Annual Report of Activities

October 1, 2011, to September 30, 2012

Delta Operations for Salmonids and Sturgeon (DOSS)

Technical Working Group

October 2012

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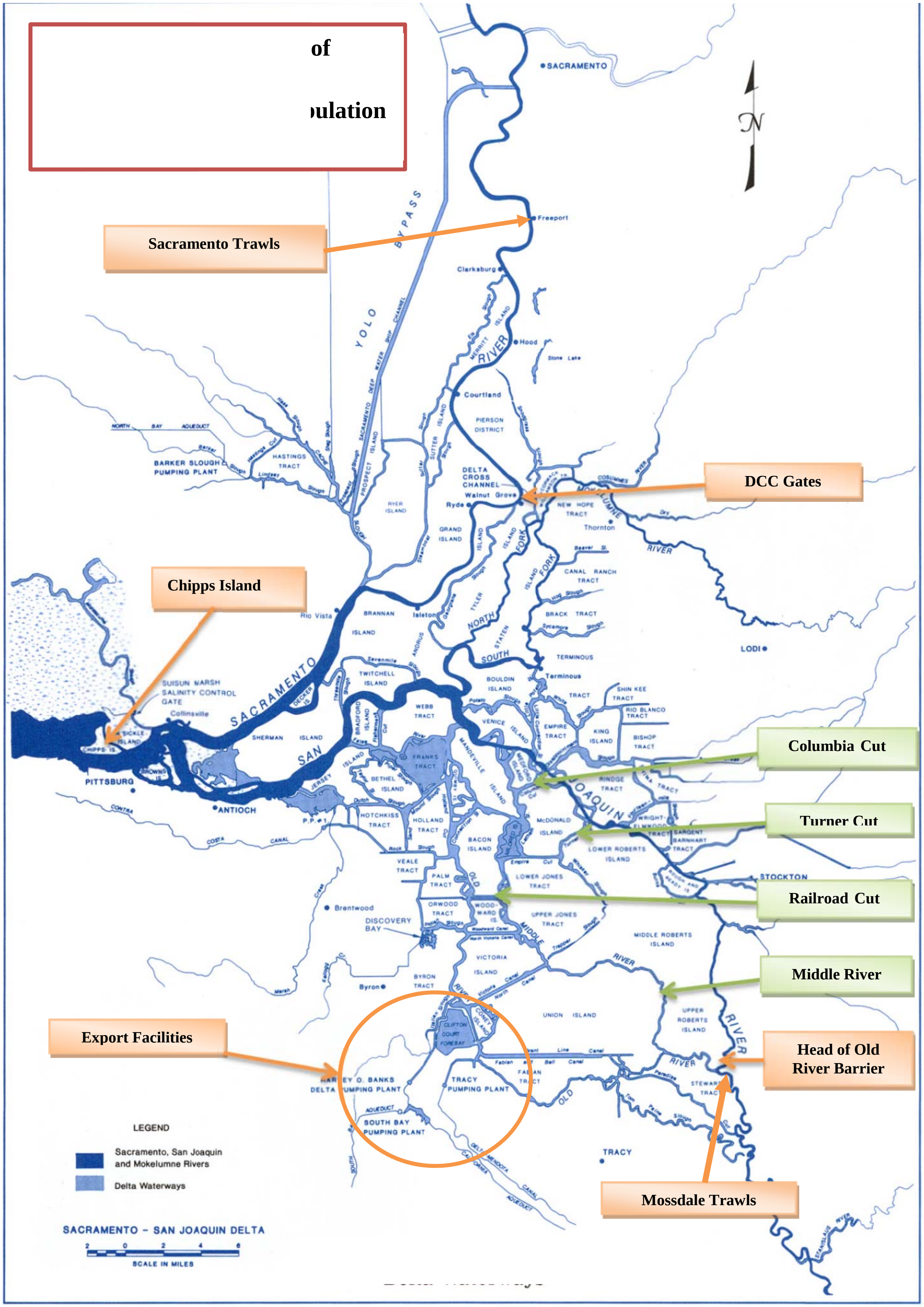
Acronyms and Abbreviations

BDCP	Bay-Delta Conservation Plan
BiOp	Biological Opinion
CDFG	California Department of Fish & Game
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
DSP	Delta Science Program
DSM2	Delta Simulation Model
DPM	Delta Passage Model
DPS	distinct population segment
DWR	California Department of Water Resources
EFH	essential fish habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
I:E	inflow-to-export ratio
FWS	U.S. Fish & Wildlife Service
IEP	Interagency Ecological Program
IRP	independent review panel
JPE	juvenile production estimate
KLCI	Knights Landing Catch Index
LSNFH	Livingston Stone National Fish Hatchery
MAF	million acre-feet
NGO	non-governmental organization
NMFS	National Marine Fisheries Service
OCAP	Operations, Criteria and Plan for the Central Valley Project and State Water Project
OMR	net tidal flow measurement in Old and Middle Rivers combined
PTM	particle tracking model
PWA	public water agencies
RBDD	Red Bluff Diversion Dam
Reclamation	U.S. Bureau of Reclamation
RPA	Reasonable and Prudent Alternative
RST	rotary screw trap
SAR	smolt to adult return rate
SCI	Sacramento Catch Index
SWG	Smelt Working Group
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet

USGS	U.S. Geological Survey
VAMP	Vernalis Adaptive Management Program
WOMT	Water Operations Management Team
WY	water year



Sacramento–San Joaquin Delta Atlas *Department of Water Resources*

Chapter 1 – Background

1.1 Background

On June 4, 2009, 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). NMFS BiOp reasonable and prudent alternative (RPA) Action IV.5 called for the formation of the Delta Operations for Salmon and Sturgeon (DOSS) Technical Working Group. DOSS is a technical team that comprises biologists, hydrologists, and operators with relevant expertise from the U.S. Bureau of Reclamation (Reclamation), California Department of Water Resources (DWR), California Department of Fish and Game (CDFG), U.S. Fish and Wildlife Service (FWS), State Water Resources Control Board (SWRCB), U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (EPA), and NMFS 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/ SWP export facilities to salmonids and green sturgeon.

The purposes of DOSS are to:

1) provide recommendations for real-time management of operations to WOMT and NMFS, 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; and

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

1.2 Participants

DOSS consisted of the following representatives in 2011–2012:

U. S. Bureau of Reclamation (Reclamation)
Paul Fujitani
John Hannon
Josh Israel*
Elizabeth Kiteck
Russ Yaworsky*

U. S. Fish and Wildlife Service (FWS)
Leigh Bartoo*
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National Marine Fisheries Service (NMFS)
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James Gleim
Angela Llaban*
Tracy Pettit
Kevin Reece
Dan Yamanaka
Edmund Yu

State Water Resources Control Board (SWRCB)
Kari Kyler*
Anne Snider*

U. S. Environmental Protection Agency (EPA)
Erin Foresman
Bruce Herbold*

U.S. Geological Survey (USGS) (Non-participant in 2012)
Jon Burau*

*Designated representative of the agency

1.3 Summary of Key Delta RPA Actions

Key RPA actions relating to Delta operations (topics) on which advice was provided to NMFS and WOMT 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 operation that will reduce loss of emigrating winter-run Chinook, spring-run Chinook, steelhead, and green sturgeon.

