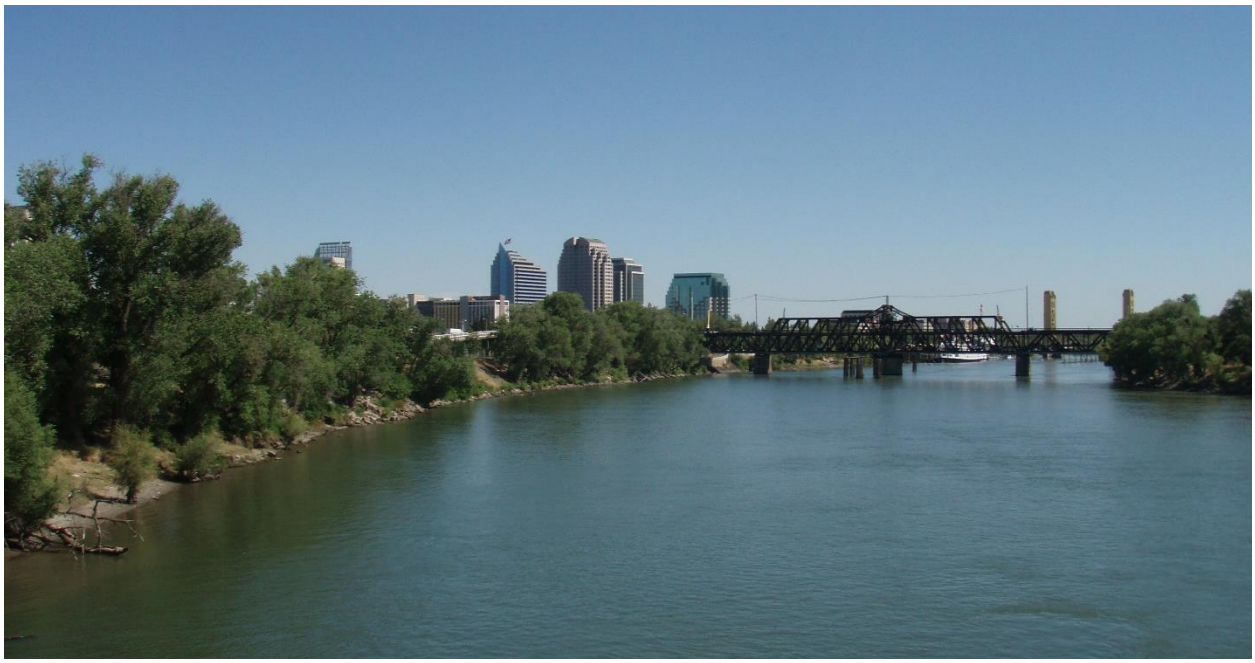
Annual Report of Activities
October 1, 2016, to
September 30, 2017



Delta Operations for
Salmonids and Sturgeon (DOSS)
Technical Working Group
November 2017

(revised November 2021)

November 2021 Revisions:

- Report body: Addition of Section 2.4.4.2; revisions to Section 4.2.3, including the addition of Figure 4-4; addition of Section 4.2.4; addition of Figure 4.7.
- Appendix B: Addition of KLCI and SCI indices from 10/1/16 to 11/9/16; addition of explanation for how KLCI and SCI indices are calculated
- Appendix F: Inclusion of 2017 Incidental Take and Monitoring Report
- Appendix I: Addition of tables with information on catch/detection of coded-wire-tagged and acoustic-tagged hatchery winter-run Chinook salmon (associated with addition of Figure 4.7 to report body)

Cover Photo: *Looking downstream on the Sacramento River towards the I St. Bridge, the northern extent of the statutory Delta.*

Credit: *NMFS*

TABLE OF CONTENTS

Acronyms and Abbreviations

Term	Definition
BiOp	Biological Opinion
CDEC	California Data Exchange Center
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
CDFW	California Department of Fish & Wildlife
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

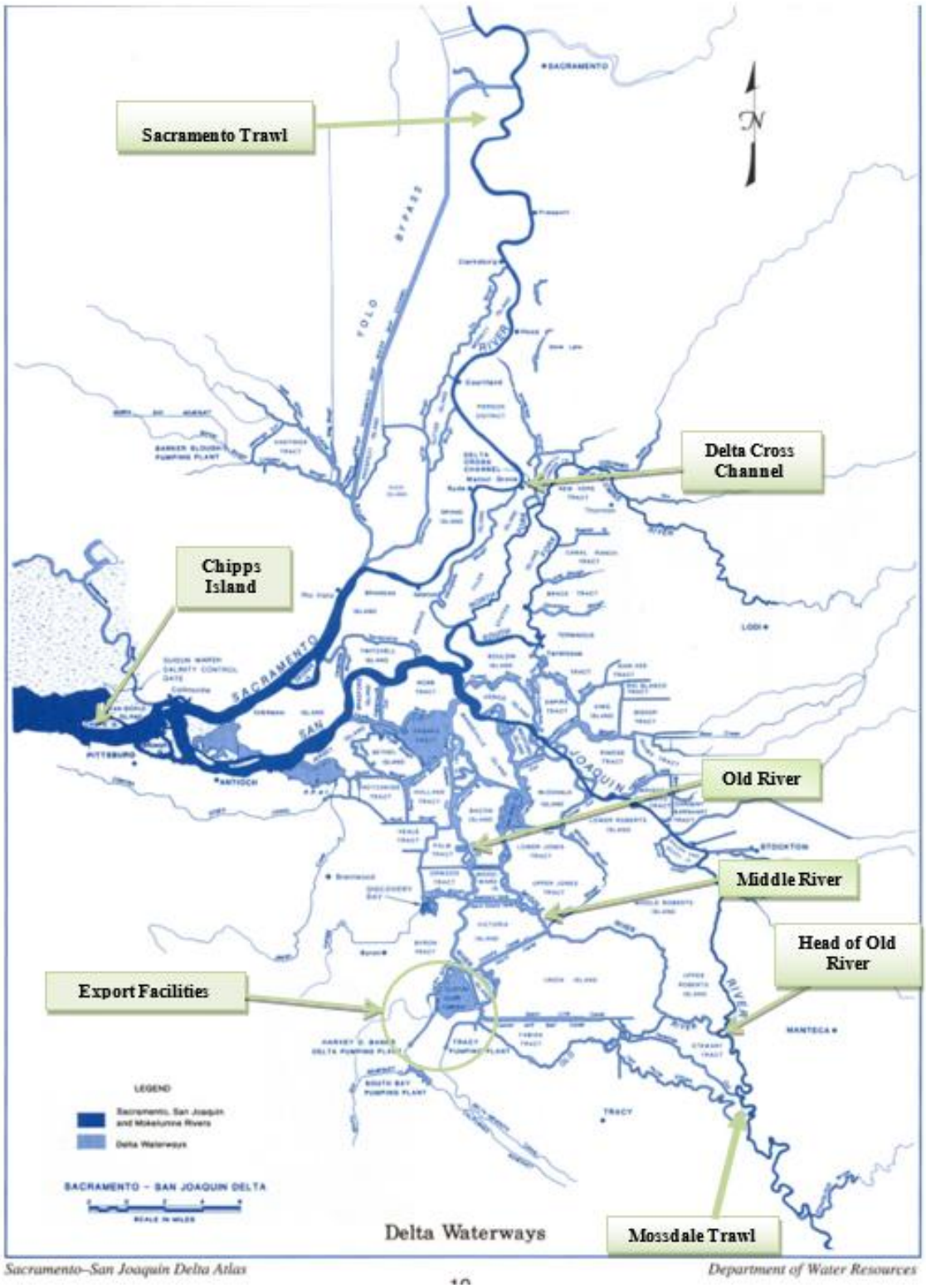


Figure 1-1. Delta map with DOSS-related points of interest.

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 (DFW)
- 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 (CCV steelhead, *O. mykiss*), and southern distinct population segment 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 CCV 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 Chips 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 CCV 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, CCV steelhead. Based on the findings of the status review, DOSS will make recommendations to NMFS, Reclamation, DFW, 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, CCV 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.

CHAPTER 2 SUMMARY OF DOSS DISCUSSIONS AND ADVICE/RECOMMENDATIONS

2.1 Weekly Discussion Topics

- CVP AND SWP operations
- Delta fish monitoring, salvage, loss, and loss densities
- Hatchery releases
- DCC operations
- OMR flow management
- I:E ratio
- Coordination with other technical teams (e.g., Delta Smelt Working Group)
- DOSS Estimates of Fish Distribution
- Assessments of Entrainment Risk

2.2 Other Discussion Topics

- Sampling effort at fish collection facilities
- 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
- Genetic Sampling at Export Facilities
- SJRRP release of Adult spring-run Chinook salmon
- WIIN Act

2.3 Summary of WY 2017 RPA Action Implementation

RPA Action implementation during WY 2017 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 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 2017 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 10/1/16 through 11/30/16; the DCC gates were closed for the season on 12/1/16. During the period of October and November, the first alert was triggered on 10/3/16, and every day from 10/14/16 to 11/30/16. The second alert was triggered on all but one day for the period 11/21/16 to 11/30/16. 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 2016, 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), resulting in three separate DCC closures (on 11/6/16, 11/12/16, and 11/25/16) prior to the seasonal DCC closure on 12/1/16. Note that the Seine SCI of 3.4 on 11/30/16 triggered a DCC closure per the October 1-November 30 guidelines in Action IV.1.2, but because the DCC gates were already scheduled for closure on December 1 per the December 1-14 guidelines, no further DCC action was required.

As shown below in the implementation timeline for the 11/12/17 closure, DCC closures may be implemented with a lag due to concerns about boater notification and safety.

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

Date	KLCI	Seine SCI	Trawl SCI	DCC position	Day of Action
11/10/16	0	4	0	Open	--
11/11/16	0	No sampling	No sampling	Open	--
11/12/16	0	No sampling	No sampling	Closed in AM	1
11/13/16	0	No sampling	No sampling	Closed	2
11/14/16	0	0	0	Closed	3
11/15/16				Opened in AM	--

The DCC gates were closed on 12/1/15 per the operations table in Action IV.1.2, and did not open again until 6/23/17. The operations table in 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 mornings and closing the gates on Mondays at noon during this period. However, in WY 2017, the DCC gates remained closed throughout this entire period because the Sacramento River flows remained above the approximate 20,000 cfs threshold above which the DCC gates are not opened due to concerns about scouring around the DCC gates structure. From June 15-September 31, there are no RPA requirements for DCC operations and the Projects usually have the gates open throughout this period.

Appendix B summarizes the Knights Landing Catch Index (KLCI), the Seine Sacramento Catch Index (Seine SCI), and Trawl Sacramento Catch Index (Trawl SCI) for October and November 2016, and Appendix A summarizes DCC gate operations.

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 Basin at the onset of RPA Action IV.2.1 on 4/1/16 was designated as "Wet", which would have required a 4:1 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, the flood condition offramp[3] for Action IV.2.1 allows unrestricted exports whenever Vernalis stage is equal to or greater than the flood warning stage of 24.5 feet. Vernalis stage dropped below 24.5 feet on

[3] On 5/1/17, NMFS issued a letter clarifying that the flood condition offramp is intended to be based on the flood warning stage of 24.5 feet. The Vernalis flow associated with a stage of 24.5 feet is determined by the rating curve. Letter available at: http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/clarification_of_san_joaquin_i-e_ratio_flood_condition_offramp_-_may_1__2017.pdf

5/12/17, and, with an approved lag of up to three days for export scheduling, implementation of the 4:1 I:E ratio began on 5/15/17 and ended on 5/31/17.

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." DOSS will wait for all six years of data to be analyzed before conducting the review.

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 CCV 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 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 2017, temperatures at Mossdale ("MSD" station data reported on CDEC) did not satisfy the temperature offramp and OMR flow restrictions were in effect through 6/15/17.

During the January 1 through June 15 Action IV.2.3 implementation period, no loss or loss-density triggers were exceeded that required an OMR limit less negative than -5,000 cfs. The high flows at Vernalis due to flood releases and runoff in the San Joaquin basin resulted in positive OMR flows from early February through May.

A summary of OMR limits in effect during WY 2017 and whether or not controlling 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 2017 is provided in Appendix D (for Chinook salmon) and Appendix E (for CCV 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, CCV 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 2017, no loss or loss-density triggers were exceeded that required action under RPA Action IV.3. A summary of catch, salvage, loss at the CVP and SWP, and combined loss density during WY 2016 is provided in Appendix D (for Chinook salmon) and Appendix E (for CCV steelhead).

2.4 Other Topics

2.4.1 Juvenile Production Estimate for Winter-run Chinook Salmon

NMFS issued the juvenile production estimate (JPE) for brood-year 2016 winter-run Chinook salmon on 2/3/17[4]. The JPE for juvenile winter-run estimated to enter the Delta in WY 2017 (juveniles from brood year 2016) was 166,189 natural-origin fish, and 58,188 juveniles from Livingston Stone National Fish Hatchery (LSNFH). The authorized incidental take for naturally-produced winter-run has been established in the NMFS BiOp as 2 percent of the JPE to allow for errors in fish identification due to use of the length-at-date criteria to determine salmon race *(i.e.*, differentiating winter-run from fall run, late-fall run, and spring-run Chinook salmon). In WY 2017, Reclamation and DWR contracted with Cramer Fish Sciences to provide genetics-based run classification of unclipped juvenile Chinook salmon collected at the CWP and SWP 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/SWP Delta pumping 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/SWP Delta pumping facilities for WY 2016 was set at **1,662 natural (non-clipped or wild)** winter-run (1% of the JPE). The incidental take for hatchery winter-run is set at **582 hatchery-produced** winter-run (1% of the LSNFH release expected to enter the Delta).

Action IV.2.3 (OMR flow management) includes a loss-density trigger based on the JPE. As in WY 2016, the two levels of the JPE-based OMR trigger for WY 2017 RPA implementation were 2.5 fish/TAF and 5.0 fish/TAF (minimum density if JPE-based OMR trigger is less than these densities). Per the DOSS advice from 12/20/16[5], the 2.5 fish/TAF and 5.0 fish/TAF triggers were implemented on an interim basis beginning on 1/1/16 and prior to NMFS' formal determination on the brood-year 2016 JPE.

2.4.2 Rapid Genetic Testing Protocol

Some of the action response 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, defined based on Chinook race classifications made using length-at-date tables. These older juvenile triggers are primarily intended to protect natural-origin winter-run Chinook salmon. Because race classification by genetics (especially for winter-run Chinook salmon) is more accurate than the classification based on length-at-date tables (which can result in false positive assignments), in WY 2015 DWR and Reclamation piloted a rapid genetic testing protocol. The objective of the protocol is to process genetic samples that were collected from older juvenile salmonids salvaged at the SWP and CVP as soon as practicable after salvage to assess the race assignment that was based on the existing length-at-date table in order to avoid or minimize the duration of export reductions that were triggered by loss of fish designated in this size range that were not genetic winter-run.

[4] http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/winter-run_juvenile_production_estimate__jpe__-_february_3__2017.pdf

[5] See agenda item 10 in the 12/20/16 DOSS notes, available at: http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Delta%20Operations%20for%20Salmonids%20and%20Sturgeon/DOSS%20WY2016/2016.12.20_final_doss_notes.pdf

Reclamation and DWR more formally implemented this procedure again during WY 2017, in coordination with the DFW, FWS, and the NMFS. The rapid genetic identification protocol used in WY 2015 was reviewed through DOSS during the fall. As in previous years, the procedure is a precautionary approach that is intended to avoid (or minimize the duration of) export reductions triggered based on older juveniles that are not genetic winter-run. Actions to reduce pumping at the CVP and SWP export facilities are initiated 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 genetic winter-run Chinook did not exceed the trigger threshold, then export reductions will be cancelled. NMFS supported the use of this protocol, with the two additional conditions that all unclipped Chinook salmon have tissue samples collected for subsequent analysis, and that the annual incidental take limit was set at 1% of natural winter-run (the 2% of the JPE for incidental take assumes 50% misclassification of winter-run Chinook based on the length-at-date tables). During WY 2017, rapid genetic analysis was not initiated because older juvenile loss density triggers (under Actions IV.3 or IV.2.3) were never exceeded.

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 being released. The CNFH late fall-run Chinook salmon are considered appropriate surrogates for 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 in the upper Sacramento River based on turbidity and flow events that mimic natural storm events in spring-run Chinook salmon natal streams.

Table 2-1. Summary of all CNFH late fall-run releases and DOSS input to CNFH on the spring-run surrogate releases

Release Type	DOSS Input	Date Released	Number of Fish Released
Production Release	No DOSS input. When possible, the December production release occurs coincident with a rainfall event.	12/9/16	861,966
First Surrogate Release	Mid-December, ~3 days after from the production release and coincident with a rainfall event	12/12/16	75,000
Second Surrogate Release	Late December, ideally preceding (by ~3-7 days) a precipitation event and at least a week after the previous surrogate release.	12/21/16	81,279
Third Surrogate Release	Mid-January, ideally preceding (by ~3-7 days) a precipitation event and at least a week after the previous surrogate release.	1/9/17	75,000

After each release, DOSS tracked the cumulative loss of each spring-run Chinook salmon surrogate group at the Delta fish facilities 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 2017, loss of 0.242%, 0.427%, and 0.000% was observed for the first, second, and third spring-run Chinook salmon surrogate release groups (Table 2-2). Since the percent loss of all release groups was less than 0.5%, no action response based on spring-run surrogate catch was triggered in WY 2017.

Table 2-2. 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 6/14/17

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]
12/9/2016	LF	Coleman NFH	Battle Creek	Production	1642.62	861,966	n/a	0.191	n/a	n/a	12/18/2016	1/23/2017
12/12/2016	LF	Coleman NFH	Battle Creek	Spring Surrogate	181.82	75,000	n/a	0.242	n/a	0.5%	12/22/2016	1/19/2017
12/21/2016	LF	Coleman NFH	Battle Creek	Spring Surrogate	346.73	81,279	n/a	0.427	n/a	0.5%	12/30/2016	1/29/2017
1/9/2017	LF	Coleman NFH	Battle Creek	Spring Surrogate	0.00	75,000	n/a	0.000	n/a	0.5%	*	*
2/2/2017	W	Livinstone NFH	Sacramento River	WR	0.00	141,388	n/a	0.000	n/a	0.5%	*	*
11/29/2016	F	SJRRP	San Joaquin River	Experimental	175.35	1200	n/a	14.613	n/a	n/a	12/23/2017	1/25/2017
11/29/2016	S	SJRRP	San Joaquin River	Experimental	6.05	544	n/a	1.112	n/a	n/a	12/27/2016	1/14/2017
3/6/2017	S	SCARF	San Joaquin River	Experimental	762.54	60,108	n/a	1.269	n/a	n/a	3/29/2017	5/15/2017
3/6/2017	S	SIRF	San Joaquin River	Experimental	448.77	38,106	n/a	1.178	n/a	n/a	4/2/2017	5/17/2017
4/24/2017	F	MRH	Merced River	Experimental	176.44	70,591	n/a	0.250	n/a	n/a	5/2/2017	6/1/2017

UNCONFIRMED HATCHERY (ADIPOSE-FIN CLIPPED) CHINOOK SALMON LOSS AT THE SWP & CVP DELTA FISH FACILITIES, 2016/2017

Facility	Unknown CWT Loss[5]	Unread CWT Loss[6]	Unknown Hatchery Loss[7]	Acoustic Tag Loss[8]	Number of Unassigned CWTs[9]
SWP	266.47				
CVP	32.88				
TOTAL	**279.60**				

SWP and CVP adipose-fin clipped Chinook lost from 10/1/2016 through 6/14/2017.
[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.
[10]Chinook outside of the length-at-date criteria (Delta model) are not reported.
**** Information not yet available.**

DWR-DES Revised 6/15/2017
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

An unusually high number of Chinook Salmon larger than 300 mm FL were observed at the SWP's Skinner Fish Facility during WY 2017. These fish were collected at the facility from November through May, and ranged in size from 306 mm to 674 mm FL. It was unclear how these large salmon were entering the facility through the trash rack. An annual dive inspection of the trash rack in March indicated that the trash rack was intact, but identified several locations where the opening between the vertical members of the trash rack was wider than 2 inches. In April, divers installed Dynaform angle (fiberglass version of angle iron) in those locations to reduce the size of the openings.

Another possible explanation for the increase in large salmon entering the facility could be due to the presence of marine mammals that have resided at the facility throughout the year. Facility workers have observed them working as a team and chasing large salmon in the direction of the trash rack.

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

At minimum, once per week, the secondary channels at DWR's Skinner Fish Facility are drained and flushed (typically after daily export pump shutdowns) for predatory fish removal and to clean the louvers or screens. DWR staff identifies and counts any fish collected and the data are sent to CDFW for data processing and listed species reporting.

During the WY 2017 CDFW noted from daily salvage datasheet entries that 1) the frequency of secondary flushes increased from once to up to five times per week and 2) flushes required that normal salvage operations were interrupted for short periods of time up to 30 minutes per fish collection building.

In late January, CDFW noticed an absence of salvage counts during secondary channel flush procedures at DWR's Skinner Fish Facility and mentioned it on the January 31 DOSS call. At that time, DWR was increasing exports toward historic high rates and continuous 24 h/day exports at full export capacity (see Table 2-3). During a three-week period starting in mid-January, DWR operators reported that fish were not collected or numerated from eight flushes and indicated heavy debris prevented them from doing so without significant mortality of salvaged fish.

On February 1, key fishery agency members of the DOSS team arranged a conference call with local DWR managers to obtain more details on salvage operations. DWR explained that, because of the exceptional circumstances, non-routine salvage practices were followed. Skinner Fish Facility staff were in communication with CDFW to find alternative solutions to process salvaged fish during periods of extremely high debris while minimizing mortality and stress. To obtain more information on these modified flush procedures for the DOSS team, CDFW staff made a site visit later that same day and later sent an email request to clarify those operations. These efforts for more information were not successful. Skinner Fish Facility staff did report later on February 1 that, after conversations with the Operations Control Office, flows through the facility would be adjusted to accommodate a return to routine secondary flush procedures starting February 2.

Table 2-3. SWP flushes, salvage interruptions, count time variances and daily exports during WY 2017.

Summary of WY 2017 DOSS Table Results for SWP Flushes, Salvage Interruptions, Count Time Variances and Daily Exports

Prepared by Bob Fujimura on 7/26/17

		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
11/8/16	10/31-11/6/17	0%	0%	0%	0%	0%	0%	0%	→	0%	9,485	10,122	10,122	11,398	12,661	12,548	13,064	↗	11,343
11/15/16	11/7-11/13/17	0%	0%	0%	0%	0%	0%	0%	→	0%	13,032	12,293	8,981	8,844	8,118	7,026	5,852	↘	9,164
11/22/16	11/14-20/17	0%	0%	0%	0%	0%	0%	0%	→	0%	5,943	4,873	4,049	5,561	6,979	2,178	5,283	↗	4,981
11/29/16	11/21-29/16	0%	0%	0%	0%	0%	0%	0%	→	0%	5,578	10,033	12,948	13,066	13,057	13,048	13,035	↗	11,538
12/6/16	11/28-12/4/16	0%	0%	0%	0%	75%	0%	0%	↗	11%	13,056	13,865	13,304	13,400	13,327	13,327	12,760	↗	13,291
12/13/16	12/5-11/16	0%	0%	0%	0%	0%	0%	0%	↘	0%	13,272	13,272	11,748	11,214	10,795	13,216	12,842	↗	12,337
12/20/16	12/12-18/16	0%	0%	0%	0%	0%	0%	0%	→	0%	13,215	12,688	12,963	11,316	8,757	7,065	6,767	↗	10,396
12/27/16	12/19-25/16	0%	0%	0%	0%	0%	0%	0%	→	0%	6,851	8,864	6,860	5,767	6,295	6,715	6,806	↗	6,880
1/3/17	12/26/16-1/1/17	0%	0%	0%	0%	0%	0%	0%	→	0%	7,352	6,230	7,296	6,570	6,624	7,352	5,896	→	6,760
1/10/17	1/2/17-1/8/17	0%	0%	20%	0%	0%	0%	0%	↗	3%	5,896	6,233	6,078	6,260	7,991	8,593	9,521	↗	7,225
1/17/17	1/9-15/17	0%	0%	0%	0%	0%	17%	17%	↗	5%	11,609	11,530	11,944	14,037	17,940	17,950	17,950	↗	12,280
1/24/17	1/16-22/17	0%	0%	17%	75%	58%	8%	42%	↗	29%	17,752	18,465	18,719	19,939	19,891	19,621	19,550	↗	19,134
1/31/17	1/23-29/17	58%	33%	0%	0%	0%	0%	0%	↗	13%	20,297	20,288	20,297	20,297	20,297	20,297	20,297	↗	20,296
2/7/17	1/30-2/5/17	0%	0%	0%	0%	0%	0%	0%	↗	0%	20,297	20,297	20,297	20,680	20,211	20,211	20,297	→	20,327
2/14/17	2/6-12/17	0%	17%	0%	0%	0%	0%	0%	↗	2%	20,210	19,778	19,638	19,437	19,568	19,369	19,751	→	19,679
2/21/17	2/13-19/17	0%	0%	0%	0%	42%	42%	0%	↗	12%	19,487	19,961	19,842	16,215	12,194	7,355	6,608	↗	14,523
2/28/17	2/20-26/17	0%	0%	0%	0%	0%	0%	0%	↗	0%	6,608	6,608	6,608	6,608	8,063	8,064	7,700	↗	7,180
3/7/17	2/27-3/5/17	0%	0%	0%	0%	0%	0%	0%	→	0%	8,221	7,352	6,624	7,352	5,350	3,530	2,984	↗	5,916
3/14/17	3/6-12/17	0%	0%	0%	0%	0%	0%	0%	→	0%	2,920	2,938	3,507	2,912	3,101	2,928	2,806	↗	3,016
3/21/17	3/13-19/17	0%				0%	0%		→	0%	1,344	0	0	0	3,449	291	0	↗	726
3/28/17	3/20-26/17										0	0	0	0	0	0	0	↗	0
4/4/17	3/27-4/2/17					53%			↗	53%	0	0	0	0	2,728	0	0	↗	390
4/11/17	4/3-9/17										0	0	0	0	0	0	0	↗	0
4/18/17	4/10-16/17							0%	→	0%	0	0	0	0	0	0	2,939	↗	420
4/25/17	4/17-23/17	8%	0%	0%	0%	0%	0%	0%	↗	1%	5,869	7,028	5,941	4,513	4,284	4,757	4,757	↗	5,307
	4/24-30/17	0%	0%	0%	0%	0%	0%	0%	↗	0%	4,753	4,424	4,303	4,477	8,397	8,815	8,808	↗	6,282
5/9/17	5/1-7/17	0%	0%	0%	8%	0%	0%	0%	↗	1%	8,832	10,980	8,710	14,898	14,868	13,207	13,652	↗	12,164
5/16/17	5/8-14/17	0%	38%	33%	93%	87%	100%	43%	↗	56%	15,262	6,385	15,299	14,758	13,148	12,552	13,063	↗	12,924
5/23/17	5/15-21/17	58%	83%	100%	92%	42%	42%	17%	↗	62%	4,557	5,623	5,141	4,970	5,137	4,578	4,677	↗	4,955
5/30/17	5/22-28/17	0%	11%	0%	8%	8%	0%	0%	↗	4%	5,136	5,295	5,138	3,633	3,619	3,442	3,432	↗	4,242
6/6/17	5/29-6/4/17	0%	0%	92%	92%	33%	67%	8%	↗	42%	3,918	2,509	3,931	13,142	13,180	12,835	12,606	↗	8,874
6/13/17	6/5-11/17	63%	21%	0%	0%	8%	17%	0%	↗	16%	11,435	13,704	13,717	13,711	13,159	13,196	13,521	↗	13,206

Yellow highlighted counts indicated dates secondary channel flushes occurred at SWP fish salvage facility during water exports.
Blue highlighted counts indicate dates when brief interruptions of fish salvage facility operations occurred during water exports

2.4.5 WIIN Act

In December 2016, Congress passed 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 USFWS 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. However, WIIN Act provisions did not govern Delta operations during WY 2017 due to the extremely wet hydrology.

2.4.6 Smelt Working Group

SWG participants who also participated in the DOSS calls provided updates each week on SWG advice and the status of any existing or pending determinations from FWS (for delta smelt) and DFW (for longfin smelt). Summaries of SWG advice and related determinations can be found at: https://www.fws.gov/sfbaydelta/CVP-SWP/SmeltWorkingGroup.htm

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

CHAPTER 3 WY 2017 OPERATIONS SUMMARY

The final WY 2017 hydrologic year type in the Sacramento basin and San Joaquin river basin were both classified as Wet based on the May runoff forecast. A summary of WY 2017 operations and controlling factors is provided in Appendix A; some summary operations charts are provided below in Figures 3.1, 3.2, 3.3, and 3.4.

Damage to the Clifton Court Forebay intake structure was identified on 3/1/17. After two weeks of investigation and planning, during which SWP exports through Clifton Court were limited to prevent further damage, emergency repair work began to replace a failed section the concrete apron on the downstream side of the radial gates. The repair work occurred from March 15th to April 15th. SWP exports through Clifton Court were limited to prevent damage the curing concrete work from April 16th to May 3rd.

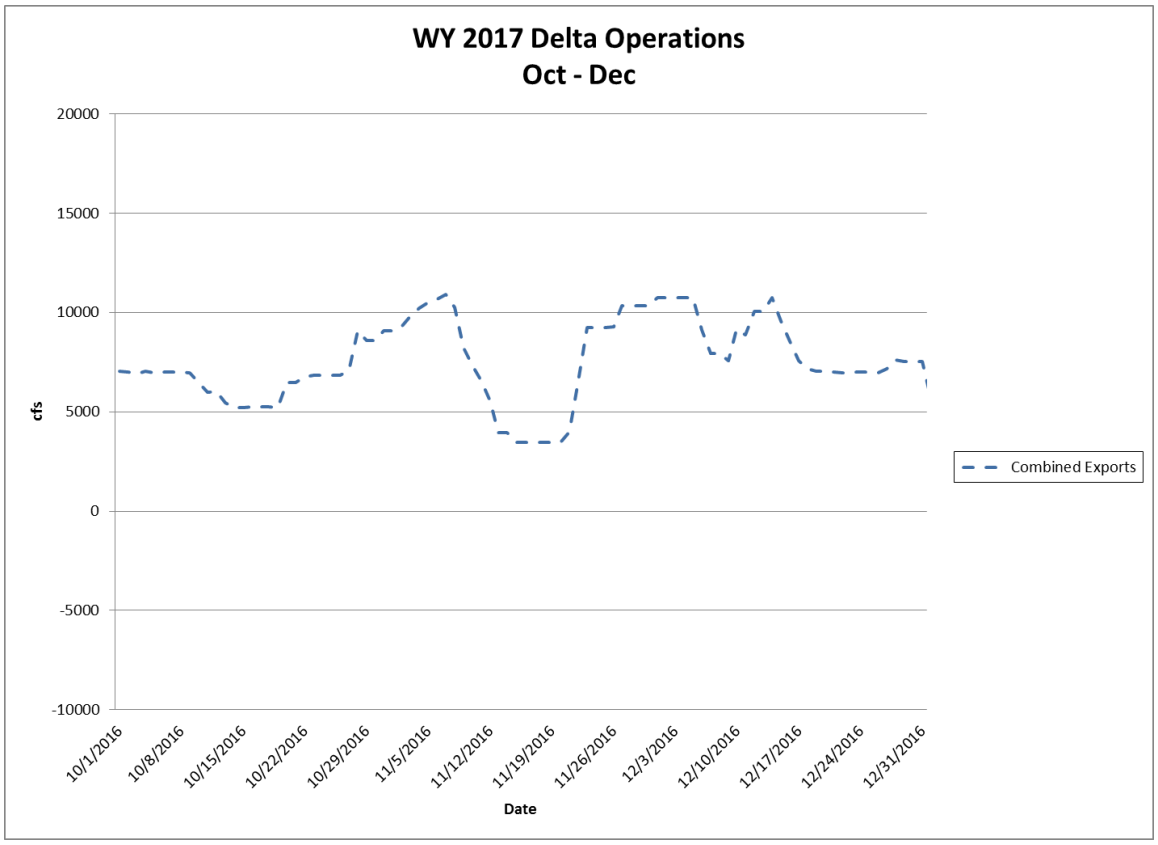


Figure 3.1: Combined exports at the CVP and SWP from October through December 2016.

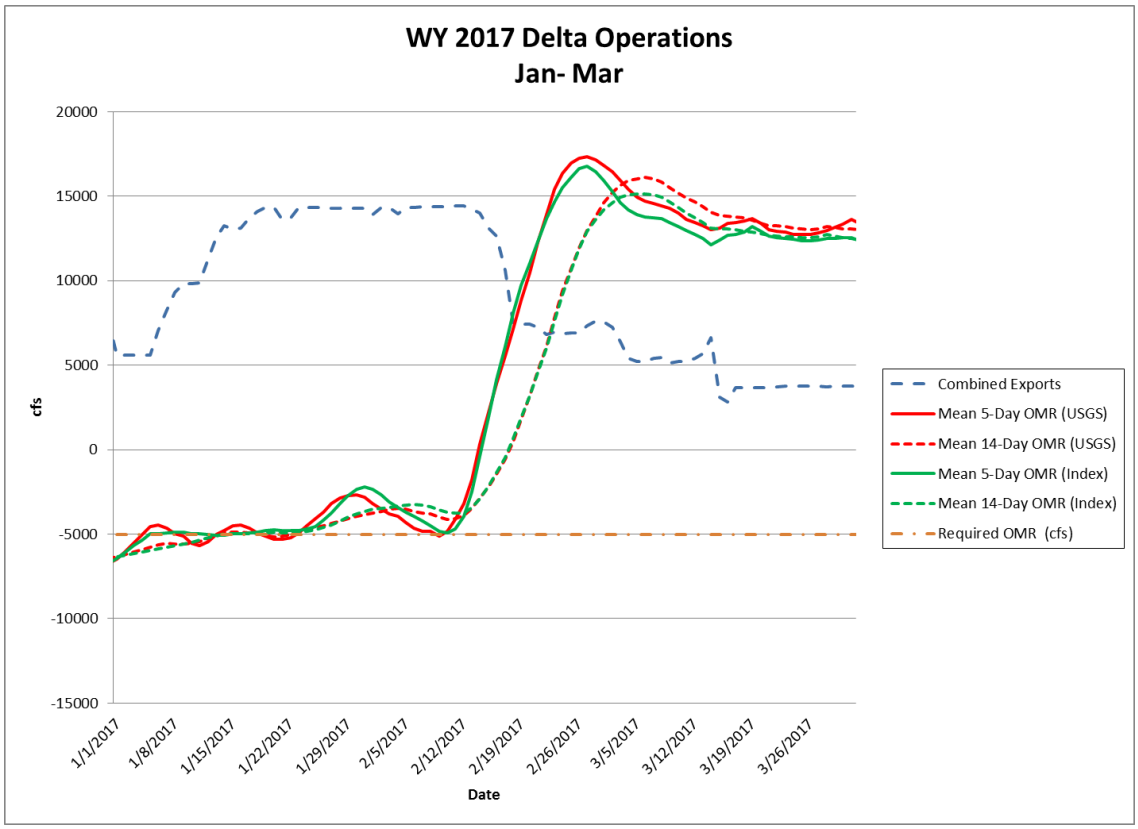


Figure 3.2: Combined exports at the CVP and SWP and Old and Middle river flows from January through March 2017.

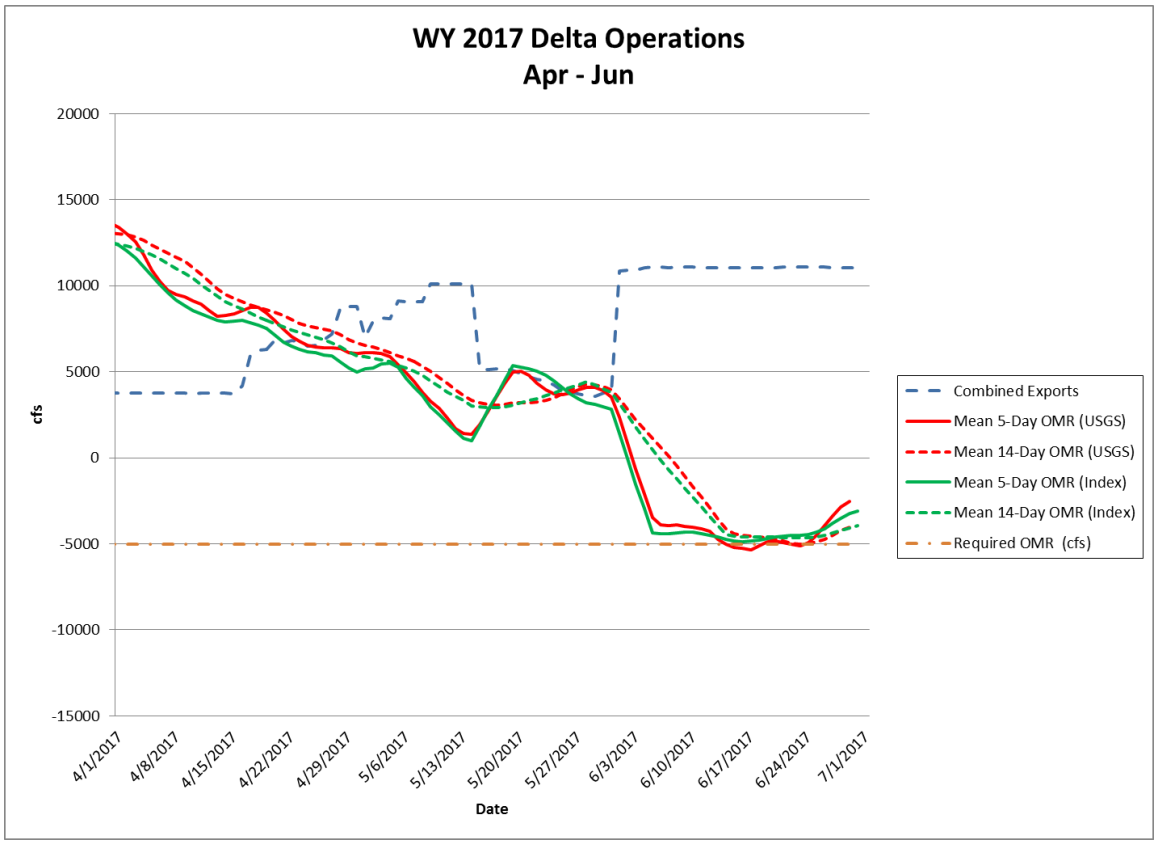


Figure 3.3: Combined exports at the CVP and SWP and Old and Middle river flows from April through June 2017.

