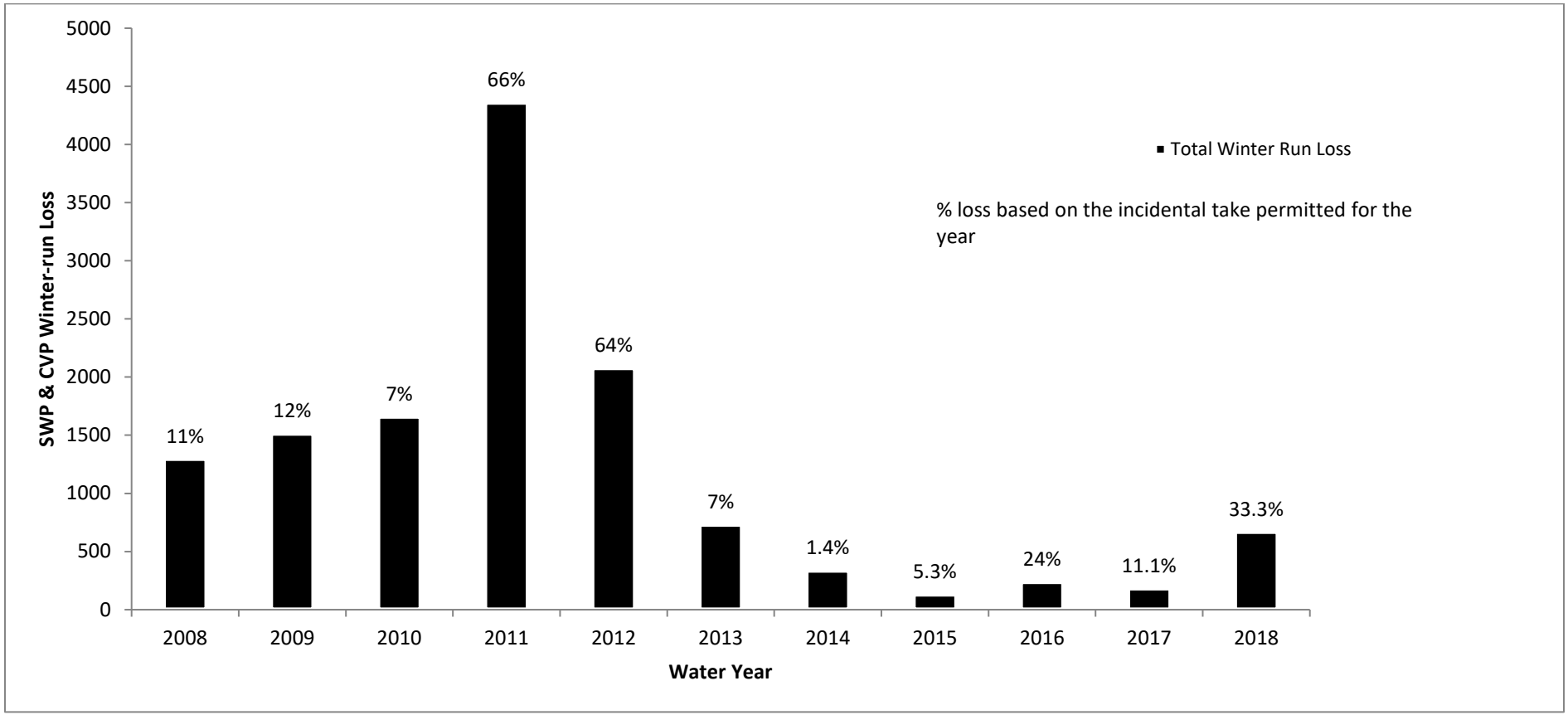


Figure 5. Daily loss and loss density of non-clipped fry/smolt Chinook Salmon at the Delta fish facilities using the current loss equation (DFW 2013), October 1, 2017 through July 31, 2018.

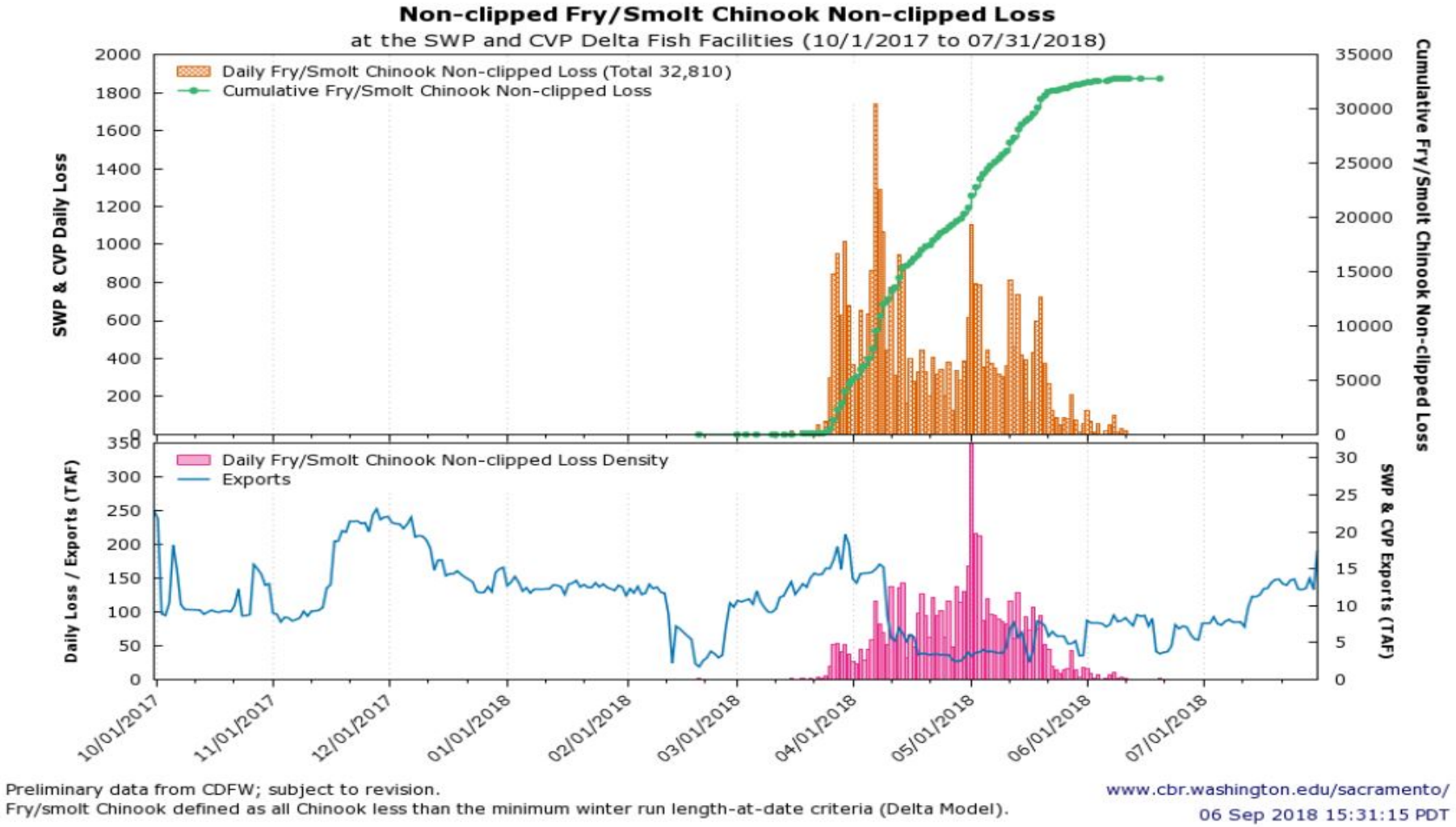


Figure 6. Non-clipped fry/smolt Chinook Salmon loss at the Delta fish facilities from October to July using the current loss equation (DFW 2013), water years 2008 through 2018.

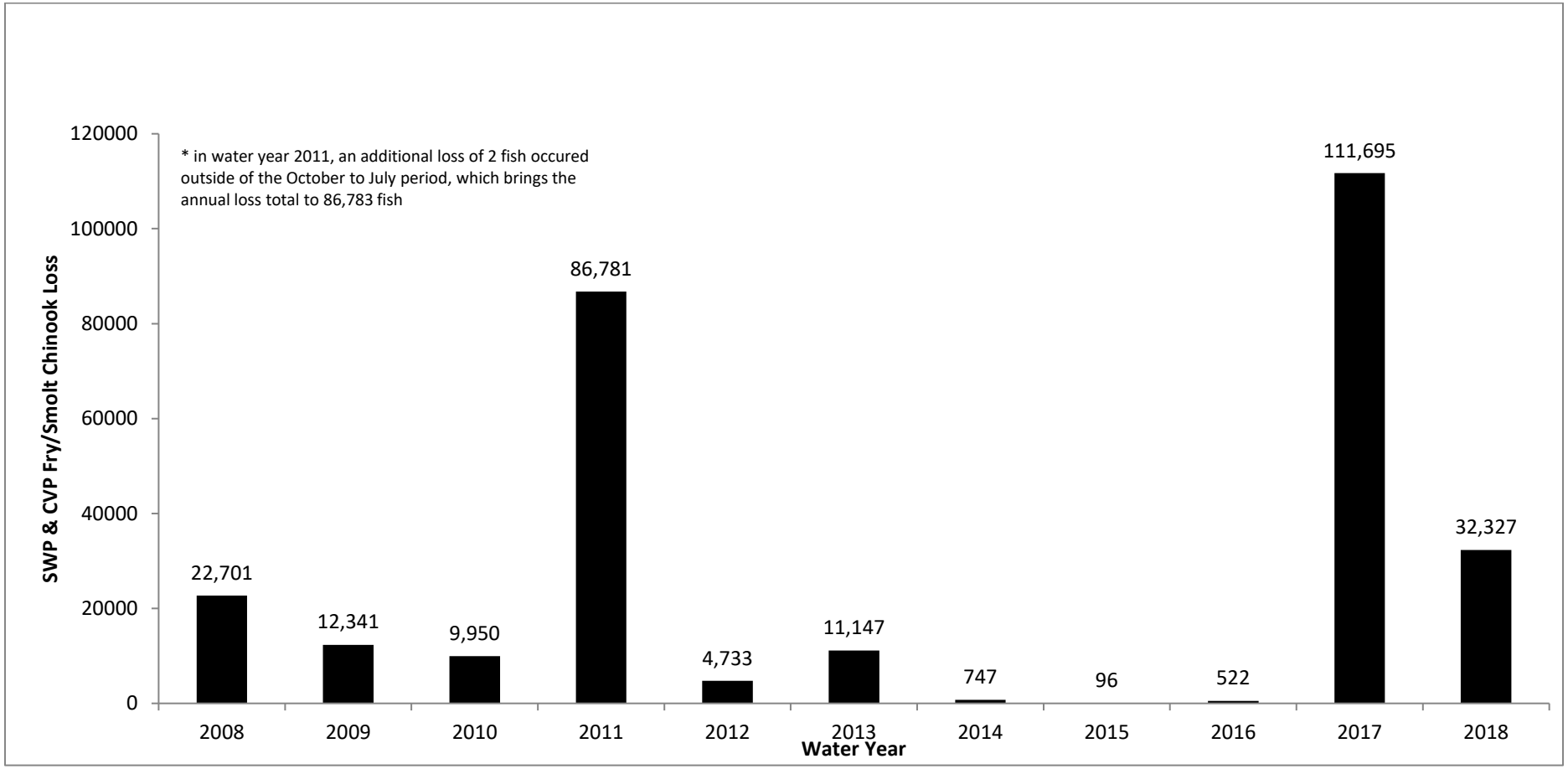


Figure 7. Older juvenile Chinook Salmon and LSNFH Winter-run Chinook Salmon recoveries from the Delta monitoring program and loss at the Delta fish facilities, October 1, 2017 through July 31, 2018.

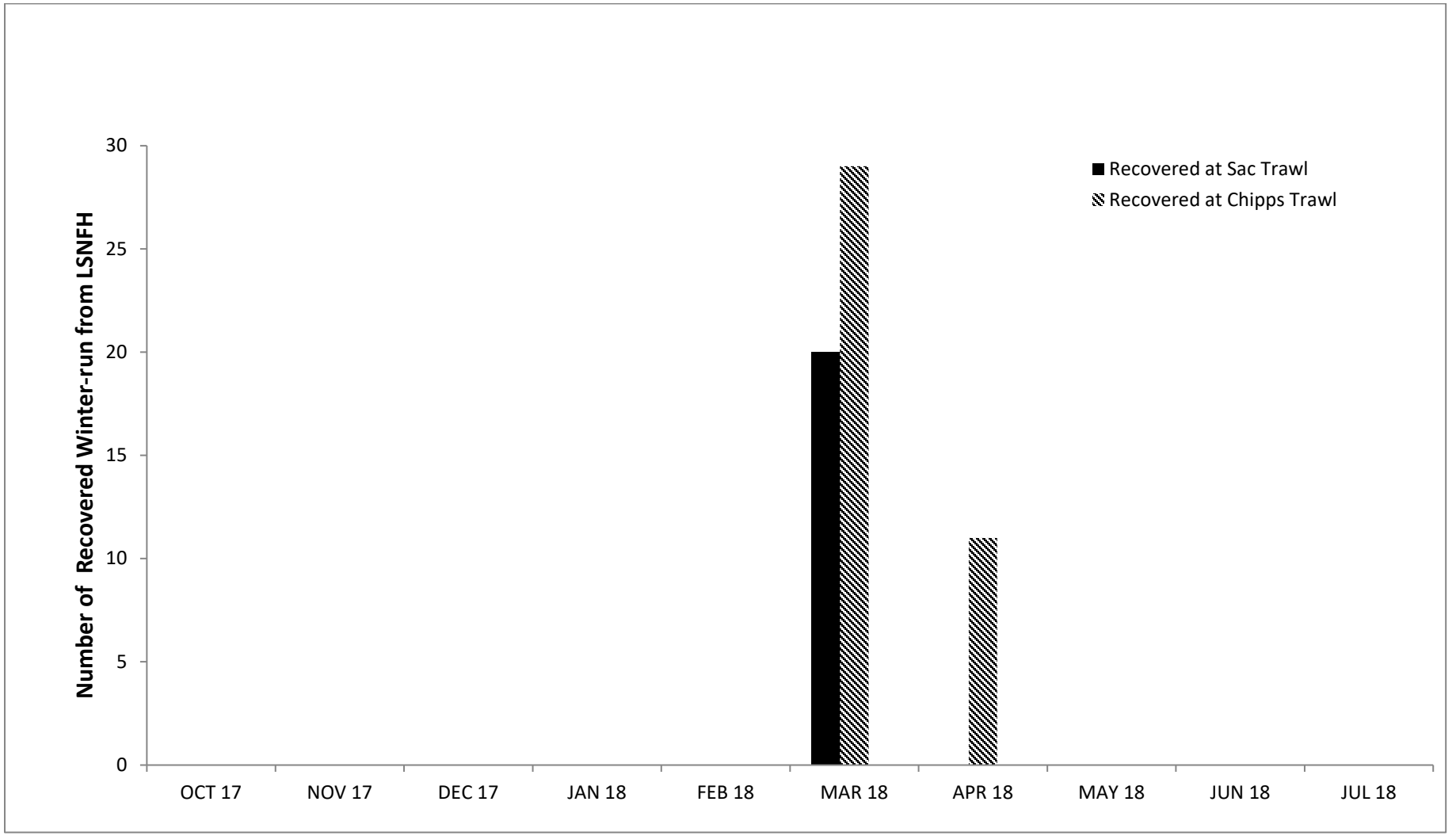


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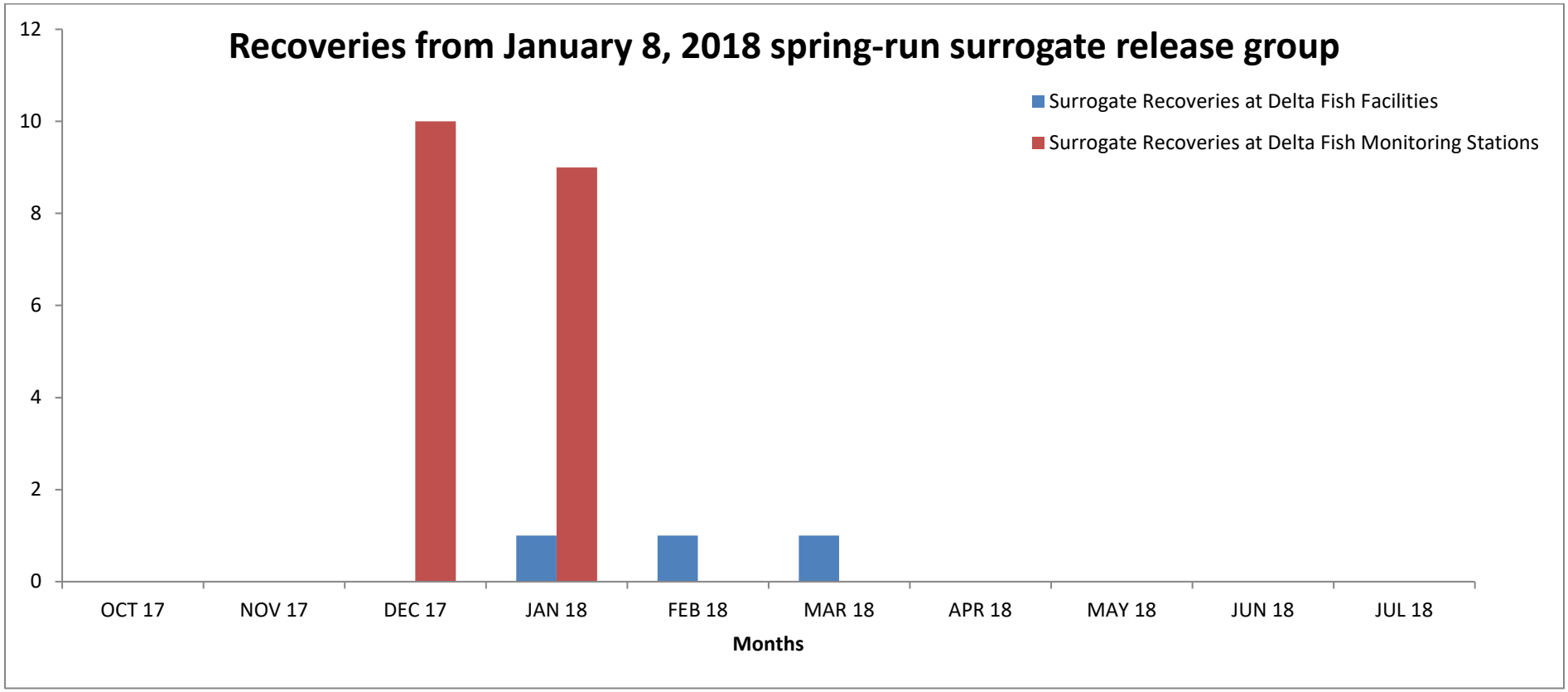
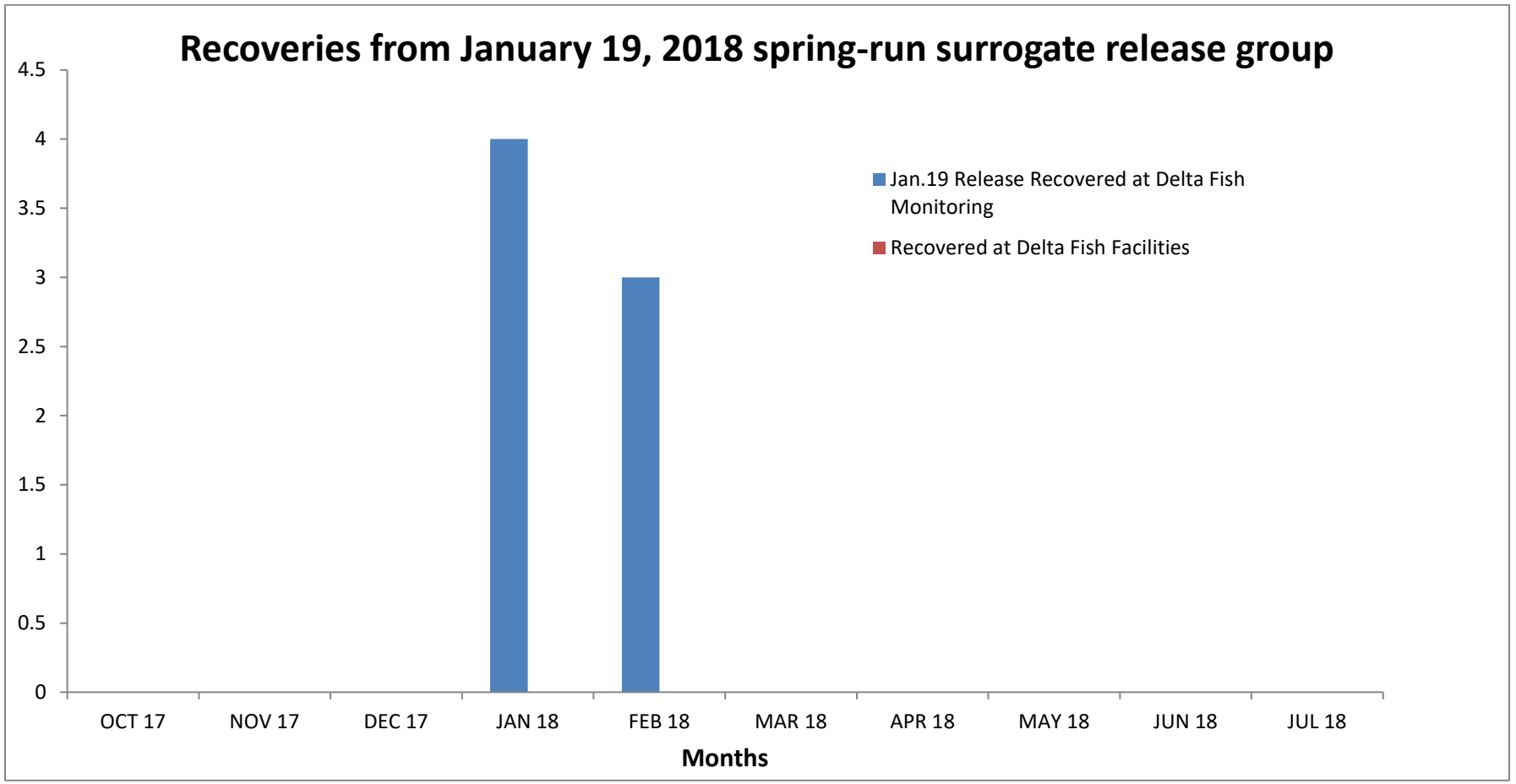
Figure 8. Older juvenile Chinook Salmon and CNFH late-fall Chinook Salmon (spring-run surrogate) recoveries from the Delta monitoring program and loss at the Delta fish facilities, October 1, 2017 through June 30, 2018.