- **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):**

- **Action IV.2.3**: Control the net negative flows toward the export pumps in Old and Middle Rivers to reduce the likelihood that fish will be diverted from the San Joaquin River or Sacramento River into the southern or central Delta.

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

Increase the inflow-to-export ratio to reduce the vulnerability of emigrating California Central Valley 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/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 of the San Joaquin River for emigrating fish, including greater net downstream flows.

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

DOSS will conduct annual reviews of the experiment results. At the end of the 6-year period, a status review of Action IV.2.1 shall be prepared by DOSS and used to assess the success of Action IV.2.1 in increasing survival through the Delta for San Joaquin River basin salmonids but, in particular, steelhead. Based on the findings of the status review, DOSS will make recommendations to NMFS, Reclamation, CDFG, 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. **Entrainment/salvage reporting (Action IV.4.3)**

- **Action IV.4.3**: Improve overall survival of listed species at facilities (Tracy and Skinner) through accurate real-time salvage reporting and state-of-the-art salvage release procedures. This reporting is also necessary to provide the data needed to trigger OMR actions. (*e.g.*, coded wire tag [CWT] reading, fish triggers, spring-run surrogate loss).

Chapter 2 –2011 Independent Review Panel Review

In October 2011, the Delta Science Program (DSP) conducted an annual review of the RPA actions in the 2009 NMFS and FWS BiOps. An Independent Review Panel (IRP) made the following recommendations (*in italics*):

General (page 4):

1. *Adopt a centralized web-based data management system*
2. *Standardize formats for technical reports*
3. *Include measured responses of fish populations or life stages targeted*
4. *Link RPA actions to vital rates within life stages (e.g., juvenile survival rate)*

Specific to DOSS (flows inside the Delta – anadromous species pages 14–17):

a) *Use of a framework that combines the interactions of operations of DCC, OMR, and I:E expressed in total survival of fish passing through the Delta.*
b) *Use of a model that expresses total survival as a sum of four routes through the Delta (i.e., Yolo, Sacramento, San Joaquin, and transport at the pumps)*
c) *Evaluation of the sensitivity of the system to determine effectiveness of actions (e.g., use of Delta Simulation Model (DSM2) water volume fingerprinting)*
d) *Encourage developing data management initiatives with other groups in the Delta (e.g., SWRCB, DSP, water quality monitoring)*

2.1 DOSS Responses

DOSS initially chose to have a small subgroup work on how to implement the above IRP recommendations throughout the year; however, because of workload and staffing constrains, the subgroup was able to meet only once. Some of the recommendations are beyond the scope of DOSS, but where progress was made, it is indicated below.

General:

1. As part of RPA Action IV.4.3(c), DOSS has taken steps to greatly improve the use of a centralized web-based data system. In 2012, CDFG implemented an Enhanced Monitoring Program that centralized and summarized daily salvage, loss, loss density, and CWT information from the CVP/SWP export facilities into one location that was web-based (see Chapter 5). These summary reports were then used by DOSS to provide advice on project operations. A comprehensive centralized database for all biological and hydrological data in the Delta/Central Valley has long been a sought after goal. Many agencies have tried but failed to achieve this, the latest example being CALFED's now defunct website: Bay-Delta and Tributaries database (BDAT). Centralized database systems require a database

manager and constant input from many sources, which is expensive to maintain. Systems that are left up to the users to provide information, such as CalFish, contain patchy and out-of-date information. CalFish is a cooperative anadromous fish and habitat database representing information from 10 agencies in California; however, it does not contain the real-time information on monitoring sites up and down the Central Valley that DOSS needs. Even the Regional Mark Information System (RMIS), which compiles all CWT information in the Pacific Northwest, is approximately 3 years behind in adding new data.

2. DOSS implemented a standardized format for the 2012 report based on the Clear Creek Technical Team and Stanislaus Operations Group's 2011 reports.

3. DOSS included measured responses of juvenile salmonid life stages (*i.e.*, smolts) by using either uniquely marked surrogate hatchery releases or acoustically tagged steelhead and salmon. These responses were measured in percentages of each group entrained or by measuring in real time the direction and timing of tagged fish as they passed certain receivers.

4. DOSS did not link RPA actions to specific juvenile survival or growth rates, although by implementing the RPA actions such as DCC gate closures and more positive OMR flows, juvenile survival rates should increase (based on previous studies). DOSS recognizes that much work needs to be done and has undertaken the first steps toward this recommendation by identifying data needs and analyzing data from studies initiated in 2012 (*e.g*., Stipulation Study, 6-Year Acoustic Tag Experiment, and VAMP-like studies).

Specific to DOSS:

a) Use of a framework that combines the interactions of operations of DCC, OMR, and I:E expressed in total survival of fish passing through the Delta;

b) Use of a model that expresses total survival as a sum of four routes through the Delta (i.e., Yolo, Sacramento, San Joaquin, and transport at the pumps);

DOSS has made some progress in developing a framework/model that would be capable of expressing total survival of fish passing through the Delta, and has begun to collect specific reach survival and routing information that could be used as input to such a model. DWR is currently investigating the use of the Delta Passage Model (DPM) developed by Cramer Fish Sciences; however, in 2011, a workshop on salmonid life-cycle models concluded that none of the currently available models (including the DPM) were sufficiently well suited to examining water management and RPA questions to justify their selection as the model to be used. The DOSS subgroup concluded that there currently was not enough data to develop a robust and Delta-wide survival and routing model. Reach-specific survival studies would need to be conducted under a variety of different flow regimes. All agencies would need to agree on the modeling assumptions, such as mortality from predation and other stressors. In addition, the timescale for evaluating parameters within the model would need to be decided. DOSS is gaining more information each year from studies like the 6-year Acoustic Tag Experiment that will inform a model such as what IRP report suggested; however, considering that VAMP studies have gone on for 10 years now and are not yet complete, it will be some time before we can meet this recommendation.

c) *Evaluation of the sensitivity of the system to determine effectiveness of actions (e.g., use of DSM2 water volume fingerprinting); and*

DOSS utilized DSM2 runs and the particle tracking model (PTM) results for designing the range of OMR flows and export pumping levels in the Joint Stipulation Study (see separate report). These initial model runs were used as bookends to guide the experimental steelhead acoustic tag releases. DOSS also used DSM2 to guide decisions on experimental DCC gate closures. The use of water volume fingerprinting was included in this report to compare the hydrologic effects from WY 2011 to WY 2012 (see Chapter 4 and Figures 9 and 10 in Appendix A for results).

d) *Encourage developing data management initiatives with other groups in the Delta (e.g., SWRCB, DSP, water quality monitoring).*

This is outside the responsibility of the DOSS group (see Chapter 1, "The purposes of DOSS"); however, it is something that is being addressed by the Interagency Ecological Program (IEP). The IEP and DSP have collaborated in undertaking an ambitious goal of providing web-based data management initiatives with other groups such as the SWRCB and the Central Valley Regional Water Quality Control Board. The IEP has taken the first step by assisting in the development of web portals that highlight water quality monitoring information, as well as health alerts, and information on recent restoration projects (http://www.waterboards.ca.gov/centralvalley/water_issues/delta_water_quality/comprehensive_monitoring_program/index.shtml).