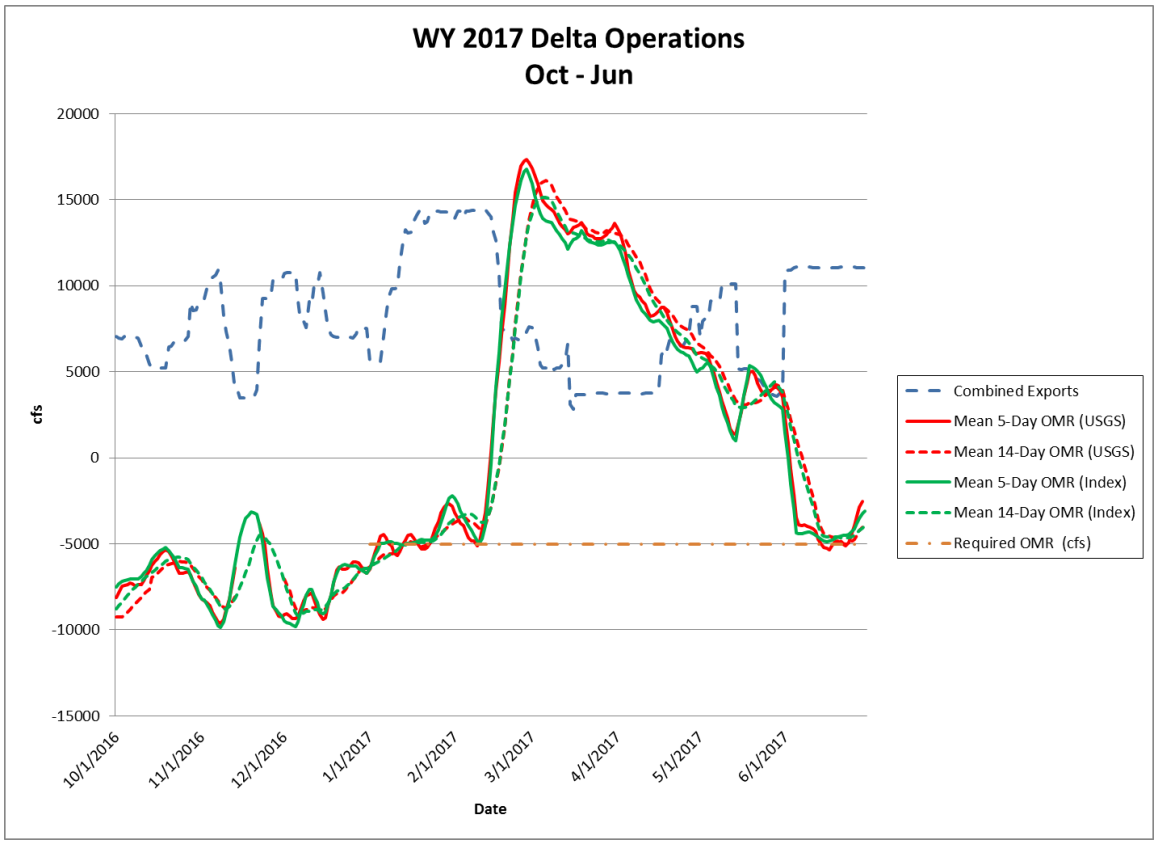


Figure 3.4: Combined exports at the CVP and SWP and Old and Middle river flows from October 2016 through June 2017.

CHAPTER 4 MONITORING ACTIVITIES

4.1 WY 2017 Incidental Take Report

The 2016/2017 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 2017 at the CVP and SWP export facilities in the south Delta.

4.2 WY 2017 Monitoring summary

4.2.1 WY 2017 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[7]. 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

In WY 2017, 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: www.baydeltalive.com/djfmp
- SacPAS: Sacramento Prediction & Assessment of Salmon available at http://www.cbr.washington.edu/sacramento/

Bay Delta Live includes a "DOSS Dashboard" (click on the "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 Delta Cross Channel operations, and compiles recent hydrologic and water operations data (including salvage) for convenient review by the DOSS group.

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 was available

[7] WY 2017 DOSS notes are available at:
http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/ocapwy2017.html

for six out of the seven monitoring areas listed earlier in this section (rotary screw trap data from GCID was not available in real-time). Summaries of winter-run Chinook salmon, spring-run Chinook salmon, and CCV steelhead cohort monitoring for the WY 2017 outmigration season at the six monitoring locations for which real-time data were available are presented in Figures 4-1 through 4-3 below.

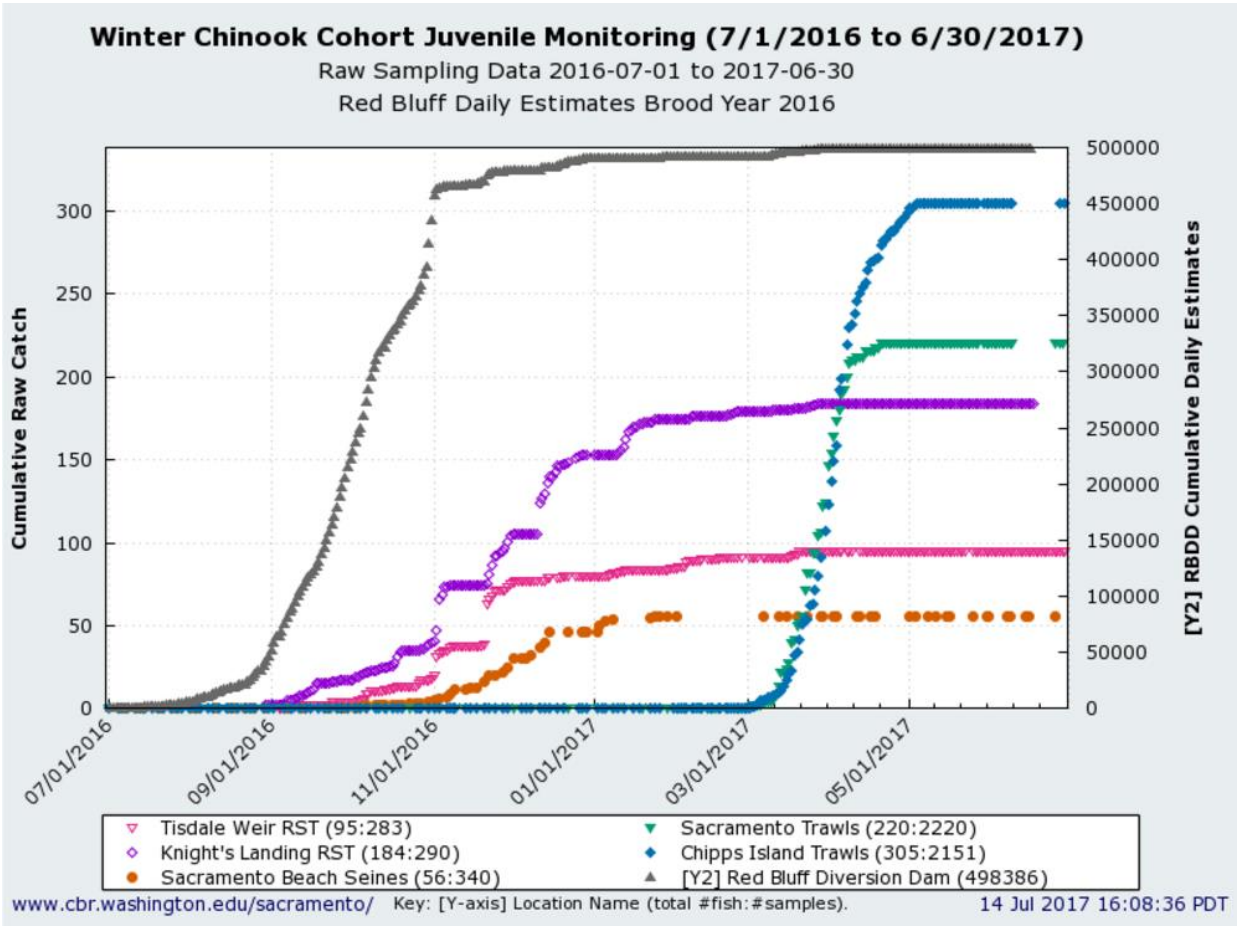


Figure 4-1 Cumulative catch of juvenile winter-run Chinook at six monitoring locations: Red Bluff Diversion Dam, Tisdale Weir, Knights Landing, Sacramento Beach Seines, Sacramento Trawls, Chipps Island.

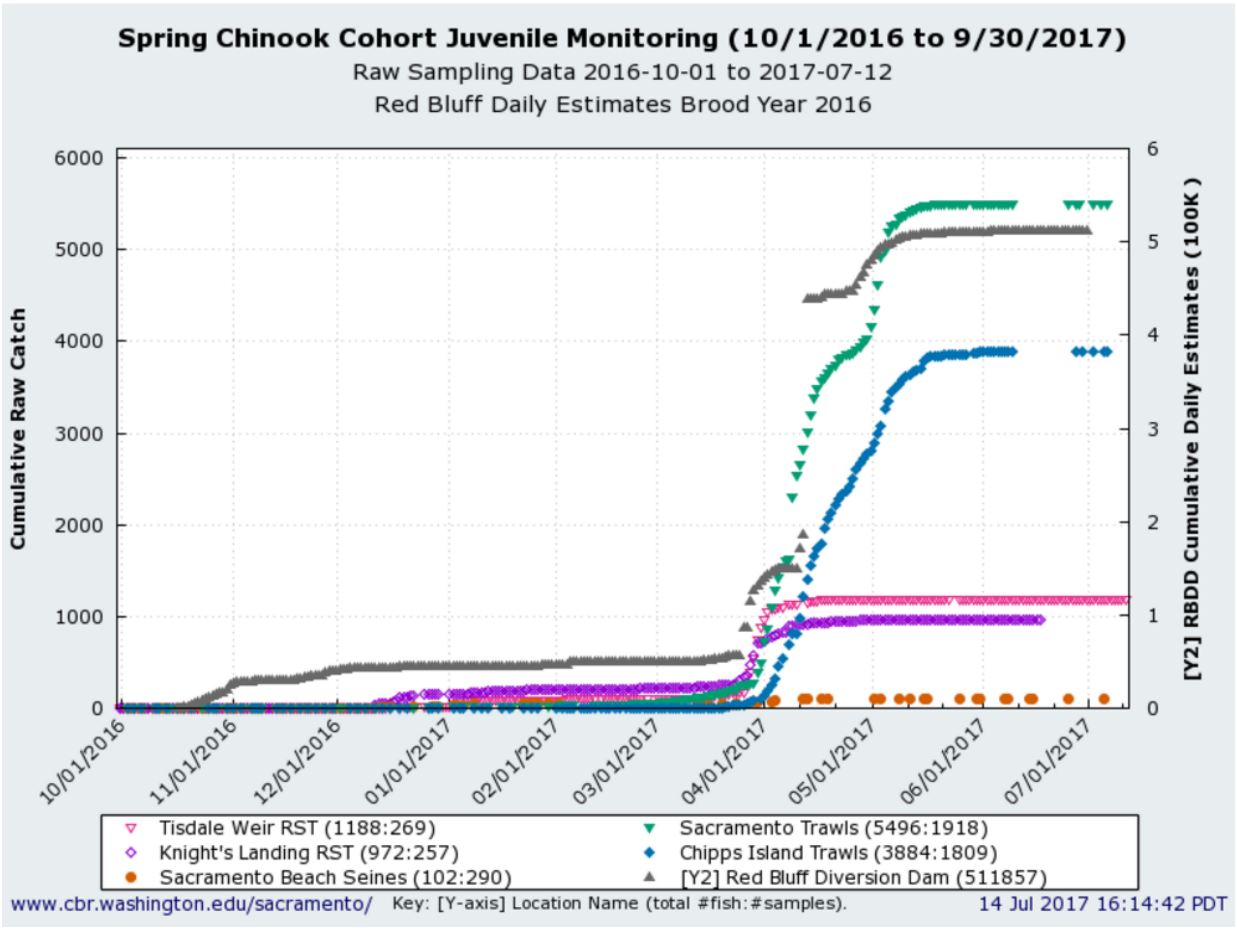


Figure 4-2 Cumulative catch of juvenile spring-run Chinook at six monitoring locations: Red Bluff Diversion Dam, Tisdale Weir, Knights Landing, Sacramento Beach Seines, Sacramento Trawls, Chipps Island.

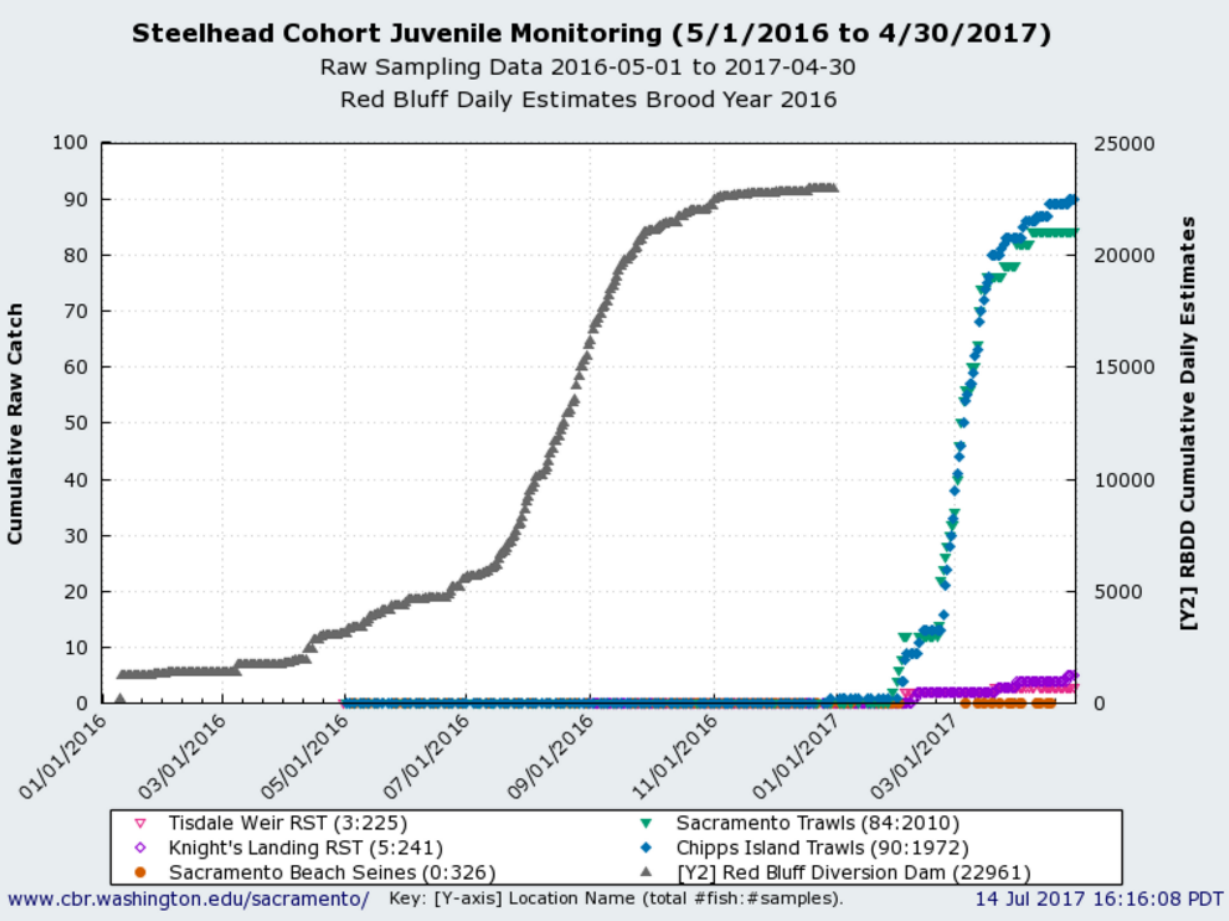


Figure 4-3 Cumulative catch of juvenile steelhead at six monitoring locations: Red Bluff Diversion Dam, Tisdale Weir, Knights Landing, Sacramento Beach Seines, Sacramento Trawls, Chipps Island.

SacPAS also generates, for each monitoring location and three categories of fish (unmarked older juvenile Chinook Salmon, unmarked fry/smolt Chinook Salmon, or unmarked CCV steelhead), figures that plot catch at each monitoring location along with environmental variables associated with fish migration cues [including temperature (°C), flow (cfs), and turbidity (NTU)]. These figures, for the WY 2017 outmigration season, are provided in Appendix G, Figure G-1 through Figure G-18.

Collectively, DOSS members use these types of fish monitoring data and summaries 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, support DOSS's weekly estimates of (a) the distribution of listed salmonids (see Section 4.3, "Review of DOSS's weekly distribution estimates") and (b) entrainment risks for listed salmonids.

4.2.2 Salmonid information from Enhanced Delta Smelt Monitoring Program

In WY 2017, the USFWS began a new Enhanced Delta Smelt Monitoring (EDSM) program, which was designed to collect data that would yield estimates of abundance, survival, and proportional entrainment of Delta smelt with greater precision and less selection bias than estimates based on catches from other ongoing surveys. The EDSM program used high-frequency sampling stratified by regions that, based on differences in hydrodynamics, differed in Delta Smelt density and risk of entrainment. USFWS employed a stratified sampling design that included multiple crews trawling concurrently at multiple sites in Delta regions that, based on differences in hydrodynamics, differed in Delta Smelt density and risk of entrainment.

While the EDSM program was designed for Delta smelt, the sampling gear for adult Delta smelt was also expected to catch salmonids and provide useful information on salmonid distribution in the Delta. USFWS briefed DOSS on the program in October 2016[8], EDSM sampling began 12/15/16, and DOSS reviewed the first EDSM salmonid report at the 12/27/16 DOSS meeting. In April 2017, when the EDSM sampling program transitioned to 20mm townet gear for the collection of larval delta smelt (a gear not suited for catching juvenile salmonids), DOSS no longer had EDSM data to review. DOSS's last EDSM update, covering sampling through 3/30/17, was at the 4/4/17 DOSS meeting.

The regional designations and reporting details evolved over time, based on input from DOSS members and detailed in the weekly DOSS notes, but generally included a summary of raw and effort-adjusted catch by sampling region. An example of the EDSM reporting from the 3/14/17 DOSS notes is shown below:

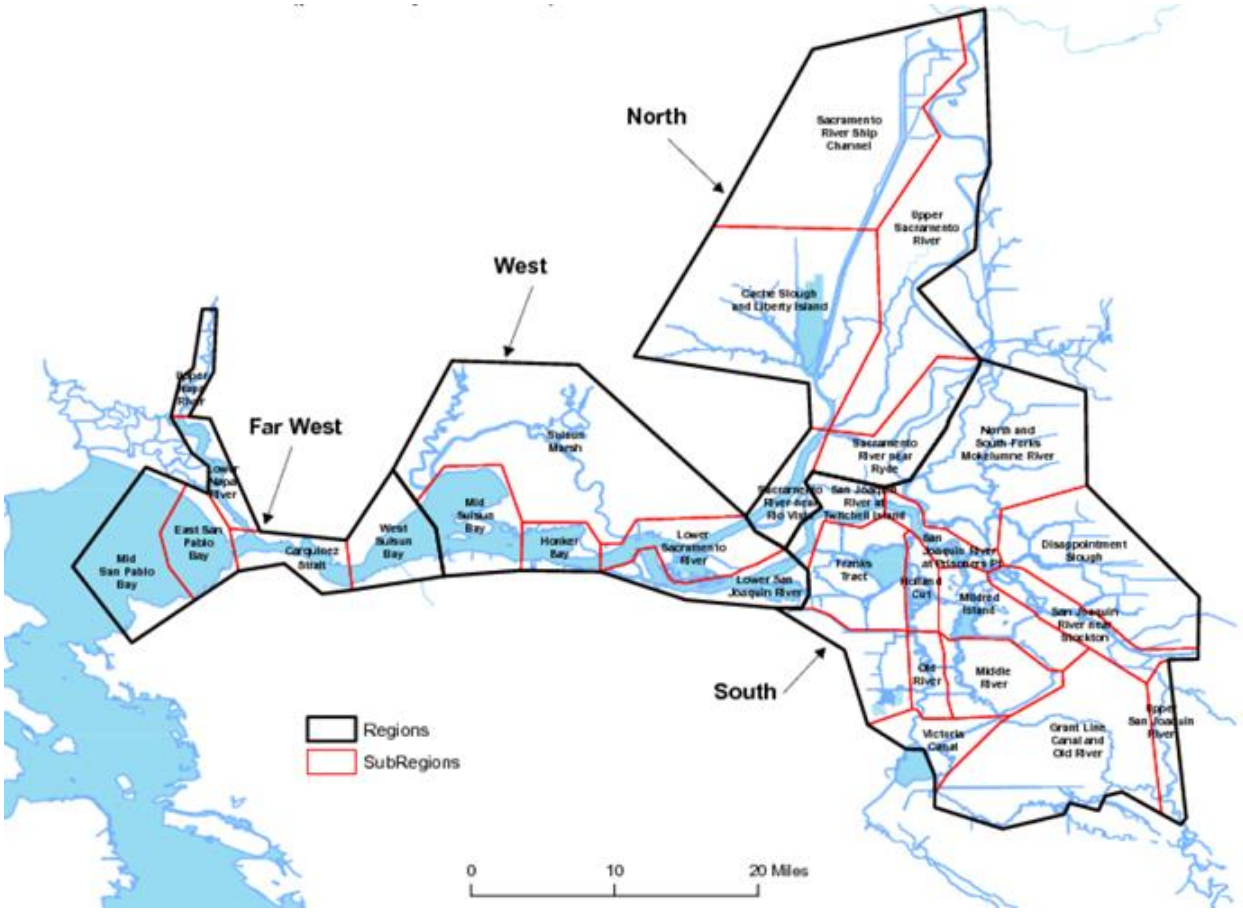
> **Enhanced Delta Smelt Monitoring (EDSM) Catch**
>
> **EDSM data posted on DJFMP website:**
> https://www.fws.gov/lodi/juvenile_fish_monitoring_program/jfmp_index.htm
>
> Chinook run assignments for unclipped fish are based on length-at-date criteria. DOSS acknowledges the limitations of the length-at-date criteria, particularly in distinguishing between young-of-year spring run Chinook and young-of-year fall-run Chinook. When reviewing spring-run catch in the monitoring data, DOSS considers that run misclassifications might arise from both large genetic fall-run falling into the spring-run sized class and small genetic spring-run falling into the fall-run size class.
>
> For the sampling period 3/6/17-3/9/17, a total of 27 fall-run-sized Chinook, 4 spring-run Chinook, 4 winter-run, and 9 adipose clipped steelhead were caught across all sampling sites. Salmonid catch in the EDSM sampling is summarized in the table below by subregion, and in the bubble plots by individual sampling location.

[8] See Agenda Item 2 in the 10/11/16 DOSS notes, available at:
http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/ocapwy2017.html

	Raw catch							Catch per 10-minute tow*						
Subregion	Winter-run Chinook	Spring-run Chinook	Fall-run Chinook	Late-fall-run Chinook	Tagged Chinook	Tagged Steelhead	Total Tow Minutes	Winter-run Chinook	Spring-run Chinook	Fall-run Chinook	Late-fall-run Chinook	Tagged Chinook	Tagged Steelhead	Region
Upper Sacramento River	1	1	8	0	0	1	160	0.06	0.06	0.50	0.00	0.00	0.06	North
Mildred Island	0	0	3	0	0	0	320	0.00	0.00	0.09	0.00	0.00	0.00	South
San Joaquin River at Prisoner's Pt	0	1	1	0	0	2	180	0.00	0.06	0.06	0.00	0.00	0.11	South
San Joaquin River near Twitchell Island	0	0	7	0	0	1	180	0.00	0.00	0.39	0.00	0.00	0.06	South
Honker Bay	1	0	0	0	0	0	25	0.40	0.00	0.00	0.00	0.00	0.00	West
Lower Sacramento River	0	0	1	0	0	1	25	0.00	0.00	0.40	0.00	0.00	0.40	West
Lower San Joaquin	0	0	5	0	0	0	30	0.00	0.00	1.67	0.00	0.00	0.00	West
Carquinez Straight	0	0	0	0	0	2	80	0.00	0.00	0.00	0.00	0.00	0.25	Far West
East San Pablo Bay	1	0	0	0	0	0	160	0.06	0.00	0.00	0.00	0.00	0.00	Far West
West Suisun Bay	1	2	2	0	0	2	320	0.03	0.06	0.06	0.00	0.00	0.06	Far West
Total	4	4	27	0	0	9	1480							

*Raw catch/Total tow minutes*10

Map of EDSM sampling regions and subregions:



4.2.3 Acoustic tracking

During WY 2017, 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. DOSS tracked the Livingston Stone National Fish Hatchery (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. 569 acoustic-tagged hatchery winter-run Chinook from LSNFH were released on February 2, 2017, at Caldwell Park in Redding. As of the final update in early April, 113 (20%) of the acoustic-tagged hatchery winter-run Chinook had passed the I-80/50 Bridge receiver in Sacramento, with the timing shown in Figure 4-4.

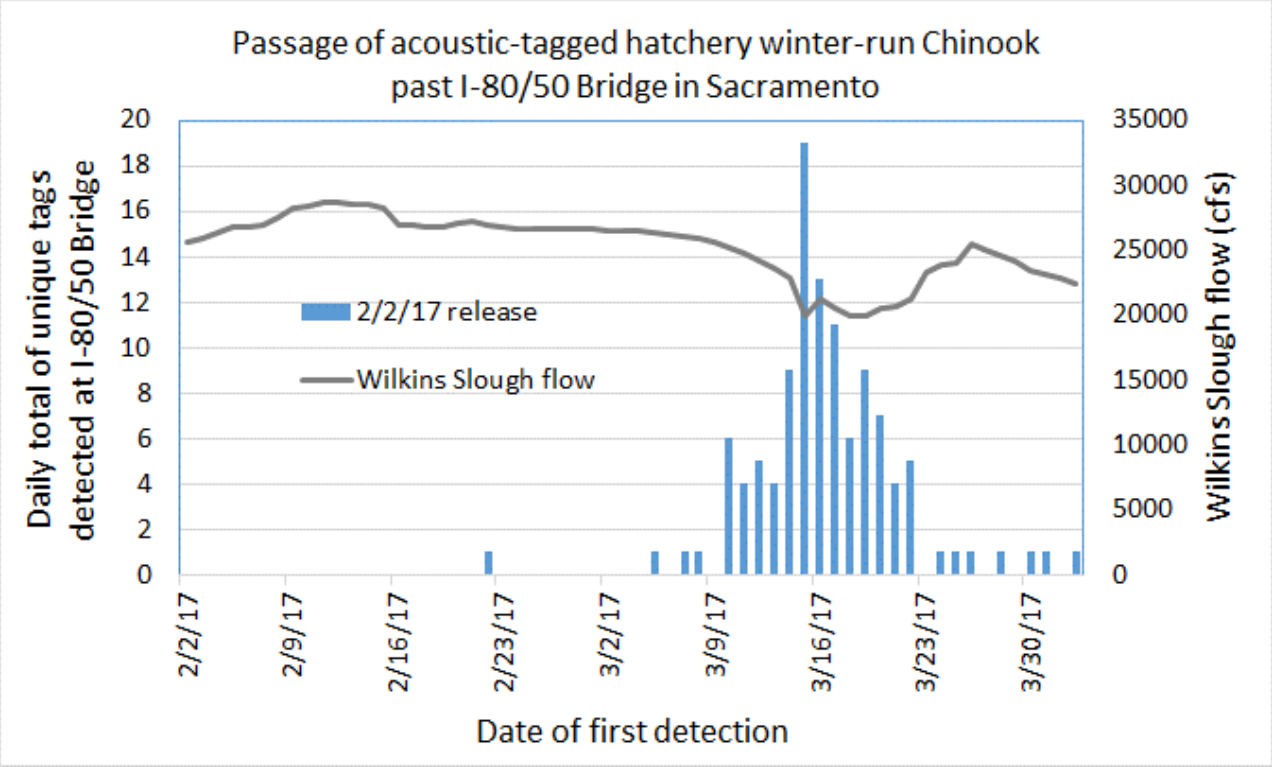


Figure 4-4 Bars represent the daily total of unique acoustic-tags first detected at the I-80/50 Bridge acoustic receiver array, indicating passage of acoustic-tagged hatchery winter-run Chinook. The gray line represents flow (cfs) at Wilkins Slough; data from the WLK station on the California Data Exchange Center (CDEC).

4.2.4 Spring Kodiak Trawl Survey

In WY 2017, the CDFW provided salmonid catch data from its annual Spring Kodiak Trawl Survey (SKT). Since 2002, the SKT samples 40 stations in the Delta each month from January to May. This survey provides relative abundance and distribution of spawning Delta Smelt primarily for the USFWS's Smelt Working Group to help assess the entrainment risk for the federal and state water projects. The SKT net is a surface towed trawl with a mouth dimension of 25' wide by 6' deep.

Although the SKT was designed to catch adult Delta Smelt, it has demonstrated the ability to catch salmonids. The salmonid catch results were circulated to DOSS in table format listing the raw catch, run assignments based on length-at-date criteria, and adipose fin status. CWT results were also provided when that information was available. With fixed stations and standardized fishing effort, the SKT data provided information on the relative densities and distribution of salmonids in the Delta.

4.2.5 WY 2017 Monitoring Gaps

4.2.5.1 Red Bluff Diversion Dam Rotary Screw Traps

The majority of monitoring gaps at the Red Bluff Diversion Dam (RBDD) rotary screw traps (RSTs) during WY 2017 were due to high runoff events and/or sustained high volume releases out of Keswick Reservoir. Sampling was suspended for 11 days in December 2016 (runoff events), 19 days in January 2017 (Keswick releases and runoff events), 24 days in February 2017 (Keswick Dam releases and runoff events) and 7 days in March (largely due to Keswick releases).

There were also a number of times in which sampling was suspended in order to lessen impacts to Coleman National Fish Hatchery (CNFH) production releases of fall-run Chinook salmon into Battle Creek. In these cases, sampling was usually suspended for 2-3 days immediately following a release date (depending upon the number of hatchery fish released per event) and added up to 12 total days of missed sampling from late March to the end of April for 4 different production release events.

A few other short-term sampling gaps occurred, but 95% of the sampling gaps at the RBDD rotary screw traps were due to high flows or CNFH production releases, as described above.

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 (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 BiOp, no RPA implementation was impacted by sampling gaps at RBDD.

4.2.4.2 Glenn Colusa Irrigation District Rotary Screw Trap

Sampling at the Glenn Colusa Irrigation District (GCID) RST was suspended for much of WY 2017 (Table 4-1). Sampling gaps October through March were primarily due to high flows and heavy debris and those flow/debris conditions also often limited sampling to < 24 hours on days when sampling did occur. Sampling gaps in April and May were related to renewal of a Scientific Collection Permit. 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 Red Bluff Diversion Dam) or downstream (Tisdale or Knights Landing) during at least part of the GCID shutdown window 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 BiOp, no RPA implementation was impacted throughout this period.

Table 4-1: Number of days per month during WY 2017 that sampling was suspended at the GCID rotary screw trap.

Month	Days without sampling	Primary reason
October	7	High flows and heavy debris
November	10	
December	12	
January	27	
February	28	
March	28	
April	30	Renewing Scientific Collection Permit
May	17	
June	0	N/A
July	0	
August	0	
September	0	

4.2.4.3 Tisdale Rotary Screw Traps

Trapping at the Tisdale RSTs for the 2016-17 season began on 9/4/16. The traps were not in operation for 141 hours in December due to repairs and heavy debris loads. In addition, the RSTs were out of operation for 52 hours in April due to high flows and heavy debris. The traps were pulled for the season on 7/17/17 due to high water temperatures not suitable for handling salmonids. For the purposes of DOSS, Tisdale is used in conjunction with 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 BiOp, no RPA implementation was impacted throughout this period.

4.2.4.4 Knights Landing Rotary Screw Traps

Trapping at the Knights Landing RSTs was initiated on 8/29/16 at 1430 hours and continued through the juvenile emigration period with only brief interruptions in monitoring primarily due to increases in river flow and heavy debris loading. Monitoring was suspended at 1000 hours on 6/19/17 due to observed daily average river water temperatures greater than 72°F that exceeded the safe handling range[9]. Because Knights Landing data are not used as the basis for any alert or trigger in the NMFS BiOp during June, this suspension of sampling for the season did not have an impact on the implementation of Action IV.1.2.

4.2.4.5 Delta Juvenile Fish Monitoring Program

USFWS's Delta Juvenile Fish Monitoring Program (DJFMP) includes the Sacramento Trawl, Mossdale Trawl, Chipps Island Trawl, and beach seine sampling. Substantive sampling gaps occurred for the Mossdale Trawl and some south Delta beach seining locations in the February through March period of WY 2017 due to boating restrictions related to high river stages and concerns for levee stability. 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 BiOp. Because there were no gaps in sampling during October and November, RPA implementation was not impacted during this period. DJFMP data are used throughout the year, in conjunction with other upstream sampling sites, to track movement of juvenile fish emigration through the Delta. Gaps in the south Delta beach seine sampling and Mossdale trawl sampling February through March did somewhat limit DOSS's ability to evaluate fish distribution in the south Delta (DOSS did have salvage information as a source of information about fish presence in the south Delta) during this period, but did not affect RPA implementation.

[9] 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 are intended to give managers and stakeholders[10] 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), In Delta,* and *Exited the Delta (past Chipps Island).* 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[11].

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 length-at-date run identification used to assign individuals to Chinook run (*e.g.*, potential misclassifications of unmarked hatchery fall-run as wild spring-run Chinook). Acknowledging those uncertainties, Figures 4-1 through 4-3 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 fork length of many of the fall-run hatchery production releases was near the size range of young-of-year spring-run, so many of the larger-than-average individuals in the releases would fall into the spring-run size class (Table 4-2). 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 fork length of fall-run hatchery production was far enough from the size range of young-of-year 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 data, since those fish were identified based on the CWT or acoustic-tag (AT) codes, not the length-at-date criteria.

[10] For example, these weekly estimates were shared with both the Data Assessment Team (DAT) and Delta Conditions Team (DCT) stakeholder groups.

[11] DOSS notes available at: http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/doss.html.

Table 4-2. Summary of releases of hatchery-origin fall-run Chinook salmon during WY 2017. 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 rotary screw traps, Sacramento trawl, Sacramento beach seines, Chipps Island trawl), and (b) included unmarked fish. For multiple-day releases, the spring-run length-at-date 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)
3/22/2017	CNFH	Battle Creek	64-71	423,133	1,269,400	1,692,533	69-92
4/4/2017	FRH (Annex)	Boyd's Pump	65	533,120	0	533,120	75-100
4/4/2017	FRH (Annex)	Gridley Boat Ramp	61	112,137	0	112,137	75-100
4/5/2017	CNFH	Battle Creek	75	1,737,174	5,211,516	6,948,690	75-101
4/12/2017	CNFH	Battle Creek	75	415,923	1,247,768	1,663,691	79-106
4/21/2017	CNFH	Battle Creek	67-75	460,293	1,380,877	1,841,170	84-112
4/24/2017	MER	Merced River Hatchery Outlet	80.76	70,591	259,788	330,379	85-114
4/24/2017	MOK	Sherman Island Net Pens	86	112,500	337,500	450,000	85-114
4/25/2017	FRH (Annex)	Boyd's Pump	83.8	521,411	0	521,411	86-115
4/26/2017 - 4/27/2017	FRH (Annex)	Mare Island Net Pens	91.4	255,240	765,721	1,020,961	87-116
4/29/2017	MOK	Millers Ferry Bridge, N. Fork	90	100,000	0	100,000	88-118
4/30/2017	MOK	Golden Gate	90	200,000	0	200,000	89-119
5/3/2017	MER	Merced River Hatchery Outlet	79.65	100,697	419,596	520,293	91-122
5/8/2017	MOK	Sherman Island Net Pens	86	112,500	387,500	500,000	94-126
5/9/2017	MOK	Golden Gate Bridge	86	112,500	387,500	500,000	94-126
5/10/2017	MOK	Pillar Point Harbor	98	240,000	0	240,000	95-127
5/11/2017	MOK	Santa Cruz Harbor	98	120,000	0	120,000	95-128
5/11/2017 - 5/12/2017	FRH (Annex)	Mare Island Net Pens	87	206,023	677,745	883,768	95-128
5/15/2017	FRH	Boyd's Pump	90.5	510,763	0	510,763	98-132
5/15/2017	MOK	Sherman Island Net Pens	100	112,500	337,500	450,000	98-132
5/16/2017	MOK	Sherman Island Net Pens	86	112,500	337,500	450,000	99-132
5/17/2017	MOK	Pillar Point harbor	102	240,000	0	240,000	99-133
5/18/2017	MER	Merced River Hatchery Outlet	77.78	80,034	404,147	484,181	100-134
5/18/2017 - 5/19/2017	FRH (Annex)	Mare Island Net Pens	85-94	264,096	759,450	1,023,546	100-134
5/22/2017	MOK	Sherman Island Net Pens	86	112,500	337,500	450,000	103-138
5/23/2017	MOK	Sherman Island Net Pens	82	31,427	94,341	125,768	103-139
5/24/2017	MOK	Pillar Point Harbor	102	240,000	0	240,000	104-140
5/24/2017	NIM	Sunrise Boat Ramp	78	151,501	454,680	606,181	104-140
5/24/2017	NIM	Jibboom St. Boat Ramp	87	154,729	464,449	619,178	104-140
5/25/2017	MOK	Fort Baker	98	112,500	0	112,500	105-141
5/25/2017 - 5/26/2017	FRH (Annex)	Fort Baker	102-105	265,858	798,207	1,064,065	105-141
5/26/2017	MOK	Fort Baker	98	112,500	0	112,500	105-142
5/29/2017	MOK	Sherman Island Net Pens	102	112,500	337,500	450,000	107-144
5/30/2017	MOK	Sherman Island Net Pens	86	112,500	337,500	450,000	108-145
5/31/2017	NIM	Sunrise Boat Ramp	76	138,417	415,470	553,887	109-146
5/31/2017	NIM	Jibboom St. Boat Ramp	77	148,281	445,005	593,286	109-146
6/6/2017	NIM	Mare Island Net Pens	85	145,802	437,559	583,361	113-152
6/12/2017	NIM	Mare Island Net Pens	75	132,552	393,237	525,789	118-158
6/15/2017	MOK	Mokelumne River Hatchery	102	100,000	0	100,000	120-162
6/15/2017	MOK	Woodbridge Dam	102	100,000	0	100,000	120-162

The figures below compare the weekly DOSS estimates to fish monitoring data. The estimates based on monitoring data were determined as described in Table 4-3.

Table 4-3. 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 compares 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). Panels B and C for these spring-run comparisons look fairly similar since the highest values were removed in both. 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 (details in Appendix I). Hatchery winter-run Chinook were released in Redding in early February (see Section 4.2.3 for details); all were marked with CWTs and clipped adipose fins and a total of 569 were also acoustic-tagged.