Recoveries from January 19, 2018 spring-run surrogate release group
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
OCT 17
NOV 17
DEC 17
JAN 18
FEB 18
MAR 18
APR 18
MAY 18
JUN 18
JUL 18
Months
Jan.19 Release Recovered at Delta Fish Monitoring
Recovered at Delta Fish Facilities

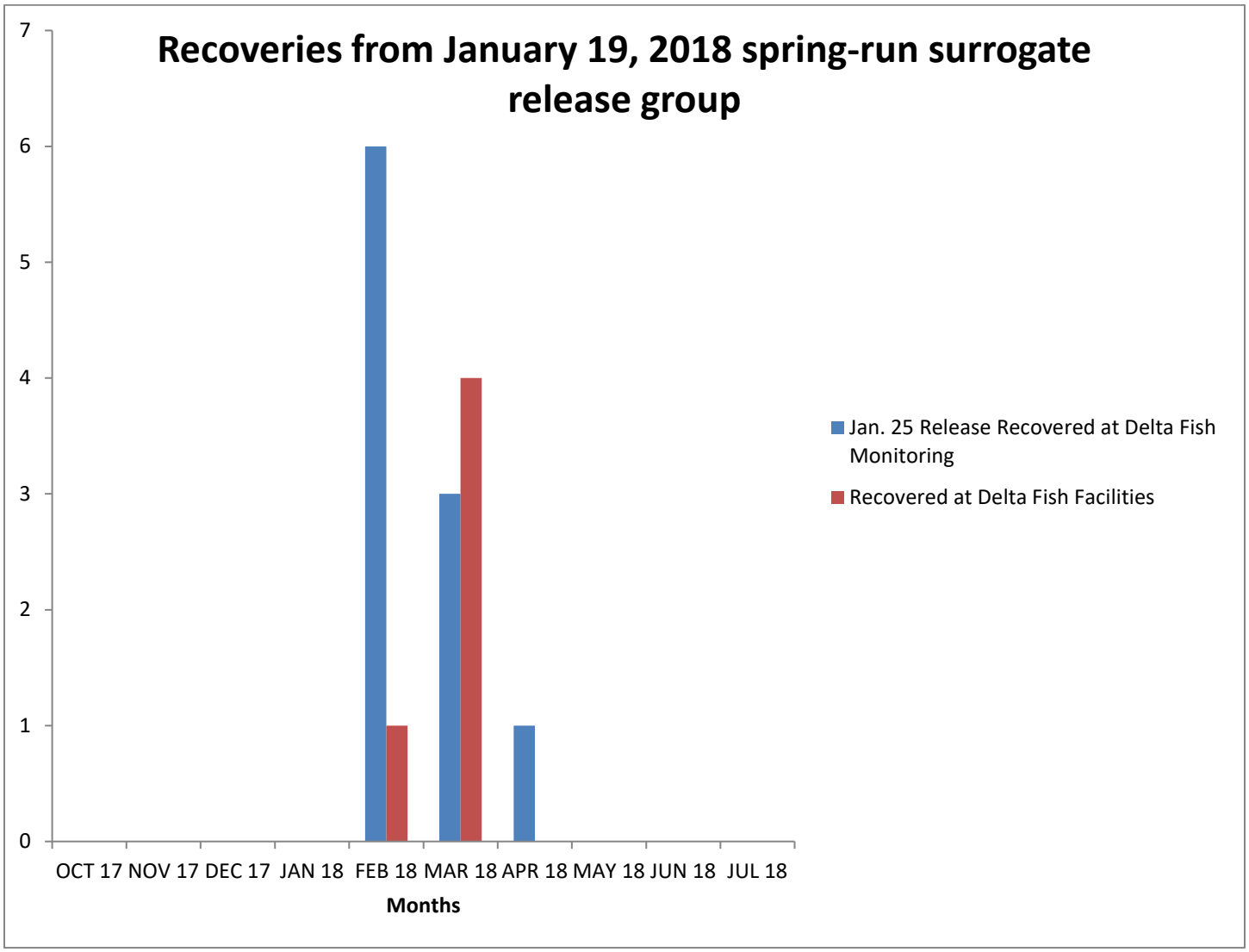

Recoveries from January 19, 2018 spring-run surrogate release group
7
6
5
4
3
2
1
0
OCT 17 NOV 17 DEC 17 JAN 18 FEB 18 MAR 18 APR 18 MAY 18 JUN 18 JUL 18
Months
Jan. 25 Release Recovered at Delta Fish Monitoring
Recovered at Delta Fish Facilities

Figure 9. Non-clipped steelhead salvage at the Delta fish facilities, October 2017 through July 2018.

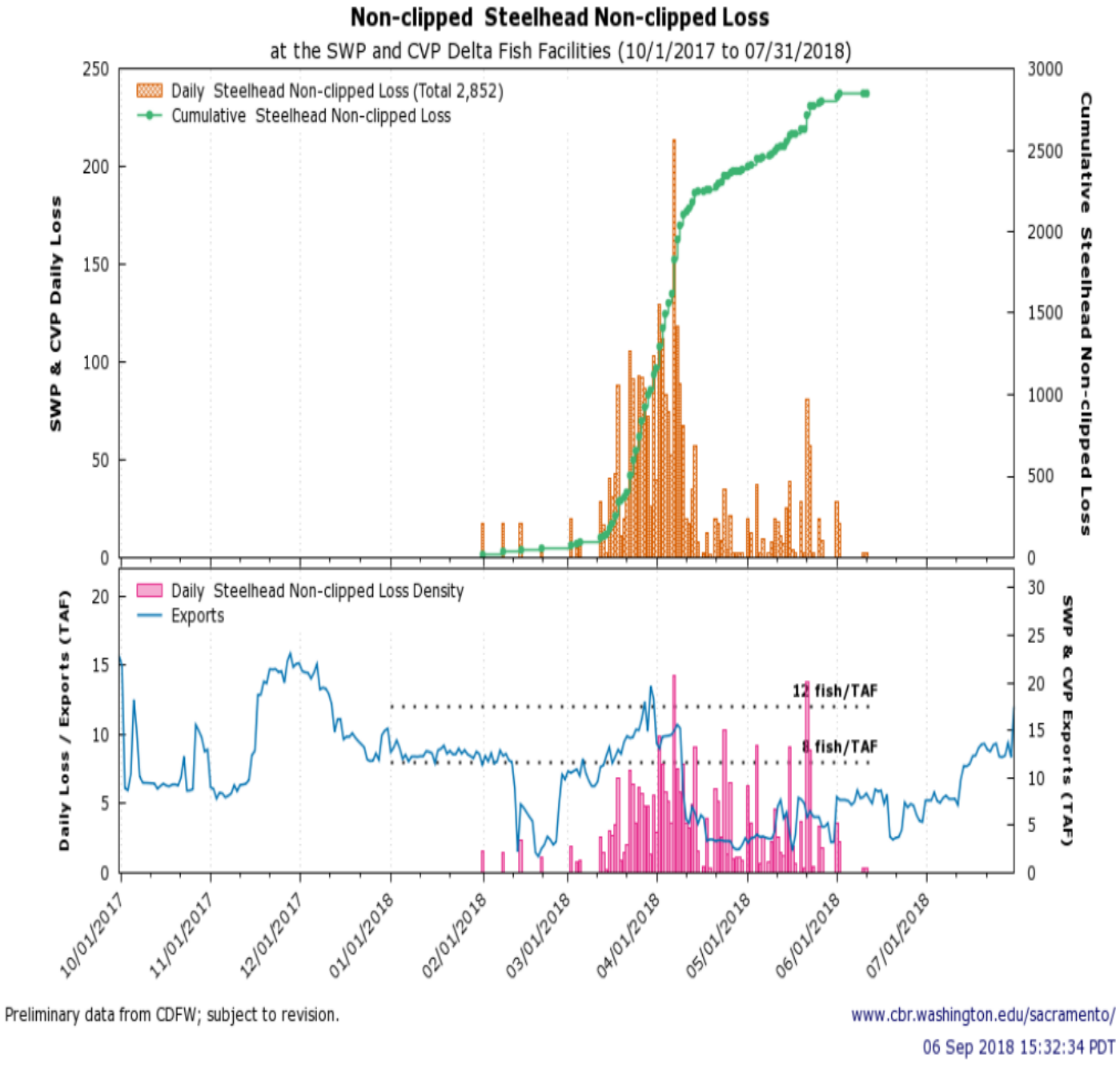


Figure 10. Total steelhead salvage (adipose fin clipped & non-clipped) at the Delta fish facilities, October 2017 through July 2018.

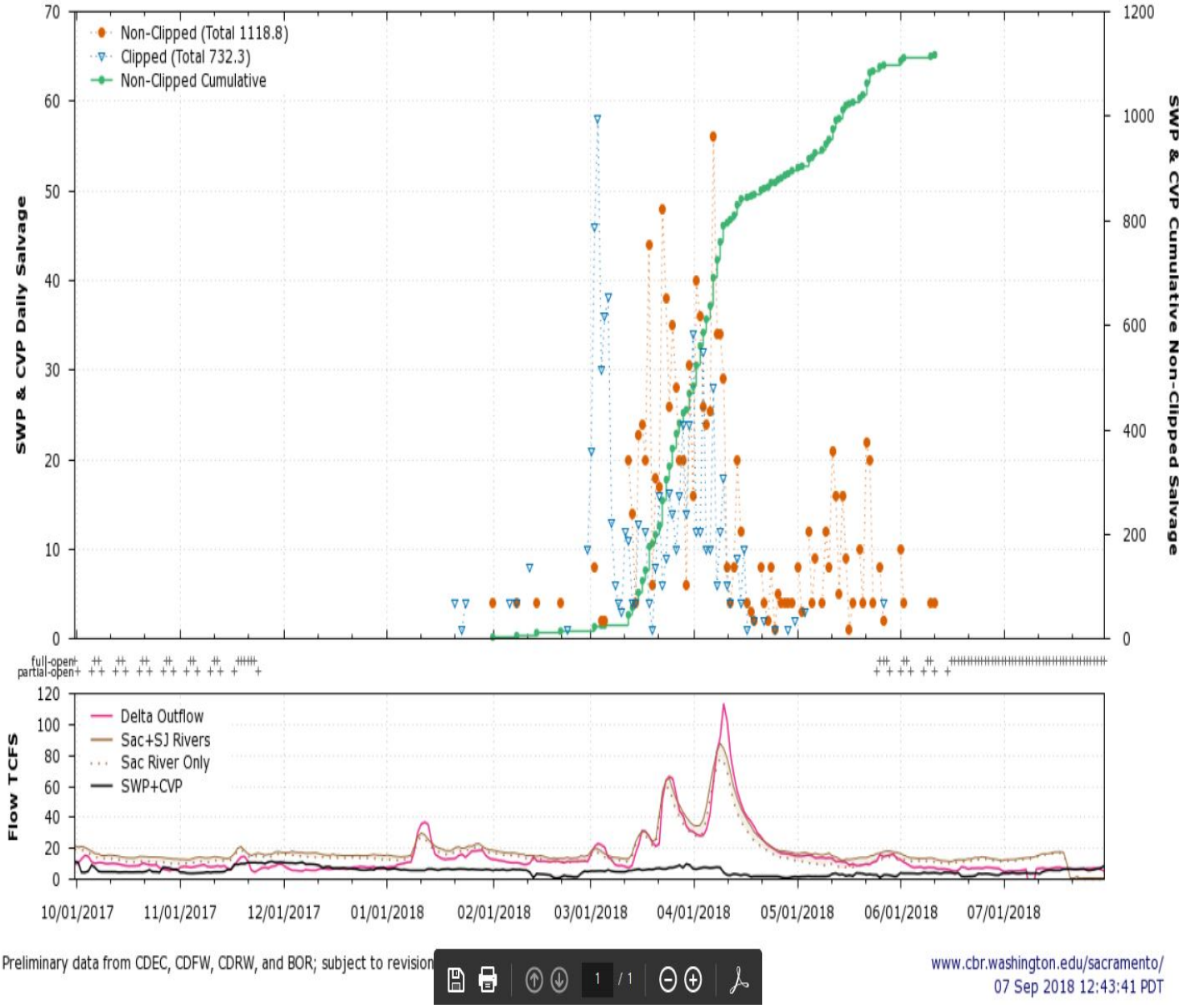


Figure 11. Non-clipped steelhead salvage at the Delta fish facilities from October to July, water years 2007 through 2018.

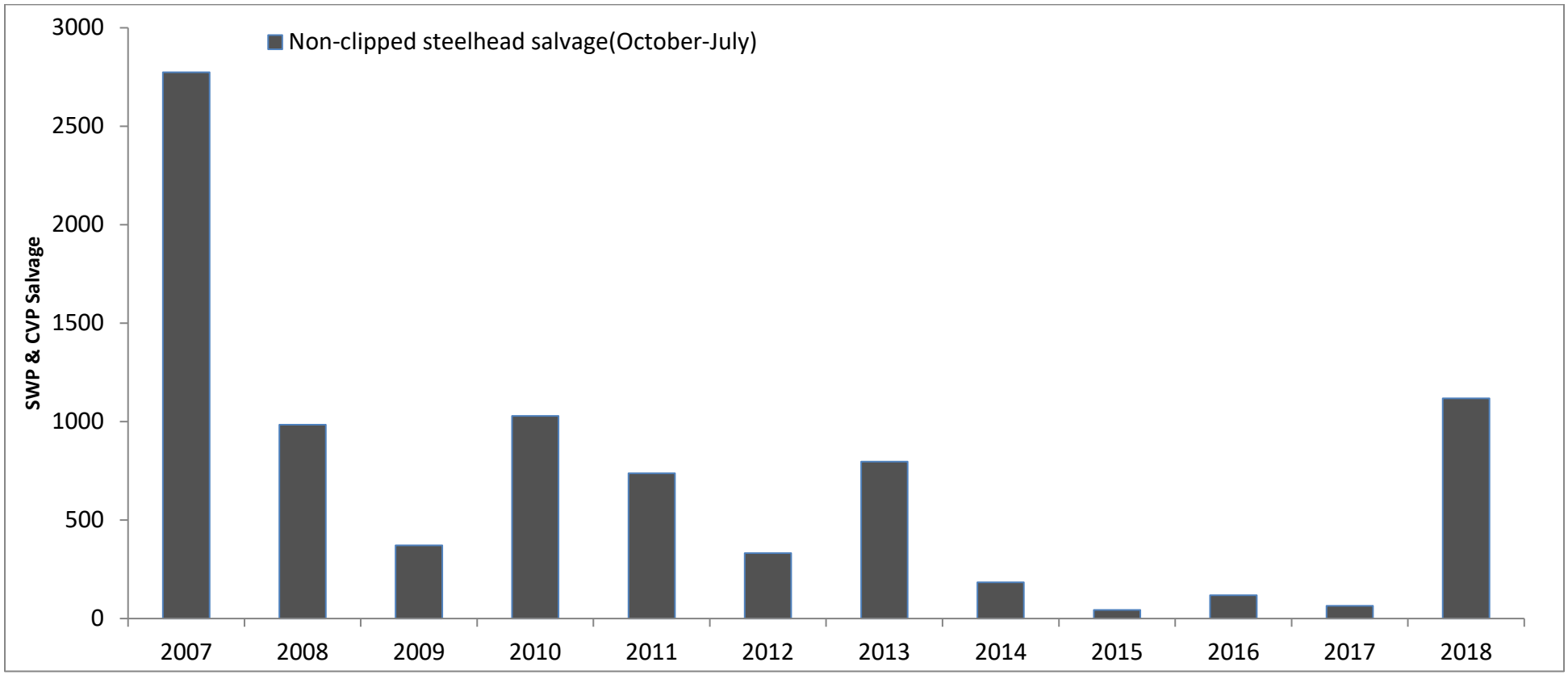
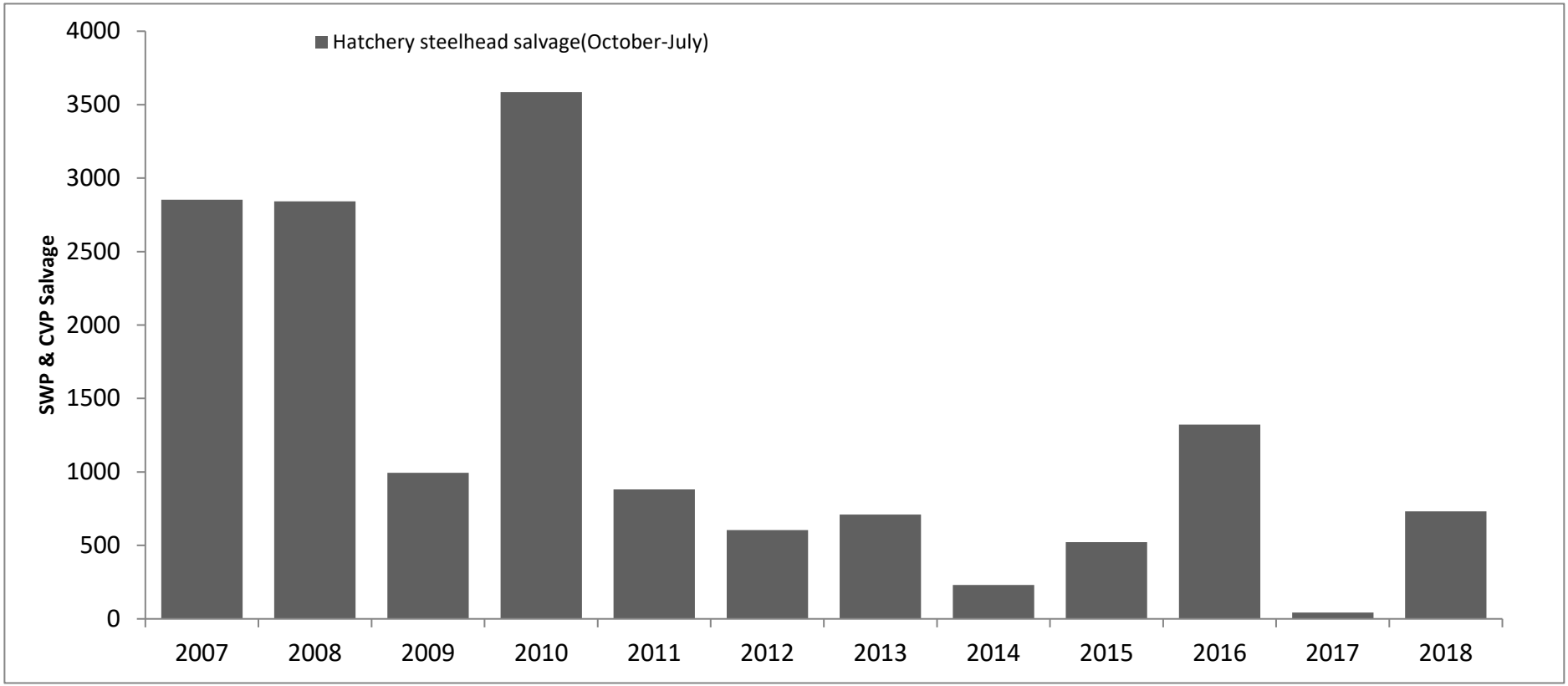


Figure 12. Hatchery (adipose fin clipped) steelhead salvage at the Delta fish facilities from October to July, water years 2007 through 2018.