2.2 Questions from the 2011 Annual Review

The IRP responded to specific questions that DOSS asked last year with recommendations in its report (pages 25–27) as shown below (*in italics*). DOSS is providing a follow-up response this year.

DOSS question #1: What is the best method for evaluating RPA actions in Delta?

IRP response: *Effects on routing and travel time using the framework model provided to measure total Delta survival.*

DOSS response: Results of the Six-Year Acoustic Tag Experiment on the survival of steelhead smolts during outmigration in the San Joaquin River and Delta (Action IV.2.2) will identify survival, routing, and travel time of steelhead during the outmigration period of March through June at least three times annually. In 2011 and 2012, eight releases under distinct combinations of outflow and export were undertaken, and analyses done detailing results that will be useful for developing relationships for use in a process model to measure how steelhead through-Delta survival is influence by San Joaquin River inflow and exports. This study will not evaluate the influence of DCC operations because under the BiOp, DCC gates are closed for nearly the entire period of San Joaquin River steelhead outmigration.

DOSS question #2: What biological indicators should DOSS use to measure performance of the RPA actions?

IRP response: *Use fish routing, survival, and travel time.*

DOSS response: DOSS will be able to evaluate steelhead routing, survival, and travel time and how they are affected by Actions IV.2.1 and IV.2.3, and the SWRCB D-1641 required spring pulse flow on the San Joaquin River as a result of the 6-Year Acoustic Tag Experiment (Action IV.2.2).

DOSS question #3: What statistical approach should DOSS use to separate out RPA actions from variables such as flow and tides?

IRP responses:

a) use multiple regression analysis; before and after; however, little chance of success based on past history

b) use modeling approach; using fish routing such as ELAM (Goodwin 2006, and Rose 2011).

DOSS Response: As identified in the Task 3 section of the 2011 and 2012 study plan for the 6-Year Acoustic Tag Experiment (Action IV.2.2), results concerning reach-specific survival, routing, and travel time will be synthesized into a management-friendly process model. To ensure that this model encapsulates natural variation in San Joaquin River inflow, it is suggested that this model be developed after at least 3 years of steelhead releases have been analyzed. While the second 3-year period of the 6-year experiment is likely to provide additional information, the inclusion of a wet year (2011) with 2 years unlikely to capture this unique hydrology will yield sufficient information to initiate development of the management tool. It is unknown whether the life-cycle model being developed by NMFS will include steelhead on the San Joaquin River. Although ELAM is most likely of use as well, this model's smaller scale might be less useful for landscape-scale through-Delta survival evaluation than reach-scale process models.

Chapter 3 – Summary of Discussions and Advice/Recommendations

DOSS held 41 conference calls between 9/27/11 and 6/6/12. These calls were scheduled weekly on Tuesday mornings so that data from the previous week, including the weekend, could be reviewed before the next WOMT meeting. In addition, there were emergency calls on two Fridays concerning weekend operations, and one special call to provide advice on Chipps Island monitoring (Appendix B). For some topics that could not be resolved during the weekly conference call, a smaller subgroup of DOSS members was also convened. Three workshops were held to provide information on tools and data available to DOSS: two on the Joint Stipulation Study and one on the loss calculation. DOSS provided 21 advice/recommendations to NMFS and WOMT (Table 3.1), of which all but one were adopted. Most of the advice centered on triggers to control OMR flows in the Delta. Notes from each call to NMFS and WOMT are posted online at: http://swr.nmfs.noaa.gov/ocap/doss.htm.

Table 3.1. Summary of DOSS advice in 2012.

RPA Action*	Number of Calls	Subject of Advice
IV.2.3	4	OMR flows based on historical presence of juvenile Chinook
IV.2.3	9	OMR flows based on real-time loss densities at the CVP/SWP export facilities
IV.2.3	3	OMR flow based on PTM runs in NMFS technical memo (per Joint Stipulation Study)
IV.2.3	1	OMR flow based on PTM runs and DCT proposal (per Joint Stipulation Study)
IV.2.3	5	OMR flow based on daily acoustic tag results (per Joint Stipulation Study)
IV.2.1	1	I:E ratio based on D-1641 Waiver
IV.2.2	1	6-yr experiment required 1:1 inflow-to-export ratio

PTM: Particle Tracking Model; DCT: Delta Conditions Team
*Note: Some advice combined multiple triggers; therefore, they appear under two subjects.

3.1 Weekly Discussion Topics

- CVP/SWP export facilities pumping rates
- Fish monitoring, calculating salvage, loss, and loss densities
- DCC gate closures
- Joint Stipulation Study and resulting study (see separate report)

- OMR flow management (see Figure 1)
- Coordination with other technical teams

3.2 Other Discussion Topics

Limited discussions were held over the past year on the following topics. Some of these are included in this report, but the reader should refer to the weekly notes.

- Response to recommendations from the 2011 IRP report
- Monitoring requirements for the Sacramento River
- Changes in winter-run Chinook juvenile production estimate (JPE)
- Daily monitoring reports and Chipps Island advice (Appendix B)
- 6-Year Acoustic Tag Experiment
- 2012 VAMP-like experimental releases and San Joaquin River flow
- New juvenile sturgeon identification protocols
- Improvements to quantification of loss equation (Term and Condition 2[a])

3.3 Summary of RPA Actions

3.3.1 Topic 1. DCC Gate Operations (Action IV.1.2)

The first DOSS meeting was convened 9/27/11 with a discussion regarding early DCC gate closure timed with a pulse flow on the Mokelumne River to increase adult salmon returns to the Mokelumne River Fish Hatchery. DOSS was requested to coordinate with operators and provide comments on the study to ensure that closing the DCC gates did not compromise water quality in the interior Delta. A concern for DOSS was if water quality deteriorates because of the study, it might affect when the DCC gates are closed under Action IV.1.2. The experimental DCC gate closure was developed by CDFG and East Bay Municipal Utility District (EBMUD) to determine whether abundance of fall-run Chinook spawning in the Mokelumne River increased and whether stray rates into adjacent rivers (*i.e.,* American River) would be reduced from the closure.

Based on DSM2 runs, water quality did not exceed operational concern levels at multiple locations within the Delta; therefore, the DWR modified the DCC gate closure plan to begin on 10/4/11 (instead of about 10/1/11) and hold for 10 days until 10/14/11. The timing was changed to 10/4/11 to take better advantage of the tides to monitor adult fish and any changes in their movement from flows. CDFG began capturing fall-run salmon using gill nets near Jersey Island in the Delta (Figure 1). CDFG tagged only hatchery fish with acoustic tags, targeting 15 first and 15 more when the DCC gates were closed. At the same time, EBMUD began releasing higher flows on the Mokelumne River over a 10-day period of DCC closure to document any behavioral changes in returning spawners.

The DCC gates were closed from 10/4/11 to 10/14/11 (10 days). According to the DSM2 model runs by DWR, water quality was not expected to degrade through the 10-day closure period. There were 60 adults seen on 10/3/11 and approximately 200 passed the Woodbridge Dam ladder on 10/4/11. Approximately 164 salmon passed Woodbridge on 10/3/11 (adults and grills). The pulse flows began on 10/4/11; it takes approximately 1 day for the water to get down to the Woodbridge Dam (Hwy. 99) fish ladder. This information should help DWR with modeling.