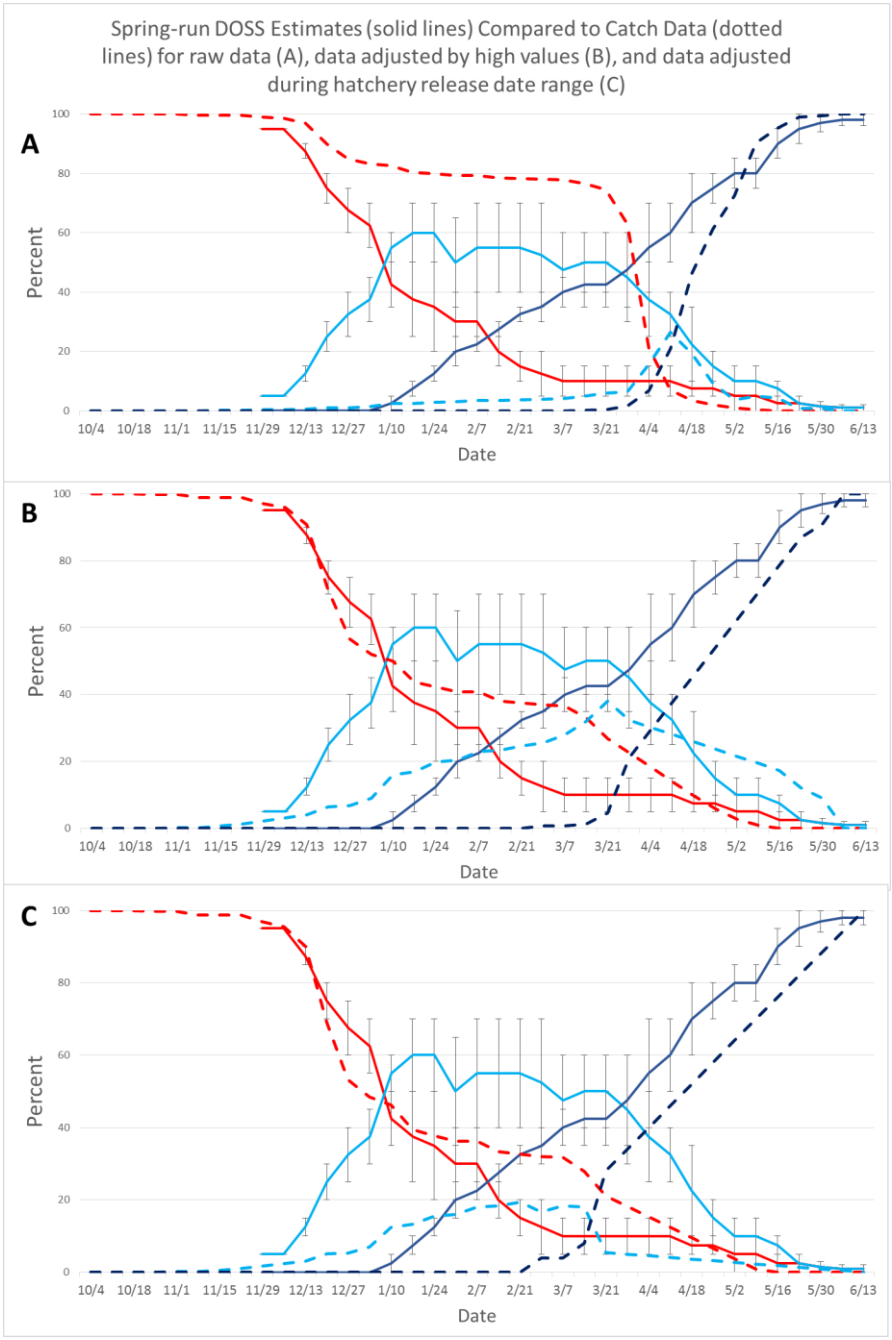


Figure 4-5 Spring-run weekly DOSS estimates compared to raw data (A), adjusted high values only (B), and adjusted hatchery release date range (C). Red lines indicate "Yet to Enter the Delta", light blue lines indicate "In Delta", and dark blue lines indicate "Exited the Delta". Solid lines are weekly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

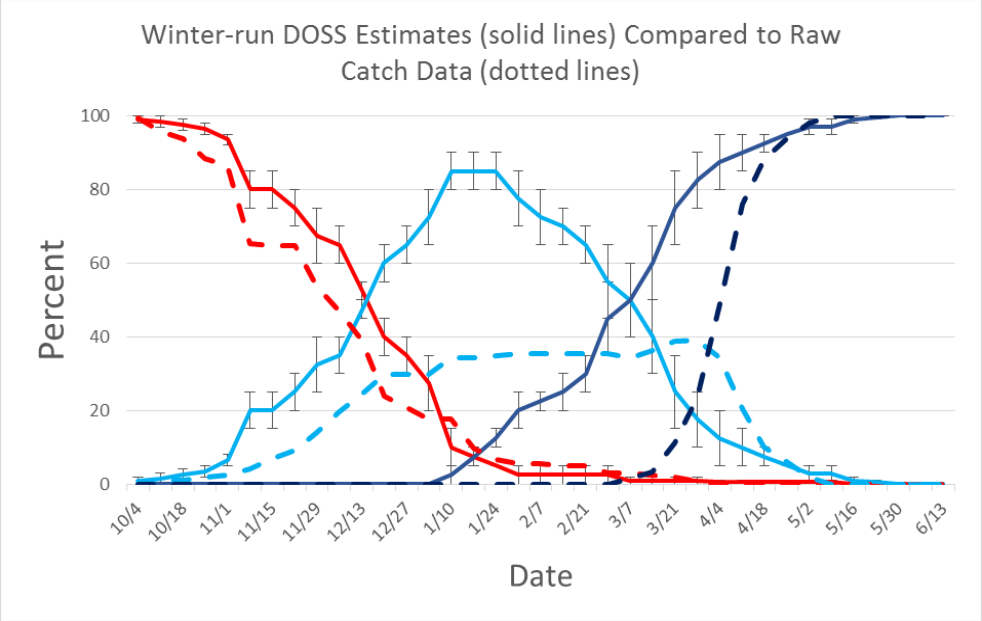


Figure 4-6 Winter-run weekly DOSS estimates compared to raw data. Data was not adjusted for hatchery influence since no high data numbers were observed. Red lines indicate "Yet to Enter the Delta", turquoise lines indicate "In Delta", and dark blue lines indicate "Exited the Delta". Solid lines are weekly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

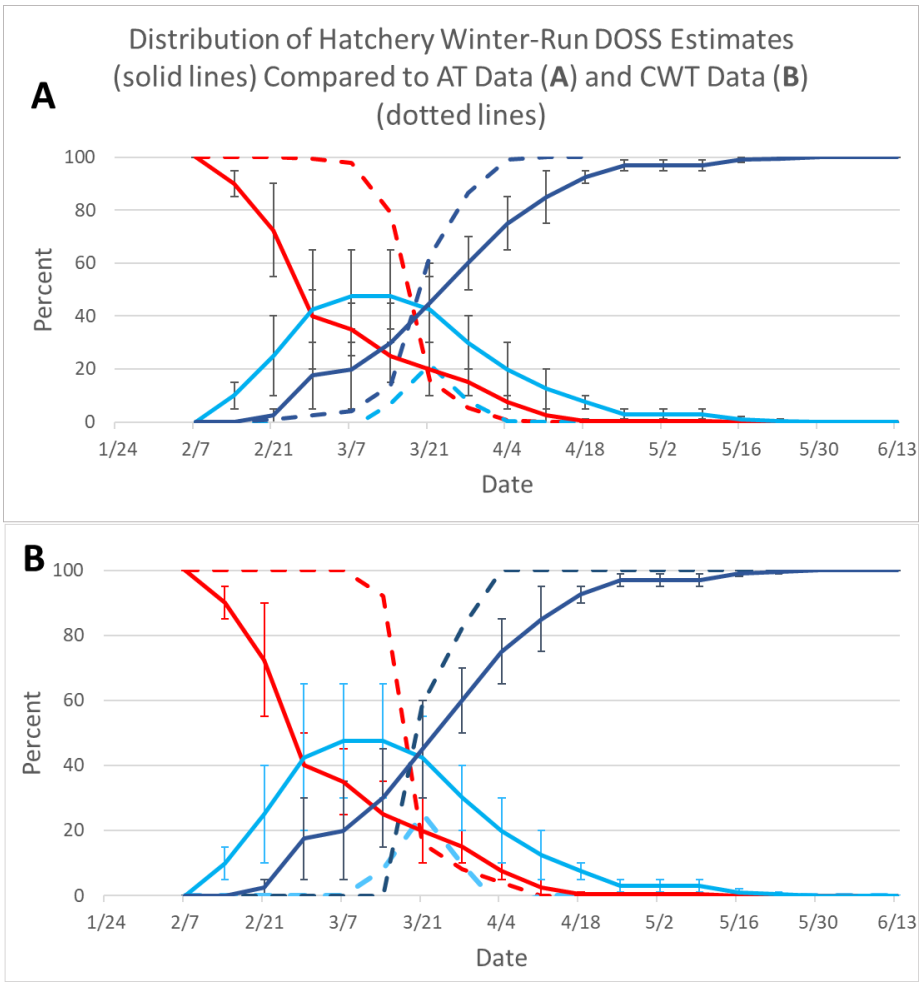


Figure 4-7 Hatchery winter-run weekly DOSS estimates compared to acoustic tag data (A) and coded wire tag data (B). Red lines indicate "Yet to Enter the Delta," turquoise lines indicate "In Delta," and dark blue lines indicate "Exited the Delta." Solid lines are weekly DOSS estimates and dashed lines are detection (for acoustic tags) or catch (for coded wire tags) data.

REFERENCES CITED

NMFS. 2009. Final Biological Opinion and Conference Opinion of the Proposed Long-term Operations of the Central Valley Project and State Water Project. U.S. Department of Commerce National Marine Fisheries Service. 4 June 2009. http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/nmfs_biological_and_conference_opinion_on_the_long-term_operations_of_the_cvp_and_swp.pdf

NMFS. 2011. 2009 RPA with 2011 Amendments. U.S. Department of Commerce National Marine Fisheries Service. 7 April 2011. http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Operations,%20Criteria%20and%20Plan/040711_ocap_opinion_2011_amendments.pdf

Appendix A – Operations Summary Tables

GUIDE TO THE WY 2017 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.

• 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 a 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
10/1/2016	B	4064	2991	O	-8124	-9254	-7504	-8784	*D-1641 Delta Outflow (4,000 cfs)*; Delta WQ
10/2/2016	B	3992	2990	O	-7822	-9270	-7344	-8613	
10/3/2016	B	3927	2995	O	-7482	-9240	-7172	-8406	
10/4/2016	B	4048	2994	O	-7434	-9140	-7149	-8204	
10/5/2016	B	3989	2990	O	-7352	-8966	-7080	-7995	
10/6/2016	B	3986	2997	O	-7282	-8814	-7053	-7819	
10/7/2016	B	3990	2996	O	-7326	-8646	-7043	-7655	
10/8/2016	B	3998	2994	O	-7448	-8451	-7046	-7493	
10/9/2016	B	3991	2984	O	-7370	-8305	-7026	-7332	
10/10/2016	B	4003	2473	O	-7362	-8133	-6924	-7170	
10/11/2016	B	4002	1995	O	-7142	-7954	-6736	-7042	
10/12/2016	B	4007	1998	O	-6844	-7804	-6551	-6916	
10/13/2016	B	3457	1989	O	-6570	-7634	-6260	-6797	
10/14/2016	B	3236	1989	O	-6244	-6959	-5929	-6653	
10/15/2016	B	3231	1994	O	-5992	-6845	-5697	-6525	
10/16/2016	B	3239	1998	O	-5868	-6725	-5548	-6400	
10/17/2016	B	3248	1989	O	-5632	-6596	-5376	-6274	
10/18/2016	B	3246	1990	O	-5428	-6396	-5281	-6130	
10/19/2016	B	3236	1992	O	-5350	-6244	-5219	-5989	
10/20/2016	B	3225	3240	O	-5422	-6181	-5389	-5930	
10/21/2016	B	3237	3247	O	-5676	-6136	-5568	-5874	
10/22/2016	B	4027	2742	O	-6042	-6094	-5812	-5833	
10/23/2016	B	4090	2748	O	-6420	-6057	-6087	-5794	
10/24/2016	B	4099	2746	O	-6728	-6018	-6365	-5789	
10/25/2016	B	4091	2748	O	-6730	-6034	-6407	-5813	
10/26/2016	B	4089	2739	O	-6652	-6067	-6440	-5834	
10/27/2016	B	4078	2995	O	-6630	-6115	-6471	-5909	
10/28/2016	B	4084	4982	O	-6822	-6264	-6874	-6132	
10/29/2016	B	4083	4492	O	-7184	-6444	-7177	-6318	
10/30/2016	B	4089	4494	O	-7626	-6661	-7479	-6502	
10/31/2016	B	4087	4991	O	-7920	-6884	-7872	-6725	
11/1/2016	E	4083	4989	O	-8218	-7111	-8223	-6960	*D-1641 Delta Outflow (4,500 cfs)*;D-1641 65% E/I 14 day average
11/2/2016	E	4078	5195	O	-8316	-7323	-8248	-7213	
11/3/2016	E	4065	5751	O	-8398	-7506	-8492	-7426	
11/4/2016	E	4066	6139	O	-8580	-7699	-8816	-7662	
11/5/2016	E	4199	6288	O	-8970	-7930	-9100	-7900	
11/6/2016	E	4236	6411	C	-9282	-8134	-9418	-8149	[DCC Gates - NMFS Action IV.1.2]; D-1641 65% E/I 14 day average
11/7/2016	E	4244	6671	C	-9514	-8318	-9751	-8423	
11/8/2016	B	4250	5996	C	-9606	-8534	-9854	-8657	Delta WQ
11/9/2016	B	3734	4491	O	-9374	-8671	-9514	-8760	[DCC Gates - Delta WQ]; Delta WQ
11/10/2016	B	2816	4498	O	-8844	-8721	-8965	-8790	
11/11/2016	B	2542	3999	O	-8230	-8636	-8245	-8639	
11/12/2016	B	2043	3494	C	-7472	-8421	-7279	-8459	[DCC Gates - NMFS Action IV.1.2]; Delta WQ
11/13/2016	B	975	2989	C	-6366	-8084	-6140	-8179	
11/14/2016	B	975	2990	C	No Data	No Data	-5372	-7867	

11/15/2016	B	975	2488	O	No Data	No Data	-4595	-7494	[DCC Gates - Delta WQ]; Delta WQ
11/16/2016	B	976	2493	O	No Data	No Data	-3955	-7106	
11/17/2016	B	976	2492	O	No Data	No Data	-3497	-6676	
11/18/2016	B	972	2494	O	No Data	No Data	-3332	-6220	
11/19/2016	B	977	2488	O	No Data	No Data	-3166	-5748	
11/20/2016	B	977	2493	O	No Data	No Data	-3174	-5264	
11/21/2016	B	976	2998	O	No Data	No Data	-3269	-4790	
11/22/2016	B	1825	4746	O	-3787	No Data	-3836	-4526	
11/23/2016	B	2578	6672	O	-4431	No Data	-4886	-4568	
11/24/2016	B	2578	6676	O	-5139	No Data	-5936	-4666	
11/25/2016	B	2577	6663	C	-6426	No Data	-6983	-4814	[DCC Gates - NMFS Action IV.1.2]; Delta WQ
11/26/2016	B	2588	6679	C	-7798	No Data	-7943	-5028	
11/27/2016	E	3659	6672	C	-8606	No Data	-8628	-5415	Available Operational Capacity
11/28/2016	E	3651	6671	C	-8916	No Data	-8826	-5801	
11/29/2016	E	3658	6677	O	-9182	No Data	-9017	-6246	[DCC Gates - Delta WQ]; Available Operational Capacity
11/30/2016	E	3666	6678	O	-9242	No Data	-9209	-6690	
12/1/2016	E	4064	6671	C	-9132	-7044	-9475	-7162	*D-1641 Delta Outflow (4,500 cfs)*;[DCC Gates - NMFS Action IV.1.2]; Available Operational Capacity
12/2/2016	E	4076	6678	C	-9066	-7383	-9565	-7641	
12/3/2016	E	4082	6679	C	-9212	-7752	-9643	-8114	
12/4/2016	E	4075	6674	C	-9354	-8256	-9727	-8586	
12/5/2016	E	4087	6672	C	-9322	-8713	-9814	-9028	
12/6/2016	B	2453	6672	C	-9194	-8975	-9533	-9197	Delta WQ
12/7/2016	B	2449	5492	C	-8836	-8956	-9021	-9118	
12/8/2016	B	2442	5492	C	-8312	-8885	-8524	-9039	
12/9/2016	B	2454	5121	C	-8006	-8821	-7961	-8936	
12/10/2016	B	2463	6677	C	-7918	-8756	-7676	-8932	
12/11/2016	E	2467	6422	C	-7848	-8704	-7636	-8843	Available Operational Capacity
12/12/2016	E	3364	6675	C	-8260	-8721	-8018	-8829	
12/13/2016	E	3365	6670	C	-8770	-8738	-8398	-8818	
12/14/2016	E	4064	6678	C	-9108	-8773	-8973	-8851	
12/15/2016	E	4079	5490	C	-9372	-8841	-9052	-8781	Export Reduction for Longfin Smelt (SWP decreased 1000 cfs/day)
12/16/2016	E	4067	4493	C	-9284	-8782	-8992	-8638	
12/17/2016	E	4052	3499	C	-8614	-8508	-8530	-8432	Turbidity Management (Combined 7000 cfs exports)
12/18/2016	E	3662	3489	C	-8002	-8255	-7968	-8190	
12/19/2016	E	3538	3499	C	-7262	-8037	-7212	-7922	
12/20/2016	E	3527	3496	C	-6532	-7891	-6694	-7767	
12/21/2016	E	3505	3493	C	-6324	-7885	-6371	-7691	
12/22/2016	E	3483	3494	C	-6462	-7847	-6240	-7616	
12/23/2016	E	3500	3490	C	-6490	-7714	-6214	-7566	
12/24/2016	E	3495	3486	C	-6454	-7514	-6258	-7415	
12/25/2016	E	3511	3487	C	-6240	-7316	-6276	-7282	
12/26/2016	E	3496	3480	C	-6068	-7102	-6276	-7069	
12/27/2016	E	3693	3490	C	-6072	-6884	-6312	-6871	
12/28/2016	E	4124	3497	C	-6112	-6644	-6425	-6656	Turbidity Management (OMR -7000 cfs)
12/29/2016	E	4050	3499	C	-6276	-6409	-6526	-6513	
12/30/2016	E	4025	3493	C	-6628	-6368	-6617	-6433	
12/31/2016	E	4036	3492	C	-6734	-6431	-6717	-6422	
1/1/2017	E	2523	3094	C	-6468	-6336	-6429	-6321	*D-1641 Delta Outflow (6,000 cfs)*;NMFS Action IV.2.3 (OMR -5000 cfs)

1/2/2017	E	2514	3094	C	-6026	-6202	-6058	-6244	
1/3/2017	E	2505	3090	C	-5542	-6055	-5690	-6155	
1/4/2017	E	2513	3099	C	-5042	-5910	-5334	-6063	
1/5/2017	E	2511	3093	C	-4574	-5756	-4971	-5969	
1/6/2017	E	3271	3792	C	-4458	-5610	-4982	-5881	NMFS Action IV.2.3 and FWS Action 2 (OMR -5000 cfs)
1/7/2017	E	4073	4193	C	-4646	-5556	-4924	-5767	
1/8/2017	E	4029	5289	C	-4982	-5606	-4904	-5665	
1/9/2017	E	4051	5790	C	-5124	-5573	-4879	-5564	
1/10/2017	E	4050	5793	C	-5524	-5561	-4966	-5488	
1/11/2017	E	4094	5795	C	-5678	-5455	-4954	-5356	
1/12/2017	E	4097	7198	C	-5422	-5251	-5011	-5226	
1/13/2017	E	4075	8494	C	-5026	-5034	-5059	-5109	NMFS Action IV.2.3 (OMR -5000 cfs); *FWS Action 2 in flow offramp*
1/14/2017	E	4065	9193	C	-4804	-4884	-5085	-4981	
1/15/2017	E	4039	9040	C	-4528	-4868	-4987	-4973	
1/16/2017	E	4025	9093	C	-4458	-4895	-4957	-4962	
1/17/2017	E	4017	9691	C	-4636	-4928	-4927	-4954	
1/18/2017	E	4007	10090	C	-4908	-4986	-4862	-4940	
1/19/2017	E	4040	10293	C	-5118	-5078	-4783	-4914	Available Operational Capacity
1/20/2017	E	4047	10290	C	-5312	-5173	-4751	-4891	
1/21/2017	E	4053	9590	C	-5288	-5124	-4769	-4907	NMFS Action IV.2.3 (OMR -5000 cfs)
1/22/2017	E	4047	9695	C	-5232	-5017	-4776	-4908	
1/23/2017	E	4060	10289	C	-4906	-4908	-4764	-4899	Available Operational Capacity
1/24/2017	E	4051	10295	C	-4516	-4718	-4698	-4818	
1/25/2017	E	4043	10300	C	-4059	-4595	-4543	-4744	
1/26/2017	E	4031	10288	C	-3692	-4507	-4191	-4614	
1/27/2017	E	4019	10289	C	-3176	-4356	-3736	-4435	
1/28/2017	E	4011	10299	C	-2844	-4208	-3204	-4227	
1/29/2017	E	4015	10289	C	-2717	-4071	-2722	-4009	
1/30/2017	E	4021	10289	C	-2688	-3963	-2342	-3810	
1/31/2017	E	4017	10289	C	-2816	-3857	-2202	-3641	
2/1/2017	E	4016	9885	C	-3170	-3736	-2339	-3534	
2/2/2017	E	4023	10298	C	-3518	-3636	-2661	-3469	
2/3/2017	E	4035	10290	C	-3813	-3536	-3086	-3414	
2/4/2017	E	4024	9920	C	-3944	-3483	-3412	-3325	
2/5/2017	E	4025	10289	C	-4310	-3527	-3728	-3267	
2/6/2017	E	4052	10299	C	-4642	-3641	-3958	-3246	
2/7/2017	E	4080	10298	C	-4828	-3748	-4221	-3299	
2/8/2017	E	4087	10294	C	-4839	-3814	-4505	-3400	
2/9/2017	E	4102	10290	C	-5137	-3999	-4834	-3555	
2/10/2017	E	4108	10291	C	-4842	-4122	-4905	-3684	
2/11/2017	E	4137	10279	C	-4133	-4102	-4670	-3770	
2/12/2017	E	4127	10297	C	-3185	-3915	-3955	-3739	
2/13/2017	E	4184	10055	C	-1777	-3489	-2471	-3447	
2/14/2017	E	4213	9814	C	311	-2882	-387	-2907	
2/15/2017	E	4126	8992	C	2198	-2205	1923	-2162	
2/16/2017	E	4138	8493	C	3889	-1457	4129	-1345	
2/17/2017	E	4161	6487	C	5565	-566	6092	-461	
2/18/2017	E	4158	3297	C	7144	471	8093	662	
2/19/2017	E	4143	3290	C	8834	1812	9715	1894	
2/20/2017	E	4136	3289	C	10478	3195	11047	3197	
2/21/2017	E	3965	3290	C	12276	4652	12335	4568	*FWS Action 3 (OMR -5,000 cfs)*; Available Operational Capacity
2/22/2017	E	3529	3290	C	13922	6135	13690	6037	

2/23/2017	E	3608	3333	C	15430	7817	14670	7628	
2/24/2017	E	3595	3251	C	16368	9387	15498	9181	
2/25/2017	E	3604	3288	C	16988	10738	16111	10619	
2/26/2017	E	3603	3298	C	17272	11958	16618	11915	
2/27/2017	E	3728	3593	C	17348	12965	16780	12912	
2/28/2017	E	3800	3796	C	17134	13825	16456	13643	
3/1/2017	E	3778	3796	C	16810	14606	15930	14183	
3/2/2017	E	3762	3492	C	16448	15224	15291	14605	
3/3/2017	E	3716	2689	C	15942	15664	14624	14963	
3/4/2017	E	3703	1695	C	15408	15916	14211	15097	
3/5/2017	E	3736	1495	C	14954	16011	13930	15149	
3/6/2017	E	3749	1463	C	14692	16111	13751	15149	
3/7/2017	E	3747	1668	C	14550	16036	13725	15102	
3/8/2017	E	3745	1693	C	14418	15841	13659	14952	
3/9/2017	E	3746	1395	C	14284	15507	13455	14663	
3/10/2017	E	3746	1489	C	13990	15161	13206	14330	
3/11/2017	E	3748	1490	C	13620	14908	12962	14025	
3/12/2017	E	3747	1648	C	13442	14668	12718	13709	
3/13/2017	E	3741	1961	C	13256	14380	12498	13422	
3/14/2017	E	3740	2867	C	13006	14033	12128	13118	
3/15/2017	E	3094	0	C	13134	13849	12417	13075	*Emergency Repair Work at Clifton Court*
3/16/2017	E	2828	0	C	13410	13823	12675	13090	
3/17/2017	E	3664	0	C	13440	13774	12743	13037	
3/18/2017	E	3673	0	C	13528	13709	12876	12946	
3/19/2017	E	3669	0	C	13668	13574	13211	12861	
3/20/2017	E	3671	0	C	13414	13392	12924	12780	
3/21/2017	E	3680	0	C	13008	13272	12645	12704	
3/22/2017	E	3725	0	C	12916	13238	12573	12649	
3/23/2017	E	3748	0	C	12860	13200	12511	12608	
3/24/2017	E	3748	0	C	12744	13129	12452	12591	
3/25/2017	E	3757	0	C	12720	13071	12374	12570	
3/26/2017	E	3760	0	C	12750	13025	12347	12572	
3/27/2017	E	3763	0	C	12822	13083	12403	12615	
3/28/2017	E	3728	0	C	12996	13196	12481	12734	
3/29/2017	E	3759	0	C	13160	13138	12521	12629	
3/30/2017	E	3769	0	C	13366	13055	12563	12530	
3/31/2017	E	3762	0	C	13614	13087	12548	12502	
4/1/2017	E	3744	0	C	13404	13039	12361	12431	*NMFS Action IV.2.1 -- in flood condition offramp*; Available Operational Capacity
4/2/2017	E	3749	0	C	13014	12963	12026	12311	
4/3/2017	E	3747	0	C	12540	12826	11598	12155	
4/4/2017	E	3744	0	C	11800	12624	11112	11983	
4/5/2017	E	3745	0	C	10918	12374	10576	11789	
4/6/2017	E	3746	0	C	10250	12106	10064	11558	
4/7/2017	E	3758	0	C	9718	11882	9589	11288	
4/8/2017	E	3755	0	C	9476	11667	9181	11015	
4/9/2017	E	3741	0	C	9360	11413	8833	10728	
4/10/2017	E	3739	0	C	9134	11056	8557	10415	
4/11/2017	E	3743	0	C	8936	10656	8349	10082	
4/12/2017	E	3749	0	C	8578	10246	8170	9735	
4/13/2017	E	3756	0	C	8246	9839	8006	9387	
4/14/2017	E	3746	0	C	8254	9499	7920	9075	
4/15/2017	E	3737	0	C	8382	9263	7947	8839	
4/16/2017	E	3741	465	C	8558	9065	8007	8647	
4/17/2017	E	3738	2240	C	8762	8896	7854	8397	

4/18/2017	E	3736	2525	C	8760	8753	7717	8175	
4/19/2017	E	3736	2544	C	8414	8604	7530	7987	
4/20/2017	E	4288	2527	C	7972	8449	7130	7791	
4/21/2017	E	4209	2479	C	7474	8264	6719	7622	
4/22/2017	E	4281	2525	C	7050	8030	6507	7442	
4/23/2017	E	4275	2515	C	6754	7822	6302	7271	
4/24/2017	E	4266	2244	C	6558	7684	6151	7128	
4/25/2017	E	4302	2223	C	6446	7560	6108	6991	
4/26/2017	E	4318	2552	C	6390	7482	5993	6844	
4/27/2017	E	4317	2881	C	6404	7372	5902	6691	
4/28/2017	E	4321	4489	C	6328	7134	5556	6427	
4/29/2017	E	4311	4496	C	6124	6878	5233	6158	
4/30/2017	E	4314	4494	C	6052	6665	4978	5909	
5/1/2017	E	2486	4499	C	6118	6538	5173	5887	
5/2/2017	E	2432	5492	C	6132	6434	5232	5804	
5/3/2017	E	1810	6318	C	6078	6300	5452	5684	*Emergency Repair Work at Clifton Court Completed and No Further Operations Limitations*
5/4/2017	E	1397	6675	C	5882	6131	5512	5580	
5/5/2017	E	2426	6674	C	5408	5927	5250	5384	
5/6/2017	E	2426	6670	C	4958	5791	4608	5208	
5/7/2017	E	2420	6670	C	4442	5608	4093	5014	
5/8/2017	E	2416	6673	C	3809	5318	3612	4778	
5/9/2017	E	3414	6676	C	3318	5014	2953	4453	
5/10/2017	E	3412	6674	C	2876	4672	2503	4138	
5/11/2017	E	3419	6679	C	2288	4321	2017	3821	
5/12/2017	E	3426	6668	C	1703	3956	1560	3588	
5/13/2017	E	3416	6674	C	1435	3644	1154	3321	
5/14/2017	E	3430	6678	C	1368	3341	999	3032	
5/15/2017	E	2771	2399	C	1948	3183	1859	2954	NMFS Action IV.2.1 (4:1 I:E ratio)
5/16/2017	E	2745	2393	C	2688	3091	2762	2939	
5/17/2017	E	2785	2394	C	3558	3056	3638	2940	
5/18/2017	E	2512	2684	C	4343	3094	4502	2961	
5/19/2017	E	2508	2593	C	4988	3191	5368	3074	
5/20/2017	E	2512	2390	C	5050	3216	5283	3195	
5/21/2017	E	2513	2188	C	4784	3213	5186	3329	
5/22/2017	E	1854	2694	C	4334	3244	5039	3449	
5/23/2017	E	1862	2595	C	3962	3324	4798	3619	
5/24/2017	E	1826	2390	C	3706	3488	4482	3781	
5/25/2017	E	1829	2098	C	3652	3703	4100	3939	
5/26/2017	E	1865	1998	C	3762	3948	3714	4098	
5/27/2017	E	1807	1890	C	3964	4147	3414	4256	
5/28/2017	E	1840	1796	C	4084	4294	3216	4411	
5/29/2017	E	1858	1697	C	4082	4250	3099	4224	
5/30/2017	E	1863	1896	C	3908	4139	2983	4018	
5/31/2017	E	1864	1981	C	3526	3936	2839	3813	*Last day of NMFS Action IV.2.1 (I:E ratio)*
6/1/2017	E	4174	6667	C	2336	3430	1416	3154	Available Operational Capacity
6/2/2017	E	4259	6664	C	854	2818	-36	2482	
6/3/2017	E	4386	6509	C	-640	2218	-1522	1794	
6/4/2017	E	4389	6673	C	-2128	1670	-2978	1102	
6/5/2017	E	4398	6673	C	-3460	1153	-4364	455	
6/6/2017	E	4393	6679	C	-3879	630	-4429	-141	
6/7/2017	E	4401	6669	C	-3933	90	-4427	-700	
6/8/2017	E	4408	6672	C	-3893	-477	-4386	-1237	
6/9/2017	E	4401	6677	C	-3965	-1090	-4335	-1772	

6/10/2017	E	4405	6670	C	-4035	-1704	-4335	-2313	
6/11/2017	E	4404	6662	C	-4139	-2307	-4393	-2858	
6/12/2017	E	4386	6672	C	-4270	-2893	-4494	-3412	
6/13/2017	E	4394	6672	C	-4718	-3558	-4610	-3949	
6/14/2017	E	4392	6672	C	-5044	-4151	-4728	-4475	
6/15/2017	E	4386	6671	C	-5194	-4394	-4823	-4541	*Last day of NMFS IV.2.3 OMR flow management restrictions [No more DCC restrictions per NMFS BiOp or D-1641]*
6/16/2017	E	4381	6669	C	-5270	-4494	-4858	-4581	
6/17/2017	E	4381	6671	C	-5332	-4569	-4837	-4596	
6/18/2017	E	4380	6671	C	-5094	-4617	-4778	-4592	
6/19/2017	E	4389	6671	C	-4876	-4656	-4697	-4594	
6/20/2017	E	4395	6668	C	-4832	-4734	-4602	-4603	
6/21/2017	E	4403	6674	C	-4934	-4852	-4551	-4625	
6/22/2017	E	4415	6673	C	-5040	-4979	-4529	-4647	*FWS Action 3 OMR flow management restrictions lifted based on temperature offramp*
6/23/2017	E	4415	6672	O	-5104	-5024	-4520	-4658	[DCC Gates - WQ]; Available Operational Capacity
6/24/2017	E	4413	6672	O	-4948	-4982	-4459	-4638	
6/25/2017	E	4413	6674	O	-4518	-4869	-4333	-4581	
6/26/2017	E	4408	6674	O	-3953	-4738	-4120	-4492	
6/27/2017	E	4400	6670	O	-3389	-4504	-3823	-4366	
6/28/2017	E	4393	6669	O	-2862	-4244	-3504	-4221	
6/29/2017	E	4386	6656	O	-2543	-4036	-3240	-4073	
6/30/2017	E	4381	6651	O	No Data	No Data	-3112	-3958	

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: Mill & Deer Creek flows

The first alert is triggered if Mill Creek and Deer Creek flows >95 cfs (either or both creeks), and there is an increase in flow of over 50%. Highlighted cells show exceedances.

	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
10/11/2016	86	0%	77	-0.1%
10/12/2016	86	0%	77	-0.1%
10/13/2016	86	0%	78	0.4%
10/14/2016	182	112%	117	50.8%
10/15/2016	163	-10%	151	29.5%
10/16/2016	179	10%	145	-4.4%
10/17/2016	198	11%	136	-6.3%
10/18/2016	154	-22%	127	-7%
10/19/2016	138	-10%	110	-13%
10/20/2016	126	-9%	102	-7%
10/21/2016	122	-3%	98	-4%
10/22/2016	119	-2%	97	-1%
10/23/2016	117	-2%	95	-1%
10/24/2016	120	3%	95	0%
10/25/2016	804	570%	491	399%
10/26/2016	395	-51%	291	-41%
10/27/2016	229	-42%	157	-46%
10/28/2016	418	83%	163	4%
10/29/2016	730	75%	372	128%
10/30/2016	473	-35%	311	-16%
10/31/2016	438	-7%	351	13%
11/1/2016	819	87%	465	32%
11/2/2016	455	-44%	369	-21%
11/3/2016	302	-34%	242	-34%
11/4/2016	244	-19%	190	-21%
11/5/2016	219	-10%	162	-15%
11/6/2016	200	-9%	147	-9%
11/7/2016	196	-2%	137	-7%

	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
11/8/2016	184	-6%	130	-5%
11/9/2016	178	-3%	125	-4%
11/10/2016	171	-4%	122	-3%
11/11/2016	165	-4%	119	-2%
11/12/2016	163	-1%	117	-1%
11/13/2016	170	4%	119	2%
11/14/2016	158	-7%	117	-2%
11/15/2016	155	-2%	115	-1%
11/16/2016	165	6%	126	9%
11/17/2016	143	-13%	123	-2%
11/18/2016	139	-3%	118	-4%
11/19/2016	338	143%	321	172%
11/20/2016	487	44%	467	45%
11/21/2016	376	-23%	343	-27%
11/22/2016	287	-24%	269	-21%
11/23/2016	483	68%	302	12%
11/24/2016	347	-28%	268	-11%
11/25/2016	265	-24%	223	-17%
11/26/2016	330	25%	251	13%
11/27/2016	422	28%	347	38%
11/28/2016	353	-16%	300	-13%
11/29/2016	296	-16%	273	-9%
11/30/2016	252	-15%	232	-15%
12/1/2016	227	-10%	208	-10%
12/2/2016	205	-10%	186	-11%
12/3/2016	189	-8%	170	-9%
12/4/2016	182	-4%	163	-5%
12/5/2016	176	-3%	157	-3%

Second Alert: WLK flows and KL temps

The second alert is triggered only if both components are met (Knights Landing temperatures less than 56.3°F and Wilkins Slough flows >7,500 cfs). The second alert was triggered on 11/21/16.

Wilkins Slough (WLK)		**Knights Landing (KL)**	
Date range	flow (cfs)	Date range	temperature (°F)
10/1-10/3	6,510-6,605	10/1-10/2	64-65
10/4-10/10	5,784-6,688	10/4-10/10	61-63
10/11-10/17	5,327-5,930	10/11-10/16	63-64
10/18-10/24	4,015-5,765	10/16-10/24	61-65
10/25-10/31	4,028-8,038	10/25-10/31	62-63
11/1-11/7	6,280-11,429	10/31-11/6	59-61
11/8-11/14	5,018-5,931	11/7-11/13	60-62
11/15-11/21	4,904-10,172	11/14-11/21	56-61
11/22-11/28	8,955-14,763	11/21-11/26	54-58
11/29-12/5	7,100-12,133	11/27-12/2	51-54

Third Alert: 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.

Catch indices for WY 2017 are provided below. Green cells indicate indices less than 3, red cells indicate indices greater than 3 but less than or equal to 10, and yellow cells indicate indices greater than 10.

Date	KLCI	Seine SCI	Trawl SCI	DCC position	Day of Action
10/1/2016	0	No sampling	No sampling	Open	--
10/2/2016	0	No sampling	No sampling	Open	--
10/3/2016	0	0	0	Open	--
10/4/2016	1.2	No sampling	No sampling	Open	--
10/5/2016	0	1.6	0	Open	--
10/6/2016	0.5	No sampling	No sampling	Open	--
10/7/2016	0.5	No sampling	No sampling	Open	--
10/8/2016	0.5	No sampling	No sampling	Open	--
10/9/2016	0	No sampling	No sampling	Open	--
10/10/2016	0.5	No sampling	No sampling	Open	--
10/11/2016	0	0	0	Open	--
10/12/2016	0	0	0	Open	--
10/13/2016	0.5	0	No sampling	Open	--
10/14/2016	0.6	0	0	Open	--
10/15/2016	0	No sampling	0	Open	--
10/16/2016	0	No sampling	No sampling	Open	--
10/17/2016	0.5	0	0	Open	--
10/18/2016	0	No sampling	No sampling	Open	--
10/19/2016	1.0	0	0	Open	--
10/20/2016	1.5	No sampling	No sampling	Open	--
10/21/2016	1.5	0	0	Open	--
10/22/2016	0.5	No sampling	No sampling	Open	--
10/23/2016	0	No sampling	No sampling	Open	--
10/24/2016	0	1.6	0	Open	--
10/25/2016	0	No sampling	No sampling	Open	--
10/26/2016	0	0	0	Open	--
10/27/2016	0	No sampling	No sampling	Open	--
10/28/2016	0	0	0	Open	--
10/29/2016	0.7	No sampling	No sampling	Open	--
10/30/2016	0	No sampling	No sampling	Open	--
10/31/2016	2.2	1.1	0	Open	--

Date	KLCI	Seine SCI	Trawl SCI	DCC position	Day of Action
11/1/2016	0.8	No sampling	No sampling	Open	--
11/2/2016	0.7	2	0	Open	--
11/3/2016	1.4	No sampling	No sampling	Open	--
11/4/2016	16.1	1.3	0	Open	--
11/5/2016	10.2	No sampling	No sampling	Open	--
11/6/2016	5.3	No sampling	No sampling	Closed	1
11/7/2016	2.3	1.3	0	Closed	2
11/8/2016	0	2.3	No sampling	Closed	3
11/9/2016	0.5	No sampling	0	Open	--
11/10/2016	0	4	0	Open	--
11/11/2016	0	No sampling	No sampling	Open	--
11/12/2016	0	No sampling	No sampling	Closed in AM	1
11/13/2016	0	No sampling	No sampling	Closed	2
11/14/2016	0	0	0	Closed	3
11/15/2016	0	No sampling	No sampling	Opened in morning	--
11/16/2016	0	1	0	Open	--
11/17/2016	0	No sampling	No sampling	Open	--
11/18/2016	0	0	0	Open	--
11/19/2016	0	No sampling	No sampling	Open	--
11/20/2016	0	No sampling	No sampling	Open	--
11/21/2016	0	3	0	Open	--
11/22/2016	0	No sampling	No sampling	Open	--
11/23/2016	2.2	6.4	0	Open	--
11/24/2016	3.1	No sampling	No sampling	Open	--
11/25/2016	2.9	0	0	Closed in AM	1
11/26/2016	3.6	No sampling	No sampling	Closed	2
11/27/2016	0	No sampling	No sampling	Closed	3
11/28/2016	0.9	2.3	0	Closed	4
11/29/2016	0.7	No sampling	No sampling	Open	--
11/30/2016	2.2	3.4	0	Open	--

Date	KLCI	Seine SCI	Trawl SCI	DCC position	Day of Action
12/1/2016	2.5	No sampling	No sampling	Closed	--
12/2/2016	2	5.7	0	Closed	--
12/3/2016	0.5	No sampling	No sampling	Closed	--
12/4/2016	0	No sampling	No sampling	Closed	--
12/5/2016	0	0	0	Closed	--
12/6/2016	0	no sampling	no sampling	Closed	--
12/7/2016	0	0	0	Closed	--
12/8/2016	0	no sampling	no sampling	Closed	--
12/9/2016	0	2.3	0	Closed	--
12/10/2016	0	no sampling	no sampling	Closed	--
12/11/2016	0	no sampling	no sampling	Closed	--
12/12/2016	0	10	2	Closed	--
12/13/2016	19.2	no sampling	no sampling	Closed	--
12/14/2016	3.5	6	2	Closed	--
12/15/2016	3	no sampling	no sampling	Closed	--
12/16/2016	4.8	11.2	0	Closed	--
12/17/2016	7.8	no sampling	no sampling	Closed	--
12/18/2016	0	no sampling	no sampling	Closed	--
12/19/2016	2.6	no sampling	0	Closed	--
12/20/2016	2.2	No sampling	No sampling	Closed	--
12/21/2016	0	No sampling	0	Closed	--
12/22/2016	0.6	No sampling	No sampling	Closed	--
12/23/2016	0	4	0	Closed	--
12/24/2016	0.6	No sampling	No sampling	Closed	--
12/25/2016	No sampling	No sampling	No sampling	Closed	--
12/26/2016	No sampling	No sampling	No sampling	Closed	--
12/27/2016	2.1	No sampling	0	Closed	--
12/28/2016	0.5	0	0	Closed	--
12/29/2016	0.6	0	No sampling	Closed	--
12/30/2016	0	0	0	Closed	--
12/31/2016	Data not yet available	No sampling	No sampling	Closed	--

Calculation Details: Knights Landing Catch Index (KLCI) and Sacramento Catch Index (SCI)

Juvenile Chinook salmon at or above the minimum winter-run size based on the length-at-date model used at a particular sampling location, and below the maximum size considered by the length-at-date model, on a given sampling date, are considered "**older juveniles**".