28

Figure 13. Daily loss and loss density of non-clipped steelhead at the Delta fish facilities using the current loss equation (DFW 2013), October 1, 2017 through July 31, 2018.

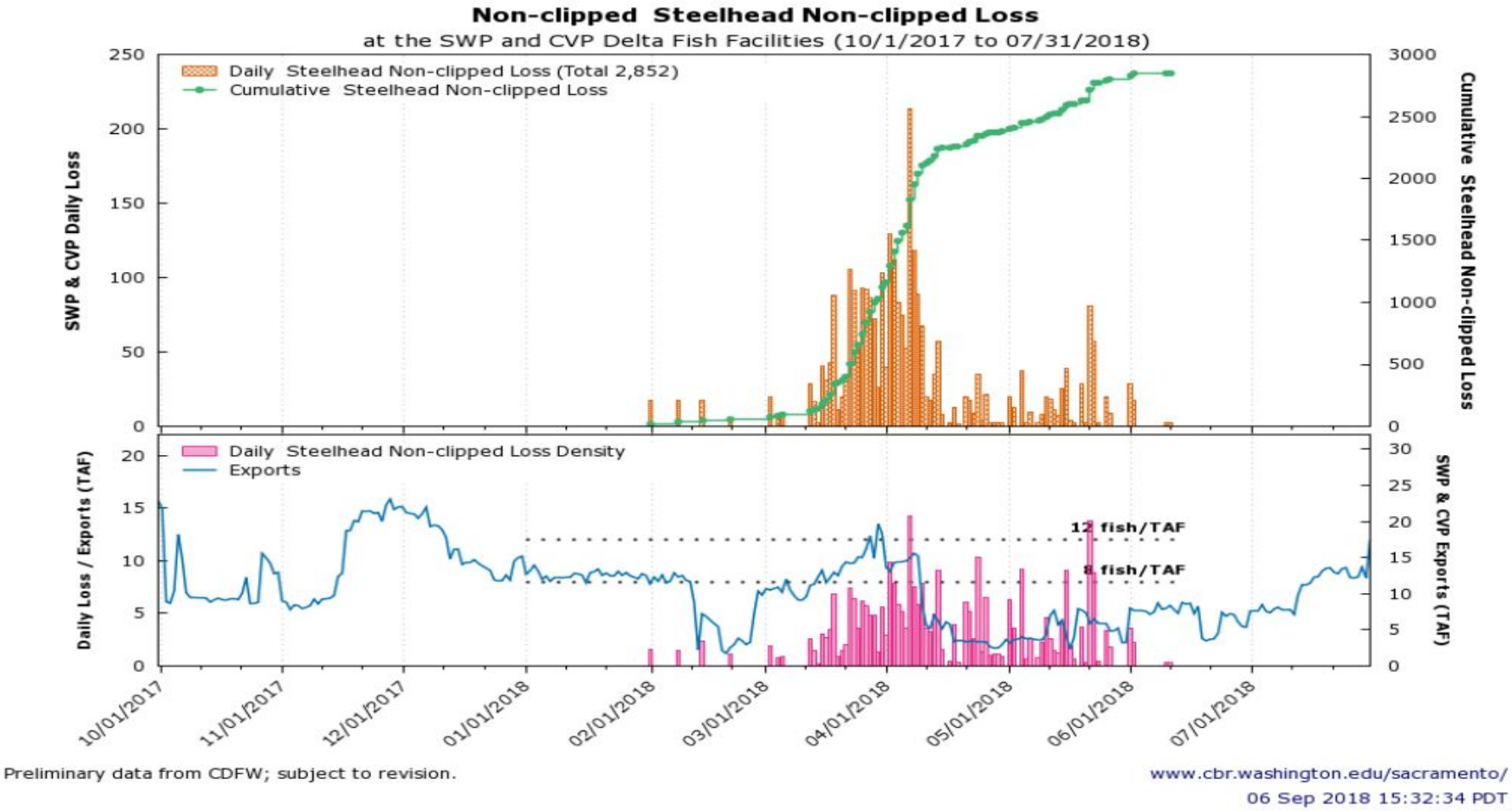


Figure 14. Green sturgeon salvage at the Delta fish facilities from October to July, water years 2007 through 2018.

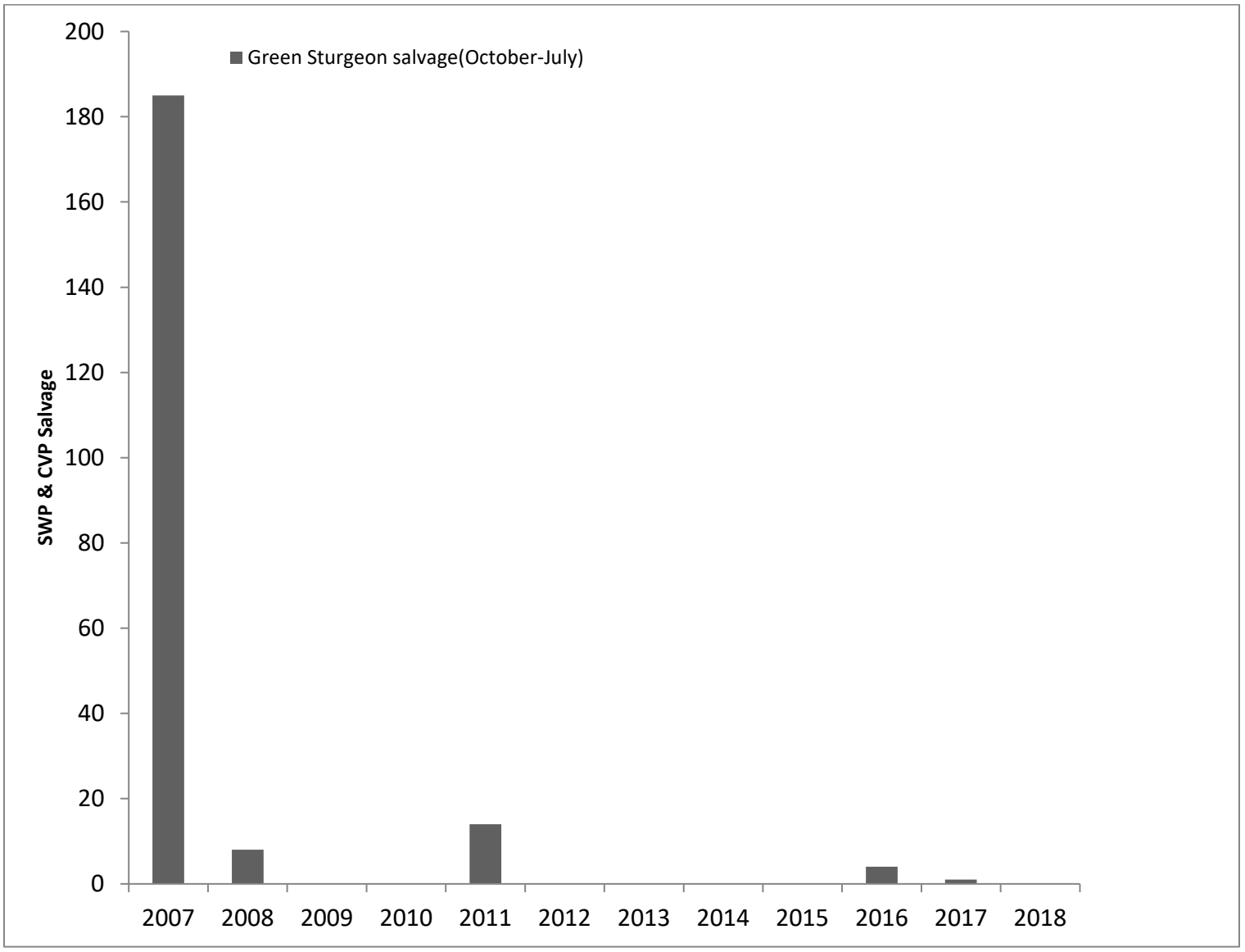
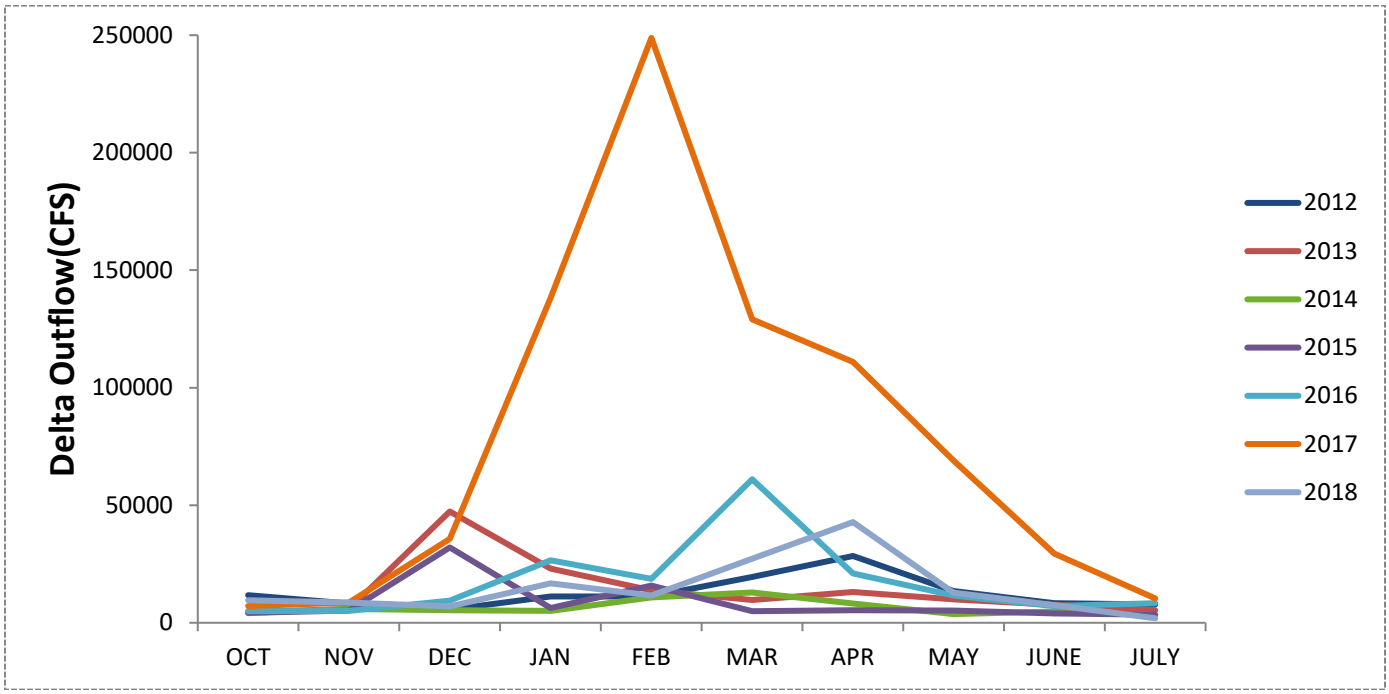
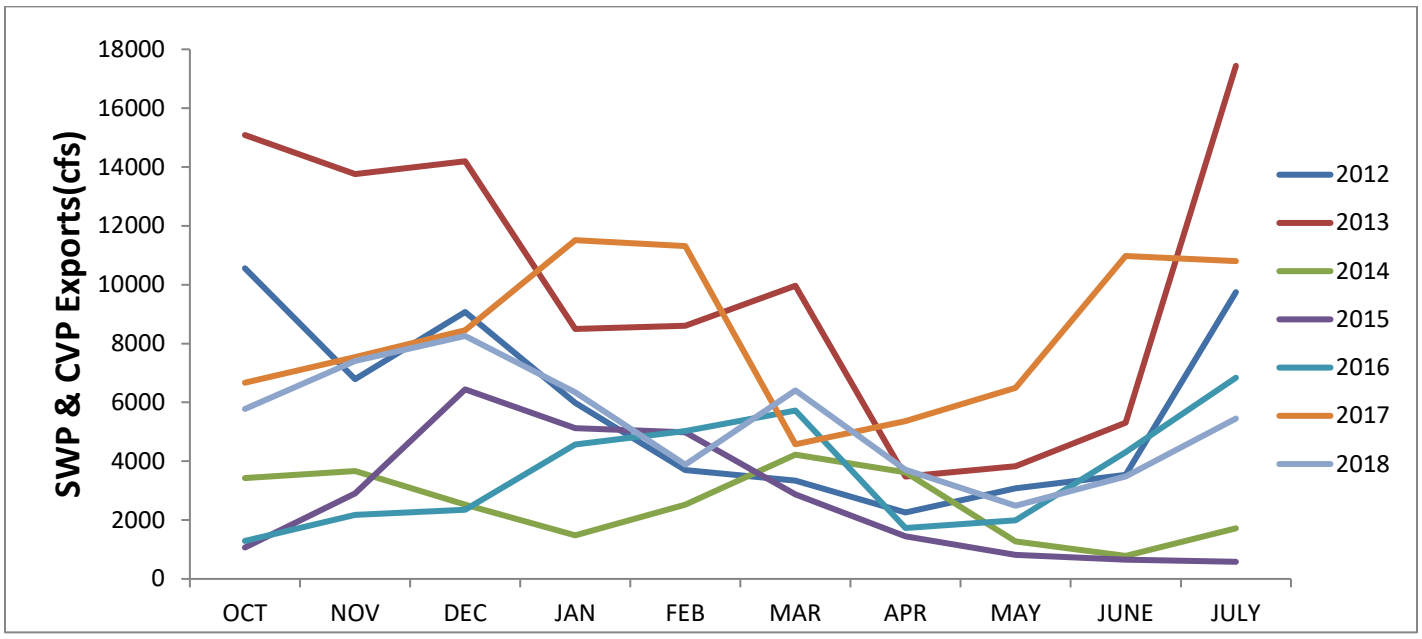
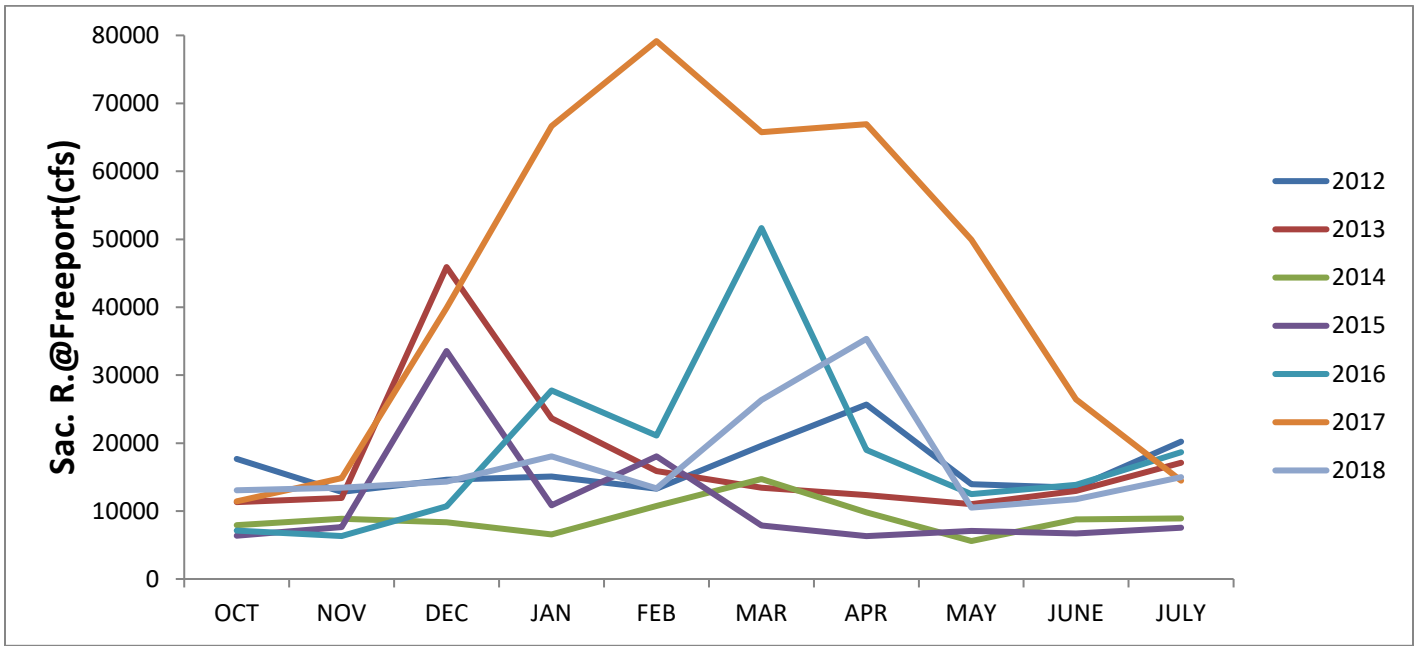


Figure15. Monthly averages of Delta hydrology from October to July, water years 2012 through 2018.