From 10/5/11 to 10/11/11, there were 3,313 adult Chinook salmon that passed through the fish ladder at Woodbridge Dam. As of midnight on Thursday, 10/13/11, 4,106 adult Chinook salmon had passed Woodbridge since 10/5/11; CDFG estimated that an additional 400–500 passed Woodbridge on Friday and Saturday (10/14–10/15/2011). Results from the fish that CDFG tagged at Jersey Point showed that two returned to the American River before the DCC gates were closed and one acoustic tag was recovered on 10/17/11 at the Mokelumne River Fish Hatchery. While the DCC gates were open, higher flows on the Mokelumne River were still being released to provide attraction flows. The 2011 fall-run Chinook salmon escapement set an all-time record on the lower Mokelumne River at 18,589 fish. This action was considered very successful by CDFG and EBMUD; however, adult fall-run returns were higher throughout the Central Valley so it is difficult to know whether the increased abundance was because of the DCC closure or higher returns. A more interesting result of the DCC closure was that straying of Mokelumne River fall-run Chinook into other watersheds in 2011 was only 7% compared with 25% in 2010 following a 2-day closure.

After the 10-day experimental closure in October, the DCC gates remained opened until 12/1/11, when they were closed for protection of juvenile winter-run Chinook pursuant to NMFS RPA Action IV.1.2. DWR continued to monitor water quality conditions in the interior Delta, especially in late December. The projects continued to evaluate reservoir storage management and Delta requirements (SWRCB D-1641) to go from excess to balanced conditions. It was not known whether D-1641 required 4,500-cfs monthly outflow, or salinity would control project operations. DOSS used daily fish monitoring reports from Red Bluff Diversion Dam, Tisdale, Knights Landing, Lower Sacramento trawl, and Chipps Island (Figure 1) to track juvenile salmon and steelhead movement into and out of the Delta (see Figure 3.1 for an example).

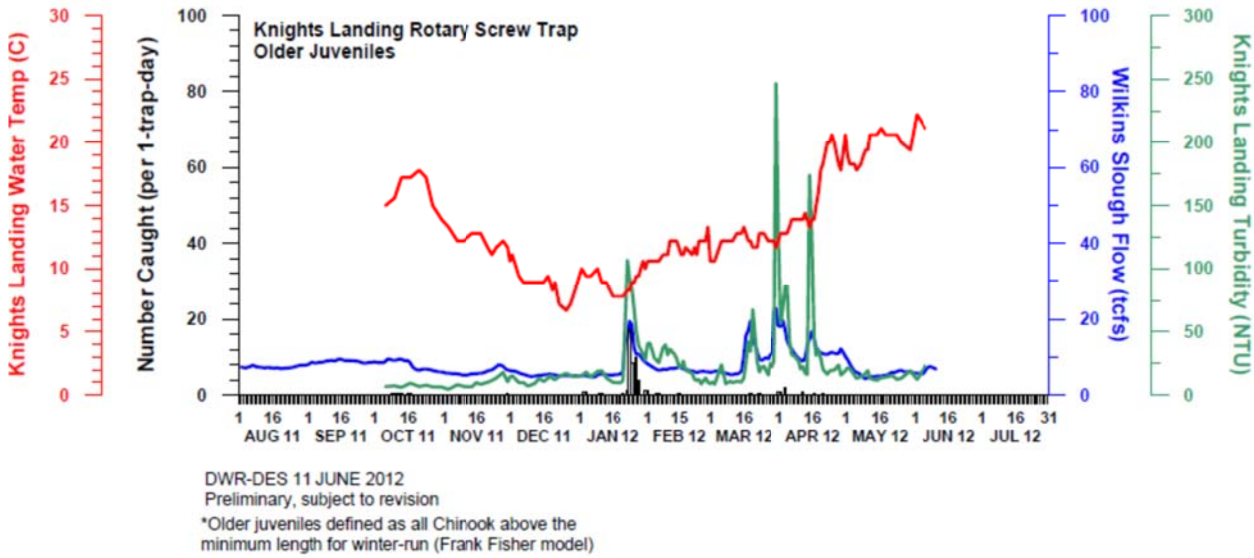

Figure 3.1. Knights Landing weekly data report to DOSS including older juvenile Chinook, water temperatures, turbidity, and flows based on preliminary CDFG data on 6/11/12.

3.3.1.1 Summary

DOSS used daily fish data and water quality data effectively to assist with the preemptive management of the DCC gates during the study period when adult salmonids historically entered the Delta. DOSS coordinated the exchange of information from the fisheries agencies to the project operators. The closure of the DCC gates increased fall-run spawner abundance on the Mokelumne River. Action IV.1.2 is a calendar-based action, and listed juvenile salmonids were not observed until approximately 1 month following the DCC gate closure, during which time outflow conditions shifted to a balanced condition. The preemptive closure of the DCC gates ensured that juvenile salmonids remained in the mainstem Sacramento River, which has a higher survival than interior Delta pathways. It is unknown what effect DCC gate closures have on green sturgeon.

3.3.2 Juvenile Production Estimates

To provide annual incidental take levels for the CVP/ SWP export facilities, NMFS calculates a JPE for winter-run Chinook salmon pursuant to the NMFS BiOp with input from the Winter-Run Project Work Team (WRPWT, see section 3.3.8.1). This estimate was used to determine the authorized level of incidental take under section 7 of the Endangered Species Act (ESA) for the CVP/SWP export facilities in water-year (WY) 2012.

Before using the preliminary JPE in December, the incidental take limit of natural winter-run for the projects was estimated to be between 1,300 and 3,000 fish. It was anticipated that based on the preliminary JPE, the OMR flow management trigger would most likely be less than the minimum 2.5 fish/TAF established in RPA Action IV.2.3. The first-stage trigger under RPA Action IV.2.3

for OMR flows is equal to 2 percent of the JPE divided by 2,000, with a minimum of 2.5 fish/TAF. This action takes effect on January 1 each year. Until the official letter from NMFS identifying the JPE and JPE-based incidental take limit for the CVP/SWP export facilities was issued, DOSS advised that the facilities use the minimum (2.5 fish/TAF) fish density trigger in RPA Action IV.2.3 based on the preliminary JPE.

Using the JPE as defined in the NMFS BiOp, NMFS estimated that 162,051 juvenile wild winter run would enter the Delta during WY 2012. An additional 185,281 hatchery winter run were released into the upper Sacramento River near Redding in February 2012, of which 96,525 (53 percent) were estimated to survive to enter the Delta. Because the number of hatchery winter run released in the upper Sacramento is known (*i.e.*, 185,281 in 2012), NMFS established the authorized incidental take as 1 percent of that release. The total authorized incidental take for 2012 was 3,241 wild and 965 hatchery winter-run Chinook salmon. In 2011/12, identification of these salmon at the CVP/SWP export facilities was based on the Delta length-at-date criteria developed by Frank Fisher, CDFG, and modified by DWR for the Delta.