The **Knights Landing Catch Index** (KLCI) is based on reported catch of older juveniles at the Knights Landing rotary screw trapping location and is calculated as the total catch of older juveniles (adjusted, as necessary, for partial cone operations) divided by the number of "trap days" (adjusted, as necessary, for downtime resulting from, for example, debris removal) since the last sampling event. This calculation for older juveniles/trap-day is implemented as [(total number of older juveniles/% cone sampling effort)/total hours fished)]*(24 hours fished/trap day).

Both the Sacramento trawl[1] and Sacramento seine[2] data (reported catch of older juveniles) are used to generate a **Sacramento Catch Index** (SCI; one for the seine data; one for the trawl data). The seine version of the catch index is standardized to eight hauls; therefore, the index is calculated as: (total number of older juveniles captured/# hauls)*8. The trawl version of the catch index is standardized to 10 tows; therefore, the index is calculated as: (total number of older juveniles captured/# tows)*10.

[1] Trawl site at Sherwood Harbor
[2] Based on the eight "Sacramento seine route" sites: Verona, Elkhorn, Sand Cove, Discovery Park, American River, Miller Park, Sherwood Harbor, and Garcia Bend.

Appendix C— Old and Middle River Flows

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

December 2016

(*** 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
12/1/2016	-9130	-7040	-9770	-9470	-7160
12/2/2016	-9070	-7380	-9870	-9560	-7640
12/3/2016	-9210	-7750	-9800	-9640	-8110
12/4/2016	-9350	-8260	-9800	-9730	-8590
12/5/2016	-9320	-8710	-9820	-9810	-9030
12/6/2016	-9190	-8980	-8370	-9530	-9200
12/7/2016	-8840	-8960	-7320	-9020	-9120
12/8/2016	-8310	-8890	-7320	-8530	-9040
12/9/2016	-8010	-8820	-6980	-7960	-8940
12/10/2016	-7920	-8760	-8400	-7680	-8930
12/11/2016	-7850	-8710	-8170	-7640	-8840
12/12/2016	-8260	-8720	-9230	-8020	-8830
12/13/2016	-8770	-8740	-9220	-8400	-8820
12/14/2016	-9110	-8770	-9860	-8980	-8850
12/15/2016	-9370	-8840	-8790	-9050	-8780
12/16/2016	-9280	-8780	-7860	-8990	-8640
12/17/2016	-8610	-8510	-6910	-8530	-8430
12/18/2016	-8000	-8260	-6410	-7970	-8190
12/19/2016	-7260	-8040	-6080	-7210	-7920
12/20/2016	-6530	-7890	-6200	-6690	-7770
12/21/2016	-6320	-7890	-6250	-6370	-7690
12/22/2016	-6460	-7850	-6260	-6240	-7620
12/23/2016	-6490	-7710	-6280	-6210	-7570
12/24/2016	-6460	-7520	-6290	-6260	-7420
12/25/2016	-6240	-7320	-6290	-6270	-7280
12/26/2016	-6070	-7100	-6260	-6280	-7070
12/27/2016	-6070	-6880	-6440	-6310	-6870
12/28/2016	-6110	-6640	-6850	-6430	-6660
12/29/2016	-6280	-6410	-6790	-6530	-6510
12/30/2016	-6630	-6370	-6750	-6620	-6430
12/31/2016	-6730	-6430	-6750	-6720	-6420

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

January 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
1/1/2017	-6470	-6340	-5000	-6430	-6320
1/2/2017	-6030	-6200	-4990	-6060	-6240
1/3/2017	-5540	-6060	-4960	-5690	-6150
1/4/2017	-5040	-5910	-4970	-5330	-6060
1/5/2017	-4580	-5760	-4940	-4970	-5970
1/6/2017	-4460	-5610	-5060	-4980	-5880
1/7/2017	-4650	-5560	-4700	-4930	-5770
1/8/2017	-4980	-5610	-4860	-4910	-5670
1/9/2017	-5120	-5570	-4840	-4880	-5560
1/10/2017	-5530	-5560	-5380	-4970	-5490
1/11/2017	-5680	-5460	-5000	-4960	-5360
1/12/2017	-5420	-5250	-4990	-5010	-5230
1/13/2017	-5030	-5030	-5100	-5060	-5110
1/14/2017	-4800	-4880	-4970	-5090	-4980
1/15/2017	-4530	-4870	-4890	-4990	-4980
1/16/2017	-4460	-4900	-4840	-4960	-4960
1/17/2017	-4630	-4930	-4840	-4930	-4960
1/18/2017	-4910	-4990	-4770	-4860	-4940
1/19/2017	-5120	-5080	-4580	-4780	-4920
1/20/2017	-5310	-5170	-4730	-4750	-4890
1/21/2017	-5290	-5120	-4930	-4770	-4910
1/22/2017	-5230	-5020	-4870	-4780	-4910
1/23/2017	-4910	-4910	-4720	-4770	-4900
1/24/2017	-4520	-4720	-4250	-4700	-4820
1/25/2017	-4060	-4600	-3950	-4540	-4750
1/26/2017	-3700	-4510	-3170	-4190	-4620
1/27/2017	-3180	-4360	-2590	-3740	-4440
1/28/2017	-2850	-4210	-2060	-3200	-4230
1/29/2017	-2720	-4070	-1830	-2720	-4010
1/30/2017	-2690	-3960	-2050	-2340	-3810
1/31/2017	-2820	-3860	-2470	-2200	-3640

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

February 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
2/1/2017	-3170	-3740	-3280	-2340	-3530
2/2/2017	-3520	-3640	-3670	-2660	-3470
2/3/2017	-3810	-3540	-3960	-3090	-3410
2/4/2017	-3940	-3480	-3690	-3410	-3330
2/5/2017	-4310	-3530	-4050	-3730	-3270
2/6/2017	-4640	-3640	-4430	-3960	-3250
2/7/2017	-4830	-3750	-4980	-4220	-3300
2/8/2017	-4840	-3820	-5380	-4510	-3400
2/9/2017	-5140	-4000	-5330	-4830	-3560
2/10/2017	-4840	-4120	-4400	-4900	-3680
2/11/2017	-4130	-4100	-3260	-4670	-3770
2/12/2017	-3190	-3920	-1410	-3960	-3740
2/13/2017	-1770	-3490	2040	-2470	-3450
2/14/2017	310	-2880	5090	-390	-2910
2/15/2017	2200	-2210	7150	1920	-2160
2/16/2017	3890	-1460	7780	4130	-1350
2/17/2017	5570	-570	8410	6090	-460
2/18/2017	7140	470	12040	8090	660
2/19/2017	8830	1810	13200	9720	1890
2/20/2017	10480	3190	13810	11050	3200
2/21/2017	12270	4650	14210	12330	4570
2/22/2017	13920	6140	15180	13690	6040
2/23/2017	15430	7820	16950	14670	7630
2/24/2017	16370	9390	17340	15500	9180
2/25/2017	16990	10740	16870	16110	10620
2/26/2017	17270	11960	16750	16620	11920
2/27/2017	17350	12960	16000	16780	12910
2/28/2017	17130	13820	15320	16460	13640

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

March 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
3/1/2017	16810	14600	14710	15930	14180
3/2/2017	16450	15220	13680	15290	14610
3/3/2017	15940	15660	13420	14630	14960
3/4/2017	15410	15920	13930	14210	15100
3/5/2017	14960	16010	13920	13930	15150
3/6/2017	14700	16110	13810	13750	15150
3/7/2017	14550	16040	13550	13730	15100
3/8/2017	14420	15840	13090	13660	14950
3/9/2017	14280	15510	12910	13460	14660
3/10/2017	13990	15160	12670	13210	14330
3/11/2017	13620	14910	12590	12960	14030
3/12/2017	13440	14670	12540	12760	13720
3/13/2017	13260	14380	11980	12540	13440
3/14/2017	13010	14030	11060	12170	13130
3/15/2017	13130	13850	14120	12460	13090
3/16/2017	13410	13820	13880	12720	13110
3/17/2017	13440	13770	12670	12740	13050
3/18/2017	13530	13710	12650	12880	12960
3/19/2017	13670	13570	12730	13210	12880
3/20/2017	13410	13390	12680	12920	12790
3/21/2017	13010	13270	12490	12640	12720
3/22/2017	12920	13240	12310	12570	12660
3/23/2017	12860	13200	12340	12510	12620
3/24/2017	12740	13130	12440	12450	12610
3/25/2017	12720	13070	12290	12370	12580
3/26/2017	12750	13030	12360	12350	12570
3/27/2017	12820	13080	12590	12400	12620
3/28/2017	13000	13200	12730	12480	12730
3/29/2017	13160	13140	12640	12520	12630
3/30/2017	13370	13060	12500	12560	12530
3/31/2017	13610	13090	12280	12550	12500

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

April 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
4/1/2017	13410	13040	11660	12360	12430
4/2/2017	13010	12960	11050	12030	12310
4/3/2017	12540	12830	10500	11600	12160
4/4/2017	11800	12620	10080	11110	11980
4/5/2017	10920	12370	9600	10580	11790
4/6/2017	10240	12110	9100	10070	11560
4/7/2017	9710	11880	8670	9590	11290
4/8/2017	9470	11670	8460	9180	11020
4/9/2017	9360	11410	8340	8830	10730
4/10/2017	9130	11050	8220	8560	10420
4/11/2017	8930	10650	8060	8350	10080
4/12/2017	8580	10240	7780	8170	9740
4/13/2017	8240	9840	7640	8010	9390
4/14/2017	8250	9500	7900	7920	9080
4/15/2017	8380	9260	8350	7950	8840
4/16/2017	8560	9060	8360	8010	8650
4/17/2017	8760	8900	7010	7850	8400
4/18/2017	8760	8750	6960	7720	8180
4/19/2017	8410	8600	6970	7530	7990
4/20/2017	7970	8450	6350	7130	7790
4/21/2017	7470	8260	6300	6720	7620
4/22/2017	7050	8030	5960	6510	7440
4/23/2017	6750	7820	5930	6300	7270
4/24/2017	6560	7680	6210	6150	7130
4/25/2017	6450	7560	6140	6110	6990
4/26/2017	6390	7480	5730	5990	6840
4/27/2017	6400	7370	5500	5900	6690
4/28/2017	6330	7130	4200	5560	6430
4/29/2017	6120	6880	4600	5230	6160
4/30/2017	6050	6670	4870	4980	5910

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

May 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
5/1/2017	6120	6540	6700	5170	5890
5/2/2017	6130	6430	5800	5230	5800
5/3/2017	6080	6300	5300	5450	5690
5/4/2017	5880	6130	4890	5510	5580
5/5/2017	5410	5930	3560	5250	5390
5/6/2017	4960	5790	3490	4610	5210
5/7/2017	4440	5610	3220	4090	5020
5/8/2017	3810	5320	2900	3610	4780
5/9/2017	3320	5010	1600	2950	4450
5/10/2017	2880	4670	1310	2500	4140
5/11/2017	2290	4320	1060	2020	3820
5/12/2017	1700	3960	940	1560	3590
5/13/2017	1440	3640	870	1160	3320
5/14/2017	1370	3340	820	1000	3030
5/15/2017	1950	3180	5610	1860	2960
5/16/2017	2690	3090	5580	2760	2940
5/17/2017	3560	3060	5310	3640	2940
5/18/2017	4340	3100	5190	4500	2960
5/19/2017	4990	3190	5150	5370	3080
5/20/2017	5050	3220	5190	5280	3200
5/21/2017	4780	3210	5090	5190	3330
5/22/2017	4330	3240	4580	5040	3450
5/23/2017	3960	3330	3980	4800	3620
5/24/2017	3710	3490	3570	4480	3780
5/25/2017	3650	3700	3280	4100	3940
5/26/2017	3760	3950	3160	3710	4100
5/27/2017	3960	4150	3080	3410	4260
5/28/2017	4080	4290	2990	3220	4410
5/29/2017	4080	4250	2990	3100	4220
5/30/2017	3910	4140	2690	2980	4020
5/31/2017	3530	3940	2440	2840	3810

Old and Middle River Flow (OMR)

Preliminary Data - Subject to Change

June 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
6/1/2017	2340	3430	-4030	1420	3150
6/2/2017	850	2820	-4270	-40	2480
6/3/2017	-640	2220	-4440	-1520	1790
6/4/2017	-2130	1670	-4590	-2980	1100
6/5/2017	-3460	1150	-4490	-4360	450
6/6/2017	-3880	630	-4350	-4430	-140
6/7/2017	-3930	90	-4260	-4430	-700
6/8/2017	-3890	-480	-4240	-4390	-1240
6/9/2017	-3970	-1090	-4330	-4330	-1770
6/10/2017	-4040	-1700	-4490	-4330	-2310
6/11/2017	-4140	-2310	-4650	-4390	-2860
6/12/2017	-4270	-2890	-4760	-4490	-3410
6/13/2017	-4720	-3560	-4820	-4610	-3950
6/14/2017	-5040	-4150	-4920	-4730	-4470
6/15/2017	-5190	-4390	-4970	-4820	-4540
6/16/2017	-5270	-4490	-4820	-4860	-4580
6/17/2017	-5330	-4570	-4660	-4840	-4600
6/18/2017	-5090	-4620	-4530	-4780	-4590
6/19/2017	-4880	-4660	-4510	-4700	-4590
6/20/2017	-4830	-4730	-4490	-4600	-4600
6/21/2017	-4930	-4850	-4570	-4550	-4630
6/22/2017	-5040	-4980	-4550	-4530	-4650
6/23/2017	-5100	-5020	-4480	-4520	-4660
6/24/2017	-4950	-4980	-4210	-4460	-4640
6/25/2017	-4520	-4870	-3850	-4330	-4580
6/26/2017	-3950	-4740	-3500	-4120	-4490
6/27/2017	-3390	-4500	-3060	-3820	-4370
6/28/2017	-2860	-4240	-2890	-3500	-4220
6/29/2017	-2540	-4040	-2890	-3240	-4070
6/30/2017			-3210	-3110	-3960

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: 7/17/2017** **Report Time: 2:38 PM**

	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* SIZE	RACE* CWT	OLDER JUV LOSS DENSITY
11/03/2016				1	2	**							582	U		
11/04/2016				1	4	**							455	U		
11/22/2016	1	2	**										628	U		
11/28/2016	3	10	**										491 - 590	U		
11/29/2016	1	2	**										549	U		
11/30/2016	1	2	**										674	U		
12/02/2016	2	15	**										597 - 670	U		
12/03/2016	5	14	**										466 - 630	U		
12/08/2016	1	2	**										581	U		
12/09/2016	2	6	**										481 - 501	U		
12/14/2016	2	4	**										639 - 656	U		
12/16/2016										1	4	2.60	180	LF		
12/17/2016	5	11	**										527 - 613	U		
12/18/2016				12	32	146.65				8	32	23.06	131 - 196	F,LF,W	LF	
12/19/2016				11	34	147.95	2	8	5.76	11	44	31.70	141 - 202	F,LF	LF	0.42
12/20/2016	1	4	17.70	11	18	79.24	1	4	2.88	23	92	66.29	135 - 218	F,LF,W	LF	1.30
12/21/2016				4	8	35.35				7	28	20.17	158 - 191	F,LF	LF	
12/22/2016	1	2	**	2	8	35.22				6	24	17.29	136 - 578	LF,W,U	LF	

	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)	SIZE CWT	DENSITY
12/23/2016				4	16	70.73				5	20	14.41	138 - 215	F,LF,W F,LF	
12/24/2016				1	4	18.05				1	4	2.88	149 - 171	LF LF	
12/25/2016				9	30	134.05							136 - 186	LF,W LF	
12/26/2016				4	16	71.50				2	8	5.76	159 - 198	F,LF LF	
12/27/2016				7	25	110.76	1	4	2.54	7	28	19.34	95 - 231	F,LF,W LF,S	0.19
12/28/2016										26	65	41.23	116 - 225	F,LF,W LF,S	
12/29/2016										4	16	10.41	119 - 185	LF,W LF	
12/30/2016										9	36	23.42	143 - 205	F,LF,W LF	
12/31/2016										1	4	2.60	138	W LF	
01/02/2017										4	16	12.75	145 - 180	LF,W LF	
01/03/2017										1	4	3.19	155	W LF	
01/04/2017										3	12	9.56	141 - 172	LF,W LF	
01/05/2017	1	2	8.88	10	30	132.91				3	12	9.56	111 - 187	LF,W LF	0.79
01/06/2017				6	20	89.30				5	20	14.41	140 - 191	LF,W LF	
01/07/2017				1	4	18.01				2	8	5.21	131 - 142	W LF	
01/08/2017	1	4	**				20	80	46.51	4	16	10.41	30 - 590	F,LF,U F,LF	
01/09/2017	1	4	18.28	13	50	227.14	16	72	41.86	5	20	13.01	30 - 211	F,LF,W LF	0.93
01/10/2017	2	7	28.62	2	6	26.31	23	92	53.49	4	16	10.41	32 - 184	F,LF,W LF	
01/11/2017	1	4	16.89	6	24	105.08	17	68	39.53	8	32	20.82	31 - 233	F,LF,W F,LF	
01/12/2017	1	4	**	1	3.5	15.13	27	108	62.79	4	16	10.41	32 - 315	F,W,U LF	

	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)	SIZE CWT	DENSITY
01/13/2017				4	16	69.48	91	364	211.62	1	4	2.60	30 - 220	F,LF,W F,LF	
01/14/2017				4	17	74.18	47	188	109.30	1	4	2.60	31 - 224	F,LF,W F,LF,S	
01/15/2017				2	6	26.33	33	132	76.74				30 - 228	F,W LF	
01/16/2017	4	16	67.57	4	15.5	69.10	34	136	79.07				31 - 161	F,W LF	
01/17/2017	24	94.5	394.27	2	8	34.90	73	292	169.76	1	4	2.60	30 - 213	F,LF,W F,LF	
01/18/2017	17	62	255.45	5	14	60.43	44	176	102.32				27 - 217	F,LF,W F,LF	0.32
01/19/2017	1	12	49.36	3	36	154.49	39	156	90.70				28 - 195	F,LF,W LF	
01/20/2017	2	14	57.57	1	2	8.80	20	80	46.51				32 - 194	F,LF LF	
01/21/2017	3	12	48.80				19	76	44.18				32 - 40	F	
01/22/2017	2	8	32.69	1	6	25.82	19	76	44.18				30 - 114	F,W LF	
01/23/2017	11	48	196.63	1	4	17.19	10	40	23.26	1	4	2.60	31 - 208	F,LF LF	
01/24/2017	28	124	484.12				69	276	160.46				22 - 310	F,U	
01/25/2017	77	238	974.68	4	13	55.66	76	304	176.74				30 - 234	F,LF F	
01/26/2017	48	182.2	741.22				28	112	65.11				30 - 41	F	
01/27/2017	32	128	517.44				36	144	83.72				32 - 44	F	
01/28/2017	46	184	745.81				37	148	86.04				28 - 46	F	
01/29/2017	49	193.7	784.43	1	4	16.94	18	72	41.86				30 - 151	F,W LF	
01/30/2017	42	168	679.28				19	76	44.18				31 - 44	F	
01/31/2017	44	173	706.51				33	129	74.99				28 - 43	F	
02/01/2017	63	252	1026.42				43	172	100.00				29 - 237	F,LF	0.60

	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		SIZE CWT	
02/02/2017	35	138	557.79				15	60	34.88				28 - 46	F	
02/03/2017	15	60	243.07				18	72	41.86				32 - 46	F	
02/04/2017	22	85.5	346.85				2	8	4.65				28 - 44	F	
02/05/2017	11	44	178.70	1	4	17.07	12	48	27.91				35 - 225	F,LF	
02/06/2017	16	64	262.49				9	36	20.93				32 - 220	F,LF	0.61
02/07/2017	13	60	248.65				4	16	9.30				33 - 207	F,W	0.62
02/08/2017	15	60	249.29				6	19	11.03				32 - 42	F	
02/09/2017	6	22	91.58	2	5	21.73	5	20	11.63				31 - 225	F,LF,W	
02/10/2017	17	64	265.74				17	68	39.53				33 - 42	F	
02/11/2017	12	47.2	196.50				11	44	25.58				30 - 42	F	
02/12/2017	52	194	810.07				20	80	46.51				30 - 44	F	
02/13/2017	88	330	1381.06				24	96	55.81				30 - 50	F	
02/14/2017	65	257.5	1079.14				17	68	39.53				31 - 184	F,W	0.62
02/15/2017	86	332	1384.99				19	76	44.18				30 - 49	F	
02/16/2017	34	131.3	554.37				8	32	18.60				30 - 58	F,S	
02/17/2017	12	47	198.92				9	36	20.93				32 - 43	F	
02/18/2017	4	12	49.86				1	4	2.33				39 - 43	F	
02/19/2017	4	16	64.81										32 - 44	F	
02/20/2017	6	24	97.38										36 - 43	F	
02/21/2017	3	12	48.61										40 - 43	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
														SIZE CWT	
02/22/2017	2	8	32.23				4	16	10.15				35 - 40	F	
02/23/2017	5	20	80.22				7	19	11.86				35 - 53	F	
02/24/2017	2	7.5	31.13				2	8	5.07				37 - 43	F	
02/25/2017	7	27.3	110.50										38 - 44	F	
02/26/2017	2	8	31.38										38 - 52	F	
02/27/2017	7	28	115.06										34 - 52	F	
02/28/2017	10	40	168.46										34 - 57	F	
03/01/2017	5	18.7	81.15										36 - 66	F,S	
03/02/2017	3	12	50.58										42 - 50	F	
03/03/2017	1	4	16.60										42	F	
03/07/2017	4	16	63.99										40 - 74	F,S	
03/14/2017							2	7.5	4.76				85 - 90	S	
03/15/2017							3	12	8.29				58 - 91	F,S	
03/17/2017							1	4	2.54				76	S	
03/20/2017							3	12	7.61				67 - 93	F,S	
03/21/2017							3	12	7.61				65 - 95	F,S	
03/22/2017							5	20	12.69				73 - 89	S	
03/23/2017							3	12	7.61				60 - 95	F,S	
03/24/2017							4	16	10.49				84 - 112	S	
03/25/2017							4	16	10.15				85 - 100	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*		
														SIZE	CWT	
03/26/2017							1	4	2.54				95	S		
03/27/2017							21	84	55.70				83 - 110	S		
03/28/2017							29	116	76.34				70 - 120	F,S,W		0.39
03/29/2017	1	1	4.33				27	108	72.64	3	12	8.30	72 - 127	S,W	S	0.77
03/30/2017							18	72	47.39	2	8	5.76	83 - 121	S,W	S	
03/31/2017							5	20	13.03				85 - 103	S		
04/01/2017							2	8	5.42				87 - 107	S		
04/02/2017							12	48	32.17	2	8	5.76	90 - 114	S	S	
04/03/2017							23	92	60.77	4	16	11.53	78 - 116	S	S	
04/04/2017							14	56	37.59	4	16	11.53	77 - 134	S,W	S	
04/05/2017							18	72	49.81	9	36	25.94	88 - 128	S,W	S	0.39
04/06/2017							13	52	35.05	3	12	8.65	83 - 120	S	S	
04/07/2017							49	196	133.64	18	72	51.88	78 - 120	S	S	
04/08/2017							26	104	70.11	9	36	25.94	72 - 126	F,S	S	
04/09/2017							26	104	68.73	1	4	2.88	81 - 120	S	S	
04/10/2017							44	176	116.47	6	24	17.29	75 - 143	F,S,W	S	
04/11/2017							32	128	86.37	11	44	31.70	75 - 137	F,S,W	S	
04/12/2017							56	224	152.08	4	16	11.53	85 - 133	S,W	S	
04/13/2017							56	224	153.81	10	40	28.82	90 - 130	S	S	
04/14/2017							57	228	152.55	4	16	11.53	83 - 130	S	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* SIZE	RACE* CWT	OLDER JUV LOSS DENSITY
04/15/2017							42	168	113.46	7	28	20.17	81 - 128	S	S	
04/16/2017							32	128	86.37	6	24	17.29	70 - 138	F,S,W	S	
04/17/2017							46	184	124.99	9	36	25.59	84 - 125	S	S	
04/18/2017	4	16	67.40				32	119	82.55	6	24	17.29	87 - 133	S	S	
04/19/2017	12	38.7	164.21	4	10	43.60	29	115.2	80.22	12	47.2	33.99	84 - 137	S	S	
04/20/2017	9	36	152.88	5	20	85.89	74	296	185.94	4	16	10.41	94 - 140	S	S	
04/21/2017	9	36	152.37	1	4	16.41	96	384	241.81	3	12	7.81	89 - 130	S	S	
04/22/2017	8	28	101.03	3	10	43.31	70	280	176.64	1	4	2.60	81 - 306	F,S,U	S	
04/23/2017	8	32	135.75	1	4	17.31	68	272	169.50	5	20	13.01	87 - 139	S	S	
04/24/2017	77	298	1273.70	3	12	51.74	79	316	201.17	6	24	15.62	84 - 187	F,S,W	S	1.30
04/25/2017	71	189	808.56	7	9	38.30	58	232	147.90	2	8	4.93	92 - 141	S	S	
04/26/2017	39	156	646.69	4	16	66.38	105	420	268.56	1	4	2.60	90 - 139	S	S	
04/27/2017	118	466	1981.56	6	24	102.80	101	404	256.94	2	8	5.21	83 - 141	F,S	S	
04/28/2017	126	490	2056.56	2	8	33.48	127	508	324.16	1	4	2.60	85 - 141	F,S	S	
04/29/2017	176	683.6	2887.42	2	8	34.23	112	448	285.40				79 - 293	F,S,W	S	0.98
04/30/2017	96	384	1619.80	1	4	17.20	80	320	199.45	1	4	2.60	92 - 142	S	S	
05/01/2017	87	348	1472.14				70	280	218.40				91 - 143	S		
05/02/2017	144	436.5	1880.32				53	212	165.07	2	8	5.95	90 - 147	S	F,S	
05/03/2017	97	301	1296.92				23	92	77.35				89 - 325	F,S,U		
05/04/2017	93	382	1673.93	2	8	34.96	30	116	102.60				89 - 149	F,S	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*		
														SIZE	CWT	
05/05/2017	86	310.5	1363.36	3	12	53.02	42	168	130.02	1	4	3.19	95 - 283	S,W	S	0.35
05/06/2017	151	646	2794.06	4	10	43.04	36	144	112.17				92 - 171	S,W	S	
05/07/2017	84	336	1426.94	2	8	34.41	39	156	119.62	2	8	5.95	88 - 150	F,S	F,S	
05/08/2017	130	510.5	2151.70	5	17	72.75	27	108	82.65				87 - 173	F,S,W	F,S	
05/09/2017	202	490.3	2111.75	5	5	21.67	40	160	111.84	2	8	5.07	84 - 161	F,S	F,S	
05/10/2017	132	586	2532.90	2	10	42.28	60	240	166.03	3	12	8.65	84 - 158	F,S	F,S	
05/11/2017	126	1218	5257.22	1	12	51.95	118	472	322.50	5	20	13.03	86 - 138	F,S	F	
05/12/2017	87	984	4162.89	1	12	50.64	85	340	232.57	3	12	7.96	78 - 162	F,S	F,S	
05/13/2017	105	1296	5573.60	2	36	159.68	90	360	250.77				84 - 167	F,S	F,S	
05/14/2017	102	556	2364.46				75	300	208.57	1	4	2.54	88 - 334	F,S,U	F	
05/15/2017	50	265	1153.81	1	12	53.41	156	624	459.45	5	20	14.24	83 - 172	F,S	F,S	
05/16/2017	135	954	4100.43				98	392	291.98	2	8	5.53	81 - 128	F,S	F	
05/17/2017	62	454	2264.71	2	24	123.59	60	237	175.85	3	12	8.71	85 - 173	F,S	F,S	
05/18/2017	78	474	2522.17				58	225.5	167.85	2	7.5	5.18	85 - 131	F,S	F	
05/19/2017	32	150	802.78				48	192	147.45	1	4	2.76	81 - 136	F,S	F	
05/20/2017	19	128	689.78				47	188	144.69				89 - 130	F,S		
05/21/2017	10	26	138.73				51	204	159.12	1	4	2.76	90 - 130	F,S	F	
05/22/2017	12	46	240.66				48	192	159.17	3	12	9.02	84 - 128	F,S	F	
05/23/2017	124	141.5	632.81	9	12	52.88	50	200	162.11	3	12	9.02	75 - 129	F,S	F	
05/24/2017	17	56	285.26				62	248	202.80	10	40	30.58	81 - 127	F,S	F	

	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		SIZE	CWT	
05/25/2017	30	52.5	250.25	3	14	72.55	52	208	165.56	12	48	36.08	83 - 129	F,S	F	
05/26/2017	6	24	127.98	1	1	4.33	46	184	149.58	5	20	15.55	75 - 131	F,S	F	
05/27/2017	6	20	104.79				52	208	166.07	3	12	9.02	85 - 131	F,S	F	
05/28/2017	8	28	143.69				64	256	210.35	1	4	3.01	83 - 132	F,S	F	
05/29/2017	7	26	137.25				45	180	146.57	3	12	9.02	85 - 131	F,S	F	
05/30/2017	40	50	232.28	6	7	31.45	38	152	123.98	3	12	9.02	84 - 190	F,S	F,S	
05/31/2017	27	193	1010.77				52	208	169.15	1	4	3.01	86 - 134	F,S	F	
06/01/2017	144	873	4039.24				121	484	299.40	11	44	26.41	80 - 127	F,S	F	
06/02/2017	62	243	1122.39				85	340	212.35	3	12	6.98	80 - 138	F,S	F	
06/03/2017	75	333	1543.82				74	296	186.50	2	8	4.93	84 - 128	F,S	F	
06/04/2017	69	247	1130.06				69	276	173.76	2	8	4.93	82 - 119	F,S	F	
06/05/2017	96	373	1762.86	3	9	40.30	49	194	119.40	2	8	4.65	70 - 129	F,S	F	
06/06/2017	208	376.0	1700.19	5	5	21.67	35	140	87.77	1	4	2.60	80 - 132	F,S	F	
06/07/2017	45	180	831.47	1	4	18.78	36	139.0	88.06	1	4	2.33	87 - 171	F,S	F,S	
06/08/2017	73	145.8	660.64	1	1	4.33	24	96	59.97	1	4	2.33	67 - 181	F,S	F,S	
06/09/2017	41	144	666.33				26	104	66.56	1	4	2.33	90 - 126	F,S	F	
06/10/2017	53	150.3	691.44				32	128	81.62	1	4	2.60	92 - 141	F,S	F	
06/11/2017	71	220	1021.20				47	188	121.77				93 - 135	F,S		
06/12/2017	29	106	459.76				35	140	89.98				96 - 131	F,S		
06/13/2017	26	82.2	380.45				64	256	163.52	1	4	2.60	92 - 130	F,S	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* SIZE	RACE* CWT	OLDER JUV LOSS DENSITY
06/14/2017	27	92	431.37				20	79.8	50.84				92 - 119	F,S		
06/15/2017	18	70	323.37				45	180	114.07				90 - 131	F,S		
06/16/2017	17	45	205.06				34	136	84.89	1	4	2.33	83 - 130	F,S	F	
06/17/2017	6	24	111.97				30	120	75.03				77 - 134	F,S		
06/18/2017	3	12	57.73				9	36	22.59				92 - 127	F,S		
06/19/2017	3	14	64.44				10	40	24.92				85 - 123	F,S		
06/20/2017							10	40	24.64				87 - 118	F		
06/23/2017							1	4	2.33				96	F		
06/24/2017							1	4	2.60				105	F		
06/25/2017							1	4	2.60				109	F		
06/26/2017							1	4	2.60				101	F		
06/27/2017							6	24	15.06				82 - 120	F		
06/28/2017							4	16	10.13				97 - 107	F		
06/29/2017	9	9	39.00				4	16	9.86				90 - 154	F,S		
06/30/2017	2	2	8.67				3	12	7.81				95 - 119	F		
07/02/2017							1	4	2.60				110	F		0.14
07/05/2017							2	8	4.93				91 - 133	F		0.28
07/06/2017	1	1	4.33										105	F		0.47
07/11/2017	1	1	4.33										101	F		0.19
07/14/2017							1	4	2.33				93	F		0.10

	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* SIZE	RACE* CWT	OLDER JUV LOSS DENSITY
07/16/2017							1	4	2.33				96	F		0.10
Season total	**22284.8**	**97156.51**		**833.0**	**3653.83**		**21996.0**	**14722.14**		**1631.7**	**1141.95**					
Weekly total	**1.0**	**4.33**		**0.0**	**0.00**		**8.0**	**4.65**		**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).

*Race of clipped (hatchery) salmon reported in this report is determined by the Delta criteria for length of the fish at date of salvage. Actual race determination will be determined from the coded wire tag data once the tag has been read (if available).

** 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.

SIZE = race determined by fish length at date of salvage criteria; CWT = hatchery fish race from coded wired tag information.

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

Appendix E— Steelhead Loss-Density Table

Steelhead - Daily Summary Table

California Department of Fish and Wildlife - Results Subject to Revision

Prepared by: Jerry Morinaka **Report Date: 7/17/2017** **Report Time: 3:06 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
11/27/2016	1	4	17.32										541	0.85
12/31/2016							1	4	2.72				170	0.18
01/03/2017							1	4	2.72				300	0.24
01/17/2017	1	4	17.32										334	0.66
01/25/2017	1	4	17.32										272	0.61
01/31/2017										1	1	0.68	510	
02/06/2017				1	4	17.32							265	
02/08/2017				1	4	17.32				1	1	0.68	235 - 256	
02/10/2017				4	14	60.62	1	4	2.72				211 - 245	0.10
02/11/2017				2	5	21.65							232 - 239	
02/13/2017	1	4	17.32										225	0.62
04/22/2017	1	2	8.66										365	0.65
05/08/2017	1	4	17.32										310	0.86
05/10/2017				2	10	43.30							270 - 291	
05/18/2017	1	6	25.98				1	4	2.72				290 - 342	2.88
05/21/2017	1	4	17.32										283	1.79
05/24/2017	1	4	17.32										232	1.98

	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
05/25/2017	1	1	4.33										265	0.60
06/03/2017										1	4	2.72	260	
06/04/2017							1	4	2.72				330	0.13
06/06/2017	1	4	17.32										332	0.77
06/16/2017							1	4	2.72				302	0.13
Season total		**41.0**	**177.53**		**37.0**	**160.21**		**24.0**	**16.32**		**6.0**	**4.08**		
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 – 2016/2017 Salmonid and Green Sturgeon Incidental Take and Monitoring Report

2016/2017
SALMONID AND GREEN STURGEON
INCIDENTAL TAKE AND MONITORING REPORT

October 30, 2017

Prepared By

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

2016/2017 SALMONID AND GREEN STURGEON INCIDENTAL TAKE AND MONITORING REPORT

TABLE OF CONTENTS **Page**

LIST OF FIGURES **Page**

LIST OF TABLES **Page**

2016/2017 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 (0. *tshawytscha)* surrogates, Central Valley steelhead (0. *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 2016/2017. 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 2016/2017 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:
http://www.water.ca.gov/swp/operationscontrol/calfed/calfeddat.cfm

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

In addition to those sites, during 2016/2017 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 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 steelhead loss 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 of the aforementioned 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 awaiting direction from Reclamation on how to proceed with the project. An analysis of the review will be included in the 2017/2018 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 2016/2017 from normal salvage counts, special studies, and secondary flushes. However, Figure 2 does not include any Chinook Salmon that cannot be classified using the Delta model length-at-date criteria. 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 2016/2017, fork lengths were obtained for all Chinook Salmon salvaged at the Delta fish facilities. At CVP, 96 sub-adults of an undetermined run of Chinook Salmon were salvaged that fell outside of the length-at-criteria (all greater than 500 mm fork length) and therefore no loss was calculated for those fish. At SWP, 6 sub-adults of an undetermined run of Chinook were observed during the 2016/2017 season.

Based on clarifications in DOSS (2013), DWR and Reclamation defined naturally-produced older juvenile Chinook Salmon as all non-adipose fin clipped (non-clipped) Chinook Salmon 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 considered in the Delta Model. The Delta Model 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.

Overall, the number of observed non-clipped older juvenile Chinook Salmon was higher than in 2015/2016. In 2016/2017, the observed non-clipped older juvenile Chinook Salmon salvaged occurred between early January and mid-July, the majority of which occurred during April and May 2017 (Figure 2). This is a departure from previous years when salvage generally occurred between December and May. There was no noticeable trend between the number of non-clipped older juvenile salvage and export levels.