Sac. R.@Freeport(cfs)
80000
70000
60000
50000
40000
30000
20000
10000
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
JULY
2012
2013
2014
2015
2016
2017
2018

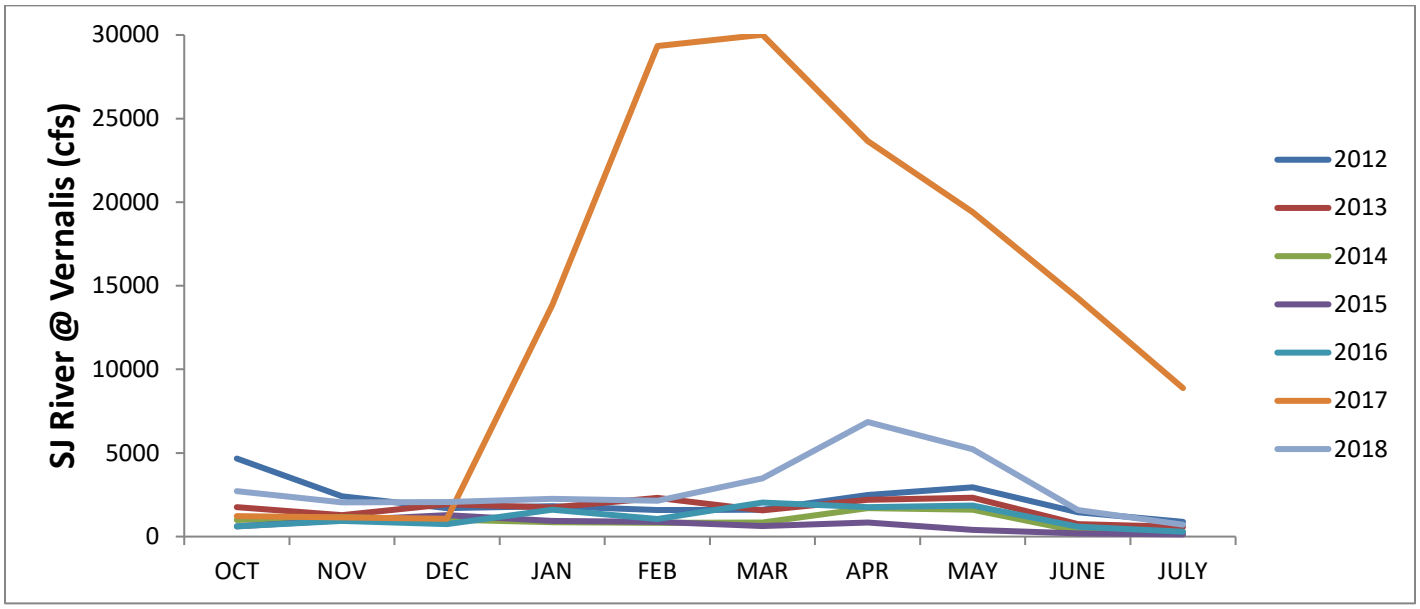

SJ River @ Vernalis (cfs)
30000
25000
20000
15000
10000
5000
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
JULY
2012
2013
2014
2015
2016
2017
2018

Figure 16. Modeled volumetric water fingerprint for the Clifton Court Forebay (SWP) as derived from DSM2, October 2017 through August 2018.

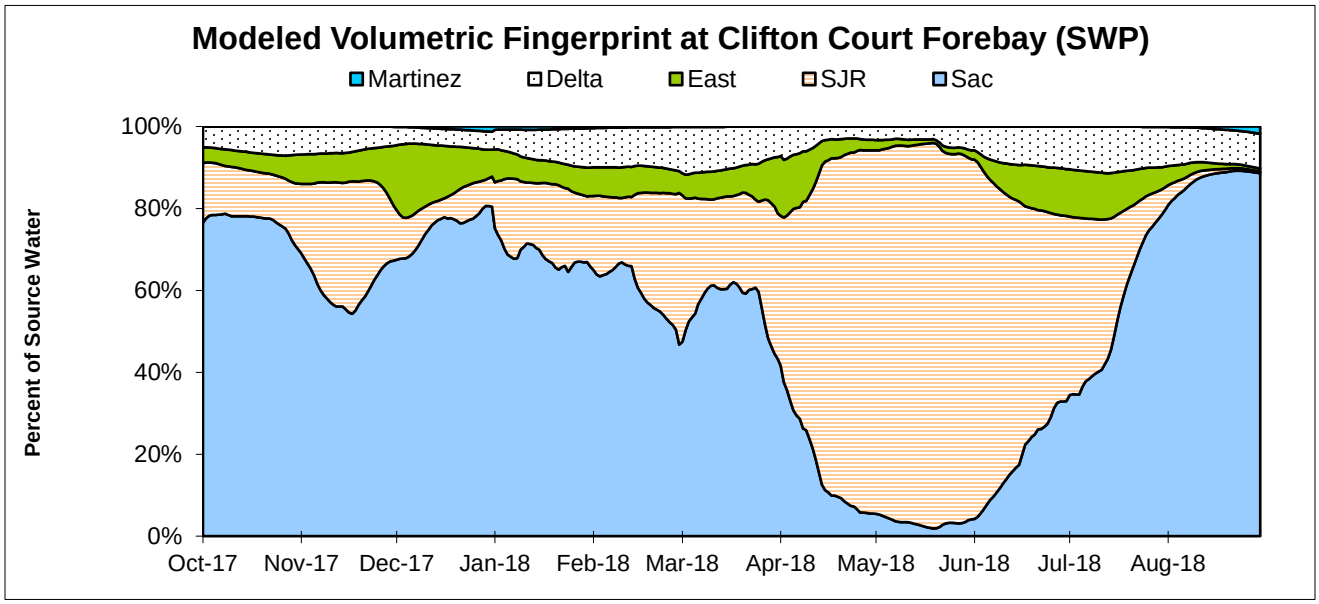
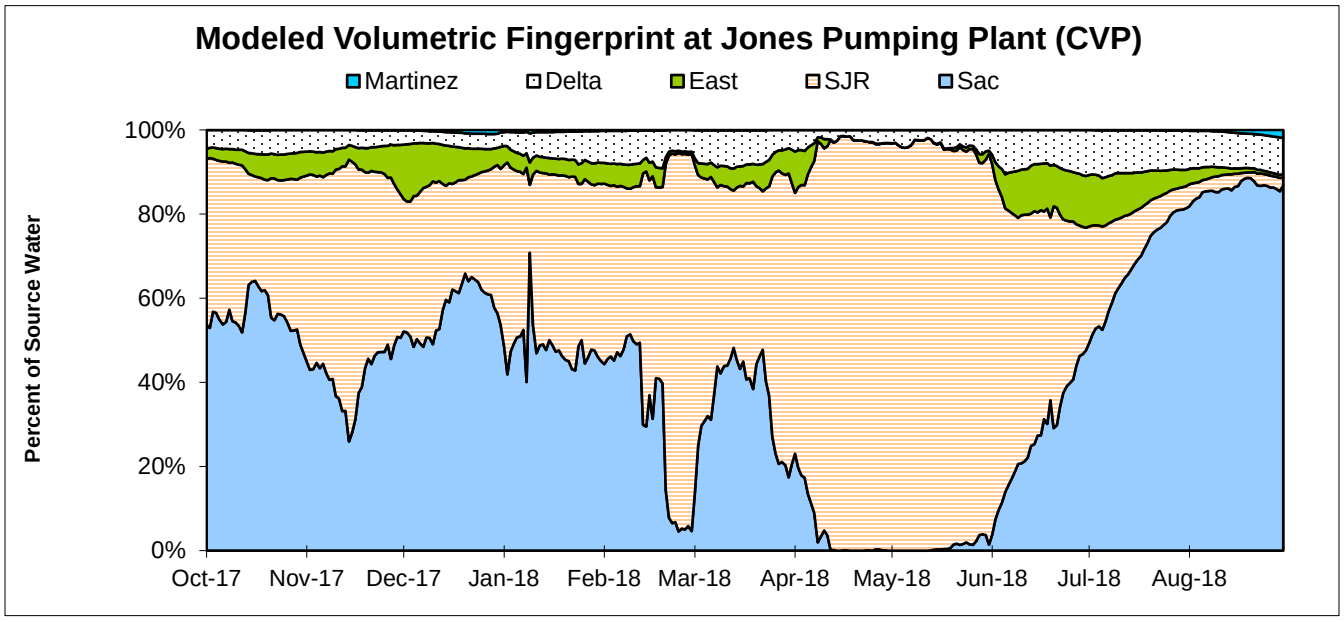


Figure 17. Modeled volumetric water fingerprint for the Jones Pumping Plant (CVP) as derived from DSM2, October 2017 through August 2018.



Delta fingerprint figures from DWR-Operations Control Office.

Table 1. Hatchery (adipose fin clipped) Chinook Salmon loss at the Delta fish facilities using the current loss equation (DFW 2014), October 2017 through June 2018.

Release Date	CWT Race	Hatchery	Release Site	Release Type	Confirmed Loss	Number Released[1]	Total Entering Delta	% Loss of Number Released[2]	% Loss of Total Entering Delta[3]	First Stage Trigger	Date of First Loss[4]	Date of Last Loss[4]
12/21/2017	LF	Coleman NFH	Battle Creek	Production	35.68	297,370	n/a	0.012	n/a	n/a	1/23/2018	4/14/2018
1/5/2018	LF	Coleman NFH	Battle Creek	Production	130.62	519,791	n/a	0.025	n/a	n/a	1/31/2018	3/28/2018
1/8/2018	LF	Coleman NFH	Battle Creek	Spring Surrogate	12.99	78,786	n/a	0.016	n/a	0.5%	1/31/2018	3/26/2018
1/19/2018	LF	Coleman NFH	Battle Creek	Spring Surrogate	0	71,645	n/a	0.000	n/a	0.5%	*	*
1/25/2018	LF	Coleman NFH	Battle Creek	Spring Surrogate	25.68	84,922	n/a	0.030	n/a	0.5%	2/20/2018	3/8/2018
3/1/2018, 3/13/2018	W	Livingstone NFH	Sacramento River	Production	55.4	216,746	n/a	0.026	n/a	0.5%	3/22/2018	4/9/2018
12/21/2017	S	SJRRP	San Joaquin River	Experimental	13.16	1450	n/a	0.908	n/a	n/a	1/11/2018	3/13/2018
1/19/2018	S	SJRRP	San Joaquin River	Experimental	167.35	31184	n/a	0.537	n/a	n/a	3/14/2018	4/13/2018
1/26/2018	S	SJRRP	San Joaquin River	Experimental	253.16	49549	n/a	0.511	n/a	n/a	3/11/2018	4/13/2018
3/2/2018	S	SJRRP	San Joaquin River	Experimental	762	87115	n/a	0.875	n/a	n/a	3/30/2018	4/11/2018

Table 2. Unknown hatchery (adipose fin clipped) Chinook Salmon loss at the Delta fish facilities using the current loss equation (DFW 2014), October 2017 through June 2018.

Facility	Unknown CWT Loss[5]	Unread CWT Loss[6]	Unknown Hatchery Loss[7]	Acoustic Tag Loss[8]	Number of Unassigned CWTs[9]
SWP	296.14				
CVP	16.02				
TOTAL	312.16				

[5]Adipose-fin clipped Chinook was observed during fish count, but tag code could not be determined (e.g., damaged tag, lost tag, no tag, or Chinook released).

[6]Adipose-fin clipped Chinook was collected during fish count and has not been processed yet.

[7]CWT has been read, but hatchery release information not yet available.

[8]Adipose-fin clipped Chinook released due to presence of sutures.

[9]CWT cannot currently be assigned to a salvage record with certainty since the CWT was lost and then found. CWT may be assigned to a salvage record if new information is available.

Table 3. Monthly averages of hydrologic parameters in the Sacramento-San Joaquin River Delta, October 2017 through July 2018.

	SWP(banks) Average Exports		CVP(Jones) Average Exports		Sacramento River Average Flow	San Joaquin River Average Flow	Delta Outflow Average Flow
Month	taf	cfs	taf	cfs	cfs	cfs	cfs
Oct	87	1416	268	4362	13045	2724	9511
Nov	258	4340	182	3064	13437	2046	8659
Dec	258	4199	250	4058	14328	2057	6996
Jan	185	3015	205	3331	18040	2265	16769
Feb	114	2055	102	1834	13359	2146	11549
Mar	226	3672	168	2739	26338	3492	27317
Apr	107	1802	114	1908	35345	6853	42844
May	51	826	102	1661	10503	5218	12855
Jun	46	778	161	2707	11748	1582	7580
Jul	98	1586	237	3859	14981	712	6525

Table 4. Rapid genetic analysis results for Chinook samples collected during WY2018.

Sample Date	Fork Length (mm)	Genetic Assignment	Length at Date	Collection Facility
3/1/2018	184	Fall	Winter	SWP
3/1/2018	187	Fall	Winter	SWP
3/2/2018	134	Fall	Winter	SWP
3/2/2018	30	Fall	Fall	CVP
3/2/2018	33	Fall	Fall	CVP
3/2/2018	33	Fall	Fall	CVP
3/2/2018	177	Fall	Winter	SWP
3/2/2018	245	Fall	Winter	SWP
3/4/2018	40	Fall	Fall	CVP
3/6/2018	131	Winter	Winter	SWP
3/6/2018	131	Winter	Winter	SWP
3/6/2018	132	Winter	Winter	SWP
3/6/2018	132	Winter	Winter	SWP
3/7/2018	40	Fall	Fall	CVP
3/8/2018	103	Fall	Winter	SWP
3/9/2018	138	Fall	Winter	CVP
3/9/2018	177	Fall	Winter	SWP
3/11/2018	38	Fall	Fall	CVP
3/12/2018	43	Fall	Fall	CVP

3/25/2018	155	Fall	Winter	CVP
3/25/2018	170	Fall	Winter	CVP
3/25/2018	125	Fall	Winter	CVP
3/25/2018	120	Fall	Winter	CVP
3/25/2018	235	Fall	Winter	SWP
3/25/2018	130	Fall	Winter	CVP
3/25/2018	120	Winter	Winter	SWP
3/25/2018	240	Fall	Winter	CVP
3/25/2018	205	Fall	Winter	CVP
3/25/2018	151	Fall	Winter	CVP
3/25/2018	148	Fall	Winter	CVP
3/25/2018	144	Fall	Winter	CVP
3/27/2018	174	Fall	Winter	SWP
3/27/2018	133	Fall	Winter	SWP
3/27/2018	240	Fall	Winter	SWP
3/27/2018	200	Fall	Winter	SWP
3/27/2018	240	Fall	Winter	SWP
3/27/2018	179	Fall	Winter	SWP
3/27/2018	191	Fall	Winter	SWP
3/28/2018	151	Fall	Winter	SWP
3/28/2018	160	Fall	Winter	SWP
3/28/2018	136	Fall	Winter	SWP
3/28/2018	203	Fall	Winter	SWP

3/29/2018	118	Fall	Winter	SWP
3/29/2018	211	Fall	Winter	CVP
3/29/2018	122	Fall	Winter	SWP
3/29/2018	158	Fall	Winter	SWP
3/29/2018	118	Winter	Winter	SWP
4/3/2018	181	Fall	Winter	SWP
4/3/2018	221	Fall	Winter	SWP
4/3/2018	209	Fall	Winter	SWP
4/3/2018	129	Fall	Winter	CVP

Appendix G – WY 2018 Fish Monitoring Figures from SacPAS

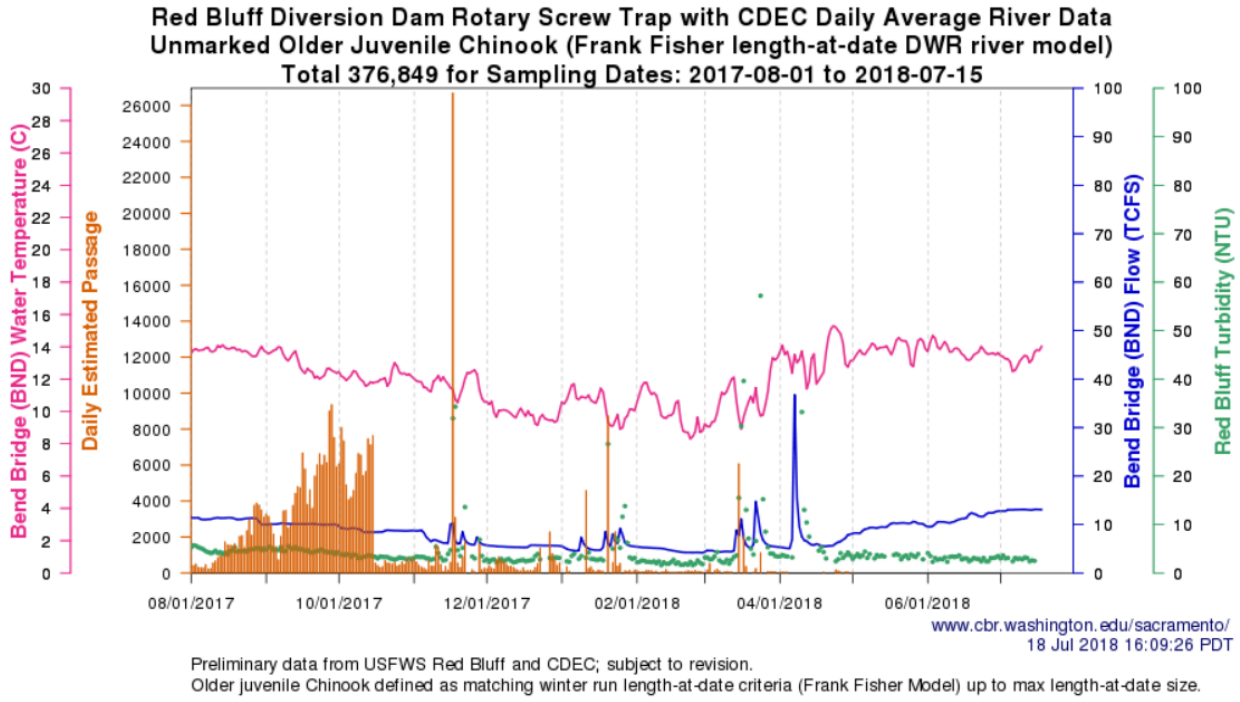


Figure G-1 Daily count of unmarked older juvenile Chinook (orange bars) captured in rotary screw traps at Red Bluff Diversion Dam compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Bend Bridge and turbidity (NTU; green points) at Red Bluff Diversion Dam.

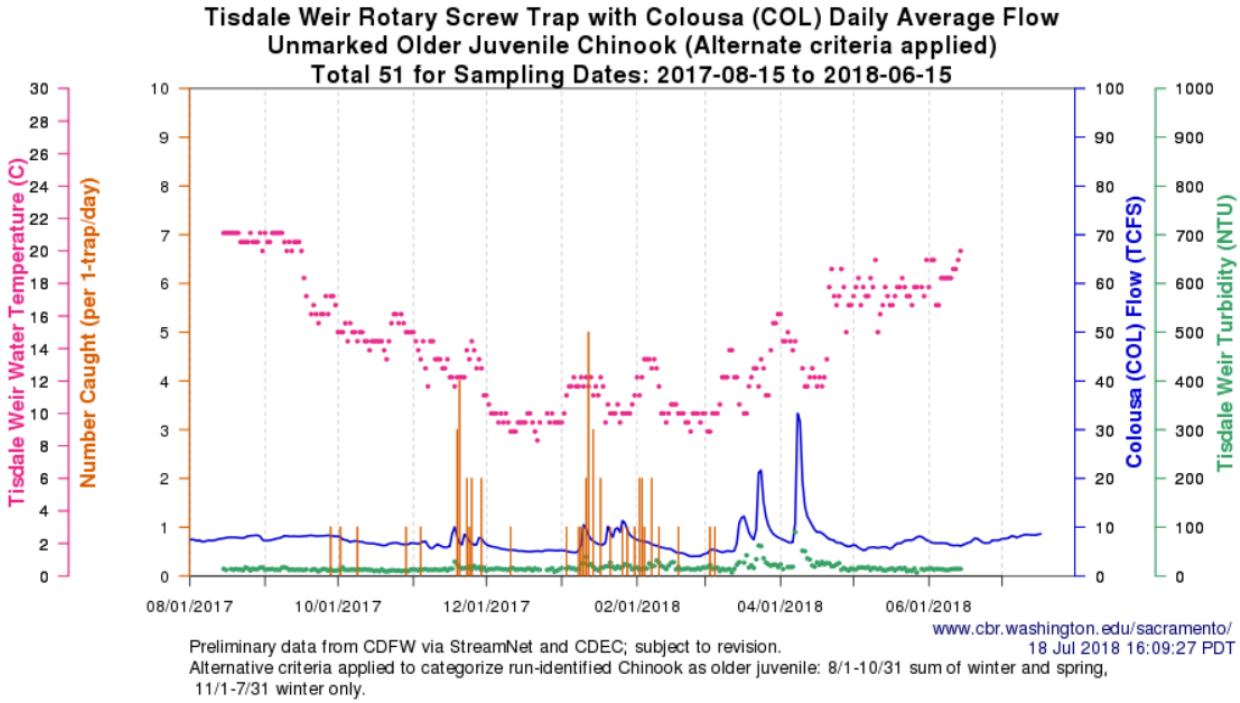


Figure G-2 Daily count of unmarked older juvenile Chinook (orange bars) captured in rotary screw traps at Tisdale Weir compared to water temperature (°C; pink points) at Tisdale Weir, flow (TCFS; blue line) at Colusa, and turbidity (NTU; green points) at Tisdale Weir.