The JPE-based loss density triggers were calculated to be 1.6 fish/TAF (first-stage trigger) and 3.2 fish/TAF (second-stage trigger) for WY 2012, both of which are below the minimum densities required in RPA Action IV.2.3; therefore, the 2.5 fish/TAF first-stage trigger and 5.0 fish/TAF second-stage trigger described in the RPA was used to implement Action IV.2.3. A CDFG website was developed specifically for DOSS to track the older juvenile loss densities on a daily basis (see Chapter 5).

3.3.3 Topic 2. Old and Middle River Flow Management (Action IV.2.3)

From January through the end of February, loss densities were monitored by DOSS, OMR flows were maintained at -5,000 cfs, and the JPE was based on the January 1 start date in the NMFS BiOp. The first-stage trigger was met at the end of February and CVP/SWP export facility operators reduced exports to meet OMR flows of no more negative than -3,500 cfs. The second-stage trigger for older juvenile loss density was exceeded for 3 days and project exports were reduced to meet OMR flows of no more negative than -2,500 cfs. Throughout March, the loss-density triggers were exceeded and OMR flows were changed among -5,000 cfs, -3,500 cfs, and -2,500 cfs eight different times. Reverse flows in Old and Middle rivers were managed within this range to reduce negative flows toward the CVP/SWP export facilities, which is hypothesized to increase survival of outmigrating juveniles originating from the San Joaquin basin and Sacramento River. This action required daily reporting of fish loss densities, which was previously not part of the usual fish facility reporting process (see Chinook and steelhead summary tables [Appendix B] for the daily loss and loss density of wild [non-clipped] winter-run-length and older juvenile Chinook salmon at the CVP/SWP export facilities from 10/1/11 through 6/30/12).

DOSS advised that the OMR flows could relax if there were 3 consecutive days of loss density below a first- or second-stage trigger. A special DOSS call was held on Friday, 3/9/12, to cover weekend operations. For daily loss density monitoring and operational changes, see Appendices B and C.

Beginning 3/26/12, DOSS advice on flows included: 1) consideration of both PTM results (per the Joint Stipulation Study), 2) information per the NMFS OMR Technical Memorandum (Tech Memo) issued 3/16/12, and 3) the loss densities per RPA Action IV.2.3. The second-stage trigger of 5.0 fish/TAF was exceeded on 4 of the last 5 days from 3/20 through 3/24/12. On 3/27/12, DOSS advised continuing OMR at no more negative than -2,500 cfs until there were 3 consecutive days of combined loss density below the 5.0 fish/TAF trigger. The action ended on 4/1/12 when the Joint Stipulation Study began.

3.3.3.1 Summary

Many monitoring improvements were made this year to allow OMR flow decisions based on daily data reporting. The daily loss triggers were exceeded on nearly a weekly basis in February and March. The daily loss triggers were set at a higher level (*i.e.*, minimum level in BiOp) than the density trigger based on just the winter-run JPE; therefore, the triggers should have been exceeded less often, but this was not the case. The low-density triggers resulted in frequent changes in exports to control OMR flows. DOSS implemented procedures to meet the new reporting requirements to cover weekends and holidays. Several emergency calls took place on Fridays (see NMFS determinations and DOSS notes at http://swr.nmfs.noaa.gov/ocap/doss.htm).

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

In January 2012, public water agencies (PWAs), State of California, and Federal agencies filed a joint stipulation in Federal court that included project operations during April and May 2012 in lieu of operating to the San Joaquin I:E ratio specified in RPA Action IV.2.1. Details of the implementation of the joint stipulation are provided in a separate report.

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

This RPA Action requires that Reclamation conduct a 6-year acoustic tag experiment to confirm proportional causes of mortality from flows, exports, and other project and non-project adverse effects on steelhead smolts outmigrating from the San Joaquin basin and through the southern Delta. Reclamation provided weekly updates to DOSS. Data for the 2011 and 2012 study periods will be analyzed during fall 2012 and winter 2013, and a report on these 2 years should be drafted for DOSS by spring 2013.

The 2012 experiment included three releases of steelhead between April 3 and 5, April 30, May 4, and May 17–21, in which 1,438 steelhead were tagged along with 72 fish tagged and held for health studies, and additional fish held in the laboratory for tag burden and battery life studies. Issues relevant to listed anadromous fish species that will be addressed include, but are not limited to:

a) increasing survival of emigrating smolts from the tributaries into the mainstem San Joaquin River;
b) increasing survival of emigrating smolts through the mainstem San Joaquin River downstream into the Delta;
c) increasing survival of emigrating smolts through the Delta to Chipps Island;
d) assessing the role and influence of flow and exports on survival in these migratory reaches;
e) selecting routes under the influence of flows and exports;
f) identifying reach-specific mortality and/or loss; and
g) assessing the effectiveness of experimental technologies, if any (*e.g.*, non-physical barrier ["bubble curtain"] at the Head of Old River).

3.3.6 Topic 5. Entrainment at the CVP/SWP exports and salvage reporting (Action IV.4.3)

In 2011, DWR added a new public website (http://www.water.ca.gov/swp/operationscontrol/calfed/calfedmonitoring.cfm) to report the daily salvage and loss at the CVP/SWP export facilities pursuant to Action IV.4.3 concerning salvage reporting. This information is reported weekly to DOSS and includes the species and number of fish counted, as well as the volume of water exported in graphical format. The following salvage and export data are reported:

- Juvenile Chinook salmon monitoring data (sites upstream and in the Delta used by
- DOSS),
- Juvenile Chinook salmon salvage data,
- Winter-run Chinook salmon loss data,
- Spring-run Chinook salmon surrogate loss data (table of hatchery release group recoveries at the CVP/SWP export facilities),
- Non-clipped steelhead salvage data, and
- Non-clipped fry/smolt Chinook salmon data.

3.3.6.1 Spring-run surrogate releases

Coleman National Fish Hatchery (CNFH) juvenile late-fall-run Chinook salmon are used as surrogates to mimic the natural yearling spring-run emigration pattern from Deer, Mill, and Antelope creeks. These fish are marked with a clipped adipose fin and unique CWT code before being released. There were three surrogate hatchery releases in 2012, one in December and two in January. DOSS also monitors the CNFH late-fall production release for percent loss at the CVP/SWP export facilities (Table 1, Appendix A). The CNFH late-fall-run Chinook salmon are considered appropriate surrogates for spring-run Chinook salmon because they are reared to a size similar to that of wild spring-run yearlings and released into the upper Sacramento River at a similar time (first storm or high flow event).

In addition to tracking the CNFH late-fall-run releases daily, DOSS tracked juvenile spring-run Chinook released from the Feather River Hatchery (FRH) in WY 2012 to determine whether they might be used as spring-run surrogates (see Table 3 in Appendix B). Out of the 1.1 million FRH spring-run production released into the Feather River, none were observed at the CVP/SWP export facilities in 2012. This might have been because of the timing of the release in April, well after most of the wild spring-run yearlings have exited the tributaries. DOSS decided not to use the FRH release spring run as surrogates.

3.3.7 Topic 6: Green sturgeon salvage

There are no RPA-specific triggers for green sturgeon. The actions taken this year to reduce the loss of salmon and steelhead at the CVP/SWP export facilities have an unknown effect on entrainment of juvenile green sturgeon.