Overall, the number of observed hatchery Chinook Salmon at the Delta fish facilities was also higher in 2016/2017 than in 2015/2016. Similar to the year 2015/2016, the Coleman Hatchery late fall-run brood year 2015 releases had the highest salvage out of all the hatchery fish observed in salvage. The number of observed Spring-run Chinook Salmon from the San Joaquin River Restoration Program were also notable.

Observed Chinook Salmon Genetic Run Assignment

For the 2016/2017 year, the Bureau of Reclamation (Reclamation) was leading the contract related to genetic analysis. This section will be updated after Reclamation receives the complete set of sample results from the Genetics laboratory.

Onset of Rapid Genetic Testing Protocol

Will be included upon receipt from Reclamation.

Winter-run Chinook Salmon

Winter-run Chinook Salmon Incidental Take

In 2016, DFW estimated a total adult escapement of 1,546 winter-run spawners to the upper Sacramento River, which is approximately 55% lower than the returns estimated in 2015 (3,439), and is also lower than the 10-year average of 2,909 adults. The methodology (Cormack-Jolly-Seber Model) used in 2016 to calculate the annual winter-run escapement was the same as was used in 2015. The Cormack-Jolly-Seber model allowed for an estimation of a 90% confidence interval, which ranged from 329 to 2,763 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 2015/2016. 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 2016 brood year. NMFS chose the Juvenile Production Index (JPI) method to calculate the Winter-run JPE from brood year 2016 because it more closely accounted for the actual hydrologic conditions that the winter-run egg and fry experienced in 2016. The process of calculating the JPE was similar to the previous year except that a significant change in the fecundity estimate occurred due to a larger than average number of returning 2-year old females to the upper Sacramento River.

For the water year 2017, NMFS estimated that 166,189 natural-origin juvenile Winter-run Chinook Salmon would enter the Delta. Based on this JPE, the incidental take level from October 1, 2016, through June 30, 2017, for the Delta fish facilities was 1,662 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 length 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/winter-run_juvenile_production_estimate__jpe_-_february_3_2017.pdf

Loss of Winter-run Chinook Salmon, based on the Delta Model, occurred at both Delta fish facilities for an expanded loss of approximately 164 fish at the SWP and approximately 20 fish at the CVP. The combined expanded loss of Winter-run sized Chinook Salmon was 184 for the season, approximately 11% of the permitted incidental take. Overall, the combined annual Winter-run sized Chinook Salmon loss was significantly 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. 17).
In 2016/2017, the combined older juvenile Chinook Salmon loss density trigger (NMFS RPA Action IV.2.3) was not exceeded and no export reductions occurred for the protection of non-clipped Winter-run Chinook Salmon.

Hatchery Winter-run Chinook Salmon Incidental Take

On February 2, 2017, an estimated 141,388 Winter-run smolts from Livingston Stone National Fish Hatchery (LSNFH) were released in the Sacramento River at Caldwell Park near Redding, California. According to the hatchery data, the release group was 100% adipose fin clipped and each was marked with a coded wire tag (CWT). The hatchery production group was not increased in 2016 because Shasta storage conditions necessary to meet the winter-run temperature criteria existed and the improvements from drought conditions. Based on preliminary release information and an updated survival term, NMFS estimated that 58,188 hatchery fish would enter the Delta. NMFS set the incidental take level at 1% of the total hatchery production entering the Delta, or 582 hatchery Winter-run Chinook Salmon from October 1, 2016, through June 30, 2017. There was no confirmed loss of hatchery Winter-run Chinook Salmon at the Delta fish facilities. Therefore, for this release group, no triggers were reached.

CWT fish salvaged at the SWP and CVP are carefully handled at the salvage facilities, in accordance with the Standard Operations Protocol. On occasion tag loss or damage does occur, and some tags are simply 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 2016/2017 year, the unknown loss was estimated at 32.88 at CVP and reported as 'Unknown CWT Loss'. (Table 2, pg. 34). At SWP, the unknown loss for 2016/2017 was estimated as 266.47 (Table 2, pg. 34). The combined unknown CWT loss at both facilities for the season was 299.35 (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 a surrogate because they would be released to begin their emigration and smoltification passage through the Delta at approximately the same time and size as wild spring-run. The Coleman National Fish Hatchery (CNFH) releases a percentage of the total CNFH Late Fall-run Chinook Salmon production into surrogate release groups.

In water year 2016/2017, CNFH released three groups of Late Fall-run Chinook Salmon uniquely marked as Spring-run Chinook Salmon surrogates into Battle Creek: 1) 75,000 on 12/12/16, 2) 81,279 on 12/21/16, and 3) 75,000 on 1/9/17. In addition to these surrogate releases, CNFH also released 434,227 Late Fall-run Chinook Salmon into Sacramento river on 6/11/15-6/12/15 and 861,966 Late Fall-run Chinook Salmon into Battle Creek on 12/9/16 as part of its production release. 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. DOSS members have also discussed the release timing for the Late Fall-run production release. DOSS provided the guidance to release the second surrogate group at least a week after the previous one, ideally preceding a precipitation event and the third group should be released 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 (2017).

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 2016/2017 season, the total Unknown loss due to Damaged Tags or Tags Not Found was 279.60 (Table 2, pg. 34). 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 75,000 CNFH Late Fall-run Chinook Salmon was released on December 12, 2016. A total confirmed loss of 181.82 was estimated from this group from the fish salvaged at the

Delta fish facilities (Table 1, pg. 33). The percent loss was calculated to be 0.242%, which was below the exceedance level according to NMFS BiOp.

Second Surrogate Release Group and Incidental Take

On December 21, 2016, CNFH released the second Spring-run Chinook Salmon surrogate hatchery group of approximately 81,279 Late Fall-run Chinook Salmon into Battle Creek. A total confirmed loss of 346.73 was estimated from this group from the fish salvaged at the Delta fish facilities (Table 1, pg. 33). The percent loss was calculated to be 0.427%, which was close to the exceedance level of 0.5% for the first stage trigger according to NMFS BiOp. DWR monitored the salvage from this group very closely to keep DOSS updated on the status of the trigger.

Third Surrogate Release Group and Incidental Take

On January 9, 2017, CNFH released the third Spring-run Chinook Salmon surrogate hatchery group of approximately 75,000 Late Fall-run Chinook Salmon into Battle Creek (Table 1, pg. 33). Interestingly, no confirmed loss occurred from this group as there was no salvage observed from this group (Table 1, pg. 33). The percent loss was calculated to be 0%, which was obviously 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 2016 and July 2017 was approximately 111,695, which is significantly higher than previous few years' salvage (Figure 5, pg. 18). 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 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 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 2016/2017 was significantly higher 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, 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. Due to the large number of CWT fish sampled, in addition to other sampling requirements, the processing of approximately 3000 fish were yet to be completed during preparation of this report. Based on the data received on 9/6/17, USFWS recovered O surrogates from the first surrogate release, 1 surrogate from the second release group, and 1 surrogate from the third release group (Figure 7, pg. 20). 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 18 surrogates from the first surrogate release, a total of 19 from the second surrogate release in February, and 6 surrogates for the third surrogate release. The total numbers of recovered surrogates were higher in 2016/2017 compared to the previous year. A similar trend has been observed when 2015/2015 numbers were compared to 2016/2017. 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.

Hatchery Winter-Run Chinook Salmon Monitoring

Recoveries of hatchery Winter-run Chinook Salmon from LSNFH in the Delta monitoring trawls were lower than 2015/2016. Between late February and late March of 2017, the USFWS recovered 4 hatchery Winter-run Chinook Salmon from LSNFH. A total of 4 hatchery Winter-run Chinook Salmon from LSNFH were recovered in the Chipps Island midwater trawl (Figure 8, pg. 21). Overall recoveries were lower than the previous water

year where USFWS caught 17 hatchery Winter-run Chinook Salmon in the Sacramento Trawls and 89 hatchery Winter-run from LSNFH in the Chipps Island trawl.

Central Valley Steelhead

Steelhead Incidental Take

Between October 2016 and July 2017, the CVP salvaged a total of 11 non-clipped steelhead, and the SWP salvaged a total of 6, (Figure 13, pg. 28). Comparing the numbers salvaged at each facility individually, SWP salvaged almost twice as many as CVP. However, DWR and Reclamation did not exceed any steelhead loss triggers from January to June 2017 for more restrictive Old and Middle River flow limits (Figure 9, pg. 24). 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 lower than in the past nine water years (Figure 14, pg.29).

The SWP and CVP total expanded salvage of non-clipped steelhead was approximately . 41 and 24, 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 2016/2017 slightly decreased from 2015/2016, when it was 119 (Figure 9, pg. 24).
The SWP and CVP salvage of hatchery (adipose fin clipped) steelhead significantly decreased in 2016/2017 compared to the previous year. From October 2016 to July 2017, the CVP salvaged a total of 6 and the SWP salvaged a total of 37 for a combined total annual salvage of 43 steelhead (Figure 10, pg. 25). It was much lower than the total of 1,321 in 2015/2016.

Green Sturgeon Incidental Take

The incidental take level for green sturgeon was set at 74 fish for water year 2017 and is based on historical salvage. In the 2016/2017 period, 1 Green Sturgeon was observed at the State Water Facility on 6/19/17. There was 1 Green Sturgeon observed at the state facility in the previous water year. No Green Sturgeon were observed at the Federal Facility during the water year 2016/2017.

Delta Hydrology

Above-average precipitation and snowpack have been observed during Water Year 2017, which officially marked the end of five consecutive years of California's drought. 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. As of May 31, 2017, The California Department of Water Resources measured the statewide

snowpack to be at 190% of the normal for the date. Above average precipitation of the water year 2017 has filled the majority reservoirs of the state of California. More information on the history of drought and hydrology of 2017 can be found at http://ca.water.usgs.gov/data/drought/.

Overall, average exports for Sacramento River and San Joaquin River were both significantly higher in 2016/2017 than they were in 2015/2015. Water year 2016 was classified as a "below normal" water year type for the Sacramento Valley, and as a "Dry" water year type for San Joaquin Valley regardless of above average precipitation during 2016 water year. 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. Overall, these fingerprints show that the majority of the water from the SWP came from San Joaquin River, which is unusual because the majority of SWP water typically comes from the Sacramento River. In 2016/2017, the majority of water at the CVP also came from the San Joaquin River, while in the previous year water at CVP was more evenly split between the Sacramento and the San Joaquin Rivers (Fig 17, pg. 32).

References

Anderson, J.J., J.A. Gore, R.T. Kneib, M.S. Lorang, J.M. Nestler, and J. Van Sickle. 2013. Report of the 2013 Independent Review Panel on the Long-term Operations Biological Opinions (LOBO) Annual Review. Prepared for the Delta Science Program.

[DFW] California Department of Fish and Wildlife. 2013. Chinook Salmon Loss Estimation for Skinner Delta Fish Protective Facility and Tracy Fish Collection Facility. Protocol. Stockton, California.

[DWR and Reclamation] California Department of Water Resources and U.S. Bureau of Reclamation. 2012. 2011/2012 Salmonid and Green Sturgeon Incidental Take and Monitoring Report. West Sacramento, California.

[DWR and Reclamation] California Department of Water Resources and U.S. Bureau of Reclamation. 2013. 2012/2013 Salmonid and Green Sturgeon Incidental Take and Monitoring Report. West Sacramento, California.

[DWR and Reclamation] California Department of Water Resources and U.S. Bureau of Reclamation. 2013. 2013/2014 Salmonid and Green Sturgeon Incidental Take and Monitoring Report. West Sacramento, California.

[DWR and Reclamation] California Department of Water Resources and U.S. Bureau of Reclamation. 2014. 2014/2015 Salmonid and Green Sturgeon Incidental Take and Monitoring Report. West Sacramento, California.

[CFS] Cramer Fish Sciences. 2013. Alternative Loss Calculation: Sensitivity Analysis. Lacey, Washington.

Dekar, M., P. Brandes, J. Kirsch, L. Smith, J. Speegle, P. Cadrett, and M. Marshall. 2013. Background Report Prepared for Review by the IEP Science Advisory Group, June 2013. U.S. Fish and Wildlife Service. Lodi, California.

[DOSS] Delta Operations for Salmonids and Sturgeon Technical Working Group. 2011. Annual Report of Activities October 1, 2010, to September 30, 2011.

[DOSS] Delta Operations for Salmonids and Sturgeon Technical Working Group. 2013. Annual Report of Activities October 1, 2010, to September 30, 2013.

[DOSS] Delta Operations for Salmonids and Sturgeon Technical Working Group. 2014. Annual Report of Activities October 1, 2013, to September 30, 2014.

[DOSS] Delta Operations for Salmonids and Sturgeon Technical Working Group. 2014. Annual Report of Activities October 1, 2013, to September 30, 2015.

[DOSS] Delta Operations for Salmonids and Sturgeon Technical Working Group. 2014. Annual Report of Activities October 1, 2015, to September 30, 2016.

[DOSS] Delta Operations for Salmonids and Sturgeon Technical Working Group. 2014. Annual Report of Activities October 1, 2016, to September 30, 2017.

Hassrick, J., and S. Hayes. Unpublished Data. Survival of Migratory Patterns of Juvenile Winter-run Chinook Salmon in the Sacramento River, Delta, and San Francisco Bay. Results of the first year acoustic tag study.

Jahn, A., and P. Smith. 1987. Effects of sample size and contagion on estimating fish egg abundance. CalCOFI Reports 28:171-177.

Jahn, A. 2011. An Alternative Technique to Quantify the Incidental Take of Listed Anadromous Fishes at the Federal and State Water Export Facilities in the San Francisco Bay-Delta Estuary. Ukiah, California.

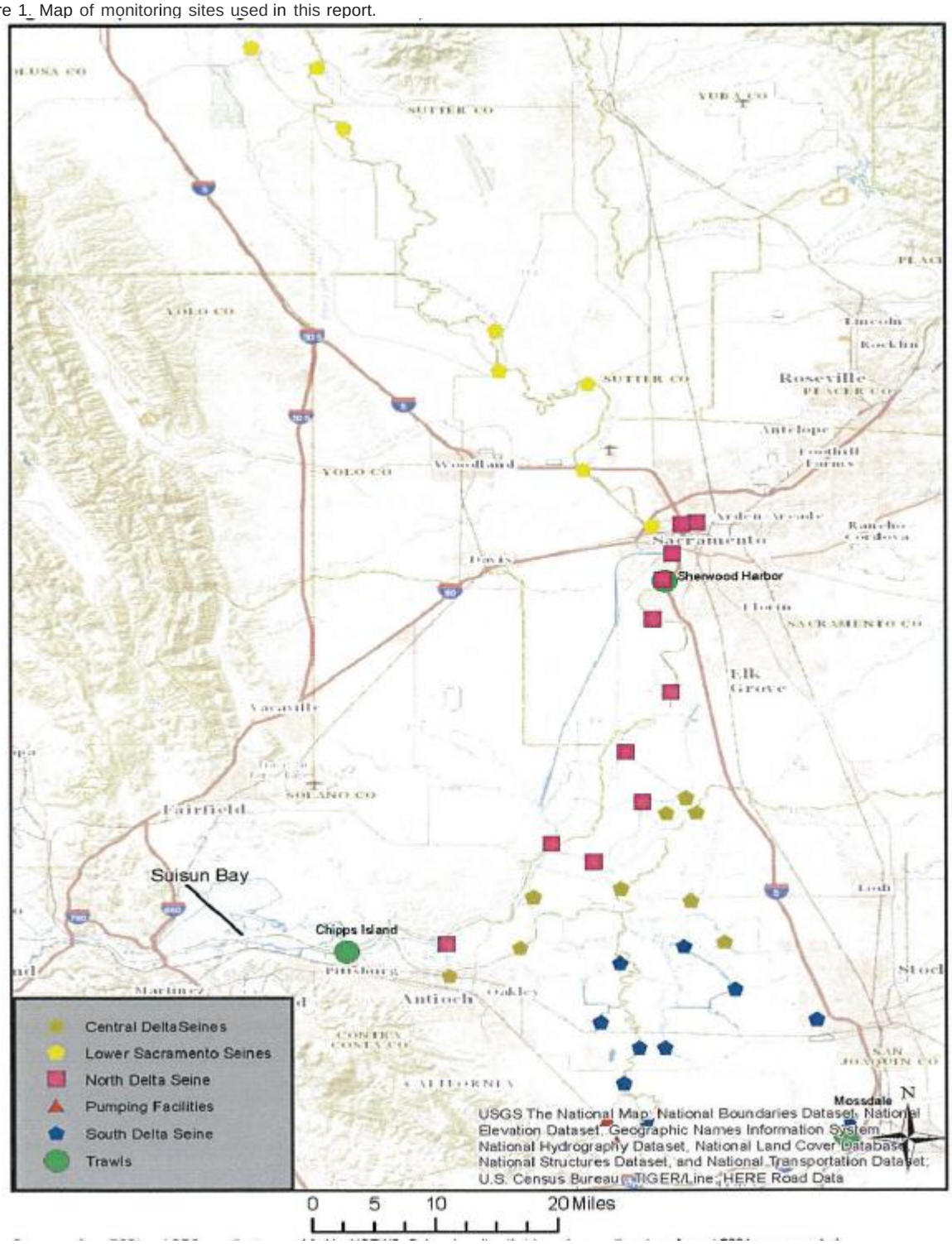
Michel, C.J., A.J. Ammann, S.T. Lindley, P.T. Sandstrom, E.D. Chapman, H.E. Fish, M.J. Thomas, G.P. Singer, P. Klimley, and B. Macfarlane. Unpublished Draft. Chinook Salmon (*Oncorhynchus tshawytscha)* Outmigration Survival between Wet and Dry Years in California's Sacramento River.

[NMFS] National Marine Fisheries Service. 2009. Biological Opinion and Conference Opinion on the Proposed Long-term Operations of the Central Valley Project and State Water Project. Long Beach, California.

Rea, M. 2017. Letter to Mr. Ron Milligan of the Bureau of Reclamation on the juvenile winter-run Chinook Salmon production estimate during water year 2017. February 3, 2017. National Marine Fisheries Service. Sacramento, California.

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 ec;tive since August 2004 are presented.

Figure 2. Observed Chinook salvage at the Delta fish facilities, with Delta hydrology, August 1, 2016, through July 31, 2017. Chinook salmon race/run designation is based on Delta model and Coded Wire Tag recoveries.

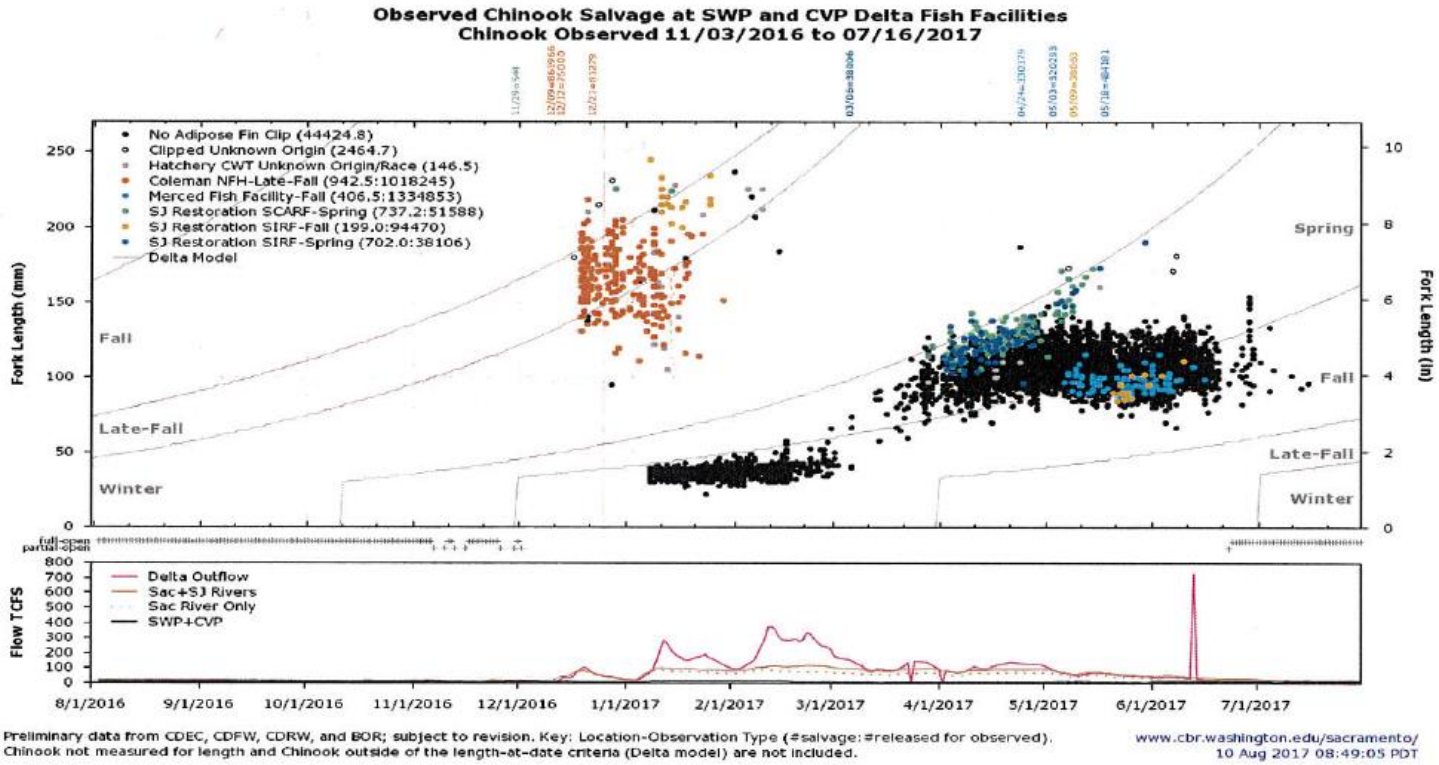


Figure 3. Daily loss and loss density of non-clipped winter-run length and older juvenile Chinook Salmon at the Delta fish facilities using the current loss equation (DFW 2013), October 1, 2016, through June 30, 2017.

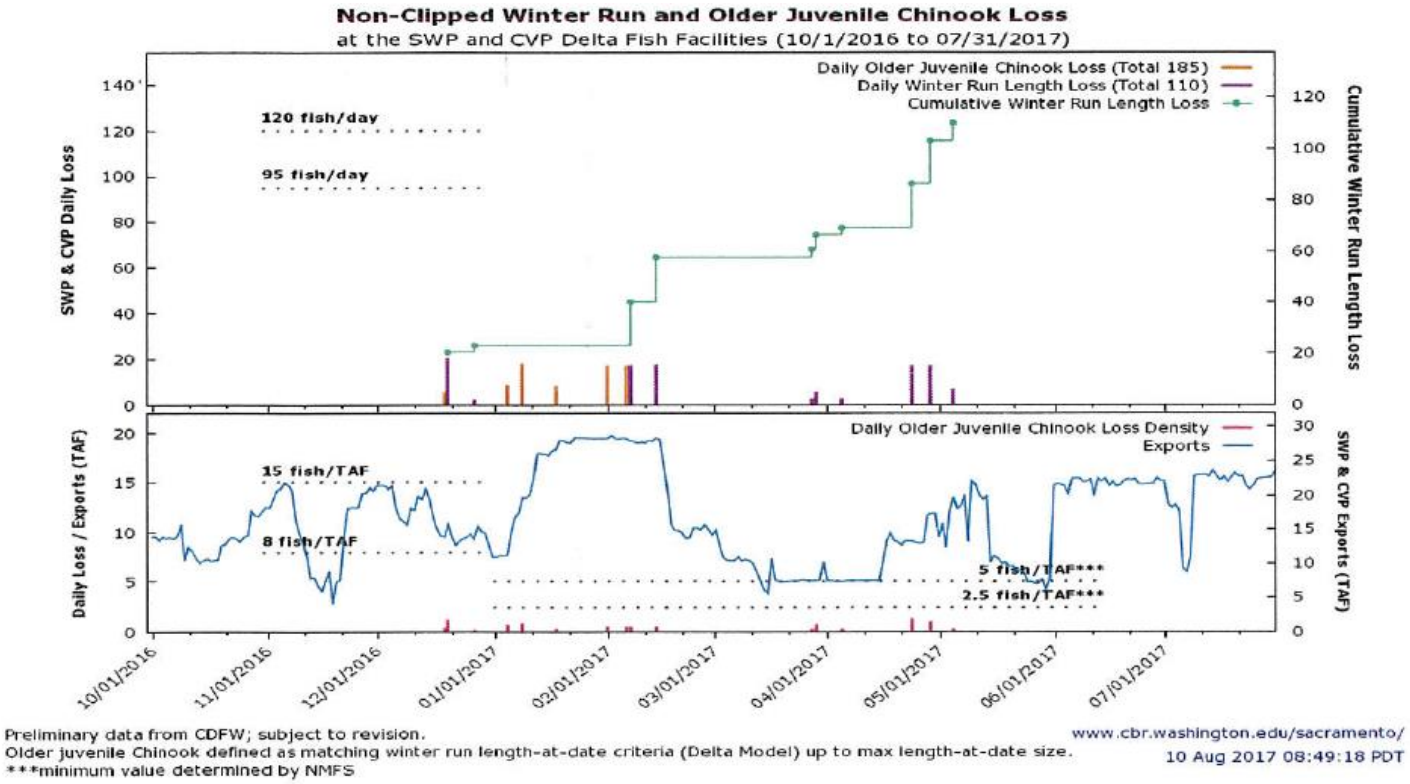


Figure 4. Non-clipped winter-run length Chinook Salmon loss at the Delta fish facilities from October to June using the current loss equation (DFW 2013), water years 2006 through 2017.

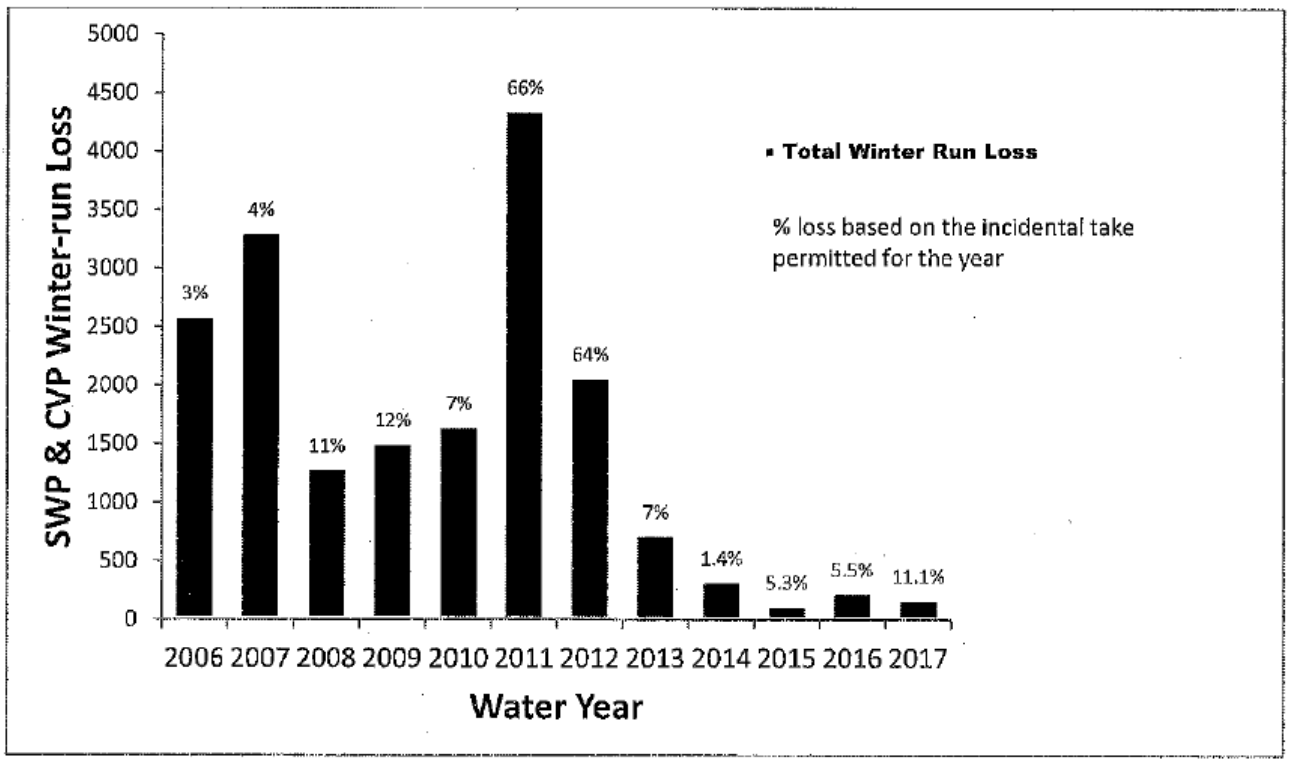


Figure 5. Daily loss and loss density of non-clipped fry/smolt Chinook Salmon at the Delta fish facilities using the current loss equation (DFW 2013), October 1, 2016 through July 31, 2017.

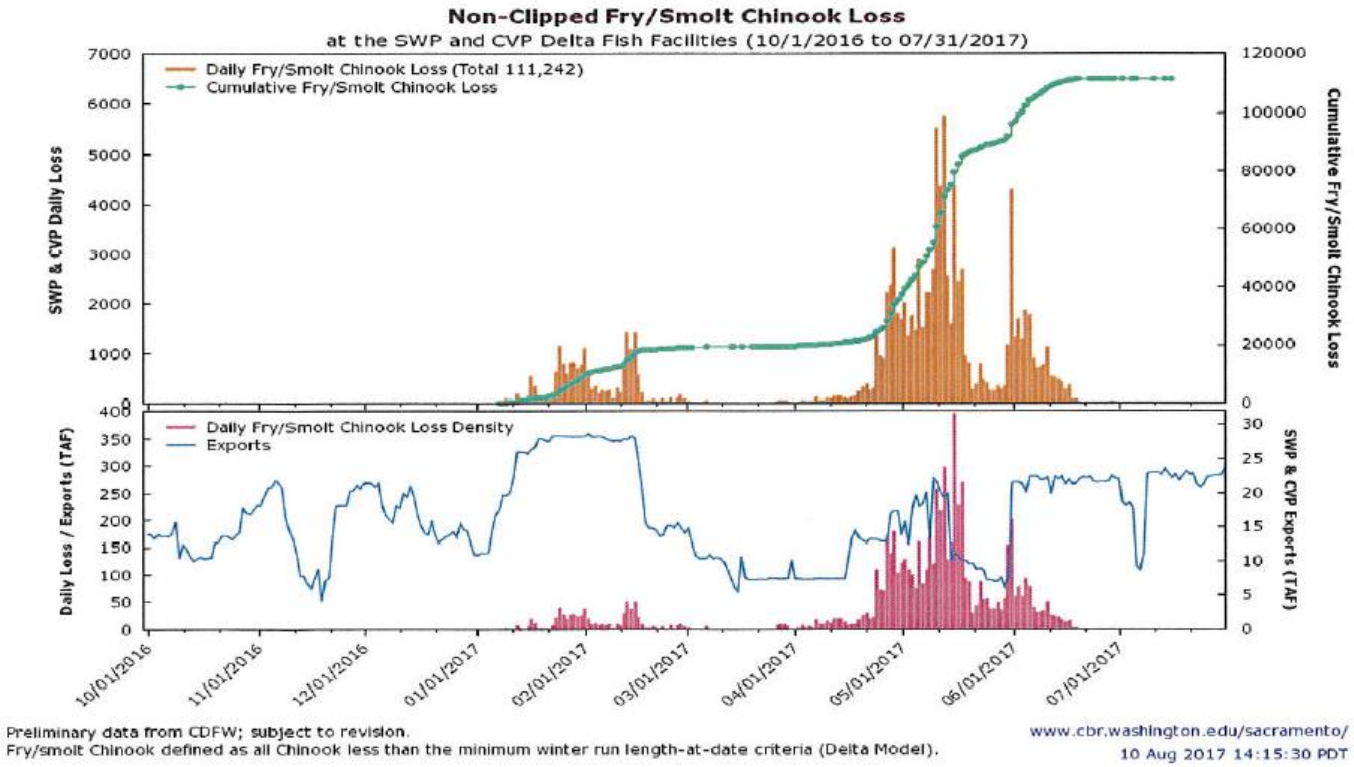


Figure 6. Non clipped fry/smolt Chinook Salmon loss at the Delta fish facilities from October to July using the current loss equation (DFW 2013) , water years 2006 through 2017.

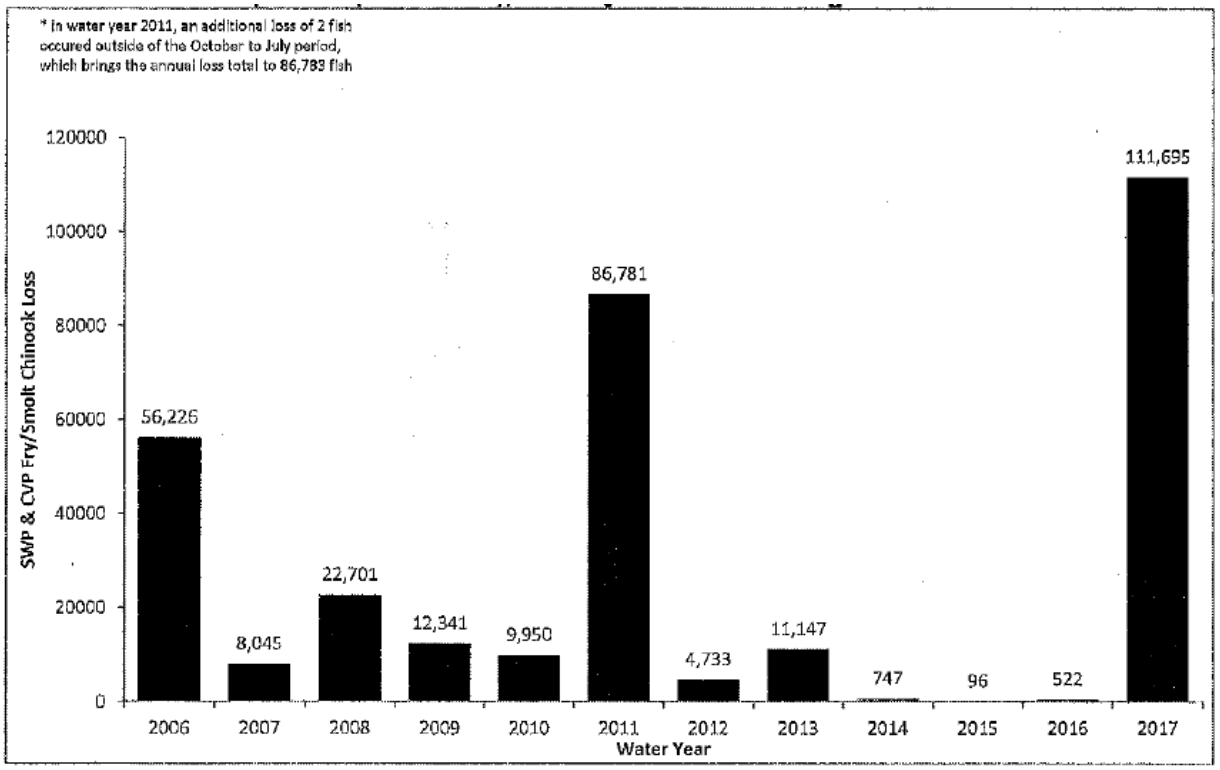


Figure 7. Older juvenile Chinook Salmon and LSNFH winter-run Chinook Salmon recoveries from the Delta monitoring program and loss at the Delta fish facilities, October 1, 2016 through July 30, 2017.