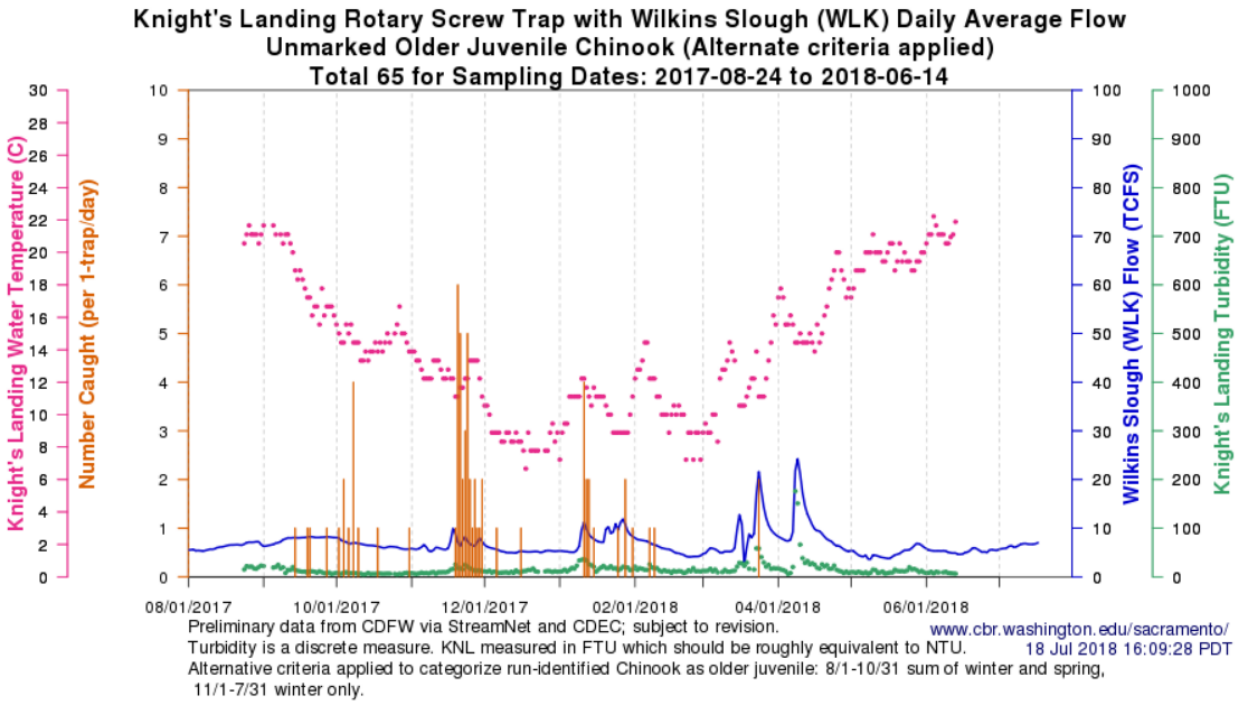


Figure G-3 Daily count of unmarked older juvenile Chinook (orange bars) captured in rotary screw traps at Knight's Landing compared to water temperature (°C; pink points) at Knights Landing, flow (TCFS; blue line) at Wilkins Slough, and turbidity (FTU; green points) at Knights Landing.

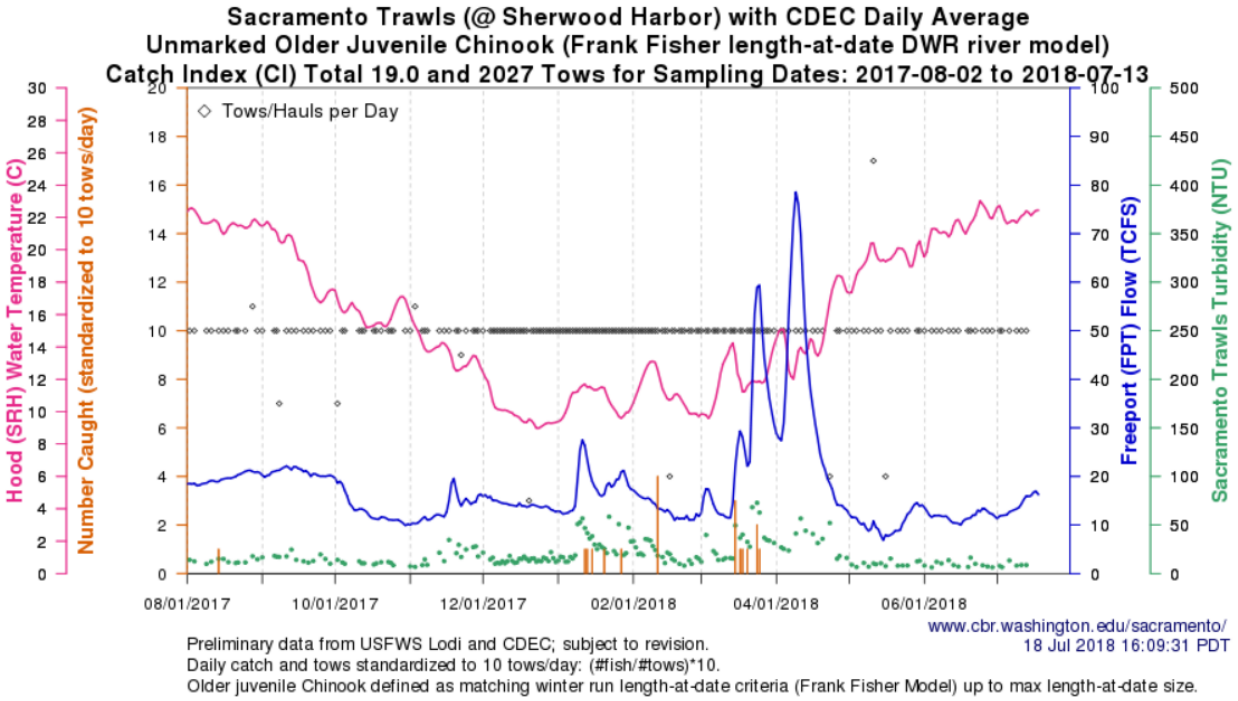


Figure G-4 Daily count of unmarked older juvenile Chinook (orange bars) captured in Sacramento Trawls at Sherwood Harbor compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green points) at Sherwood Harbor.

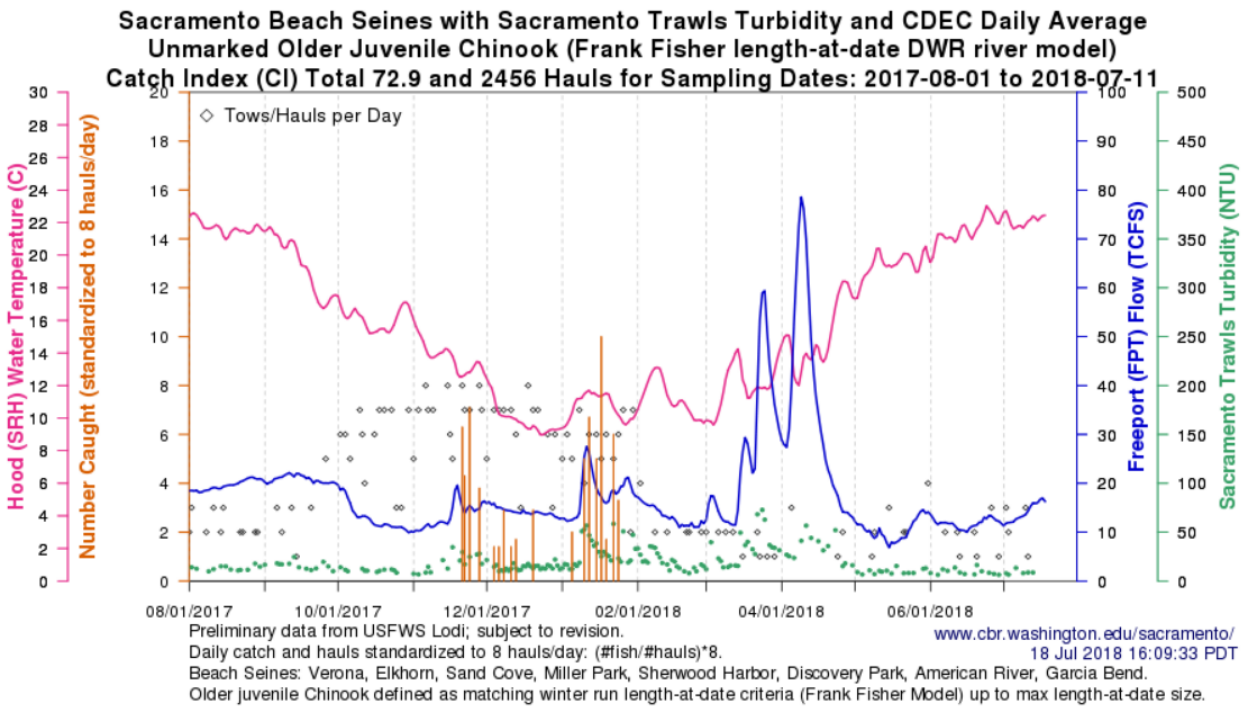


Figure G-5 Daily count of unmarked older juvenile Chinook (orange bars) captured in Sacramento Beach Seines compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green points) at Sherwood Harbor.

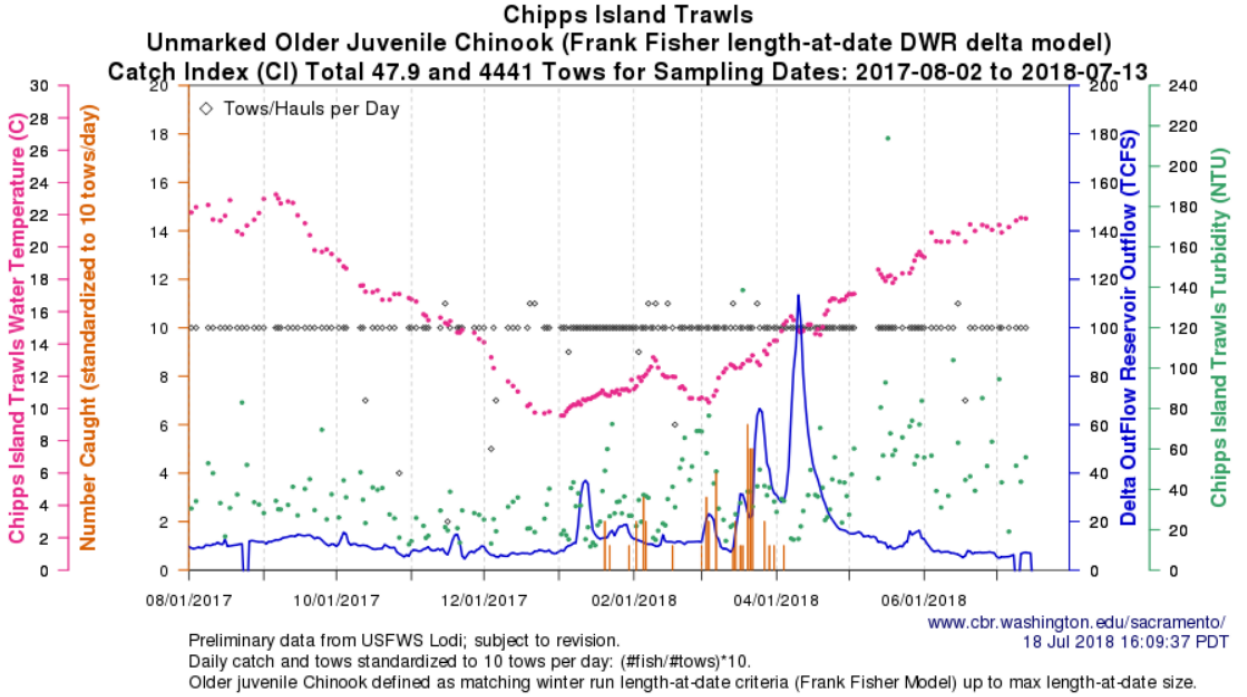


Figure G-6 Daily count of unmarked older juvenile Chinook (orange bars) captured in trawls at Chipps Island compared to water temperature (°C; pink points) at Chipps Island, Delta outflow (TCFS; blue line), and turbidity (NTU; green points) at Chipps Island.

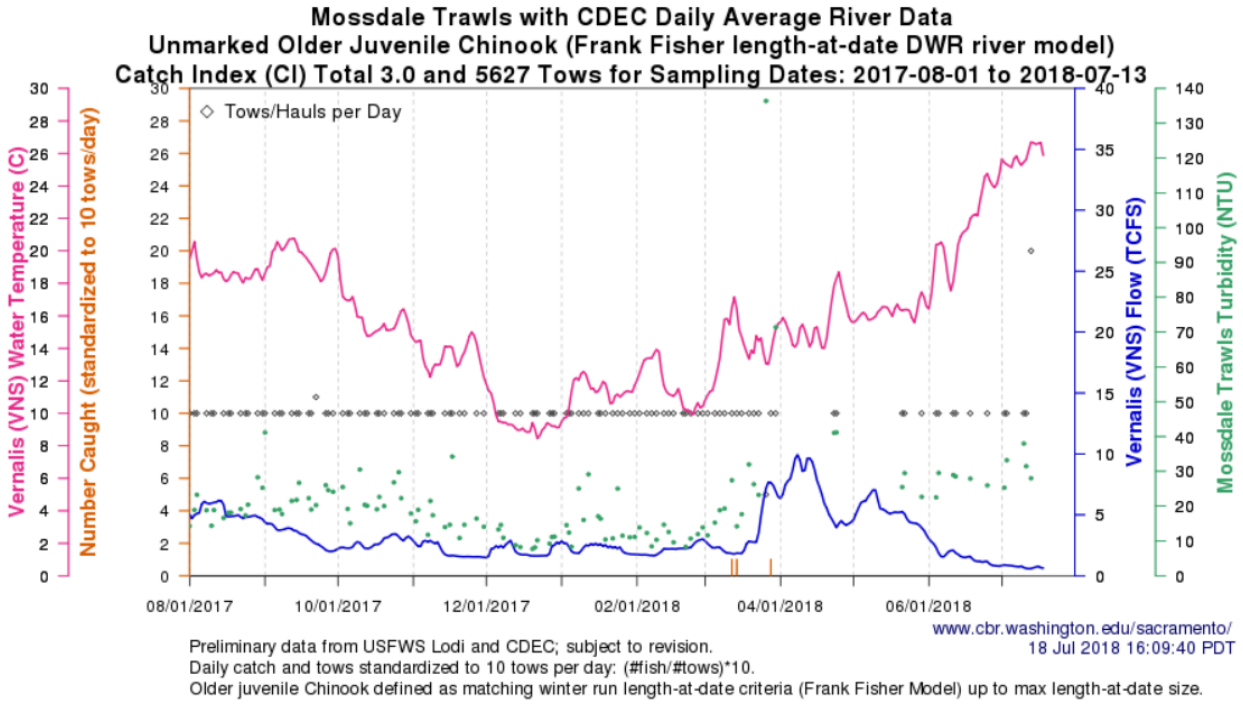


Figure G-7 Daily count of unmarked older juvenile Chinook (orange bars) captured in trawls at Mossdale compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Vernalis, and turbidity (NTU; green points) at Mossdale.

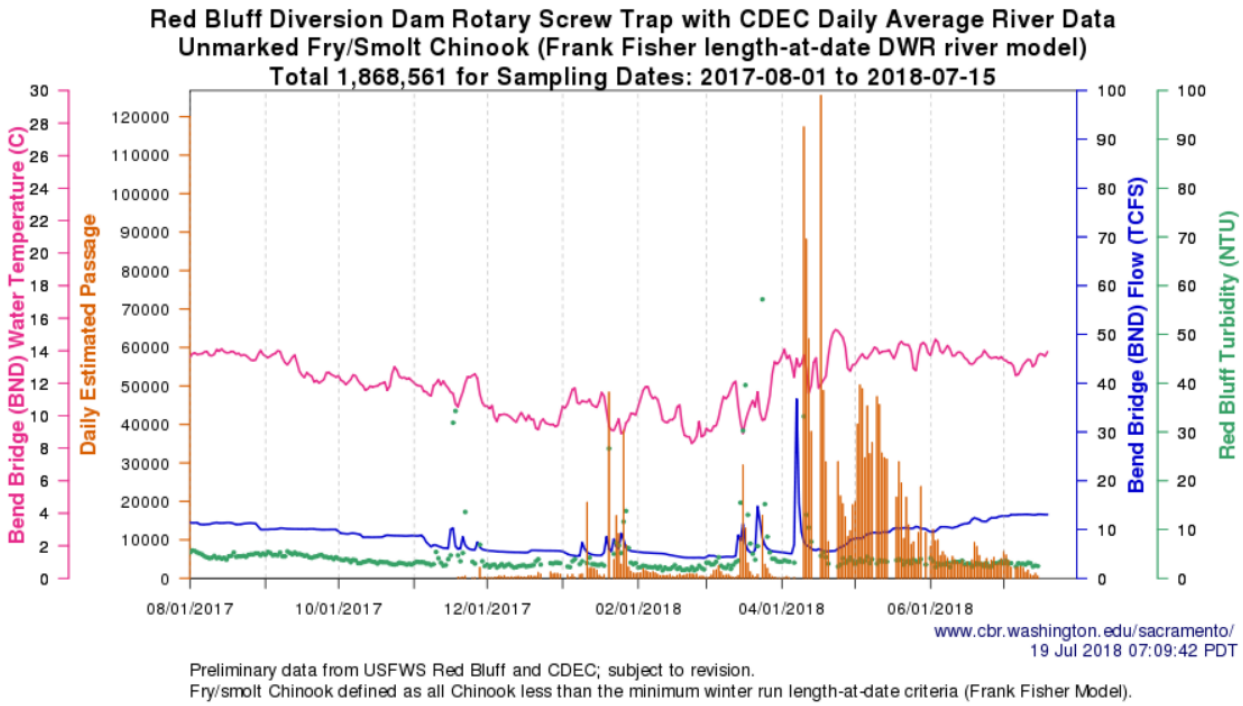


Figure G-8 Daily count of unmarked Fry/Smolt Chinook (orange bars) captured in rotary screw traps at Red Bluff Diversion Dam compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Bend Bridge, and turbidity (NTU; green points) at Red Bluff.

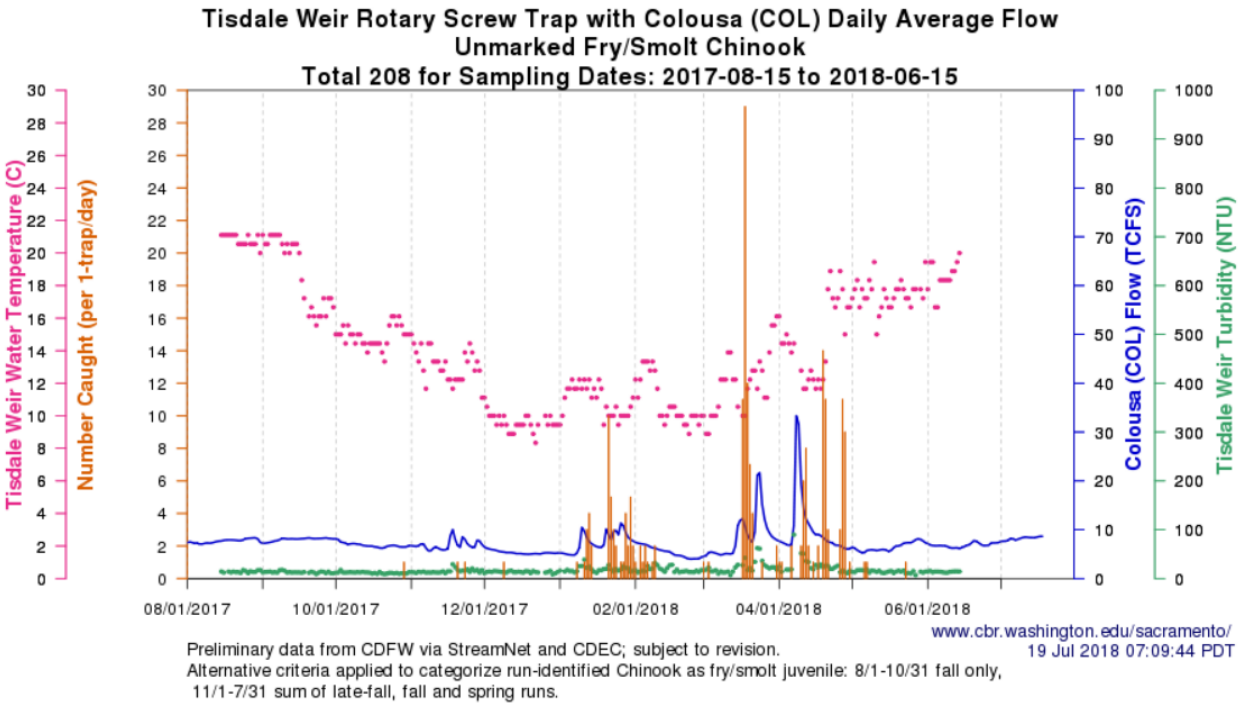


Figure G-9 Daily count of unmarked Fry/Smolt Chinook (orange bars) captured in rotary screw traps at Tisdale Weir compared to water temperature (°C; pink points) at Tisdale Weir, flow (TCFS; blue line) at Colusa, and turbidity (NTU; green points) at Tisdale Weir.