There were no green sturgeon salvaged at the CVP/SWP export facilities in 2012 (October –June) compared to 14 salvaged in 2011 (Table 5.1). There were also 64 white sturgeon salvaged in 2012. The incidental take level for green sturgeon is based on average historical salvage levels at the CVP/SWP export facilities. Green sturgeon salvage is highly variable and can be zero in some years (*e.g.*, 2004, 2009); therefore, zero salvage is not unusual and may be related to reduced export pumping levels from February through May (Figure 4.2). Green sturgeon salvage is not expanded for loss; however, DWR and Reclamation are in the process of developing a plan that will evaluate louver efficiency and prescreen predation risk to green sturgeon (Appendix A). Once these factors are known, a loss calculation can be applied to the salvage numbers.

3.3.7.1 New sturgeon identification protocols

Because of difficulties identifying juvenile sturgeon at the CVP/SWP export facilities in 2011, a new protocol was developed and adopted by the Tracy Fish Facility to include new meristic characteristics to identify juveniles and genetic tissue sampling for all juvenile sturgeon <120 mm long. The Skinner Fish Facility is considering adopting a similar protocol (see DOSS notes from 11/01/11).

3.3.8 Other topics

The following additional topics were also discussed during the DOSS calls.

3.3.8.1 IEP Winter-Run Project Work Team (WRPWT)

WRPWT met several times in November and December to consider changes to the JPE, which is used to calculate the amount of incidental take at the CVP/SWP export facilities. A subgroup developed several revisions to improve the JPE in 2012 as follows:

1) Modify juvenile survival estimates based on recent studies,
2) Update smolt survival rates to the Delta based on CWT recoveries to include ocean recoveries from 2005 through 2010,
3) Add a survival factor to account for the time juveniles spend rearing in the Delta, and
4) Review the results of acoustical tag studies done in 2011 next year for use in the JPE.

WRPWT recommended to NMFS that a new term for juvenile survival (0.359) be added to this year's JPE based on Perry (2010) juvenile survival data from Freeport to Chipps Island. Current estimates accounted for survival only up to the time that winter run entered the Delta. Peak abundance of winter run at Chipps Island and the CVP/SWP export facilities occurs approximately 3 to 4 months later than that in the lower Sacramento River. WRPWT agreed that another survival factor needed to be added to account for survival through the Delta to Chipps Island or the CVP/SWP export facilities.

NMFS updated the method used to calculate the JPE was updated in 2011/12 to reflect new information on winter-run survival. WRPWT reviewed the last 5 years of data and new studies, along with annual updates made to various factors such as number of females, fecundity rate, egg loss because of temperature, etc., used in the calculations. Revisions to be made in the JPE calculations for WY 2012 incorporated the best available data from studies conducted since the last review in 2005. These include in-river survival estimates based on the latest acoustic-tag studies. NMFS accepted the WRPWT recommended revisions to in-river survival and included these in the JPE calculations for WY 2012; however, it did not incorporate the WRPWT recommendation of a new term for through-Delta survival (*i.e.*, 35.9 percent survival from Freeport to Chipps Island) because, although important, this additional estimate would change the definition of JPE as used in the NMFS BiOp. NMFS also contracted with Cramer Fish Sciences to develop a model for the JPE that would provide some measure of error associated with the calculation. The model was completed and used for the first time in 2011.

3.3.8.2 Smelt Working Group

In the interest of coordinating operations within the Delta, a representative from DOSS attends Smelt Working Group (SWG) meetings and a representative from SWG attends DOSS meetings. The SWG notes are posted on the FWS website at http://www.fws.gov/sfbaydelta/ocap/.

SWG had its first meeting on 11/28/11 and began meeting weekly on 1/3/12. The SWG representative reported on the DOSS calls the results of SWG discussions throughout WY 2012. The annual Fall Midwater Trawl Index of 2011 was 343 and the annual Delta Smelt Recovery

Index was 55. A total of 203 adults and 2,151 juvenile (>20 mm) delta smelt were salvaged at the CVP/SWP export facilities. The authorized incidental take for delta smelt are 2,487 adults and 19,276 juveniles. For longfin smelt, no adults and 3,740 juveniles were salvaged in spring 2012. Most monitoring (spring Kodiak trawls and summer townet surveys) indicated that adults and larvae were generally downstream of the central and south Delta. Because of beneficial hydrological conditions for both longfin and delta smelt throughout WY 2012, as controlled in part by salmon criteria, SWG made no recommendations for operational changes to WOMT.

3.3.8.3 Adjustments to the RPA

In January, DOSS members were asked whether they had suggestions for any adjustments to the RPA, such as the fish-density triggers. The 2.5 fish/TAF loss density was the same for both the first- and second-stage triggers under Action IV.2.3. The easiest "fix" was to remove the minimum 2.5 fish/TAF listed in the second-stage trigger; however, that would have left the JPE-based trigger for the second stage, which would have most likely been low. Because the second-stage JPE-based density trigger is twice that of the first stage, it made sense that the minimum second-stage trigger be double that of the first stage, or 5.0 fish/TAF, and would trigger the OMR response of no more negative than -2,500 cfs. This was consistent with how the JPE-based density triggers are written. DOSS advised both NMFS and WOMT on this clarification.

3.3.8.4 Coleman National Fish Hatchery

CNFH released three groups of late-fall Chinook uniquely marked as spring-run surrogates into Battle Creek: 1) 62,400 on 12/23/11, 2) 80,800 on 1/13/12, and 3) an unknown number on 1/20/12. These releases were timed to turbidity and flow events in the upper Sacramento River that would most likely mimic natural storm events in spring-run Chinook natal streams.

In January, CNFH reported that there had been an accident while releasing the last spring-run surrogates on 1/20/12. A pipe broke when the fish were being released into Battle Creek and most of the release was stranded in the gravel. Although CNFH employees reported that about two-thirds of the fish were lost (~40,000), they recommended that DOSS assume that "none" made it into the water. As a result, DOSS decided not to use the 1/20/12 release as a trigger. DWR continued to collect data on the 1/20/12 release for tracking purposes and assumed that at least one-third, or approximately 20,000 fish, were released into Battle Creek (Appendix A).

3.3.8.5 Progress on meeting Term and Condition 2(a) in the NMFS 2009 BiOp

In 2012, DWR contracted with Cramer Fish Sciences to perform a sensitivity analysis of the loss calculation used to quantify salvage and loss at the CVP/SWP export facilities. The focus of this analysis was to review uncertainty in the loss equation and compare it to an alternative method developed in 2011 (Jahn 2011). A workshop was held in September 2012 and preliminary results comparing the alternative method to the current method are provided in Appendix A. Reclamation and DWR are required to provide a progress report at this annual review and a recommendation to the IRP in 2013. Refinement of the loss equation is needed to account for 1) losses during louver cleaning, 2) appropriate loss expansion factors for steelhead and sturgeon, 3) predation risk for green sturgeon, and 4) uncertainty in louver efficiency.