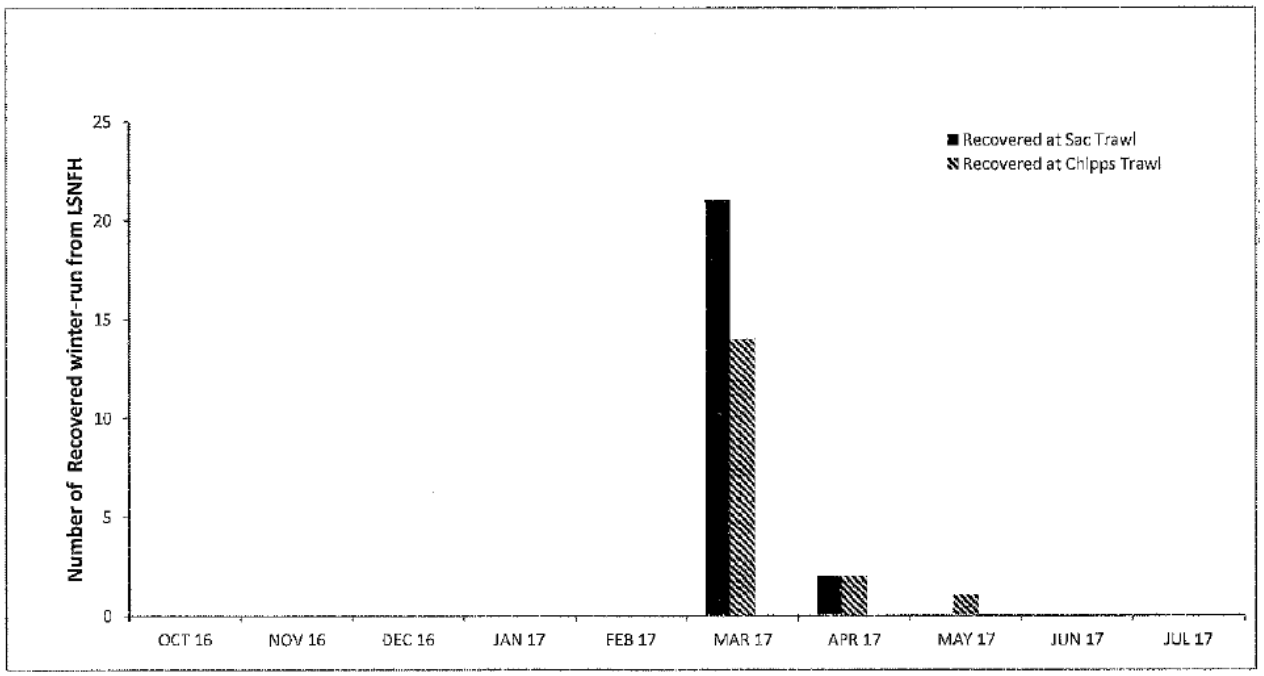
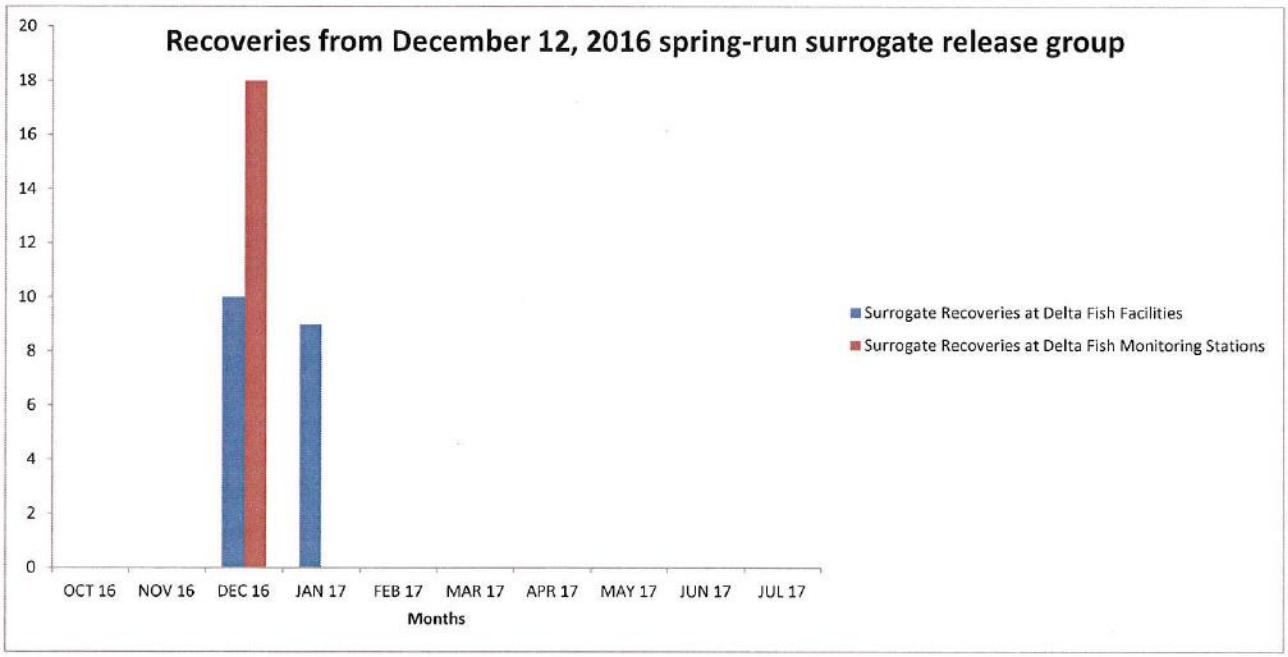
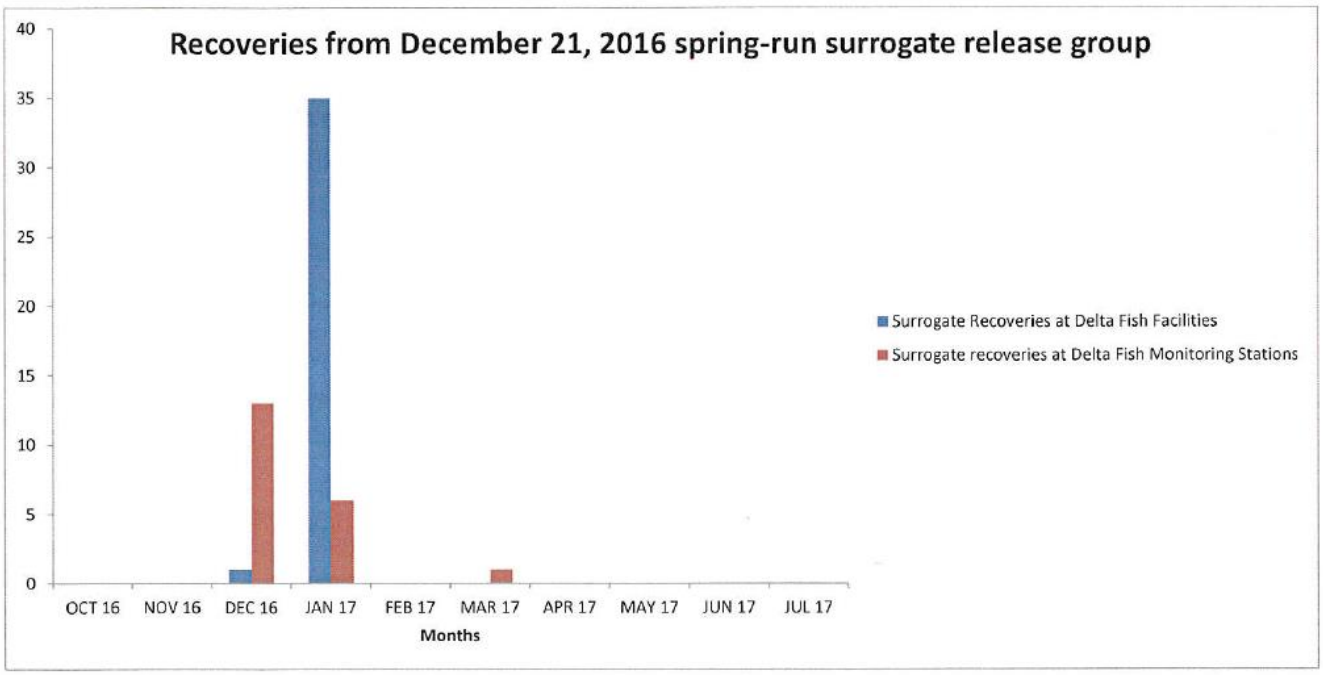
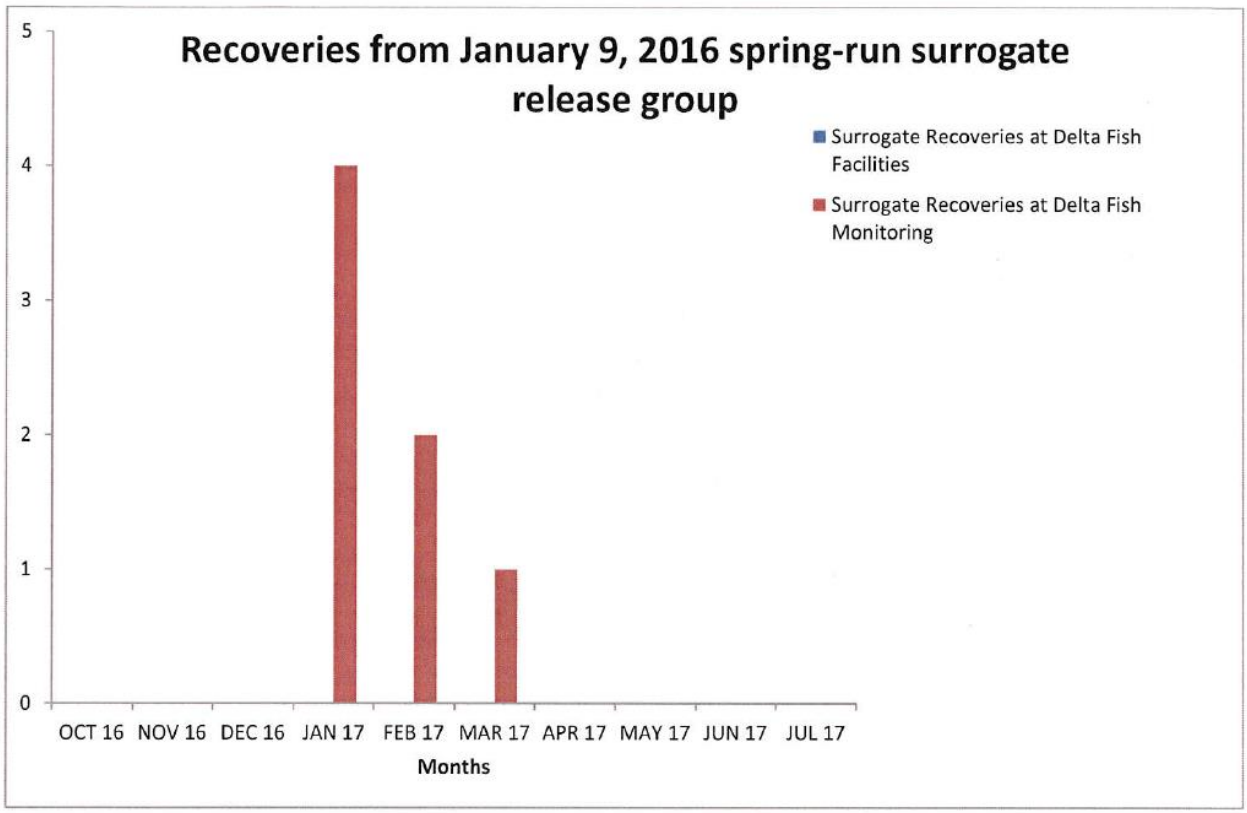


Figure 8. Older juvenile Chinook Salmon and CNFH late-fall Chinook Salmon (spring-run surrogate) recoveries from the Delta monitoring program and loss at the Delta fish facilities, October 1, 2016 through June 30, 2017.




Recoveries from December 21, 2016 spring-run surrogate release group
40
35
30
25
20
15
10
5
0
OCT 16
NOV 16
DEC 16
JAN 17
FEB 17
MAR 17
APR 17
MAY 17
JUN 17
JUL 17
Months
Surrogate Recoveries at Delta Fish Facilities
Surrogate recoveries at Delta Fish Monitoring Stations

22


Recoveries from January 9, 2016 spring-run surrogate release group
Surrogate Recoveries at Delta Fish Facilities
Surrogate Recoveries at Delta Fish Monitoring
5
4
3
2
1
0
OCT 16
NOV 16
DEC 16
JAN 17
FEB 17
MAR 17
APR 17
MAY 17
JUN 17
JUL 17
Months

23

Figure 9. Non-clipped steelhead salvage at the Delta fish facilities, October 2016 through July 2017.

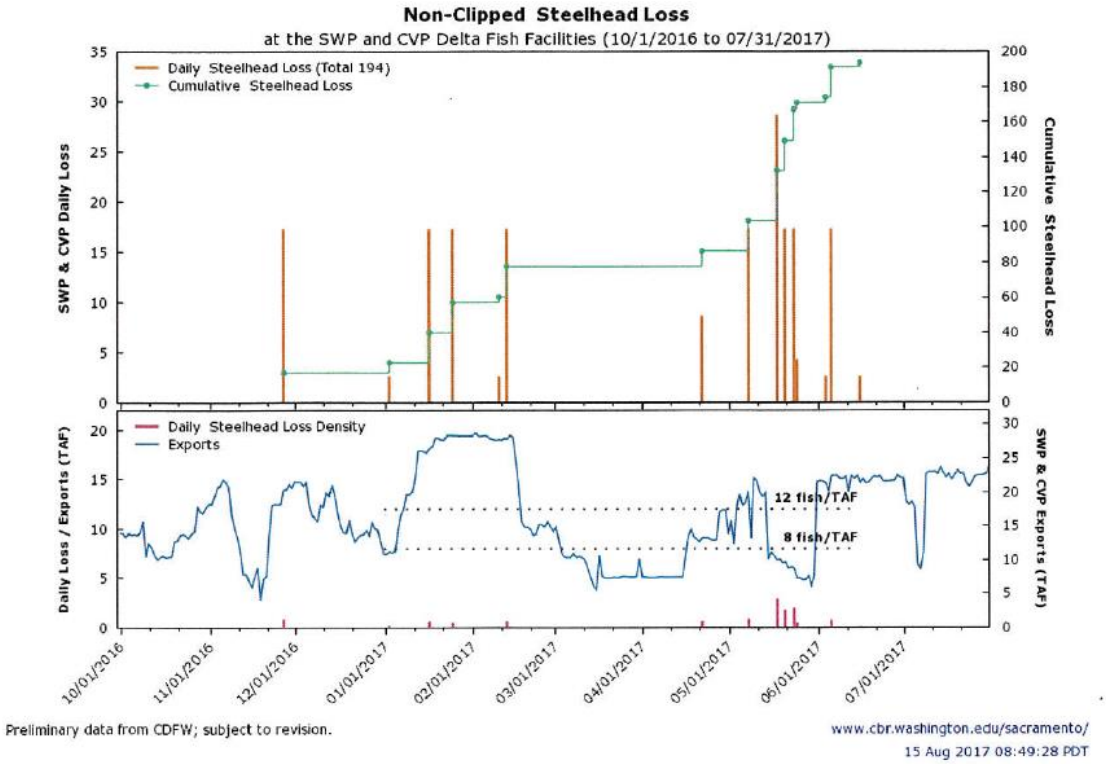


Figure 10. Total steelhead salvage (adipose fin clipped & non-clipped) at the Delta fish facilities, October 2016 through July 2017.

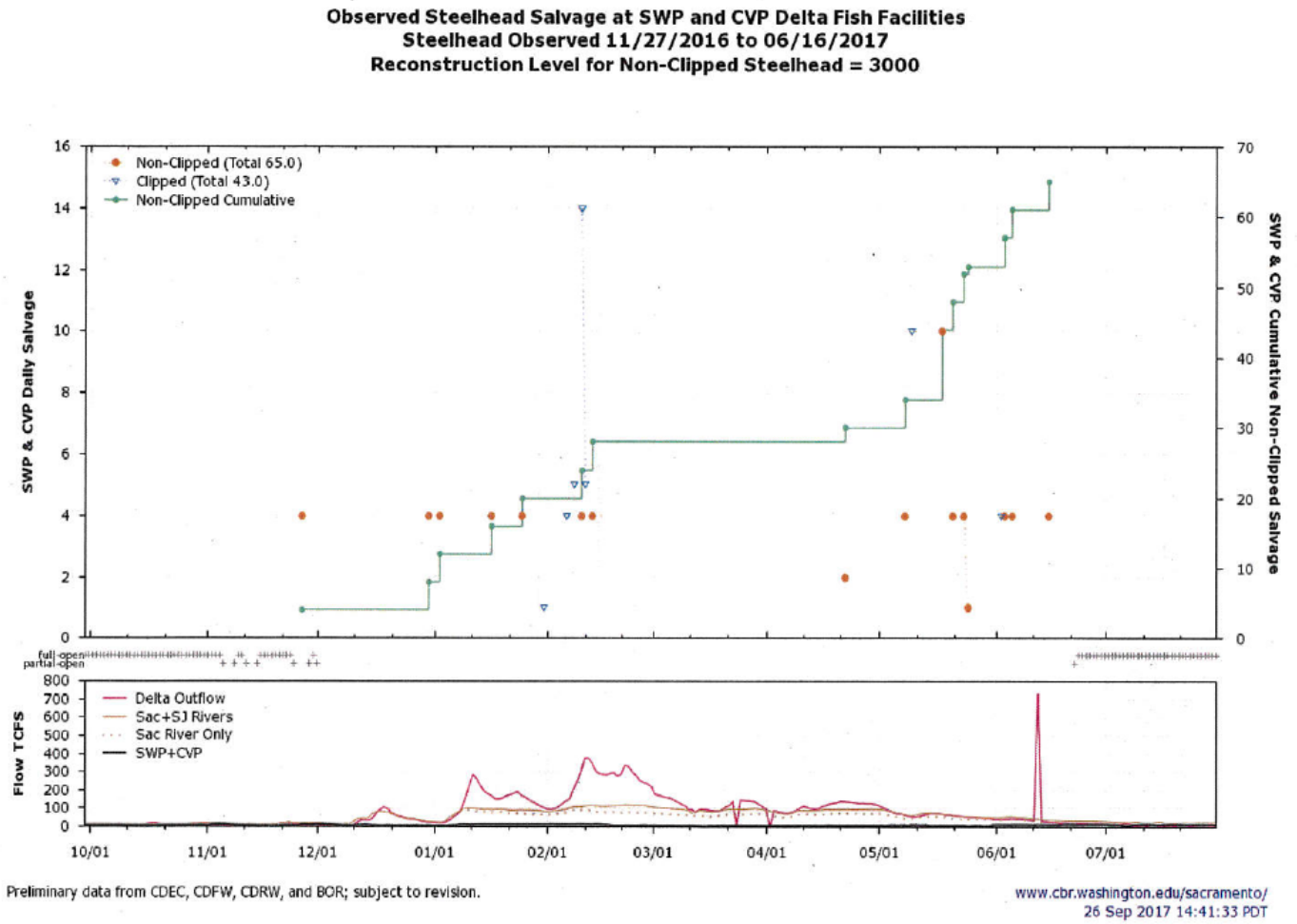


Figure 11. Non-clipped steelhead salvage at the Delta fish facilities from October to July, water years 2007 through 2017.

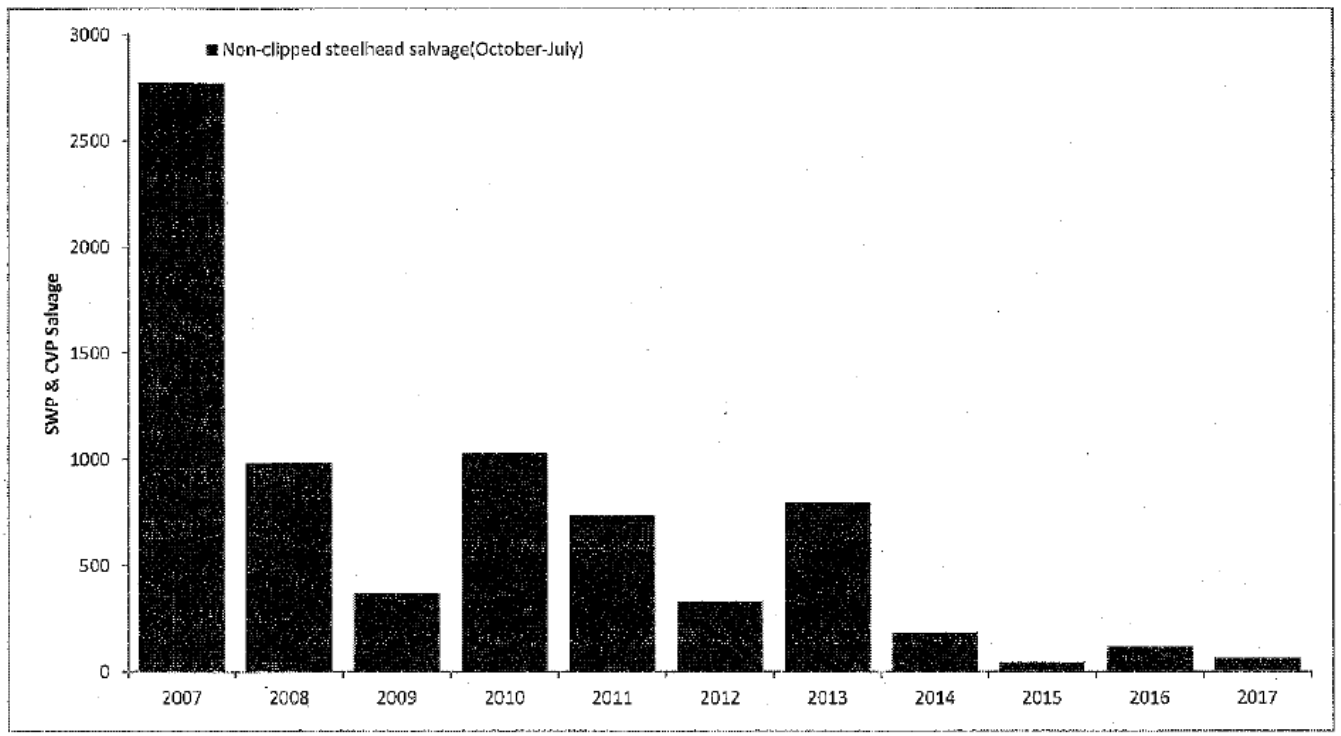


Figure 12. Hatchery (adipose fin clipped) steelhead salvage at the Delta fish facilities from October to July, water years 2007 through 2017.

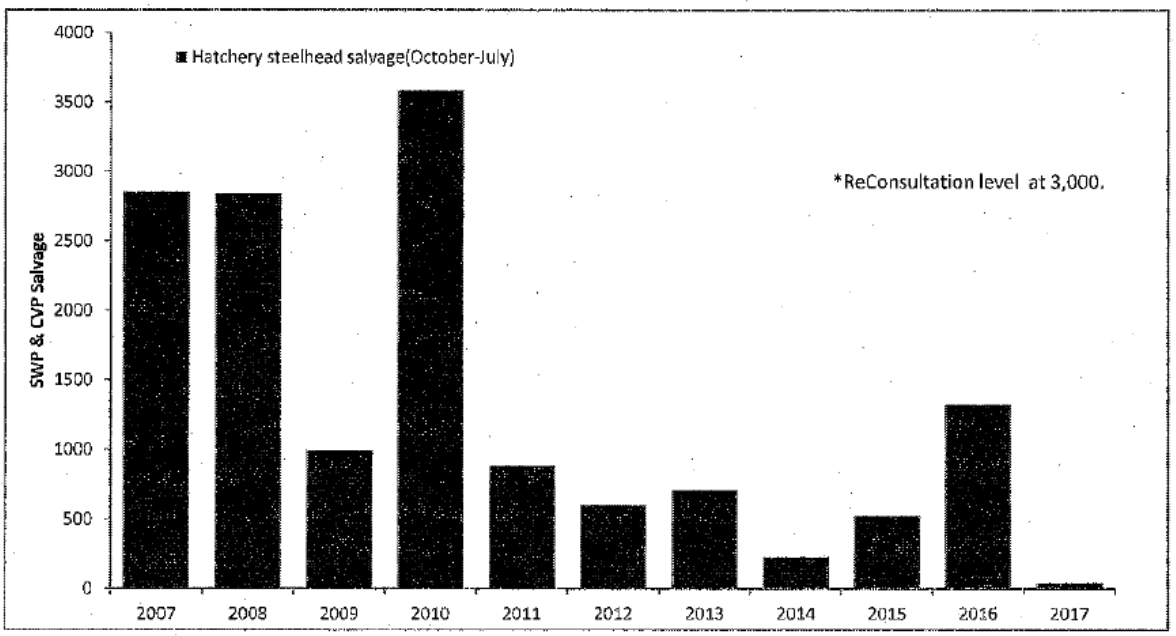


Figure 13. Daily loss and loss density of non-clipped steelhead at the Delta fish facilities using the current loss equation (DFW 2013), October 1, 2016 through July 31, 2017.

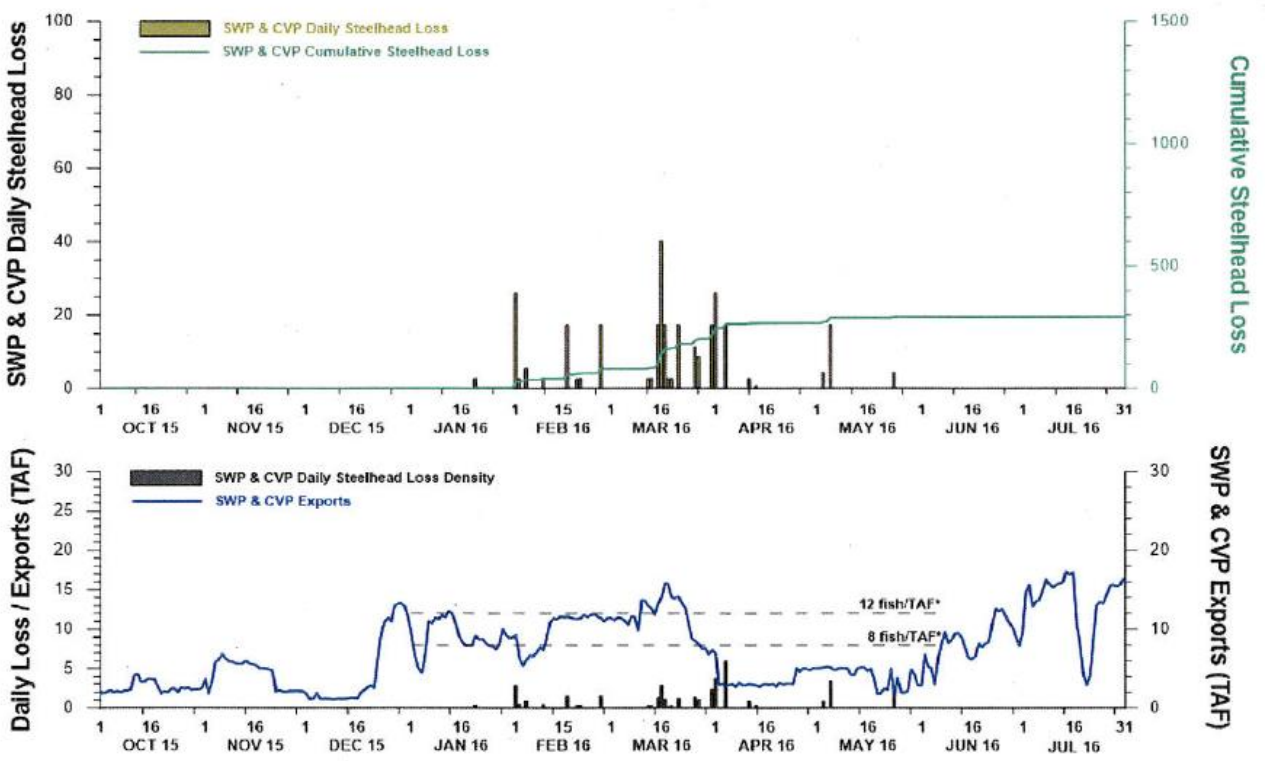


Figure 14. Green sturgeon salvage at the Delta fish facilities from October to July, water years 2007 through 2017.

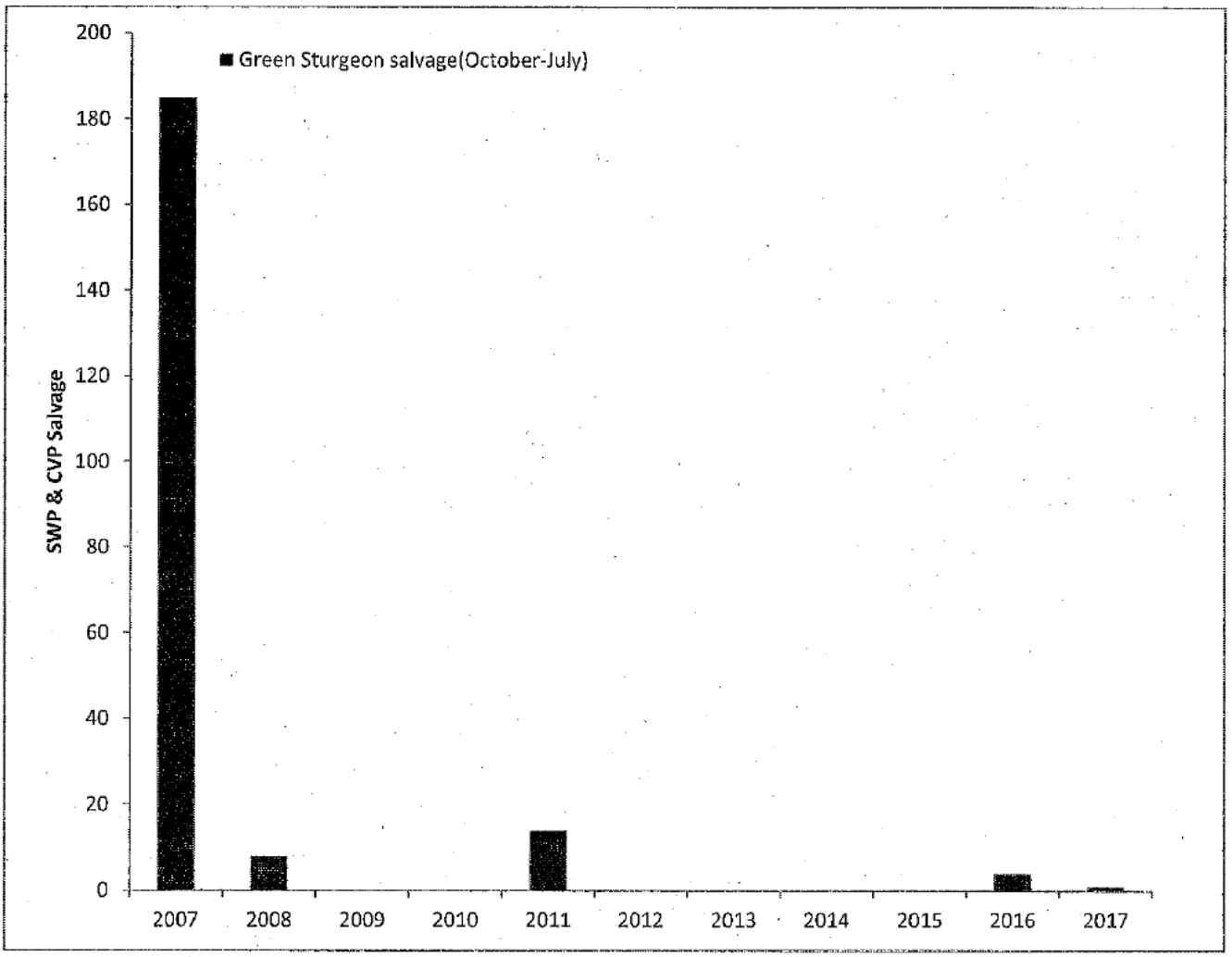
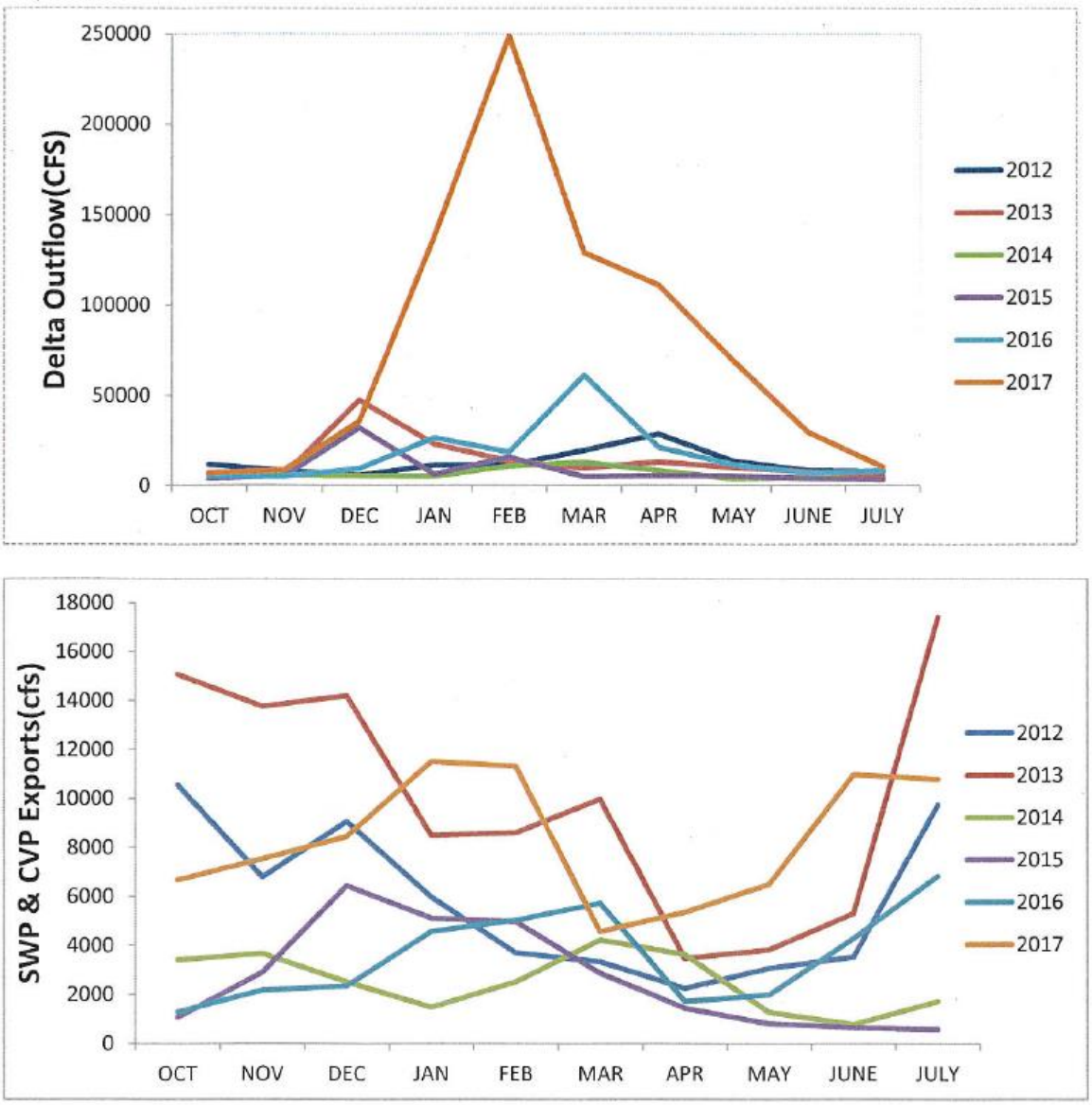
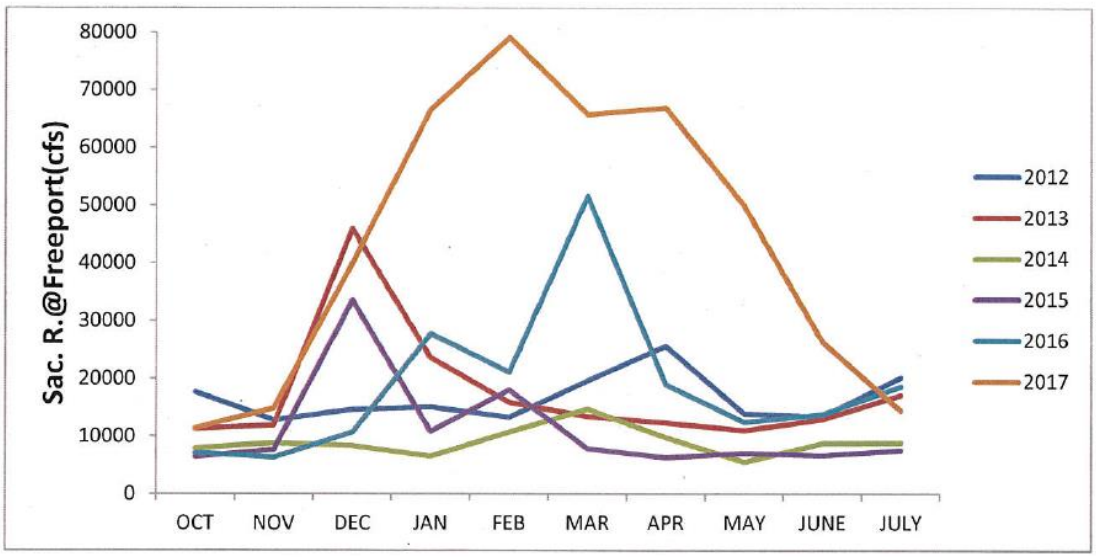


Figure15. Monthly averages of Delta hydrology from October to July, water years 2007 through 2017.




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

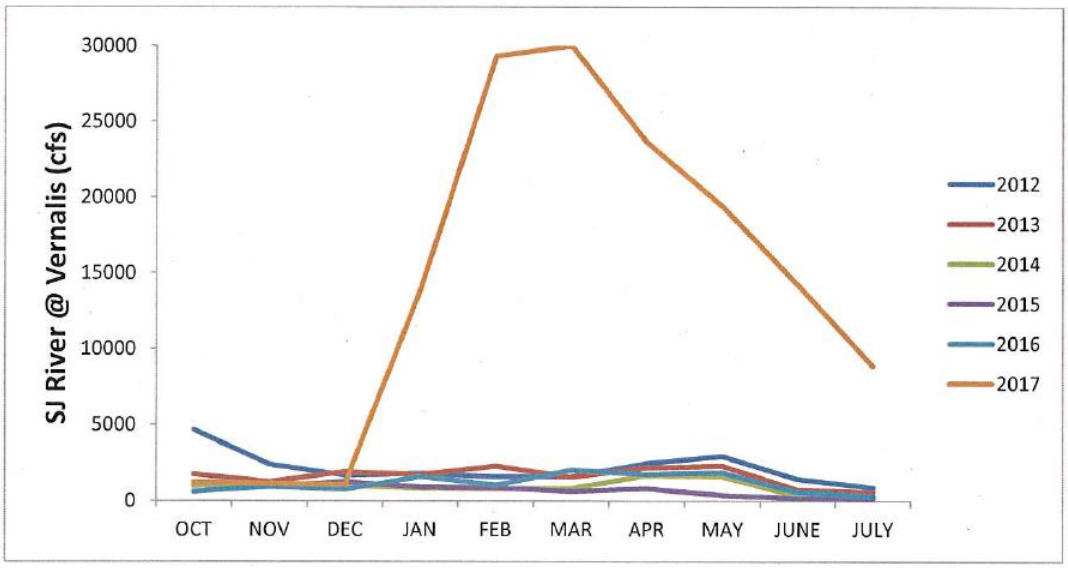

SJ River @ Vernalis (cfs)
30000
25000
20000
15000
10000
5000
0
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUNE
JULY
2012
2013
2014
2015
2016
2017

Figure 16. Modeled volumetric water fingerprint for the Clifton Court Forebay **(SWP)** as derived from DSM2, October 2016 through July 2017.

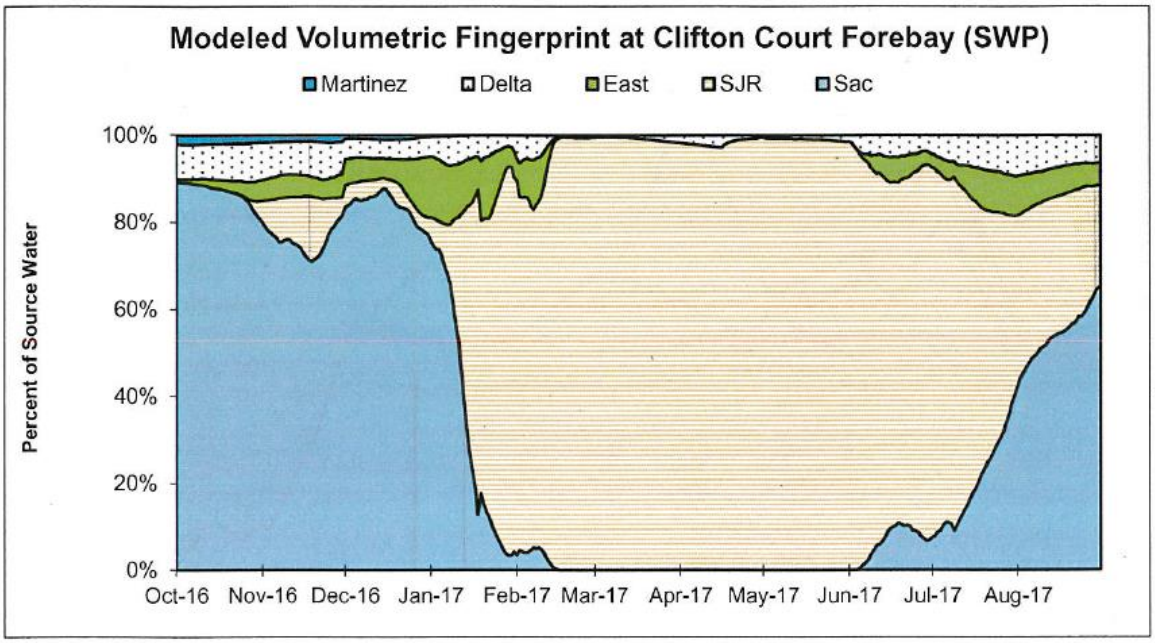
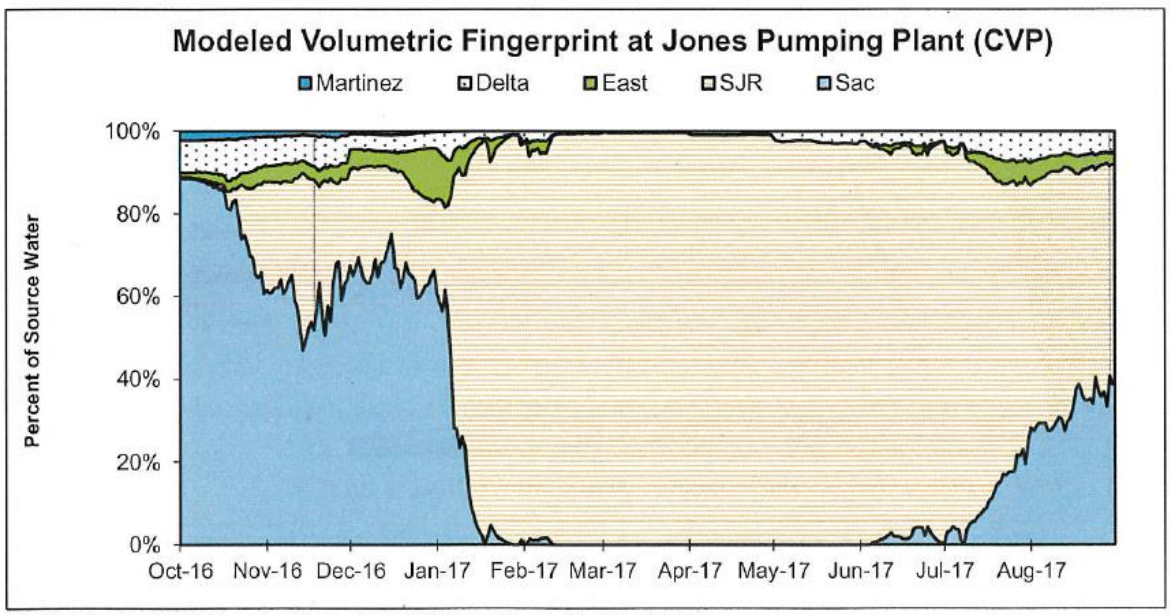


Figure 17. Modeled volumetric water fingerprint for the Jones Pumping Plant (CVP) as derived from DSM2, October 2016 through July 2017.