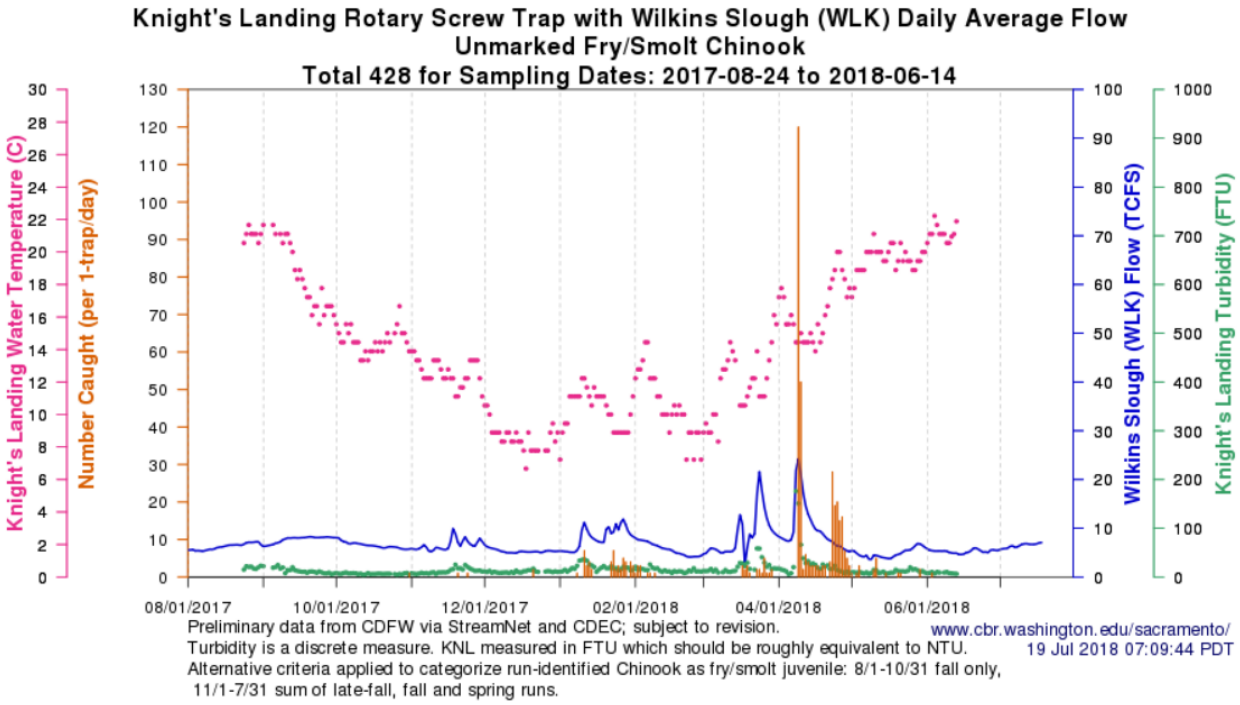


Figure G-10 Daily count of unmarked Fry/Smolt Chinook (orange bars) captured in rotary screw traps at Knights Landing compared to water temperature (°C; pink points) at Knights Landing, flow (TCFS; blue line) at Wilkins Slough, and turbidity (FTU; green points) at Knights Landing.

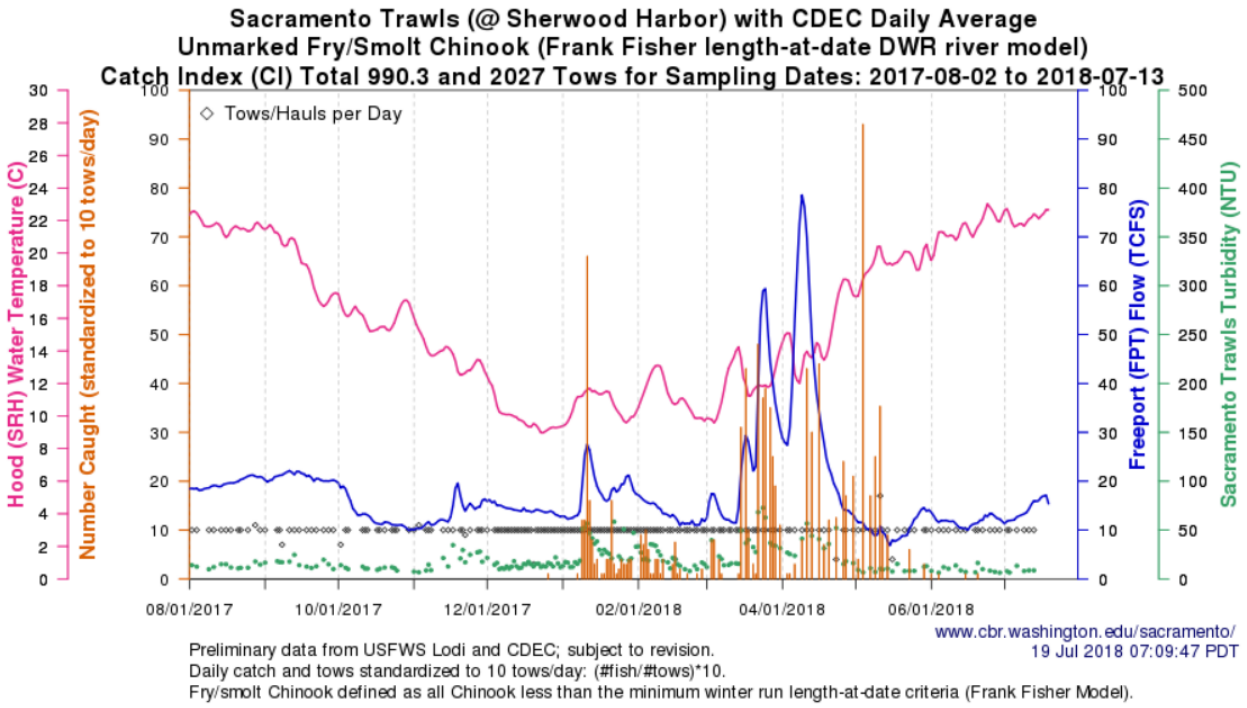


Figure G-11 Daily count of unmarked Fry/Smolt Chinook (orange bars) captured in trawls at Sherwood Harbor compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green points) at Sherwood Harbor.

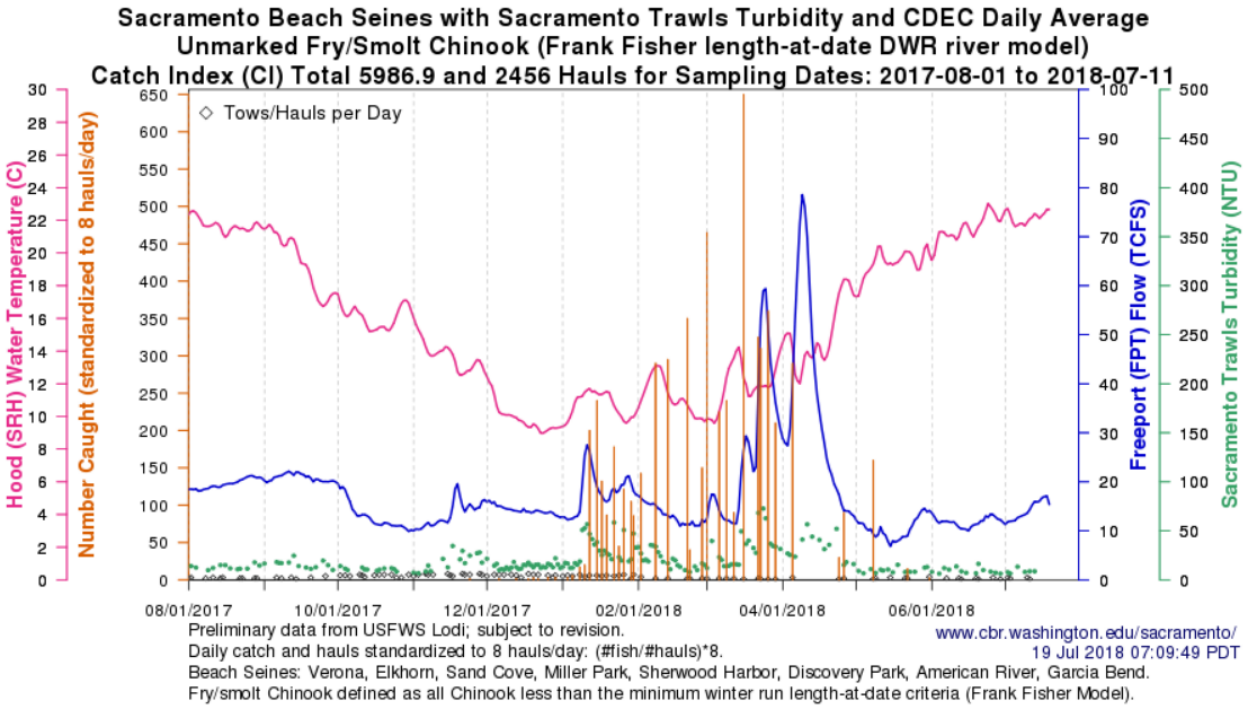


Figure G-12 Daily count of unmarked Fry/Smolt Chinook (orange bars) captured in Sacramento Beach Seines compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green points) at Sherwood Harbor.

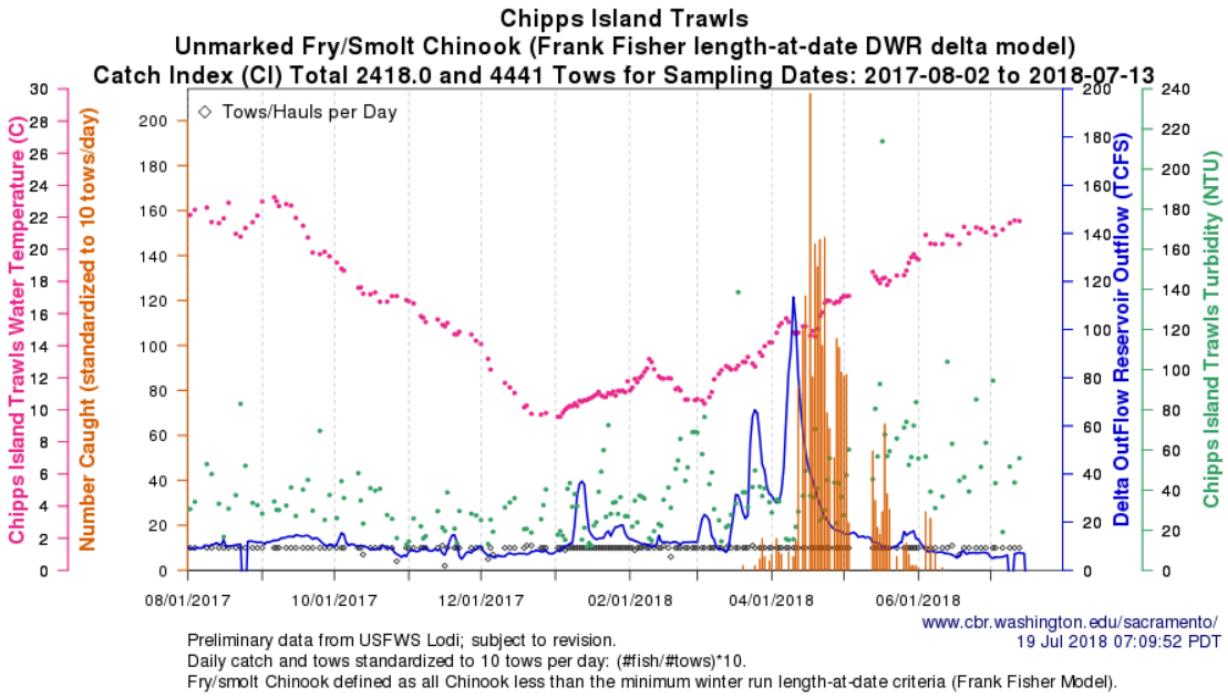


Figure G-13 Daily count of unmarked Fry/Smolt Chinook (orange bars) captured in trawls at Chipps Island compared to water temperature (°C; pink points) at Chipps Island, Delta outflow (TCFS; blue line), and turbidity (NTU; green points) at Chipps Island.

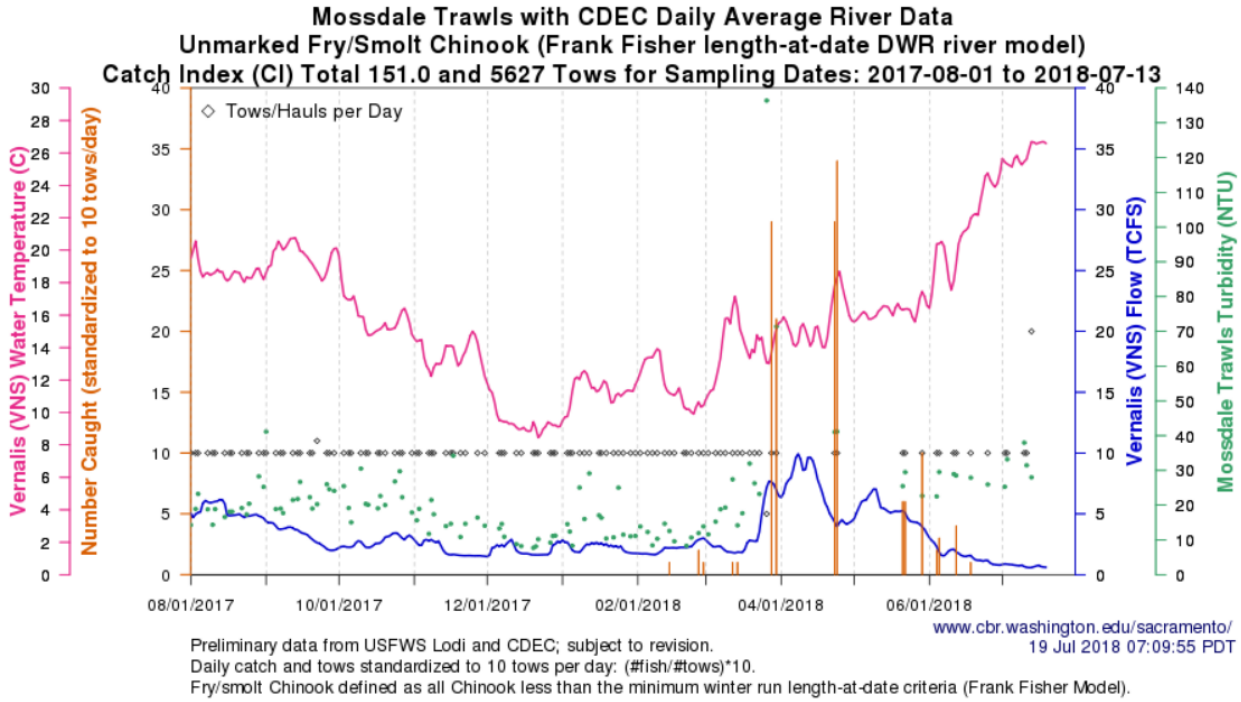


Figure G-14 Daily count of unmarked Fry/Smolt Chinook (orange bars) captured in trawls at Mossdale compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Vernalis and turbidity (NTU; green points) at Mossdale.

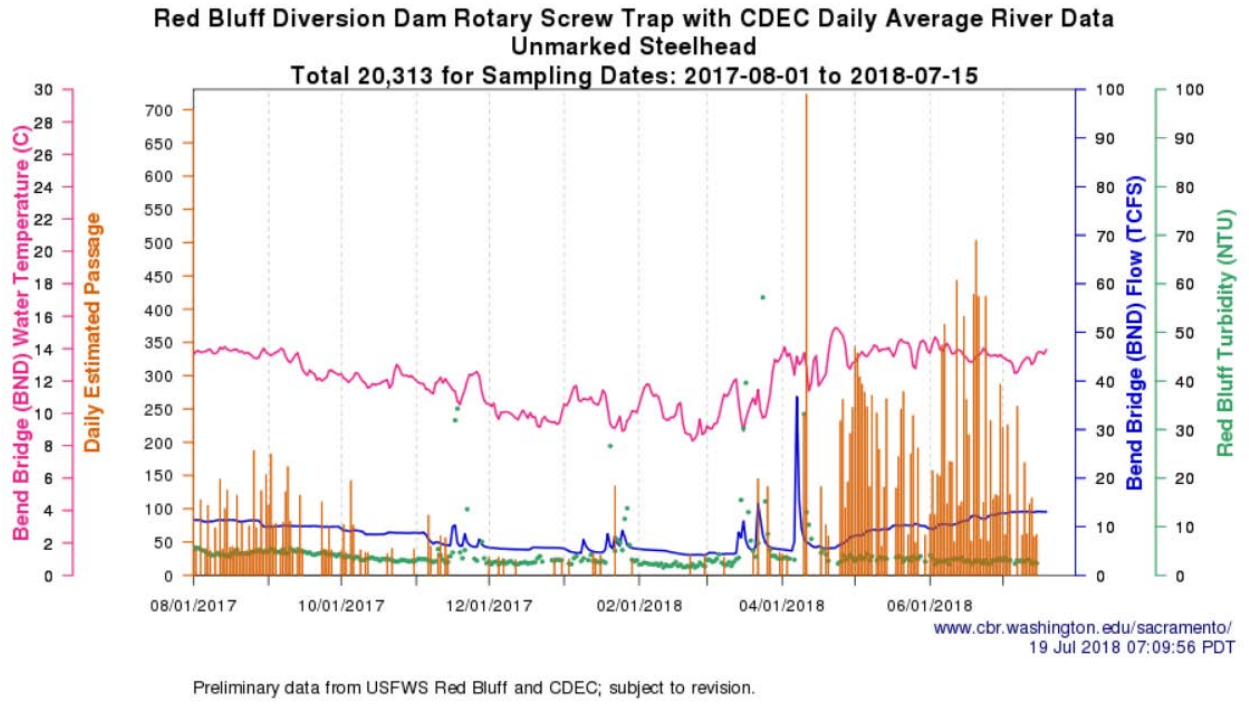


Figure G-15 Daily count of unmarked Steelhead (orange bars) captured in rotary screw traps at Red Bluff Diversion Dam compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Bend Bridge and turbidity (NTU; green points) at Red Bluff.