Chapter 4 – Operations Summary

4.1 Water Year 2012

WY 2012 was much drier than WY 2011 in both the Sacramento and San Joaquin river basins (Figure 21, Appendix A, comparison of last 10 years). In May, the Sacramento Valley was classified as a below-normal WY, while the San Joaquin Valley was classified as a dry WY. Shasta Reservoir was nearly full (98 percent). There were no flood control releases. Sacramento River flows were low all year; peak flows barely exceeded 40,000 cfs in March and April. Average monthly flows at Freeport (inflows to the Delta) were <15,000 cfs through fall and winter (see Table 3, Appendix A). Although initial storage conditions (end of September) were high from the previous year, releases were reduced to conserve storage as the year progressed. "Excess" conditions dominated the Delta from October to December 1 when they changed to "balanced" conditions (Appendix C). Exports were reduced from 11/17 through 11/30/12 to move X2 westward as part of the FWS fall salinity requirement. The Federal share of the San Luis Reservoir filled by 12/31/11. See Appendix C for a summary of what conditions were controlling export pumping. The WY classification on the San Joaquin River changed on 4/1/12, complicating operations that were based on Vernalis flows (Figure 4.1). Most of the water for the spring pulse flow on the San Joaquin River came from New Melones Reservoir releases into the Stanislaus River. The San Joaquin River averaged <2,500 cfs from December 2011 through April 2012, compared to >28,000 cfs in April 2011.

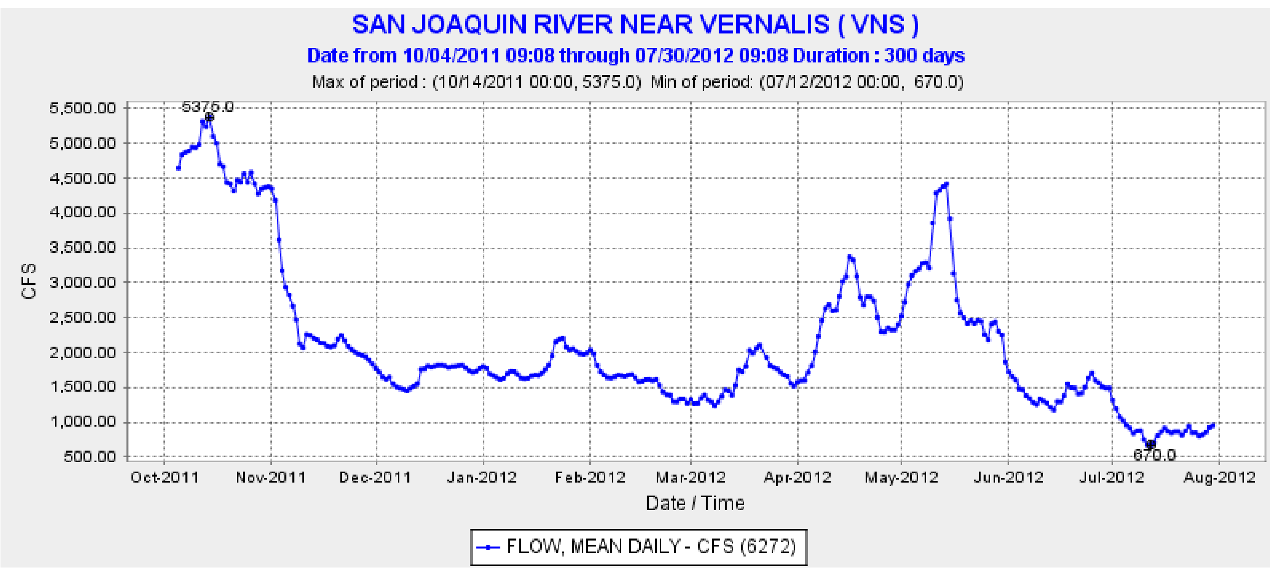

Figure 4.1. San Joaquin River flows at Vernalis October 2011 to July 2012.

One of the obvious differences in this year's hydrology can be seen in the volumetric fingerprints using the DSM2 results (Figures 9 and 10, Appendix A). These "fingerprints" show that the majority of water pumped from the Delta at the SWP export facility came from the Sacramento

River, whereas the majority of water at the CVP export facility came from the San Joaquin River. This is more typical of a dry year pattern. Last year, the high flows in the San Joaquin River constituted the majority of water at both the CVP and SWP export facilities until late summer, when Sacramento River water dominated.

OMR criteria in the NMFS BiOp controlled exports to generally less than 5,000 cfs from January through May (Figure 4.2); however, there were periods in April and May when Vernalis flow requirements (*i.e.,* D-1641 requires 1:1 and 2:1 I:E ratios depending on San Joaquin River flows) were controlling exports (see Appendix C). OMR flows remained negative from October 2011 through June 2012 (Figure 4.2). Delta outflow requirements in D-1641 controlled from June forward.

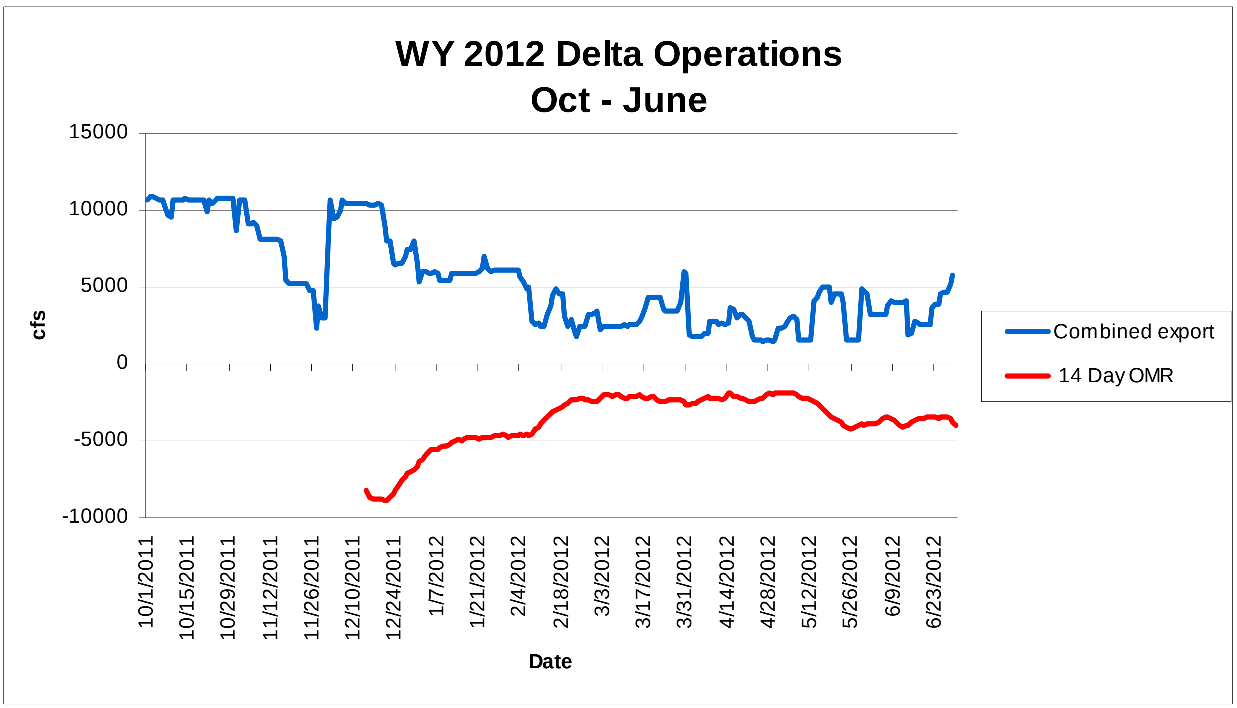

Figure 4.2. OMR operations October 2011 through June 2012.