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 2016 through June 2017.

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]
12/9/2016	LF	Coleman NFH	Battle Creek	Production	1642.62	861,968	n/a	0.191	n/a	n/a	12/18/2016	1/23/2017
12/12/2016	LF	Coleman NFH	Battle Creek	Spring Surrogate	181.82	75,000	n/a	0.242	n/a	0.6%	12/22/2016	1/19/2017
12/21/2016	LF	Coleman NFH	Battle Creek	Spring Surrogate	348.73	81,279	n/a	0.427	n/a	0.6%	12/30/2016	1/29/2017
1/9/2017	LF	Coleman NFH	Battle Creek	Spring Surrogate	0.00	75,000	n/a	0.000	n/a	0.6%	'	'
2/2/2017	W	Livinstone NFH	Sacramento River	WR	0.00	141,388	n/a	0.000	n/a	0.8%	'	'
11/29/2016	F	SJRRP	San Joaquin River	Experimental	175.35	1200	n/a	14.613	n/a	n/a	12/23/2017	1/25/2017
11/29/2016	S	SJRRP	San Joaquin River	Experimental	6.05	544	n/a	1.112	n/a	n/a	12/27/2016	1/14/2017
3/6/2017	S	SCARF	San Joaquin River	Experimental	762.54	60,108	n/a	1.269	n/a	n/a	3/29/2017	5/15/2017
3/6/2017	S	SIRF	San Joaquin River	Experimental	448.77	38,108	n/a	1.178	n/a	n/a	4/2/2017	5/17/2017
4/24/2017	F	MRH	Merced River	Experimental	178.44	70,591	n/a	0.250	n/a	n/a	5/2/2017	6/1/2017

Table 2. Unknown hatchery (adipose fin clipped) Chinook Salmon loss at the Delta fish facilities using the current loss equation (DFW 2'014), October 2016 through June 2017

Facility	Unknown CWT Loss[5]	Unread CWT Loss[6]	Unknown Hatchery Loss[7]	Acoustic Tag Loss[8]	Number of Unassigned CWTs[9]
SWP	266.47				
CVP	32.88				
TOTAL	299.35				

'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).

"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.

"Adipose-fin clipped Chinook released due to presence of sutures.

"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 Informatlon is available.

Table 3. Monthly averages of hydrologic parameters in the Sacramento-San Joaquin River Delta, October 2016 through July 2017.

	SWP Average Exports		CVP Average Exports		Sacramento River Average Flow	San Joaquin River Average Flow	Delta Outflow Average Flow
Month	taf	cfs	taf	cfs	cfs	cfs	cfs
Oct	176	2857	234	3812	11428	1224	7115
Nov	290	4872	159	2664	14867	1147	8620
Dec	302	4907	218	3540	39882	1064	35720
Jan	476	7742	232	3771	66652	13832	138190
Feb	407	7327	221	3982	79161	29334	248842
Mar	55	891	227	3684	65747	30013	129092
Apr	84	1413	235	3945	66954	23651	111047
May	251	4074	149	2424	49910	19413	69003
Jun	392	6595	261	4384	26414	14262	29482
Jul	403	6556	261	4245	14464	8879	10440

Appendix G – WY 2017 Fish Monitoring Figures from SacPAS

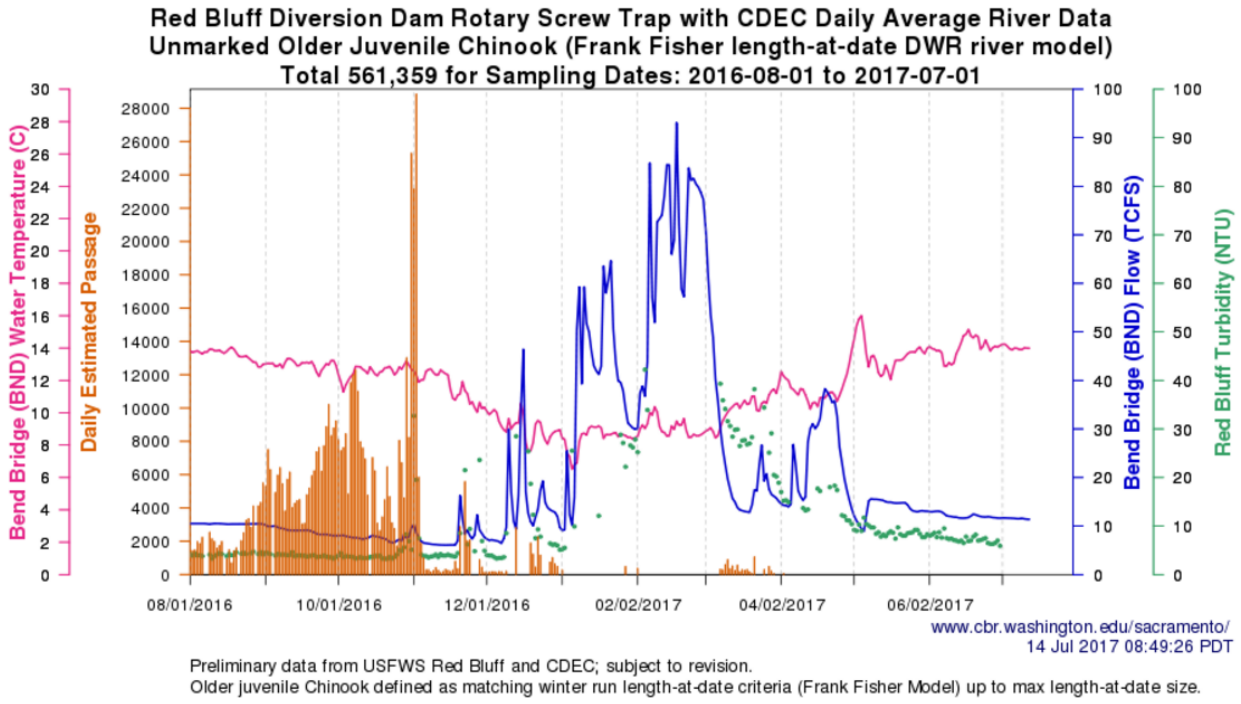


Figure 4X-1 Daily passage of unmarked older juvenile Chinook (orange bars) captured in rotary screw traps at Red Bluff Diversion Dam compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Bend Bridge and turbidity (NTU; green line) at Red Bluff Diversion Dam.

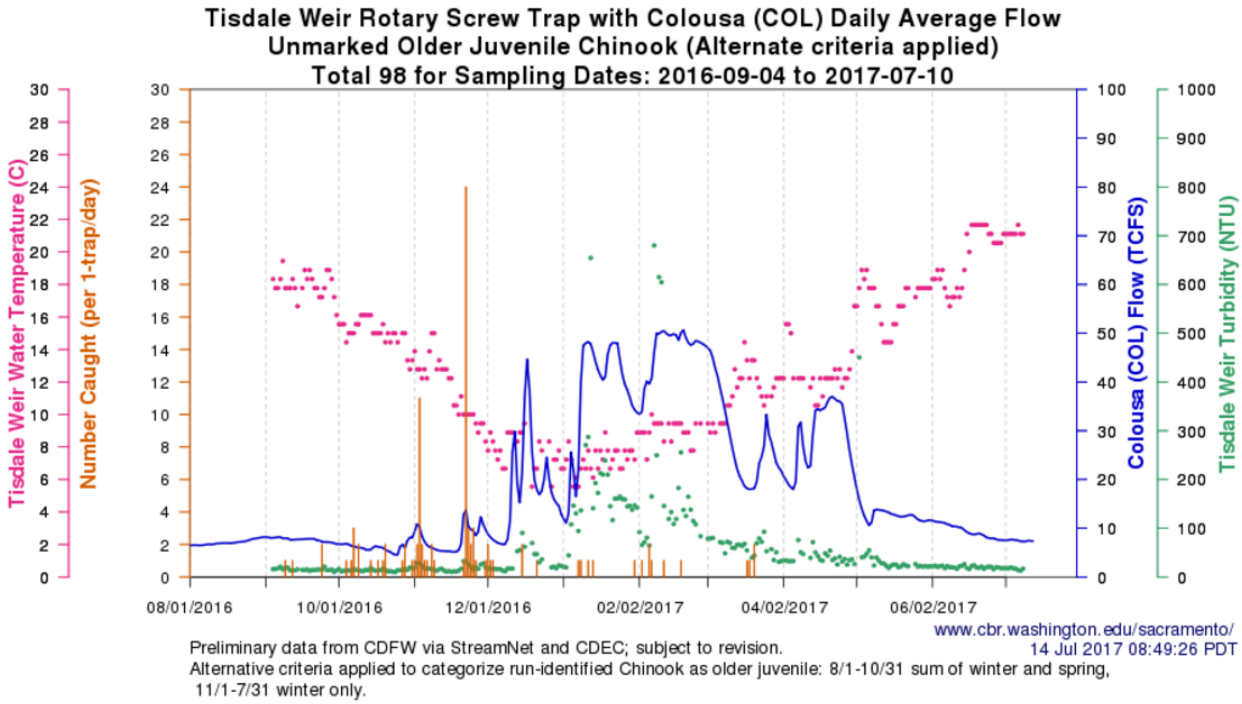


Figure 4-X2 Daily passage of unmarked older juvenile Chinook (orange bars) captured in rotary screw traps at Tisdale Weir compared to water temperature (°C; pink line) at Tisdale Weir, flow (TCFS; blue line) at Colusa, and turbidity (NTU; green line) at Tisdale Weir.

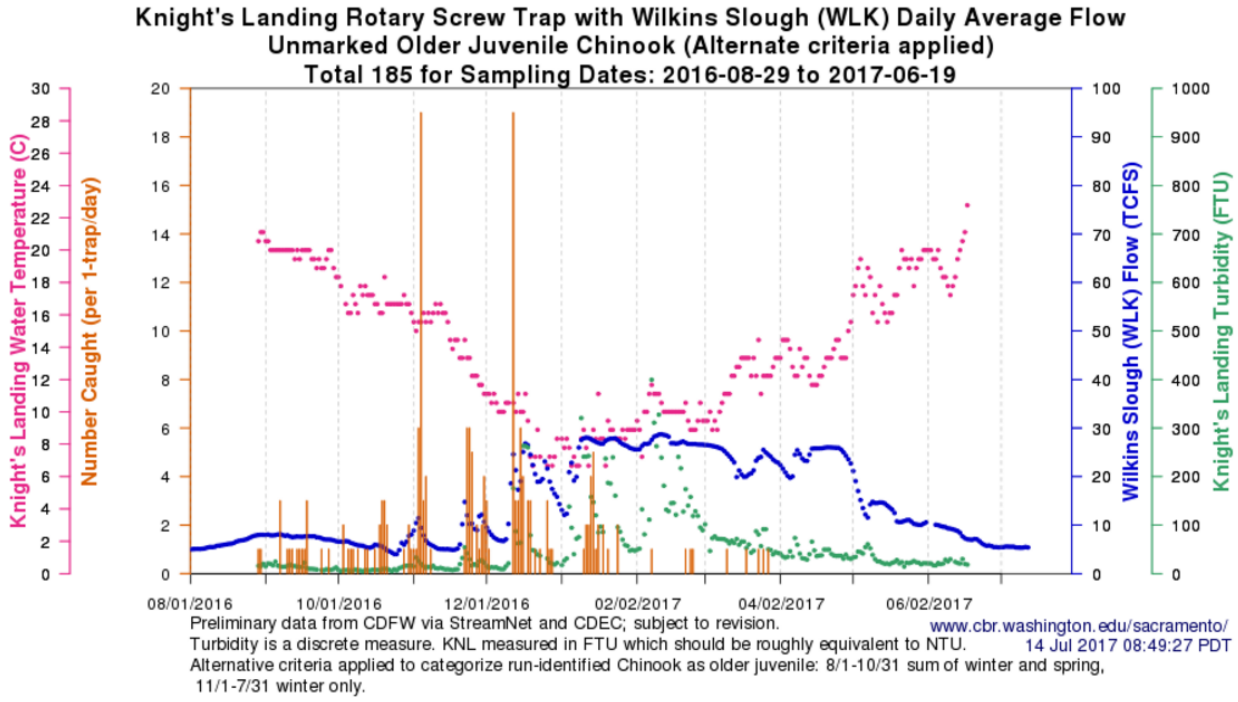


Figure 4-X3 Daily passage of unmarked older juvenile Chinook (orange bars) captured in rotary screw traps at Wilkins Slough compared to water temperature (°C; pink line) at Knights Landing, flow (TCFS; blue line) at Wilkins Slough, and turbidity (NTU; green line) at Knights Landing.

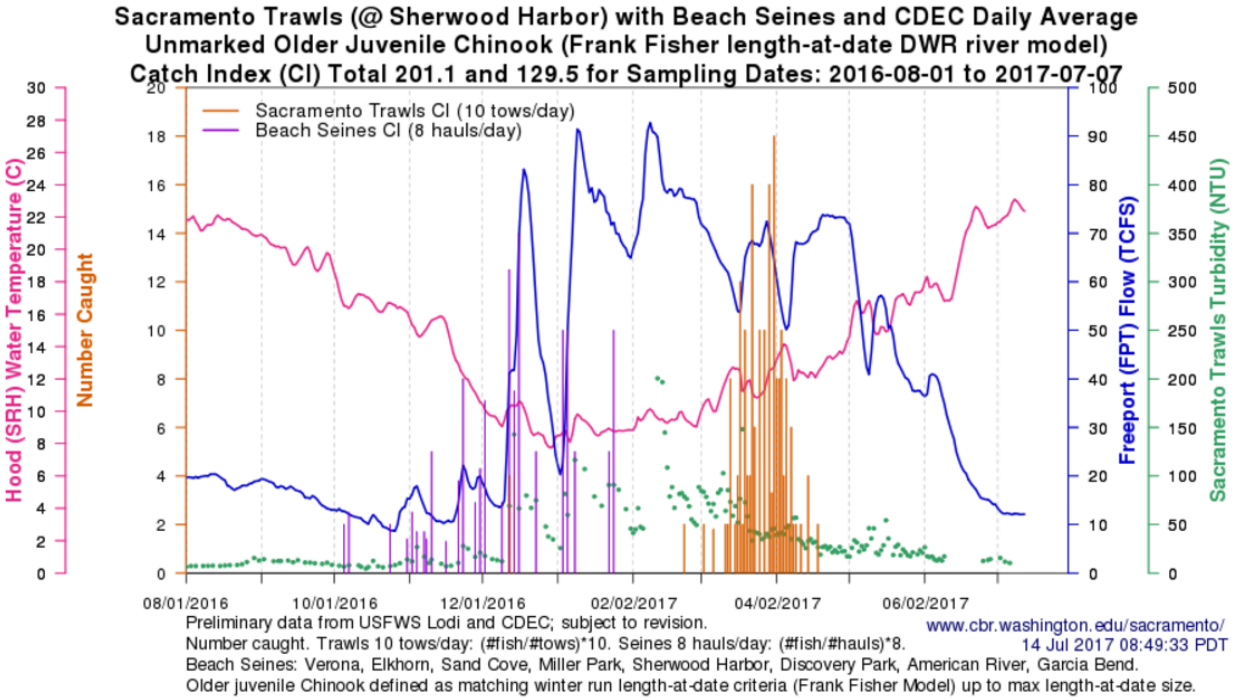


Figure 4-X4 Daily capture of unmarked older juvenile Chinook (orange bars) with beach seines at Sherwood Harbor compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green line) at Sherwood Harbor.

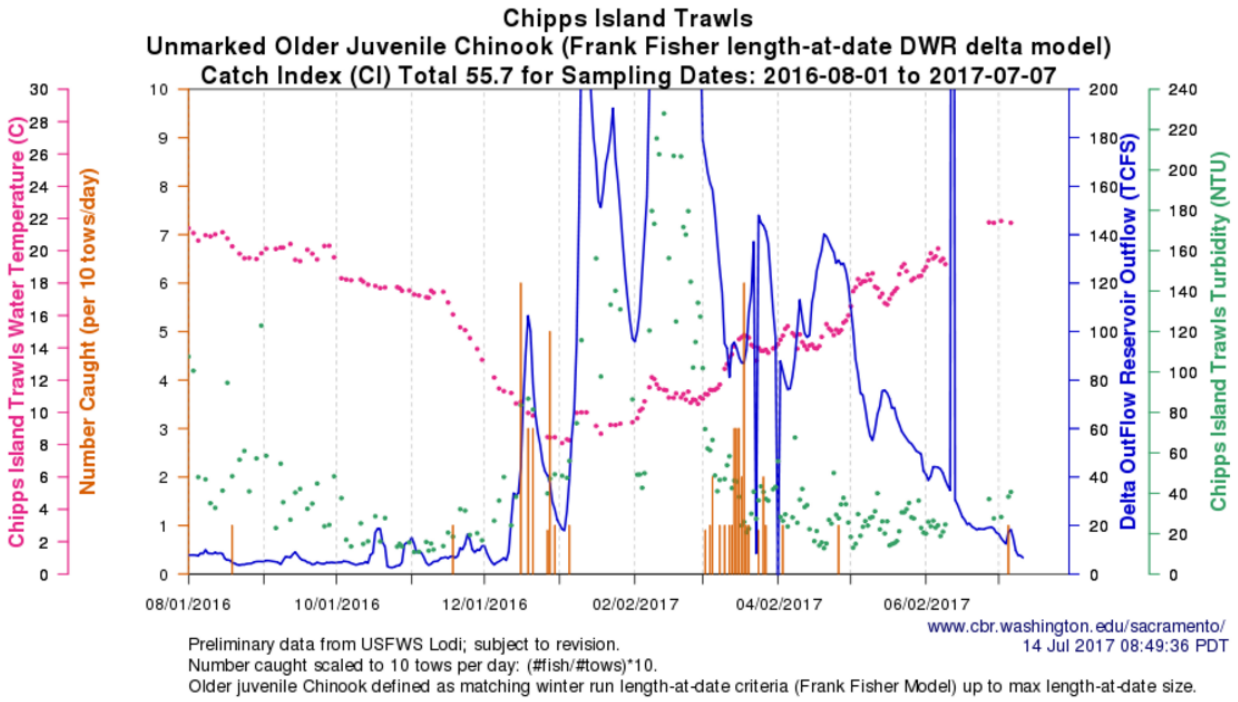


Figure 4-X5 Daily capture of unmarked older juvenile Chinook (orange bars) with trawls at Chipps Island compared to water temperature (°C; pink line) at Chipps Island, Delta outflow (TCFS; blue line), and turbidity (NTU; green line) at Chipps Island.

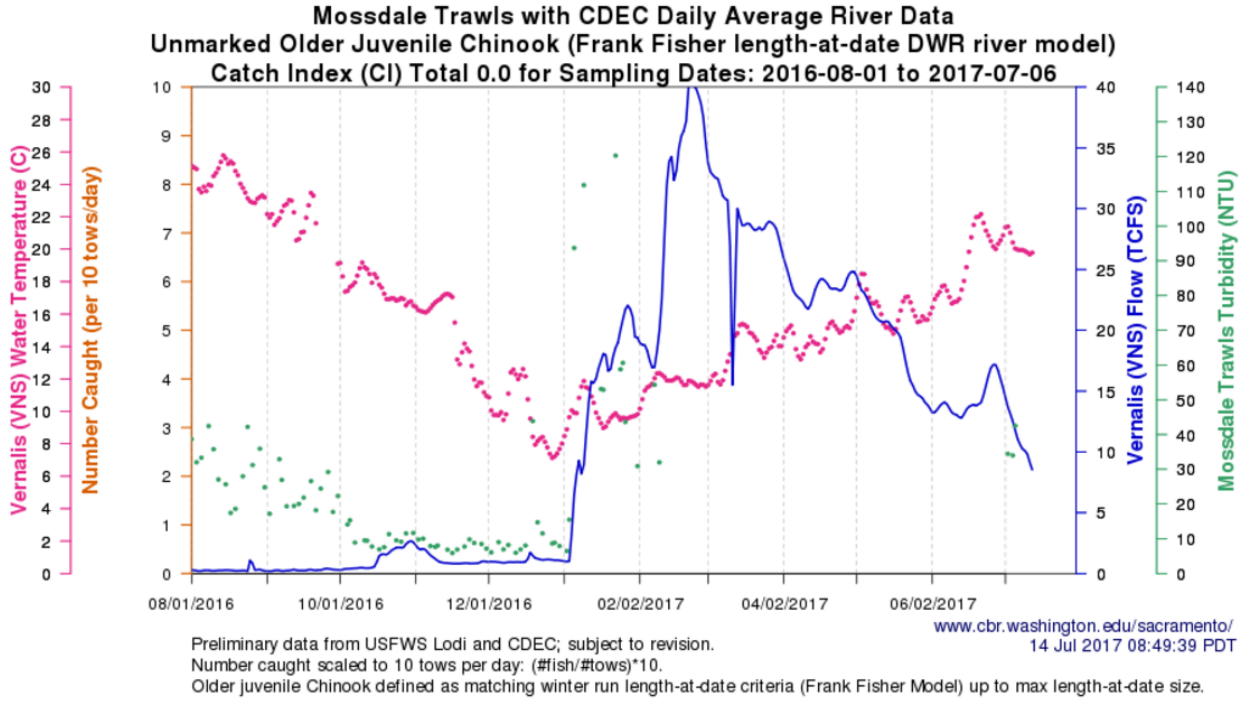


Figure 4-X6 Daily capture of unmarked older juvenile Chinook (orange bars) with trawls at Mossdale compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Vernalis, and turbidity (NTU; green line) at Mossdale.

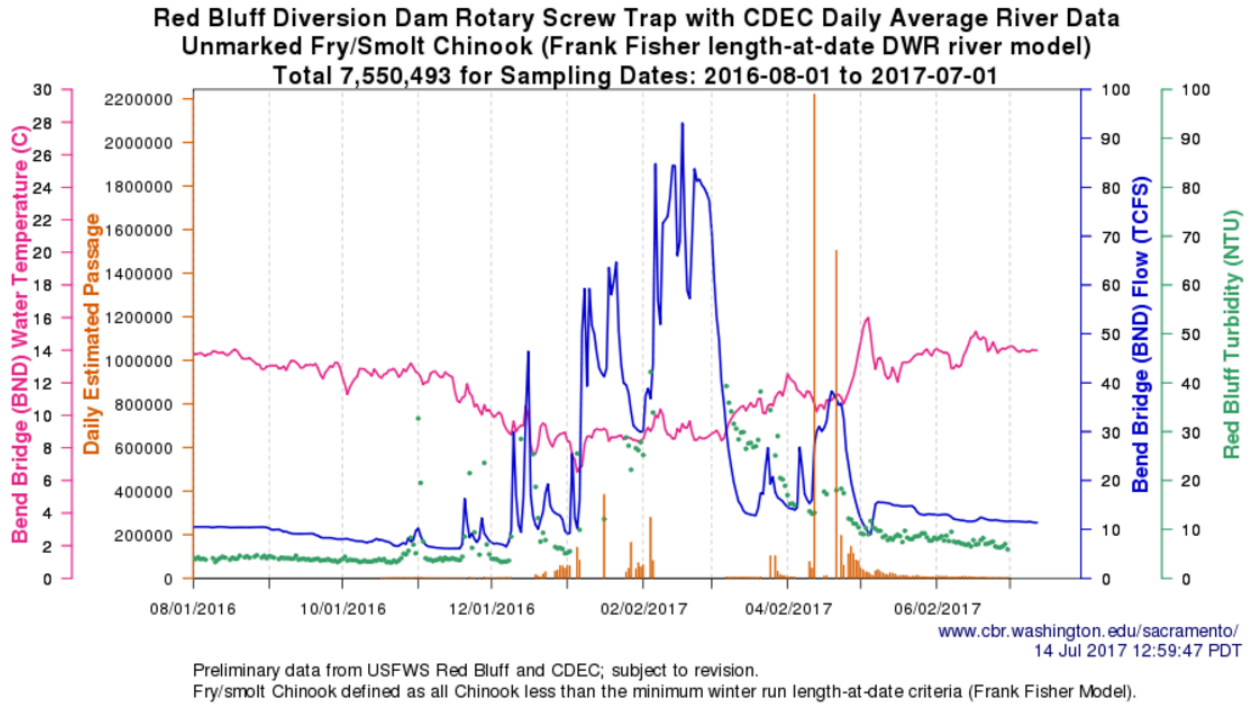


Figure 4-X7 Daily passage of unmarked Fry/Smolt Chinook (orange bars) captured in rotary screw traps at Red Bluff Diversion Dam compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Bend Bridge, and turbidity (NTU; green line) at Red Bluff.

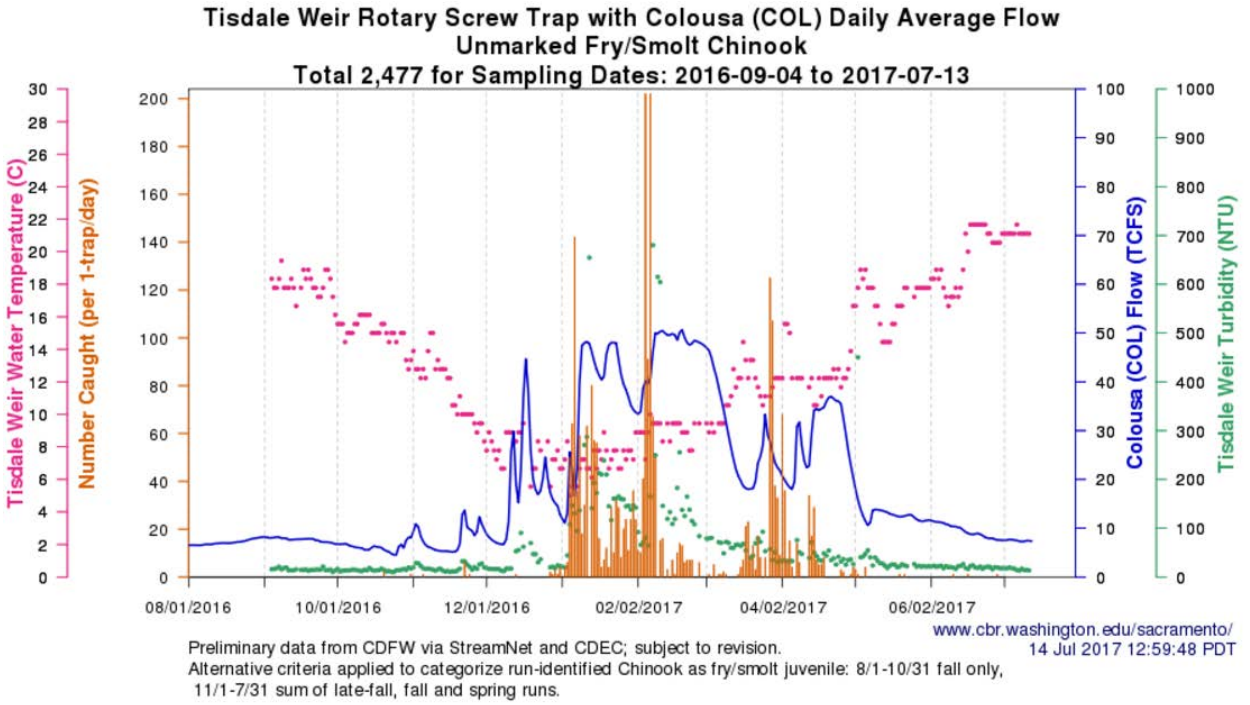


Figure 4-X8 Daily passage of unmarked Fry/Smolt Chinook (orange bars) captured in rotary screw traps at Tisdale Weir compared to water temperature (°C; pink line) at Tisdale Weir, flow (TCFS; blue line) at Colusa, and turbidity (NTU; green line) at Tisdale Weir.

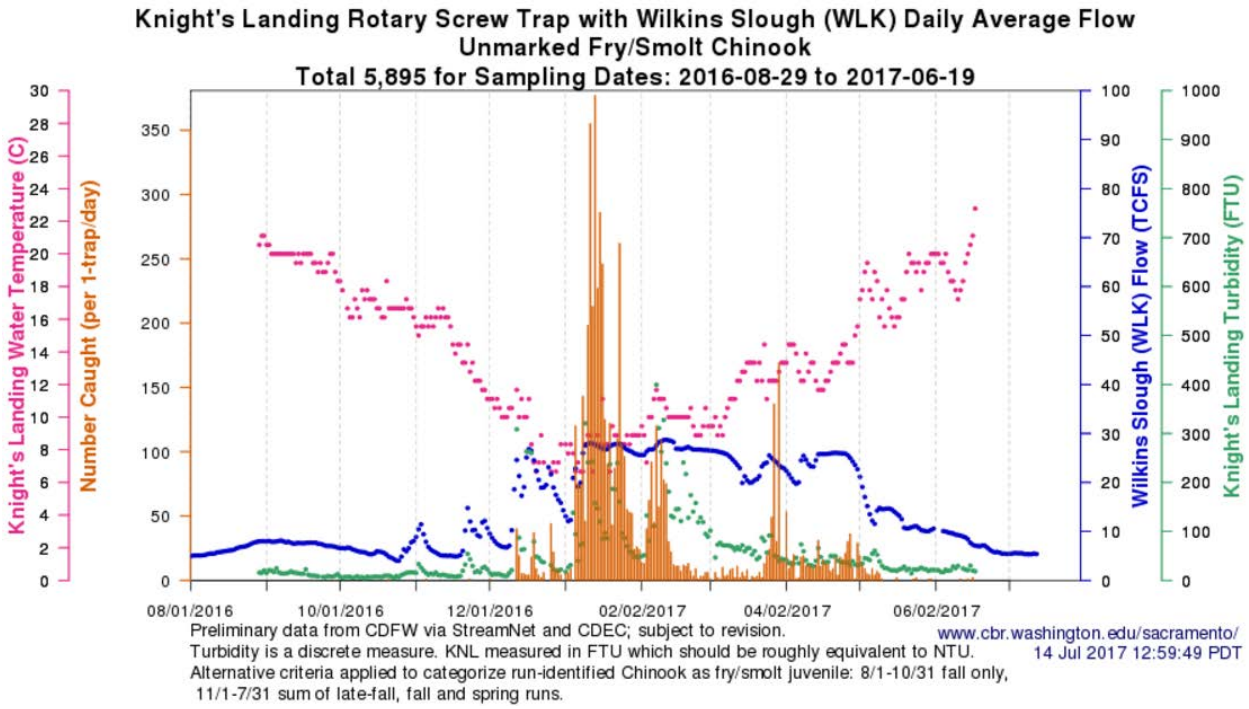


Figure 4-X9 Daily passage of unmarked Fry/Smolt Chinook (orange bars) captured in rotary screw traps at Knights Landing compared to water temperature (°C; pink line) at Knights Landing, flow (TCFS; blue line) at Wilkins Slough, and turbidity (NTU; green line) at Knights Landing.

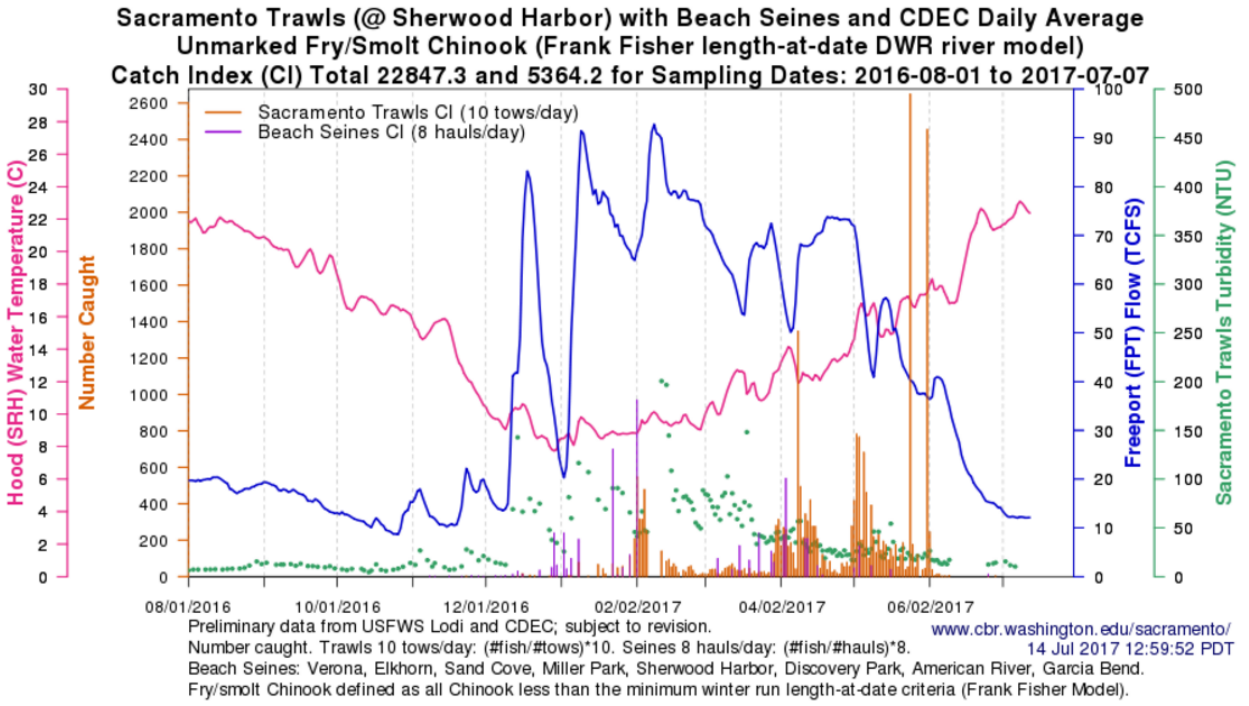


Figure 4-X10 Daily capture of unmarked Fry/Smolt Chinook (orange bars) trawls at Sherwood Harbor compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green line) at Sherwood Harbor.

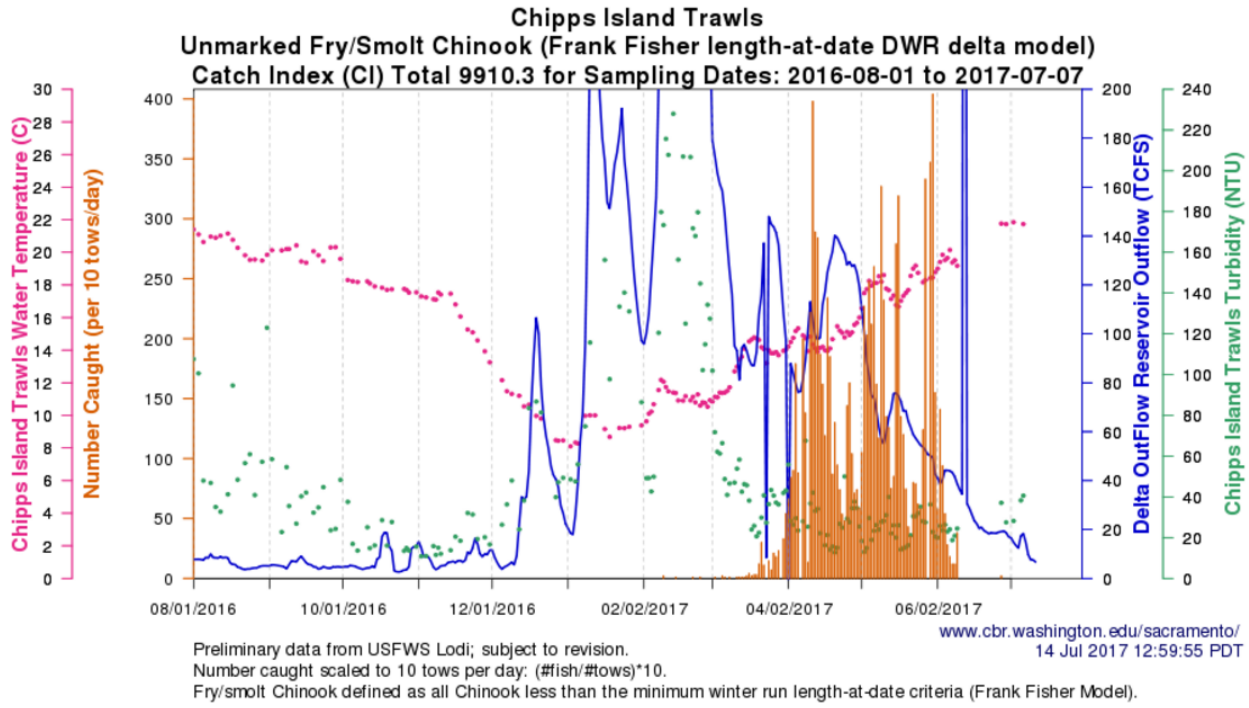


Figure 4-X11 Daily capture of unmarked Fry/Smolt Chinook (orange bars) trawls at Chipps Island compared to water temperature (°C; pink line) at Chipps Island, Delta outflow (TCFS; blue line), and turbidity (NTU; green line) at Chipps Island.