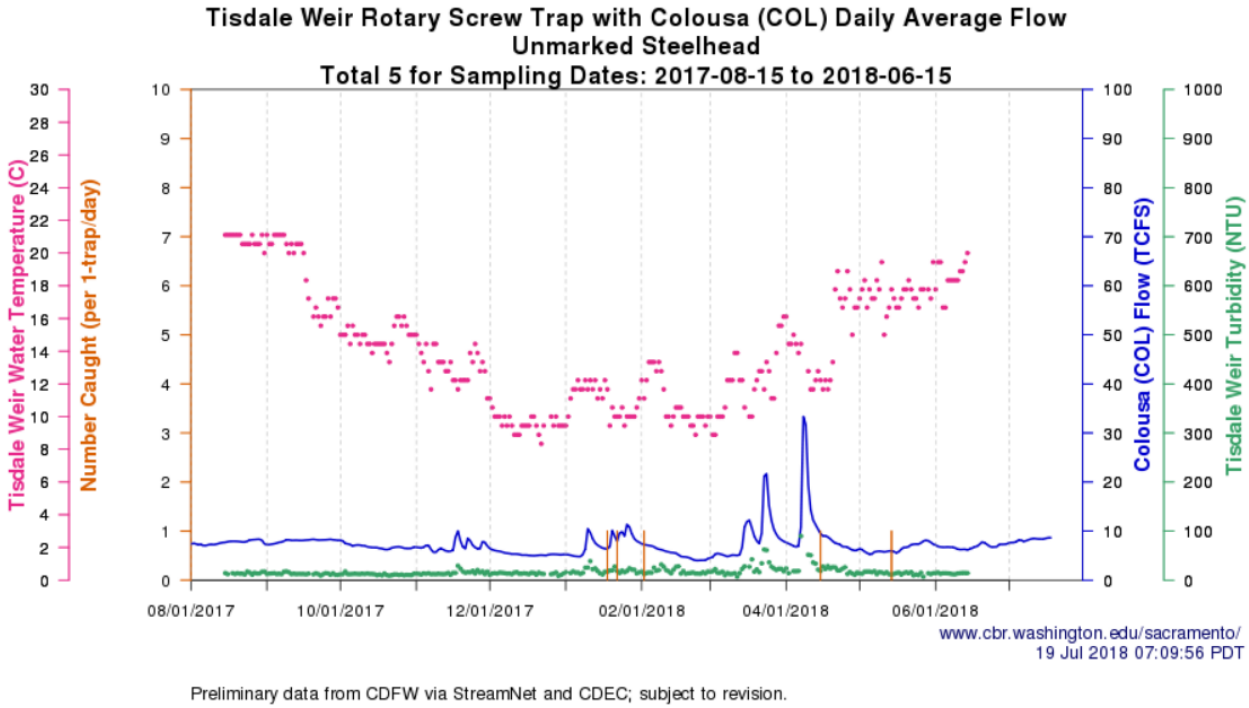


Figure G-16 Daily count of unmarked Steelhead (orange bars) captured in rotary screw traps at Tisdale Weir compared to water temperature (°C; pink points) at Tisdale Weir, flow (TCFS; blue line) at Colusa, and turbidity (NTU; green points) at Tisdale Weir.

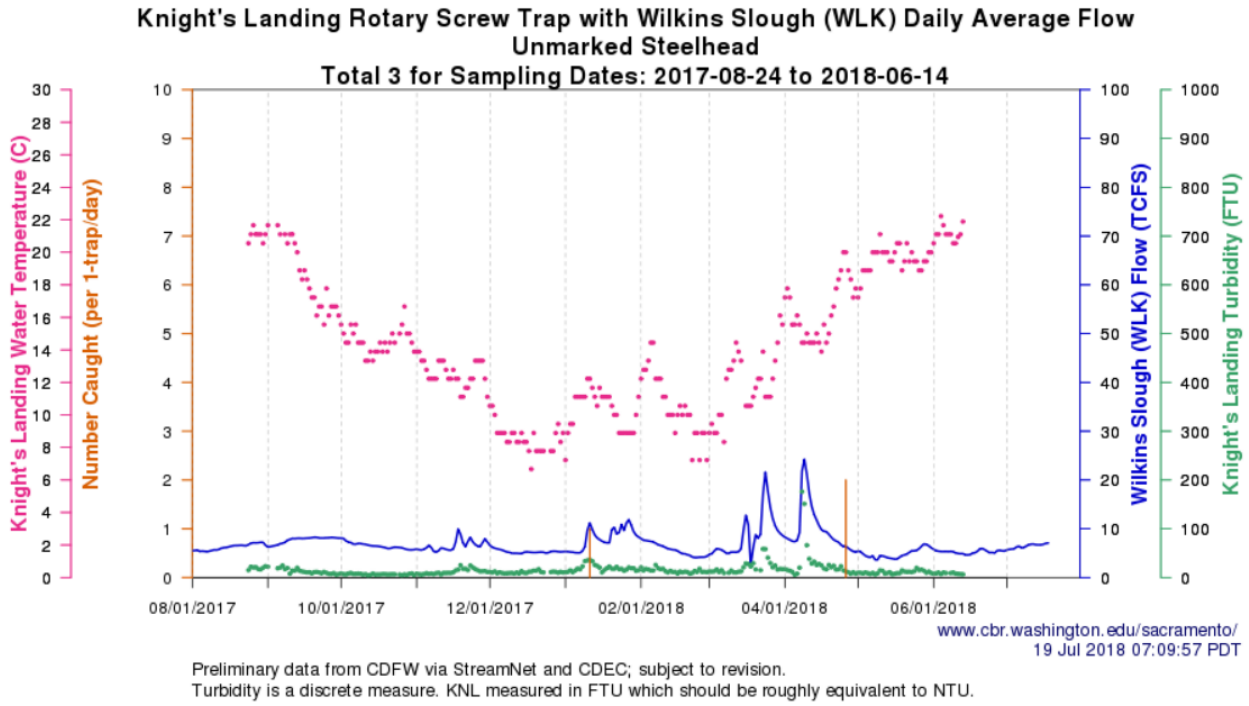


Figure G-17 Daily count of unmarked Steelhead (orange bars) captured in rotary screw traps at Knights Landing compared to water temperature (°C; pink points) at Knights Landing, flow (TCFS; blue line) at Wilkins Slough, and turbidity (FTU; green points) at Knights Landing.

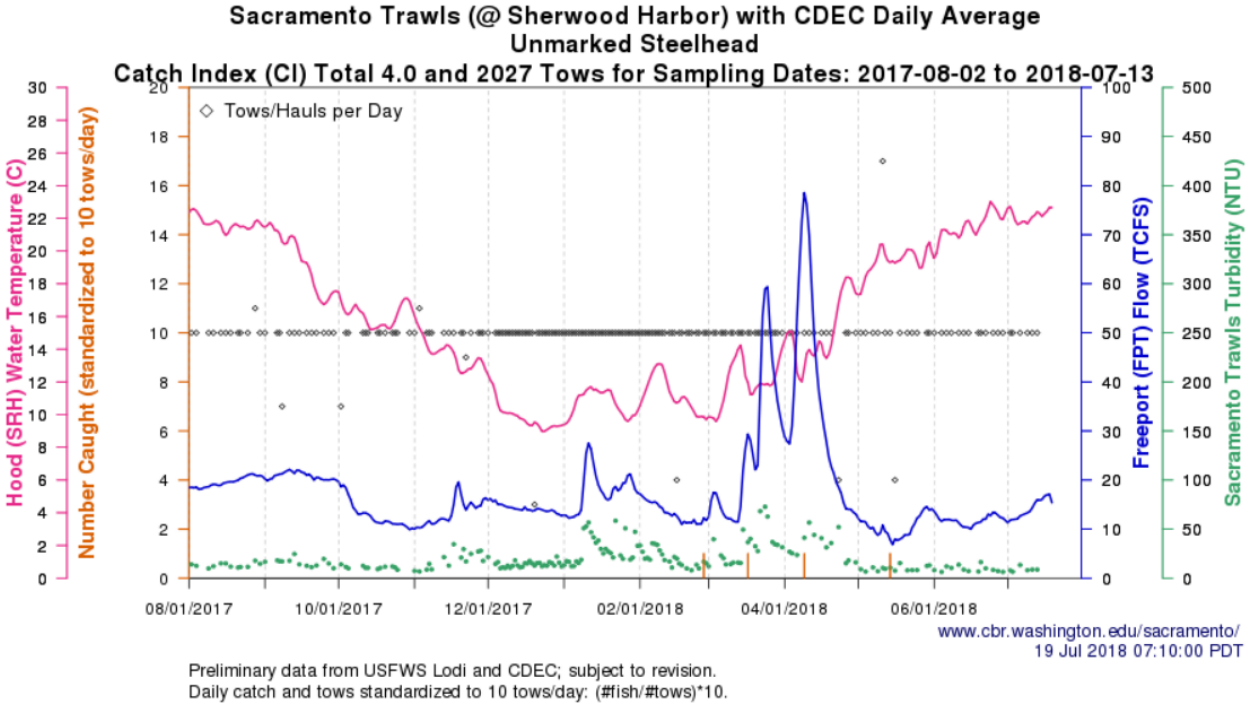


Figure G-18 Daily count of unmarked Steelhead (orange bars) captured in Sacramento Trawls at Sherwood Harbor compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green points) at Sherwood Harbor.

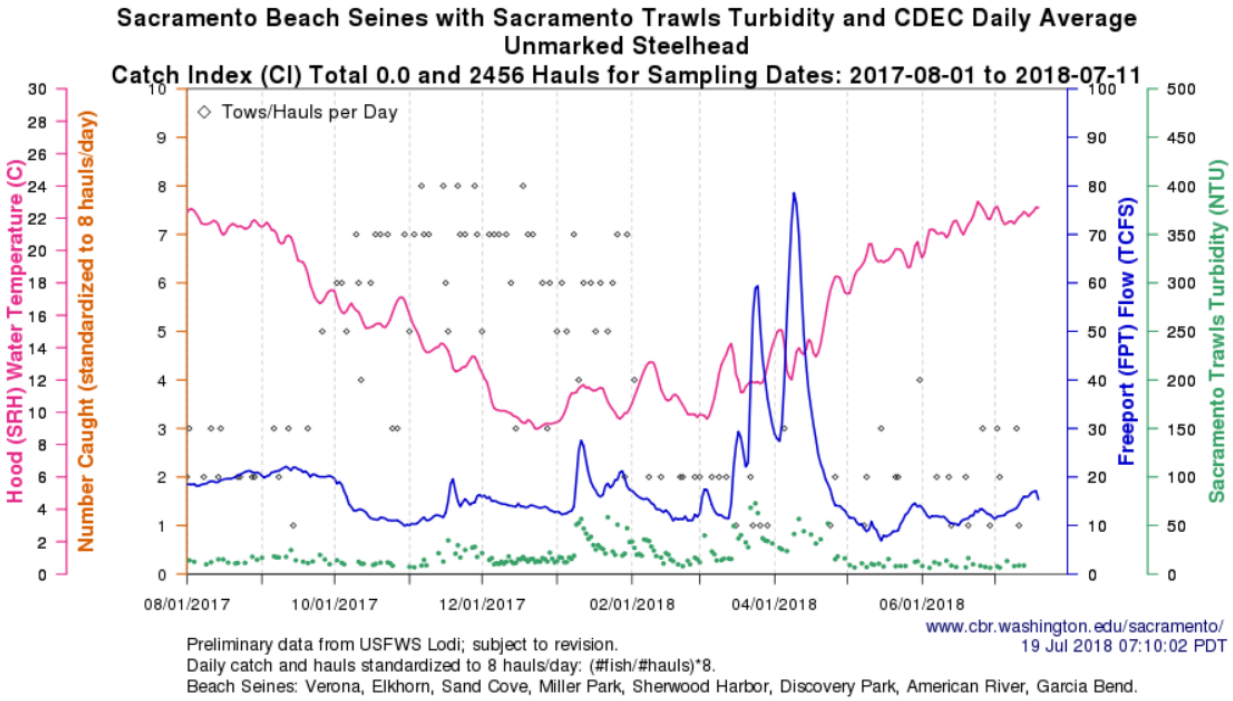


Figure G-19 Daily count of unmarked Steelhead (orange bars) captured in Sacramento Beach Seines compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green points) at Sherwood Harbor.

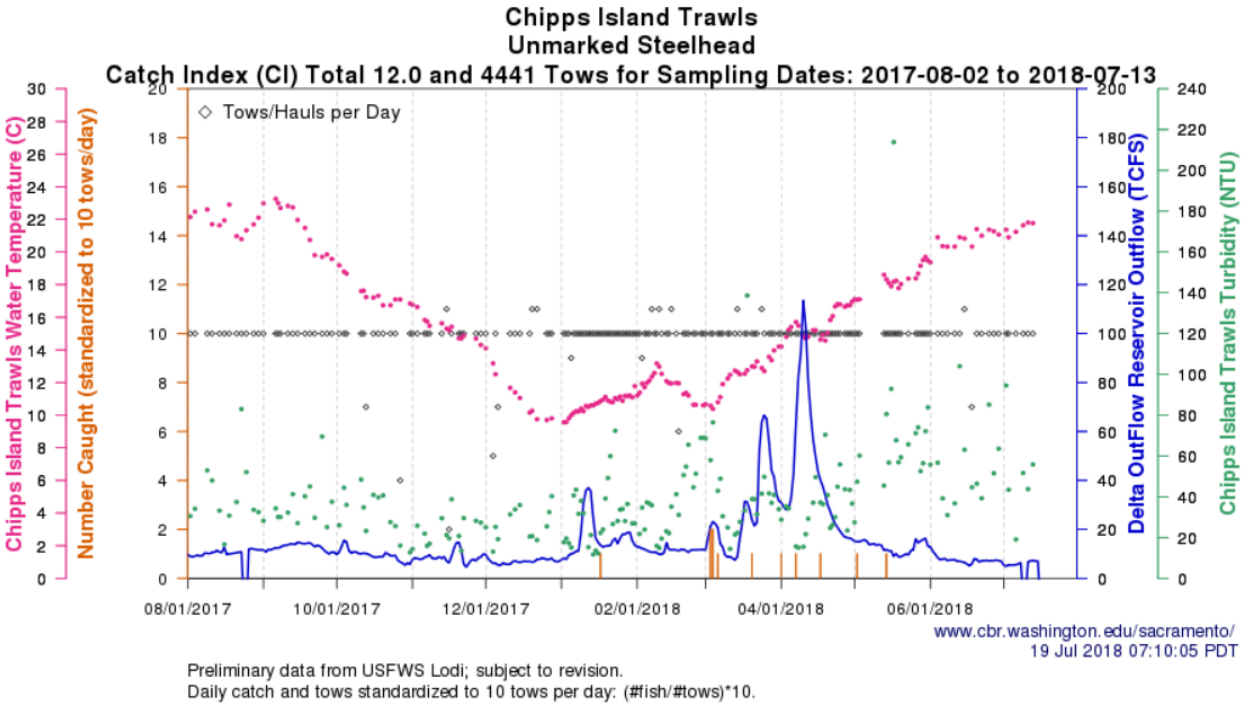


Figure G-20 Daily count of unmarked Steelhead (orange bars) captured in trawls at Chipps Island compared to water temperature (°C; pink points) at Chipps Island, Delta outflow (TCFS; blue line), and turbidity (NTU; green points) at Chipps Island.

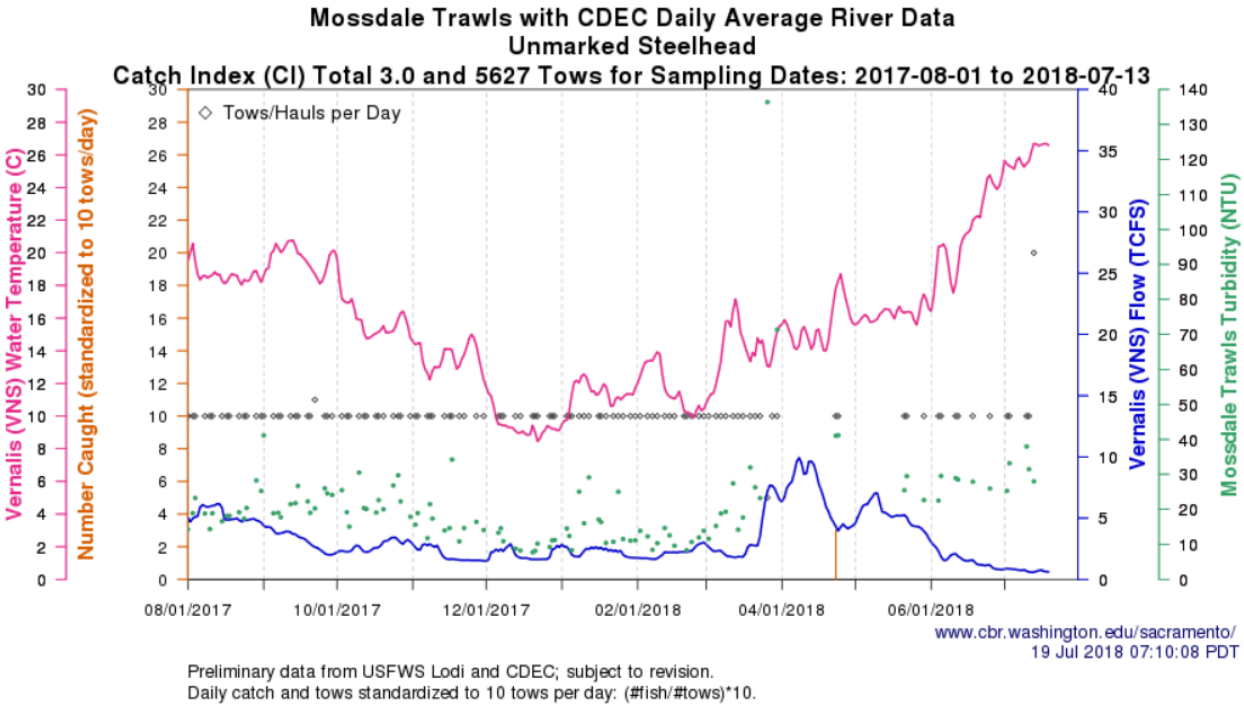


Figure G-21 Daily count of unmarked Steelhead (orange bars) captured in trawls at Mossdale compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Vernalis and turbidity (NTU; green points) at Mossdale.

Appendix H—DOSS Weekly Estimates

Weekly estimates of the proportion of the annual cohort of ESA-listed salmonids yet to enter the Delta (still upstream of the Delta in the Sacramento basin). Blank cells represent weeks in which DOSS made no quantitative estimate.

Yet to Enter the Delta				
		(above Knights Landing)		
Month	**Meeting Date**	**wild winter-run (%)**	**hatchery winter-run (%)**	**wild spring-run (%)**
October	10/3	98-100		
	10/10	98-100		
	10/17	98-99		
	10/24	97-98		
	10/31	96-97		100
November	11/7	95-96		100
	11/14	94-95		100
	11/21	89-93		98-99
	11/28	70-75		93-95
December	12/5	65-70		88-93
	12/12	62-68		86-91
	12/19	61-67		85-90
	12/26	59-66		83-89
January	1/2	58-65		81-88
	1/9	54-63		78-86
	1/16	39-48		63-76
	1/23	29-38		53-71
	1/30	24-33		50-68
February	2/6	23-31		45-63
	2/13	19-28		40-58
	2/20	18-26		38-56
	2/27	16-24		36-54
March	3/6	11-19	100	28-46
	3/13	6-14	100	18-36
	3/20	3-11	85-9	15-25
	3/27	1	75-85	10-15
April	4/3	1	60-75	5-15
	4/10	1	25	5
	4/17	1	5	2
	4/24	1	0-1	0-1
May	5/1	1	1	0-1
	5/8	0-1	0-1	0-1
	5/15	0-1	0-1	0-1
	5/22	0-1	0-1	0-1
	5/29	0-1	0-1	1
June	6/5	0-1	0-1	1
	6/12	0-1	0-1	0-1

Weekly estimates of the proportion of the annual cohort of ESA-listed salmonids in the Delta. Blank cells represent weeks in which DOSS made no quantitative estimate.