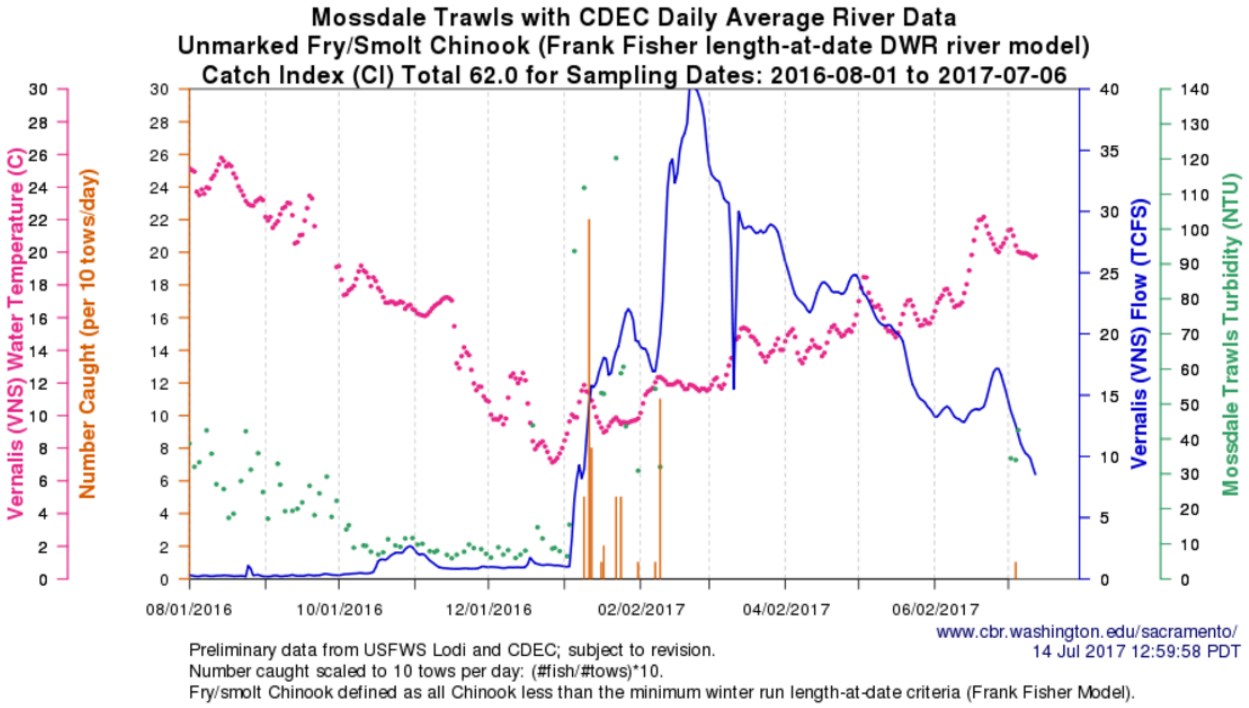


Figure 4-X12 Daily capture of unmarked Fry/Smolt Chinook (orange bars) in trawls at Mossdale compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Vernalis and turbidity (NTU; green line) at Mossdale.

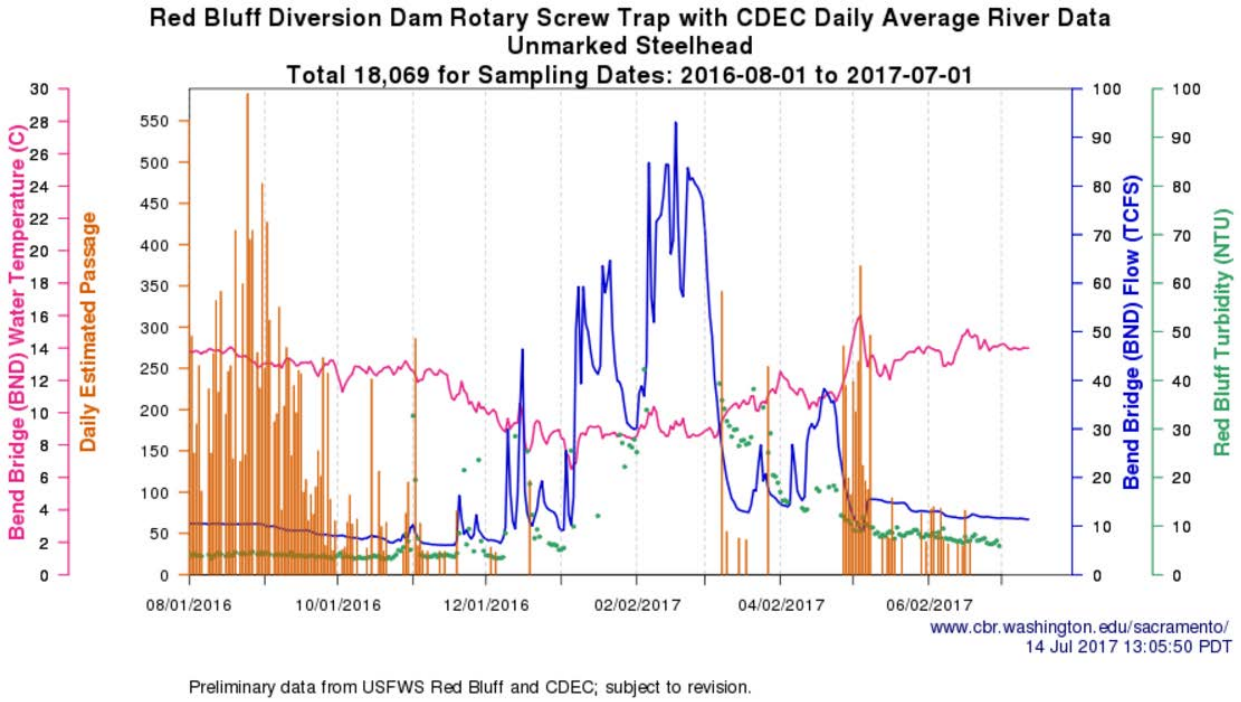


Figure 4-X13 Daily passage of unmarked Steelhead (orange bars) captured in rotary screw traps at Red Bluff Diversion Dam compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Bend Bridge and turbidity (NTU; green line) at Red Bluff.

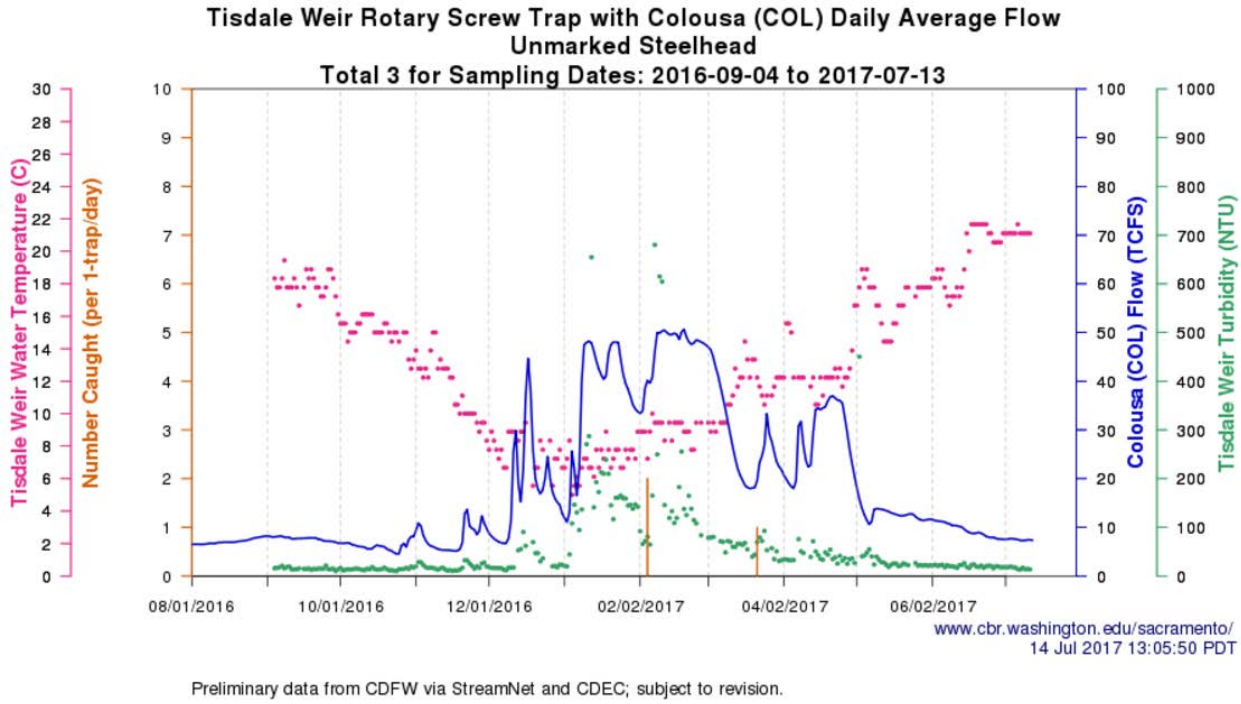


Figure 4-X14 Daily passage of unmarked Steelhead (orange bars) captured in rotary screw traps at Tisdale Weir compared to water temperature (°C; pink line) at Tisdale Weir, flow (TCFS; blue line) at Colusa, and turbidity (NTU; green line) at Tisdale Weir.

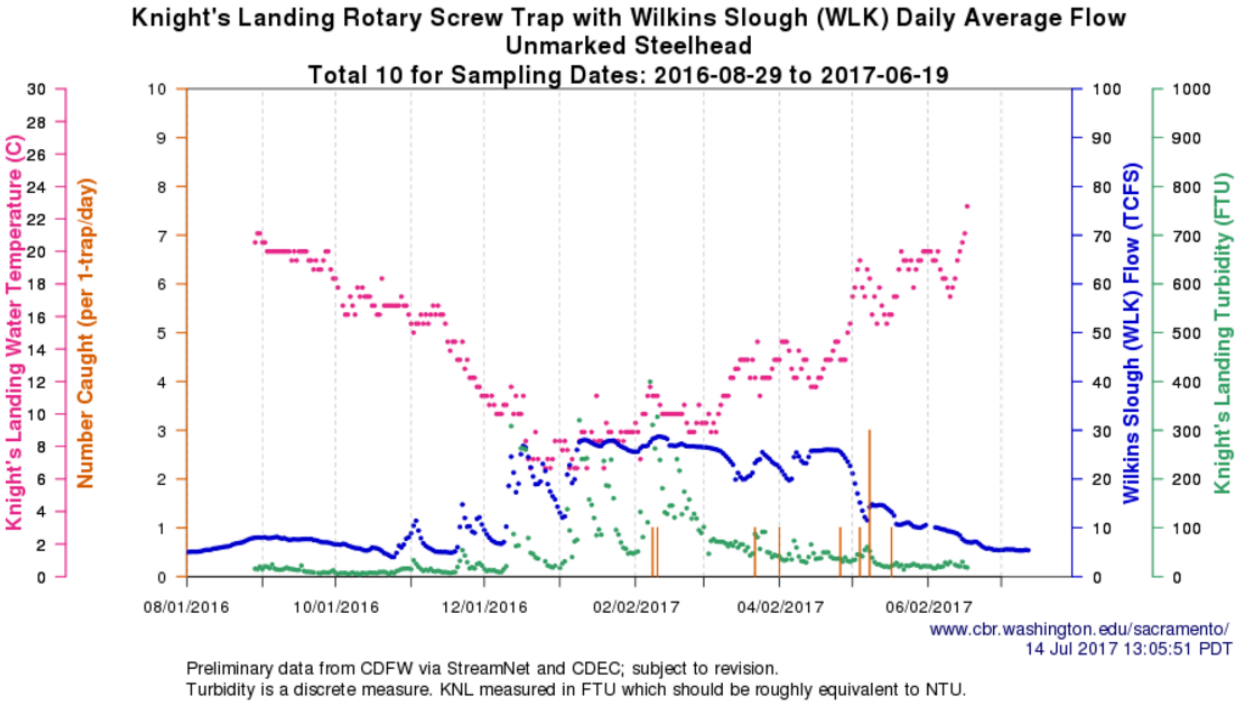


Figure 4-X15 Daily passage of unmarked Steelhead (orange bars) captured in rotary screw traps at Knights Landing compared to water temperature (°C; pink line) at Knights Landing, flow (TCFS; blue line) at Wilkins Slough, and turbidity (NTU; green line) at Knights Landing.

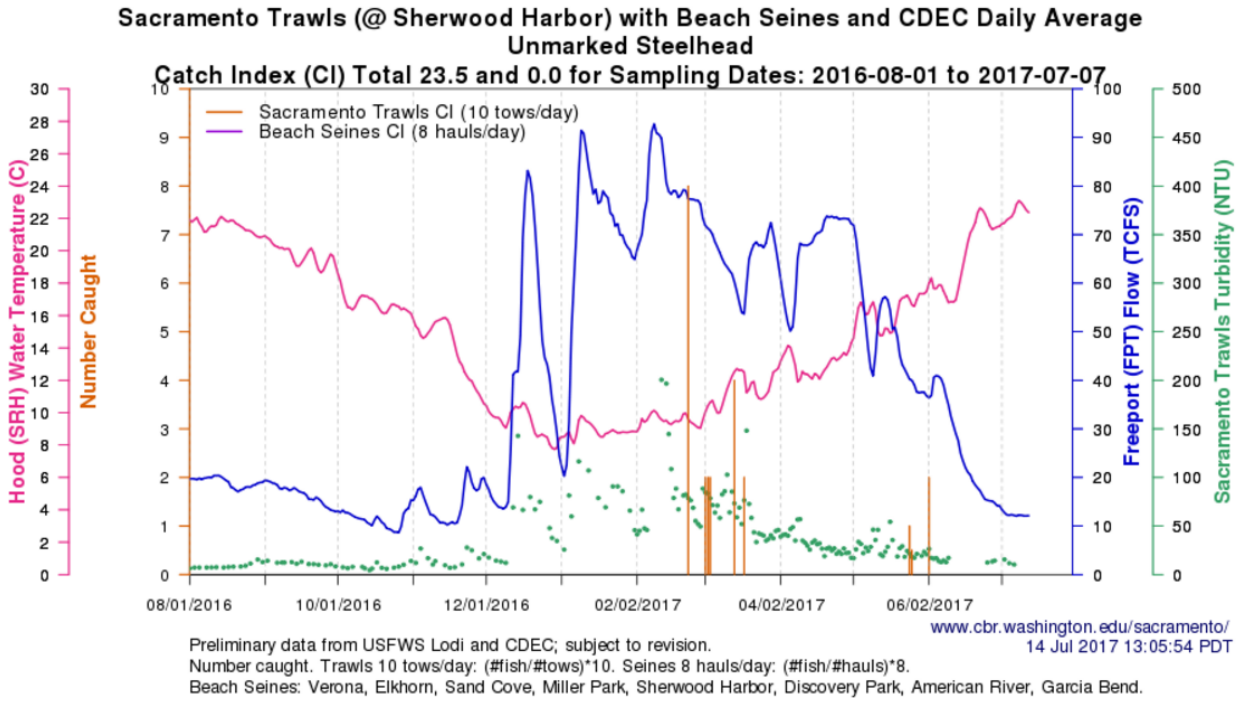


Figure 4-X16 Daily capture of unmarked Steelhead (orange bars) in beach seines at Sherwood Harbor compared to water temperature (°C; pink line) at Hood, flow (TCFS; blue line) at Freeport, and turbidity (NTU; green line) at Sherwood Harbor.

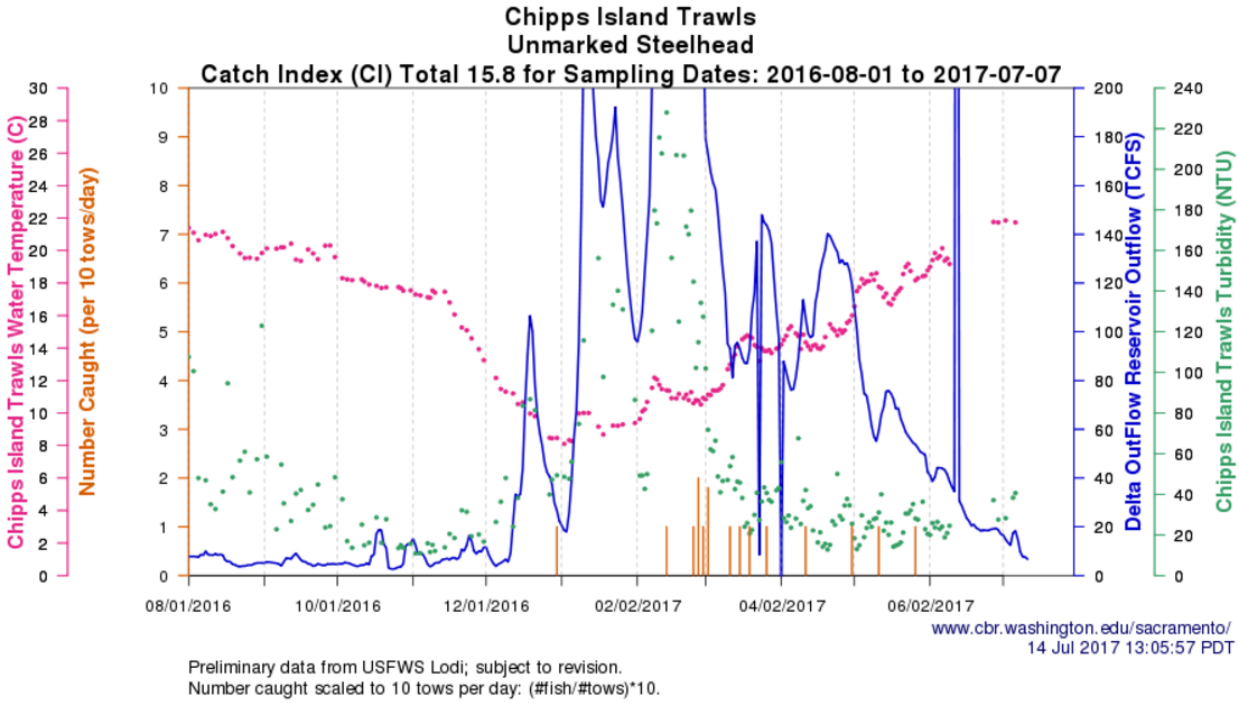


Figure 4-X17 Daily capture of unmarked Steelhead (orange bars) in trawls at Chipps Island compared to water temperature (°C; pink line) at Chipps Island, Delta outflow (TCFS; blue line), and turbidity (NTU; green line) at Chipps Island.

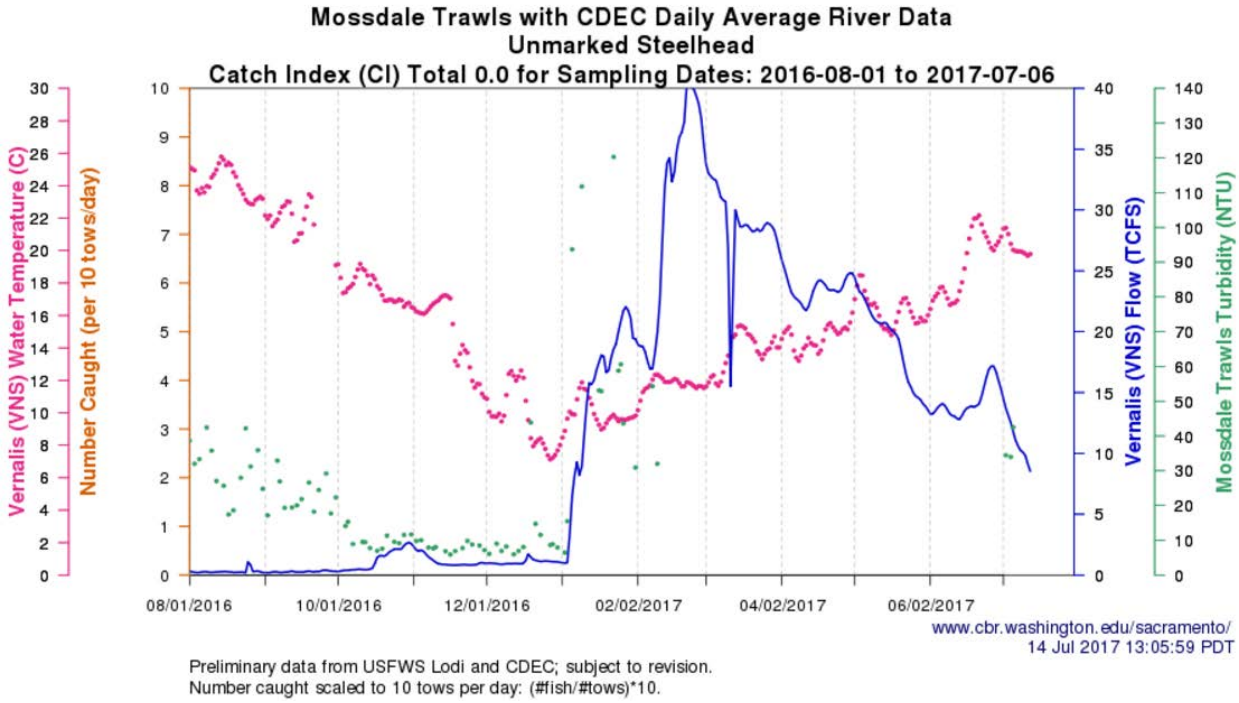


Figure 4-X18 Daily capture of unmarked Steelhead (orange bars) in trawls at Mossdale compared to water temperature (°C; pink line) and flow (TCFS; blue line) at Vernalis and turbidity (NTU; green line) at Mossdale.

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	Winter-run wild (%)	Winter-run hatchery (%)	Spring-run wild (%)
October	10/4	98-100		
	10/11	97-100		
	10/18	96-99		
	10/25	95-98		
November	11/1	92-95		
	11/8	75-85		
	11/15	75-85		
	11/22	70-80		
	11/29	60-75		95
December	12/6	60-70		95
	12/13	50-55		85-90
	12/20	35-45		70-80
	12/27	30-40		60-75
January	1/3	20-35		55-70
	1/10	5-15		35-50
	1/17	5-10		
	1/24	5		20-50
	1/31	0-5		20-40
Febrary	2/7	0-5	1	20-30
	2/14	0-5	85-95	15-25
	2/21	0-5	55-90	10-20
	2/28	0-5	30-50	5-20
March	3/7	0-2	25-45	5-15
	3/14	0-2	15-35	5-15
	3/21	0-2	10-30	5-15
	3/28	0-2	10-20	5-15
April	4/4	0-1	5-10	5-15
	4/11	0-1	0-5	
	4/18	0-1	0-1	5-10
	4/25	0-1	0-1	5-10
May	5/2	0-1	0-1	0-1
	5/9	0-1	0-1	0-10
	5/16	0	0	0-5
	5/23	0	0	0-5
	5/30	0	0	0-3
June	6/6	0	0	0-2
	6/13	0	0	0-2

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**	**Winter-run wild (%)**	**Winter-run hatchery (%)**	**Spring-run wild (%)**
October	10/4	0-2		
	10/11	0-3		
	10/18	1-4		
	10/25	2-5		
November	11/1	5-8		
	11/8	15-25		
	11/15	15-25		
	11/22	20-30		
	11/29	25-40		5
December	12/6	30-40		5
	12/13	45-50		10-15
	12/20	55-65		20-30
	12/27	60-70		25-40
January	1/3	65-80		30-45
	1/10	80-90		50-60
	1/17	80-90		50-70
	1/24	80-90		50-70
	1/31	70-85		35-65
February	2/7	65-80	0	40-70
	2/14	65-75	5-15	40-70
	2/21	60-70	10-40	40-70
	2/28	45-65	20-65	35-70
March	3/7	40-60	30-65	35-60
	3/14	30-50	30-65	40-60
	3/21	15-35	30-55	40-60
	3/28	10-25	20-40	30-60
April	4/4	5--20	10-30	25-50
	4/11	5-15	5-20	25-40
	4/18	5-10	5-10	10-35
	4/25	0.05	1-5	10-20
May	5/2	1-5	1-5	5-15
	5/9	1-5	1-5	5-15
	5/16	0-2	0-2	5-10
	5/23	0-1	0-1	0-5
	5/30	0	0	0-3
June	6/6	0	0	0-2
	6/13	0	0	0-2

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**	**Winter-run wild (%)**	**Winter-run hatchery (%)**	**Spring-run wild (%)**
October	10/4	0		
	10/11	0		
	10/18	0		
	10/25	0		
November	11/1	0		
	11/8	0		
	11/15	0		
	11/22	0		
	11/29	0		0
December	12/6	0		0
	12/13	0		0
	12/20	0		0
	12/27	0		0
January	1/3	0		0
	1/10	0-5		0-5
	1/17	5-10		5-10
	1/24	10-15		10-15
	1/31	15-25		15-25
February	2/7	20-25	0	20-25
	2/14	20-30	0	25-30
	2/21	25-35	0-5	30-35
	2/28	35-55	5-30	30-40
March	3/7	40-60	5-35	35-45
	3/14	50-70	15-45	35-50
	3/21	65-85	30-60	35-50
	3/28	75-90	50-70	35-60
April	4/4	80-95	65-85	40-70
	4/11	85-95	75-95	50-70
	4/18	90-95	90-95	60-80
	4/25	95	95-99	70-80
May	5/2	95-99	95-99	75-85
	5/9	95-99	95-99	75-85
	5/16	98-100	98-100	85-95
	5/23	99-100	99-100	90-100
	5/30	100	100	94-100
June	6/6	100	100	96-100
	6/13	100	100	96-100

Appendix I—Spring-run Raw and Adjusted Catch Data, Winter-run Raw Catch, and Hatchery winter-run CWT and Acoustic Telemetry Data

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)
10/4	0	0	0	100.0	100.0	100.0
10/11	0	0	0	100.0	100.0	100.0
10/18	0	0	0	100.0	100.0	100.0
10/25	1	1	1	99.9	99.7	99.7
11/1	0	0	0	99.9	99.7	99.7
11/8	3	3	3	99.6	98.8	98.7
11/15	0	0	0	99.6	98.8	98.7
11/22	0	0	0	99.6	98.8	98.7
11/29	6	6	6	99.0	97.0	96.8
12/6	4	4	4	98.5	95.8	95.5
12/13	17	17	17	96.8	90.8	90.1
12/20	66	66	66	89.9	71.1	68.9
12/27	49	49	49	84.9	56.5	53.2
1/3	15	15	15	83.3	52.1	48.4
1/10	7	7	7	82.6	50.0	46.2
1/17	21	21	21	80.4	43.8	39.4
1/24	5	5	5	79.9	42.3	37.8
1/31	5	5	5	79.4	40.8	36.2
2/7	0	0	0	79.4	40.8	36.2
2/14	9	9	9	78.4	38.1	33.3
2/21	2	2	2	78.2	37.5	32.7
2/28	2	2	2	78.0	36.9	32.1
3/7	1	1	1	77.9	36.6	31.7
3/14	12	12	12	76.7	33.0	27.9
3/21	21	21	21	74.5	26.8	21.2
3/28	**112**	**14.25**	**9**	62.9	22.5	18.3
4/4	**404**	**14.25**	**9**	21.0	18.3	15.4
4/11	**135**	**14.25**	**9**	7.0	14.1	12.5
4/18	**35**	**14.25**	**9**	3.4	9.8	9.6
4/25	13	13	**9**	2.1	6.0	6.7
5/2	11	11	**9**	0.9	2.7	3.8
5/9	6	6	**9**	0.3	0.9	1.0
5/16	3	3	3	0.0	0.0	0.0
5/23	0	0	0	0.0	0.0	0.0
5/30	0	0	0	0.0	0.0	0.0
6/6	0	0	0	0.0	0.0	0.0
6/13	0	0	0	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)
10/4	0	0	0	0.0	0.0	0.0
10/11	0	0	0	0.0	0.0	0.0
10/18	0	0	0	0.0	0.0	0.0
10/25	0	0	0	0.0	0.0	0.0
11/1	1	1	1	0.0	0.2	0.2
11/8	0	0	0	0.0	0.2	0.2
11/15	2	2	2	0.1	0.7	0.5
11/22	3	3	3	0.2	1.3	1.1
11/29	4	4	4	0.3	2.2	1.8
12/6	4	4	4	0.5	3.1	2.5
12/13	4	4	4	0.6	4.0	3.2
12/20	11	11	11	1.0	6.5	5.1
12/27	1	1	1	1.0	6.7	5.3
1/3	10	10	10	1.3	9.0	7.0
1/10	31	31	31	2.4	16.0	12.5
1/17	4	4	4	2.5	16.9	13.2
1/24	13	13	13	2.9	19.8	15.5
1/31	3	3	3	3.0	20.4	16.0
2/7	11	11	11	3.4	22.9	18.0
2/14	2	2	2	3.5	23.4	18.3
2/21	6	6	6	3.7	24.7	19.4
2/28	7	7	7	3.9	25.6	16.6
3/7	10	10	10	4.2	27.9	18.4
3/14	21	21	21	4.9	31.9	18.1
3/21	42	42	42	6.0	38.0	5.5
3/28	48	48	**31.5**	6.3	32.3	5.0
4/4	**436**	**27**	**31.5**	15.8	30.2	4.5
4/11	**738**	**27**	**31.5**	26.4	28.0	4.1
4/18	**548**	**27**	**31.5**	19.3	25.9	3.6
4/25	**143**	**27**	**31.5**	9.2	23.7	3.2
5/2	**171**	**27**	**31.5**	3.7	21.6	2.7
5/9	**568**	**27**	**31.5**	4.9	19.4	2.3
5/16	**126**	**27**	**31.5**	4.2	17.3	1.8
5/23	14	14	**31.5**	0.9	12.2	1.4
5/30	4	4	**31.5**	0.7	9.1	0.9
6/6	0	0	**31.5**	0.0	0.0	0.5
6/13	0	0	**31.5**	0.0	0.0	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)
10/4	0	0	0	0	0	0
10/11	0	0	0	0	0	0
10/18	0	0	0	0	0	0
10/25	0	0	0	0	0	0
11/1	0	0	0	0	0	0
11/8	0	0	0	0	0	0
11/15	0	0	0	0	0	0
11/22	0	0	0	0	0	0
11/29	0	0	0	0	0	0
12/6	0	0	0	0	0	0
12/13	0	0	0	0	0	0
12/20	0	0	0	0	0	0
12/27	0	0	0	0	0	0
1/3	0	0	0	0	0	0
1/10	0	0	0	0	0	0
1/17	0	0	0	0	0	0
1/24	0	0	0	0	0	0
1/31	0	0	0	0	0	0
2/7	0	0	0	0	0	0
2/14	0	0	0	0	0	0
2/21	0	0	0	0	0	0
2/28	2	2	2	0.1	1	4
3/7	0	0	0	0.1	1	4
3/14	2	2	2	0.1	1	8
3/21	10	10	10	0.4	5	28
3/28	49	49	**3**	1.6	21	34
4/4	**200**	**24.5**	**3**	6.8	29	40
4/11	**548**	**24.5**	**3**	20.9	38	46
4/18	**990**	**24.5**	**3**	46.4	46	52
4/25	**577**	**24.5**	**3**	61.2	54	58
5/2	**438**	**24.5**	**3**	72.5	62	64
5/9	**690**	**24.5**	**3**	90.3	70	70
5/16	**190**	**24.5**	**3**	95.2	79	76
5/23	**149**	**24.5**	**3**	99.0	87	82
5/30	12	12	**3**	99.3	91	88
6/6	27	27	**3**	100.0	100	94
6/13	0	0	**3**	100.0	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	Percent raw data	Cumulative percent	100% minus cumulative raw data
10/4	1	0.61	0.61	99.39
10/11	6	3.66	4.27	95.73
10/18	3	1.83	6.10	93.90
10/25	9	5.49	11.59	88.41
11/1	3	1.83	13.41	86.59
11/8	35	21.34	34.76	65.24
11/15	1	0.61	35.37	64.63
11/22	0	0.00	35.37	64.63
11/29	18	10.98	46.34	53.66
12/6	11	6.71	53.05	46.95
12/13	13	7.93	60.98	39.02
12/20	25	15.24	76.22	23.78
12/27	5	3.05	79.27	20.73
1/3	5	3.05	82.32	17.68
1/10	0	0.00	82.32	17.68
1/17	13	7.93	90.24	9.76
1/24	5	3.05	93.29	6.71
1/31	2	1.22	94.51	5.49
2/7	0	0.00	94.51	5.49
2/14	1	0.61	95.12	4.88
2/21	0	0.00	95.12	4.88
2/28	3	1.83	96.95	3.05
3/7	0	0.00	96.95	3.05
3/14	1	0.61	97.56	2.44
3/21	1	0.61	98.17	1.83
3/28	2	1.22	99.39	0.61
4/4	1	0.61	100.00	0.00
4/11	0	0.00	100.00	0.00
4/18	0	0.00	100.00	0.00
4/25	0	0.00	100.00	0.00
5/2	0	0.00	100.00	0.00
5/9	0	0.00	100.00	0.00
5/16	0	0.00	100.00	0.00
5/23	0	0.00	100.00	0.00
5/30	0	0.00	100.00	0.00
6/6	0	0.00	100.00	0.00
6/13	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**	**Percent raw data**	**Cumulative percent**	**Combined Beach Seine and Sac Trawl minus Chipps Island (raw data)**
10/4	0	0.00	0.00	0.0
10/11	2	1.16	1.16	1.2
10/18	0	0.00	1.16	1.2
10/25	1	0.58	1.74	1.7
11/1	1	0.58	2.33	2.3
11/8	3	1.74	4.07	4.1
11/15	5	2.91	6.98	7.0
11/22	4	2.33	9.30	9.3
11/29	8	4.65	13.95	14.0
12/6	10	5.81	19.77	19.8
12/13	8	4.65	24.42	24.4
12/20	9	5.23	29.65	29.7
12/27	0	0.00	29.65	29.7
1/3	0	0.00	29.65	29.7
1/10	8	4.65	34.30	34.3
1/17	0	0.00	34.30	34.3
1/24	1	0.58	34.88	34.9
1/31	1	0.58	35.47	35.5
2/7	0	0.00	35.47	35.5
2/14	0	0.00	35.47	35.5
2/21	0	0.00	35.47	35.5
2/28	0	0.00	35.47	35.5
3/7	1	0.58	36.05	34.4
3/14	6	3.49	39.53	36.3
3/21	18	10.47	50.00	38.9
3/28	22	12.79	62.79	39.2
4/4	35	20.35	83.14	34.3
4/11	23	13.37	96.51	20.4
4/18	3	1.74	98.26	10.1
4/25	3	1.74	100.00	6.2
5/2	0	0.00	100.00	2.0
5/9	0	0.00	100.00	0.0
5/16	0	0.00	100.00	0.0
5/23	0	0.00	100.00	0.0
5/30	0	0.00	100.00	0.0
6/6	0	0.00	100.00	0.0
6/13	0	0.00	100.00	0.0

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	Percent raw data	Cumulative percent
10/4	0	0.00	0.00
10/11	0	0.00	0.00
10/18	0	0.00	0.00
10/25	0	0.00	0.00
11/1	0	0.00	0.00
11/8	0	0.00	0.00
11/15	0	0.00	0.00
11/22	0	0.00	0.00
11/29	0	0.00	0.00
12/6	0	0.00	0.00
12/13	0	0.00	0.00
12/20	0	0.00	0.00
12/27	0	0.00	0.00
1/3	0	0.00	0.00
1/10	0	0.00	0.00
1/17	0	0.00	0.00
1/24	0	0.00	0.00
1/31	0	0.00	0.00
2/7	0	0.00	0.00
2/14	0	0.00	0.00
2/21	0	0.00	0.00
2/28	0	0.00	0.00
3/7	5	1.64	1.64
3/14	5	1.64	3.28
3/21	24	7.87	11.15
3/28	38	12.46	23.61
4/4	77	25.25	48.85
4/11	83	27.21	76.07
4/18	37	12.13	88.20
4/25	17	5.57	93.77
5/2	13	4.26	98.03
5/9	6	1.97	100.00
5/16	0	0.00	100.00
5/23	0	0.00	100.00
5/30	0	0.00	100.00
6/6	0	0.00	100.00
6/13	0	0.00	100.00

Hatchery Winter-run CWT Catch Data

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/data_management/DatCall%20Nov26-Dec02,%202017.xlsx

Coded Wire Tag (CWT) Winter-Run Catch Data						
	Sacramento Area			Chipps Trawl		
Date of DOSS Notes	Raw Catch	% CWT WR	Cumulative %	Raw Catch	% CWT WR	Cumulative %
2/7	0	0	0	0	0	0
2/14	0	0	0	0	0	0
2/21	0	0	0	0	0	0
2/28	0	0	0	0	0	0
3/7	0	0	0	0	0	0
3/14	2	8	8	0	0	0
3/21	19	76	84	10	58.82	58.82
3/28	2	8	92	4	23.53	82.35
4/4	1	4	96	3	17.65	100
4/11	1	4	100	0	0	100
4/18	0	0	100	0	0	100
4/25	0	0	100	0	0	100
5/2	0	0	100	0	0	100
5/9	0	0	100	0	0	100
5/16	0	0	100	0	0	100
5/23	0	0	100	0	0	100
5/30	0	0	100	0	0	100
6/6	0	0	100	0	0	100
6/13	0	0	100	0	0	100

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 4-3 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			
Date of	Yet to Enter the Delta	In the Delta	Exited the Delta
DOSS Notes	100% minus Cumulative % Sac Trawl	Sac Trawl minus Chipps cumulative %	Chipps cumulative %
2/7	100	0	0
2/14	100	0	0
2/21	100	0	0
2/28	100	0	0
3/7	100	0	0
3/14	92	8	0
3/21	16	25.18	58.82
3/28	8	9.65	82.35
4/4	4	-4	100
4/11	0	0	100
4/18	0	0	100
4/25	0	0	100
5/2	0	0	100
5/9	0	0	100
5/16	0	0	100
5/23	0	0	100
5/30	0	0	100
6/6	0	0	100
6/13	0	0	100

Hatchery Winter-run Acoustic Telemetry Data

On February 2, 2017, 569 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 Catch Data						
	Sacramento Area			Chipps Trawl		
Date of DOSS Notes	Raw Catch	% CWT WR	Cumultive %	Raw Catch	% CWT WR	Cumulative %
2/7	0	0	0	0	0	0
2/14	0	0	0	0	0	0
2/21	0	0	0	2	1.04	1.04
2/28	1	0.68	0.68	3	1.55	2.59
3/7	2	1.36	2.04	3	1.55	4.15
3/14	28	19.05	21.09	19	9.84	13.99
3/21	93	63.27	84.35	94	48.70	62.69
3/28	15	10.20	94.56	46	23.83	86.53
4/4	7	4.76	99.32	24	12.44	98.96
4/11	1	0.68	100	2	1.04	100
4/18	0	0	100	0	0	100

The "Sacramento Area" used receivers on Tower, I80/50, and SacTrawl sites. If fish were detected at any of these receivers it used the minimum detection date as 1 count. Notice Chipps had higher cumulative of release than Sacramento Area because of fish that went around Sacramento Area via Yolo Bypass then made it to Chipps, due to high flows overtopping weirs this year.

The table below shows the cumulative weekly passage of acoustic tagged hatchery winter-run Chinook from Livingston Stone National Fish Hatchery from the previous table, based on preliminary data. 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 4-3 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 Area cumulative percent.

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

"Exited the Delta" equals Chipps trawl cumulative percent.

Acoustic Tag (AT) Winter-Run Distribution			
	Yet to Enter the Delta	In the Delta	Exited the Delta
Date of DOSS Notes	100% minus Cumulative % Sac Area	Sac Area minus Chipps cumulative %	Chipps cumulative %
2/7	100	0	0
2/14	100	0	0
2/21	100	-1.04	1.04
2/28	99.32	-1.91	2.59
3/7	97.96	-2.10	4.15
3/14	78.91	7.10	13.99
3/21	15.65	21.66	62.69
3/28	5.44	8.03	86.53
4/4	0.68	0.36	98.96
4/11	0	0	100
4/18	0	0	100