In Delta				
		(Knights Landing to Chipps Island)		
Month	**Meeting Date**	**wild winter-run (%)**	**hatchery winter-run (%)**	**wild spring-run (%)**
October	10/3	0-2		
	10/10	0-2		
	10/17	1-2		
	10/24	2-3		
	10/31	3-4		0
November	11/7	4-5		0
	11/14	5-6		0
	11/21	7-11		1-2
	11/28	25-30		5-7
December	12/5	30-35		7-12
	12/12	32-38		9-14
	12/19	33-39		10-15
	12/26	34-41		11-17
January	1/2	35-42		12-19
	1/9	37-46		14-22
	1/16	52-61		24-37
	1/23	62-70		29-47
	1/30	64-74		32-50
February	2/6	65-73		37-55
	2/13	64-73		42-60
	2/20	64-73		44-62
	2/27	64-73		46-64
March	3/6	64-73	0	54-72
	3/13	54-68	0	64-82
	3/20	47-66	10-15	75-85
	3/27	35-50	15-25	85-88
April	4/3	15-30	20-30	80-85
	4/10	5-20	50	70-75
	4/17	5-10	50	48-53
	4/24	0-5	10	25
May	5/1	1	5	10-15
	5/8	1	1	5-10
	5/15	1	0-1	2-5
	5/22	1	0-1	1-3
	5/29	0-1	0-1	1
June	6/5	0-1	0-1	1
	6/12	0-1	0-1	0-1

Weekly estimates of the proportion of the annual cohort of ESA-listed salmonids that have exited the Delta past Chipps Island. Blank cells represent weeks in which DOSS made no quantitative estimate.

Exited the Delta				
		(Exited past Chipps Island)		
Month	**Meeting Date**	**wild winter-run (%)**	**hatchery winter-run (%)**	**wild spring-run (%)**
October	10/3	0		
	10/10	0		
	10/17	0		
	10/24	0		
	10/31	0		0
November	11/7	0		0
	11/14	0		0
	11/21	0		0
	11/28	0		0
December	12/5	0		0
	12/12	0		0
	12/19	0		0
	12/26	0		0
January	1/2	0		0
	1/9	0		0
	1/16	0		0
	1/23	1		0
	1/30	2		0
February	2/6	4		0
	2/13	7-8		0
	2/20	9-10		0
	2/27	11-12		0
March	3/6	16-17	0	0
	3/13	26-32	0	0
	3/20	31-42	0	0
	3/27	50-65	0	2
April	4/3	70-85	5-10	10
	4/10	80-95	25	20-25
	4/17	90-95	45	45-50
	4/24	95-100	90	75
May	5/1	98	94	84-89
	5/8	98	98	89-94
	5/15	98	98	94-98
	5/22	98	99	96-99
	5/29	99	99	98-99
June	6/5	99	99	98-99
	6/12	99	99	99

Appendix I—Spring-run and Adjusted Catch Data and Winter-run Raw Catch

Raw data for spring-run and winter-run catch are provided for all three locations: Knights Landing, in-Delta monitoring sites, and Chipps Island. Large catch numbers were observed at all three locations for spring-run. These anomalies were adjusted either by adjusting just the high catch numbers or by adjusting the catch numbers within the entire date range which was likely affected by the fall-run hatchery releases. Adjusted numbers (shown in bold in the tables) were derived by averaging the data two weeks before and two weeks after either the high catch numbers or the hatchery release date range.

Spring-run raw and adjusted data at Knights Landing and associated calculation of the percent of spring-run "Yet to Enter the Delta." Adjusted data are indicated in bold, highlighted text.

Knight's Landing (Spring-Run)						
Date of DOSS Notes	Spring-Run Raw Data	Spring-Run Adjusted high values*	Spring-Run Adjusted release range**	100% minus cumulative raw data	100% minus Cumulative (adjusted high values)	100% minus Cumulative (adjusted release range)
10/3	0	0	0	100	100	100
10/10	0	0	0	100	100	100
10/17	0	0	0	100	100	100
10/24	0	0	0	100	100	100
10/31	0	0	0	100	100	100
11/7	1	1	1	100	96	97
11/14	0	0	0	100	96	97
11/21	2	2	2	99	88	90
11/28	11	0.5	11	95	85	54
12/5	0	0	0	95	85	54
12/12	0	0	0	95	85	54
12/19	0	0	0	95	85	54
12/26	0	0	0	95	85	54
1/2	0	0	0	95	85	54
1/9	0	0	0	95	85	54
1/16	1	1	1	95	81	51
1/23	0	0	0	95	81	51
1/30	0	0	0	95	81	51
2/6	0	0	0	95	81	51
2/13	0	0	0	95	81	51
2/20	0	0	0	95	81	51
2/27	0	0	0	95	81	51
3/6	0	0	0	95	81	51
3/13	0	0	0	95	81	51
3/20	2	2	2	94	73	45
3/27	7	7	7	92	44	22
4/3	3	3	3	91	31	12
4/10	0	0	0	91	31	12
4/17	245	1.5	0.75	9	25	10
4/24	7	1.5	0.75	6	19	7
5/1	16	1.5	0.75	1	13	5
5/8	3	3	0.75	0	0	2
5/15	0	0	0.75	0	0	0
5/22	0	0	0	0	0	0
5/29	0	0	0	0	0	0
6/5	0	0	0	0	0	0
6/12	0	0	0	0	0	0

Spring-run raw and adjusted data from beach seine and Sacramento trawl monitoring locations, and associated calculation of the percent of spring-run "In-Delta." Raw and adjusted data cumulative percent minus Chipps Island cumulative percent represents an estimate of the percent of fish present in the Delta each week. Adjusted data are indicated in bold, highlighted text.

Combined Beach Seine and Sacramento Trawl (Spring-Run)						
Date of DOSS Notes	Spring-Run Raw Data	Spring-Run (adjusted high values only)*	Spring-Run (adjusted release range)**	Combined Beach Seine and Sac Trawl % minus Chipps Island (raw data) %	Combined Beach Seine and Sac Trawl minus Chipps Island (adjusted high value)	Combined Beach Seine and Sac Trawl minus Chipps Island (adjusted release range)
10/3	0	0	0	0	0	0
10/10	0	0	0	0	0	0
10/17	0	0	0	0	0	0
10/24	0	0	0	0	0	0
10/31	1	1	1	0	1	0
11/7	0	0	0	0	1	0
11/14	0	0	0	0	1	0
11/21	0	0	0	0	1	0
11/28	0	0	0	0	1	0
12/5	0	0	0	0	1	0
12/12	1	1	1	1	2	1
12/19	1	1	1	1	3	1
12/26	0	0	0	1	-2	0
1/2	2	2	2	1	0	0
1/9	1	1	1	2	1	1
1/16	3	3	3	3	4	1
1/23	1	1	1	3	5	2
1/30	12	12	12	7	17	5
2/6	10	10	10	10	28	8
2/13	3	3	3	11	31	9
2/20	5	5	5	12	36	10
2/27	20	5	20	18	41	16
3/6	34	5	34	29	46	26
3/13	21	5	21	35	51	32
3/20	20	5	20	41	56	37
3/27	39	5	39	53	61	49
4/3	28	5	28	60	58	44
4/10	26	5	26	66	55	34
4/17	56	5	13.5	69	52	30
4/24	29	5	13.5	29	49	26
5/1	7	7	13.5	5	48	22
5/8	5	5	13.5	1	45	19
5/15	1	1	13.5	1	30	15
5/22	0	0	13.5	0	13	11
5/29	0	0	13.5	0	3	7
6/5	0	0	13.5	0	0	4
6/12	0	0	13.5	0	0	0

Spring-run raw and adjusted data at Chipps Island, and associated calculation of the percent of spring-run that have "Exited the Delta." The cumulative percent of total catch represents the percentage of fish that have passed the Chipps Island monitoring station. Adjusted data are indicated in bold, highlighted text.

Chipps Island Trawl (Spring-Run)						
Date of DOSS Notes	Spring-Run Raw Data	Spring-Run (adjusted high values)*	Spring-Run (adjusted release range)**	Cumulative % raw data	Cumulative Spring-Run (adjusted high values)	Cumulative Spring-Run (adjusted release range)
10/3	0	0	0	0	0	0
10/10	0	0	0	0	0	0
10/17	0	0	0	0	0	0
10/24	0	0	0	0	0	0
10/31	0	0	0	0	0	0
11/7	0	0	0	0	0	0
11/14	0	0	0	0	0	0
11/21	0	0	0	0	0	0
11/28	0	0	0	0	0	0
12/5	0	0	0	0	0	0
12/12	0	0	0	0	0	0
12/19	0	0	0	0	0	0
12/26	2	2	2	0	5	1
1/2	0	0	0	0	5	1
1/9	0	0	0	0	5	1
1/16	0	0	0	0	5	1
1/23	0	0	0	0	5	1
1/30	0	0	0	0	5	1
2/6	0	0	0	0	5	1
2/13	0	0	0	0	5	1
2/20	0	0	0	0	5	1
2/27	0	0	0	0.16	5	1
3/6	0	0	0	0.16	5	1
3/13	0	0	0	0.16	5	1
3/20	0	0	0	0.16	5	1
3/27	0	0	0	0.16	5	1
4/3	21	3.25	21	1.88	13	13
4/10	31	3.25	31	4.42	22	32
4/17	171	3.25	13	18.43	30	39
4/24	597	3.25	13	67.32	38	47
5/1	317	3.25	13	93.28	46	54
5/8	64	3.25	13	98.53	54	62
5/15	6	6	13	99.02	70	70
5/22	7	7	13	99.59	87	77
5/29	4	4	13	99.92	97	85
6/5	1	1	13	100.00	100	92
6/12	0	0	13	100.00	100	100

Winter-run raw catch data at Knights Landing and associated calculation of the percent of spring-run "Yet to Enter the Delta." Raw data was converted into percent of total, cumulative percent, and 100% minus cumulative percent to show proportion of total which had passed by the Knights Landing monitoring station. Data was not adjusted for hatchery influence since no high data numbers were observed.

Knight's Landing (Winter-Run)				
Date of DOSS Notes	Winter-Run Raw Data	Winter-Run Percent	Cumulative Percent	100% minus cumulative raw data
10/3	1	1.59	1.59	98.41
10/10	8	12.70	14.29	85.71
10/17	1	1.59	15.87	84.13
10/24	1	1.59	17.46	82.54
10/31	0	0.00	17.46	82.54
11/7	0	0.00	17.46	82.54
11/14	0	0.00	17.46	82.54
11/21	2	3.17	20.63	79.37
11/28	25	39.68	60.32	39.68
12/5	6	9.52	69.84	30.16
12/12	1	1.59	71.43	28.57
12/19	1	1.59	73.02	26.98
12/26	0	0.00	73.02	26.98
1/2	0	0.00	73.02	26.98
1/9	0	0.00	73.02	26.98
1/16	8	12.70	85.71	14.29
1/23	1	1.59	87.30	12.70
1/30	3	4.76	92.06	7.94
2/6	1	1.59	93.65	6.35
2/13	2	3.17	96.83	3.17
2/20	0	0.00	96.83	3.17
2/27	0	0.00	96.83	3.17
3/6	0	0.00	96.83	3.17
3/13	0	0.00	96.83	3.17
3/20	0	0.00	96.83	3.17
3/27	2	3.17	100.00	0.00
4/3	0	0.00	100.00	0.00
4/10	0	0.00	100.00	0.00
4/17	0	0.00	100.00	0.00
4/24	0	0.00	100.00	0.00
5/1	0	0.00	100.00	0.00
5/8	0	0.00	100.00	0.00
5/15	0	0.00	100.00	0.00
5/22	0	0.00	100.00	0.00
5/29	0	0.00	100.00	0.00
6/5	0	0.00	100.00	0.00
6/12	0	0.00	100.00	0.00

Winter-run raw catch data from beach seine and Sacramento trawl monitoring locations and associated calculation of the percent of winter-run "In-Delta." Raw data was converted into percent of total, cumulative percent, and cumulative percent minus Chipps Island raw data. Data was not adjusted for hatchery influence since no high data numbers were observed.

Combined Beach Seine and Sacramento Trawl (Winter-Run)					
Date of DOSS Notes	**Winter-Run Raw Data**	Winter-Run Percent	Winter-Run Cumulative Percent	**Raw Data Cumulative % (after 50%, 100% minus Cum %)**	**Combined Beach Seine and Sac Trawl minus Chipps Island (% raw data)**
10/3	0	0.00	0.00	0.00	0.00
10/10	0	0.00	0.00	0.00	0.00
10/17	0	0.00	0.00	0.00	0.00
10/24	0	0.00	0.00	0.00	0.00
10/31	0	0.00	0.00	0.00	0.00
11/7	0	0.00	0.00	0.00	0.00
11/14	0	0.00	0.00	0.00	0.00
11/21	0	0.00	0.00	0.00	0.00
11/28	16	16.33	16.33	16.33	16.33
12/5	1	1.02	17.35	17.35	1.02
12/12	6	6.12	23.47	23.47	6.12
12/19	2	2.04	25.51	25.51	2.04
12/26	0	0.00	25.51	25.51	-2.17
1/2	0	0.00	25.51	25.51	0.00
1/9	1	1.02	26.53	26.53	1.02
1/16	12	12.24	38.78	38.78	12.24
1/23	22	22.45	61.22	38.78	21.36
1/30	6	6.12	67.35	32.65	5.04
2/6	9	9.18	76.53	23.47	7.01
2/13	2	2.04	78.57	21.43	-4.48
2/20	4	4.08	82.65	17.35	2.99
2/27	0	0.00	82.65	17.35	0.00
3/6	2	2.04	84.69	15.31	-2.31
3/13	1	1.02	85.71	14.29	-5.50
3/20	7	7.14	92.86	7.14	2.80
3/27	5	5.10	97.96	2.04	-15.55
4/3	2	2.04	100.00	0.00	-13.18
4/10	0	0.00	100.00	0.00	-3.26
4/17	0	0.00	100.00	0.00	-14.13
4/24	0	0.00	100.00	0.00	-17.39
5/1	0	0.00	100.00	0.00	0.00
5/8	0	0.00	100.00	0.00	0.00
5/15	0	0.00	100.00	0.00	0.00
5/22	0	0.00	100.00	0.00	0.00
5/29	0	0.00	100.00	0.00	0.00
6/5	0	0.00	100.00	0.00	0.00
6/12	0	0.00	100.00	0.00	0.00

Winter-run raw catch data and adjusted data at Chipps Island and associated calculation of the percent of winter-run "Exited the Delta." The cumulative percent of total catch represents the percentage of fish that have passed the Chipps Island monitoring station. Data was adjusted due to large numbers likely caused by hatchery fish releases, either by only adjusting the large numbers, or the entire hatchery release range. Adjusted data are indicated in bold, highlighted text.

Chipps Island Trawl (Winter-Run)				
Date of DOSS Notes	**Winter-Run Raw Data**	Winter-Run Percent	Cumulative Percent	**Cumulative raw data**
10/3	0	0.00	0.00	0.00
10/10	0	0.00	0.00	0.00
10/17	0	0.00	0.00	0.00
10/24	0	0.00	0.00	0.00
10/31	0	0.00	0.00	0.00
11/7	0	0.00	0.00	0.00
11/14	0	0.00	0.00	0.00
11/21	0	0.00	0.00	0.00
11/28	0	0.00	0.00	0.00
12/5	0	0.00	0.00	0.00
12/12	0	0.00	0.00	0.00
12/19	0	0.00	0.00	0.00
12/26	2	2.17	2.17	2.00
1/2	0	0.00	2.17	2.00
1/9	0	0.00	2.17	2.00
1/16	0	0.00	2.17	2.00
1/23	1	1.09	3.26	3.00
1/30	1	1.09	4.35	4.00
2/6	2	2.17	6.52	6.00
2/13	6	6.52	13.04	12.00
2/20	1	1.09	14.13	13.00
2/27	0	0.00	14.13	13.00
3/6	4	4.35	18.48	17.00
3/13	6	6.52	25.00	23.00
3/20	4	4.35	29.35	27.00
3/27	19	20.65	50.00	46.00
4/3	14	15.22	65.22	60.00
4/10	3	3.26	68.48	63.00
4/17	13	14.13	82.61	76.00
4/24	16	17.39	100.00	92.00
5/1	0	0.00	100.00	92.00
5/8	0	0.00	100.00	92.00
5/15	0	0.00	100.00	92.00
5/22	0	0.00	100.00	92.00
5/29	0	0.00	100.00	92.00
6/5	0	0.00	100.00	92.00
6/12	0	0.00	100.00	92.00

Appendix J—Hatchery Winter-run CWT and Acoustic Tag Catch Data

Table J-1: Raw catch, percent weekly passage, and cumulative weekly passage of hatchery winter-run Chinook from Livingston Stone National Fish Hatchery for the Sacramento trawl and Chipps trawl sampling, based on coded wire tagged fish. Catch is summarized for the week prior to each weekly DOSS call. Raw catch data are from the "DatCall" file downloaded from: https://www.fws.gov/lodi/juvenile_fish_monitoring_program/jfmp_index.htm

Coded Wire Tag (CWT) Winter-Run Catch Data						
	Sacramento Trawl			Chipps Trawl		
Date of DOSS Notes	Raw Catch	% CWT WR	Cumulative %	Raw Catch	% CWT WR	Cumulative %
2/6	0	0	0	0	0	0
2/13	0	0	0	0	0	0
2/20	0	0	0	0	0	0
2/27	0	0	0	0	0	0
3/6	0	0	0	0	0	0
3/13	0	0	0	0	0	0
3/20	10	45.5	45.5	4	9.3	9.3
3/27	7	31.8	77.3	9	20.9	30.2
4/3	3	13.6	90.9	20	46.5	76.7
4/10	0	0	90.9	3	7.0	83.7
4/17	2	9.1	100	4	9.3	93.0
4/24	0	0	100	3	7.0	100
5/1	0	0	100	0	0	100
5/8	0	0	100	0	0	100
5/15	0	0	100	0	0	100
5/22	0	0	100	0	0	100
5/29	0	0	100	0	0	100
6/5	0	0	100	0	0	100
6/12	0	0	100	0	0	100

Table J-2: The table below shows the cumulative weekly passage of hatchery winter-run Chinook from Livingston Stone National Fish Hatchery from the previous table. Catch is summarized for the week prior to each weekly DOSS call. The three columns on the right (with header cells colored to match the region-specific color coding in Figure 4-7 of the report) show the calculated data-based distribution estimates used to compare to the weekly DOSS estimates. Calculations:

"Yet to enter the Delta" equals 100 percent minus the Sacramento trawl cumulative percent.

"In the Delta" equals Sacramento trawl cumulative percent minus Chipps trawl cumulative percent.

"Exited the Delta" equals Chipps trawl cumulative percent.

Coded Wire Tag (CWT) Winter-Run Distribution			
	Yet to Enter the Delta	In the Delta	Exited the Delta
Date of DOSS Notes	100% minus Cumulative % Sac Trawl	Sac Trawl minus Chipps cumulative %	Chipps cumulative %
2/6			
2/13			
2/20			
2/27			
3/6			
3/13	100	0	0
3/20	54.5	36.2	9.3
3/27	22.7	47.0	30.2
4/3	9.1	14.2	76.7
4/10	9.1	7.2	83.7
4/17	0	7.0	93.0
4/24	0	0	100
5/1	0	0	100
5/8	0	0	100
5/15	0	0	100
5/22	0	0	100
5/29	0	0	100
6/5	0	0	100
6/12	0	0	100

Table J-3: On March 1 and March 13, 2018, 600 JSATS acoustic tagged winter-run Chinook salmon juveniles from Livingston Stone National Fish Hatchery were released. Raw catch, percent weekly passage, and cumulative weekly passage of detected acoustic tagged fish are provided in the table below. These results are based on preliminary results and are not final. Catch is summarized for the week prior to each weekly DOSS call.

Acoustic Tagged (AT) Winter-Run Chinook Catch Data			
Sacramento Area			
Date of DOSS Notes	Raw Catch	% CWT Winter-run	Cumultive %
2/6	0	0	0
2/13	0	0	0
2/20	0	0	0
2/27	0	0	0
3/6	0	0	0
3/13	13	8.1	8.1
3/20	51	31.9	40
3/27	56	35	75
4/3	20	12.5	87.5
4/10	15	9.4	96.9
4/17	5	3.1	100
4/24	0	0	100
5/1	0	0	100
5/8	0	0	100
5/15	0	0	100
5/22	0	0	100
5/29	0	0	100
6/5	0	0	100
6/12	0	0	100

The "Sacramento Area" used receivers on Tower, I80/50, and Sacramento Trawl sites. Since tagged fish were typically detected at each receiver multiple times, the minimum detection date was counted as 1. Note: There was no Chipps Island receiver data to determine distribution of fish presence upstream, in, and exited the Delta. Therefore, no distribution comparison (to DOSS estimates) graph is available.