Chapter 5 – Monitoring Activities

5.1 Enhanced Rapid Salvage Report for Water Year 2012

Prepared by Bob Fujimura, CDFG, on September 10, 2012

DWR, Reclamation, and CDFG staff have worked cooperatively to enhance the speed and quality of the latest salvage information reported from the CVP/SWP export facilities. Beginning in fall 2011, biologists at both facilities successfully implemented the near real-time (daily) reading and reporting of CWT information from hatchery Chinook salmon from routine salvage collections. Each business day (weekday), CWT information was sent to key salvage data specialists at DWR and CDFG for analysis.

Concurrently, CDFG Bay-Delta Region staff implemented a series of actions to provide more rapid dissemination of raw and calculated salvage/loss information from these facilities. First, CDFG staff reported daily (weekday) all raw salvage data collected the previous weekday by each facility's personnel. After data entry and quality control procedures had been completed, all raw data from the previous workday or weekend were merged with their historical MS Access database and an updated copy is uploaded to CDFG's Salvage FTP site for public access at: ftp://ftp.delta.dfg.ca.gov/salvage/ under the file name "Salvage_data_FTP.zip". In previous years, such detailed information was reported on only an annual basis.

Because of the complexity of the raw data, DWR and CDFG staff used multiple means by which to rapidly summarize and disseminate these results to key users. Weekly e-mail reports to technical advisory teams such as the DOSS, SWG, and the data analysis team (DAT) were supplemented with new customized summary graphs and tables (Tables 5.1 and 5.2; and Figure 5.1). CDFG prepared daily (weekday) summary salvage, loss, and density reports for juvenile Chinook salmon, steelhead, sturgeon, delta smelt, and longfin smelt and made them available on its Salvage FTP site (see below). Using the available CWT data, DWR staff reported the daily and cumulative losses of hatchery Chinook salmon release groups (20120507SpringSurrogateLossEstimate.xlsx). CDFG also provided web pages that allow the user to query the daily salvage results (in total fish or densities) of any species of fish for any time period since 1/1/93 (Fujimura 2011).

In 2012, CDFG merged the CWT information into its MS Access database by entering this year's data into a preexisting data table. CDFG recently posted a consolidated juvenile salmon salvage and loss dBase table that contains all race and origin (hatchery vs. wild) classification information from 1993 to present at its Salvage FTP site (SALM9312.DBF in folder, DOSS_Salvage_Tables).

Table 5.1. Sturgeon daily salvage summary.

Sturgeon - Daily Summary Table												
California Department of Fish and Game - Results Subject to Revision												
Prepared by Geir Aasen					*Report Date:*		9/14/2012 10:35					
	STATE WATER PROJECT						**CENTRAL VALLEY PROJECT**					
	GREEN STURGEON			**WHITE STURGEON**			**GREEN STURGEON**			**WHITE STURGEON**		
DATE	**CATCH**	**SALVAGE**	**SIZE**	**CATCH**	**SALVAGE**	**SIZE**	**CATCH**	**SALVAGE**	**SIZE**	**CATCH**	**SALVAGE**	**SIZE**
10/12/11										1	4	395
10/14/11										2	8	315-345
10/15/11										2	8	243-NL
10/20/11										1	12	331
10/22/11										3	12	344-NL
10/25/11										1	12	351
12/1/11										1	4	357
2/5/12										1	4	NL
6/13/12				1	12	358						

SIZE = total length in mm; reporting period = water year (Oct 1 - September 30); NL = fish length not measured
CATCH = observed number in samples; SALVAGE = estimated daily number of fish collected by fish facility; see "Salmon Loss Estimate" document for more infornation

Table 5.2. Example of DOSS weekly salvage update.

DOSS Weekly Salvage Update
Reporting Period: April 9-15, 2012
Prepared by Bob Fujimura on April 16, 2012
Preliminary Results -Subject to Revision

Criteria	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr	Trend	
Loss Densities									
Wild winter-run CS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	↘	
Wild steelhead	0.4	0.4	0.0	4.2	9.8	0.0	4.9	↘	exceeds 1st stage trigger
SWP daily export	4,368	4,368	3,458	2,557	2,184	4,368	4,368	↗	
CVP daily export	1,618	1,625	1,620	1,617	1,622	1,618	2,719	→	

Loss density = fish lost/TAF; water export = AF; trend = compared to previous week; wild = adipose fin present

Chinook Salmon Weekly/Season Salvage and Loss
Combined salvage and loss for both CVP and SWP fish facilities

		Weekly Total			Season Total		
Category		Salvage	Loss	Trend	Salvage	Loss	
Wild							
	Winter Run	0	0	↘	821	1,999	exceeds "warning level"
	Spring Run	211	285	↗	541	1,008	
	Late Fall Run	0	0	→	20	14	
	Fall Run	0	0	→	8	33	
	Total	211	285		1,390	3,054	
Hatchery							
	Winter Run	4	4	↗	444	1,152	
	Spring Run	0	0	→	4	17	
	Late Fall Run	0	0	→	25	20	
	Fall Run	0	0	→	0	0	
	Total	4	4		473	1,189	

Race determined by size at date of capture; hatchery = adipose fin missing;

Steelhead Weekly/Season Salvage and Loss
Combined salvage and loss for both CVP and SWP fish facilities

	Weekly Total			Season Total	
Category	Salvage	Loss	Trend	Salvage	Loss
Wild	32	95	→	289	981
Hatchery	46	141	↗	524	947
Total	78	236		813	1,928

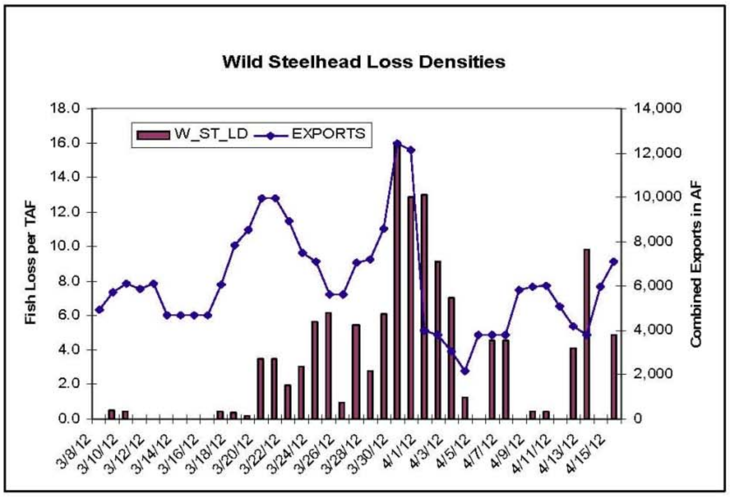

Figure 3. Wild steelhead loss densities and exports for the combined CVP and SWP facilities from March 8 through April 15, 2012. Information from DFG daily steelhead and smelts summary tables (G. Aasen; 4/16/12). Prepared by Bob Fujimura on April 16, 2012.

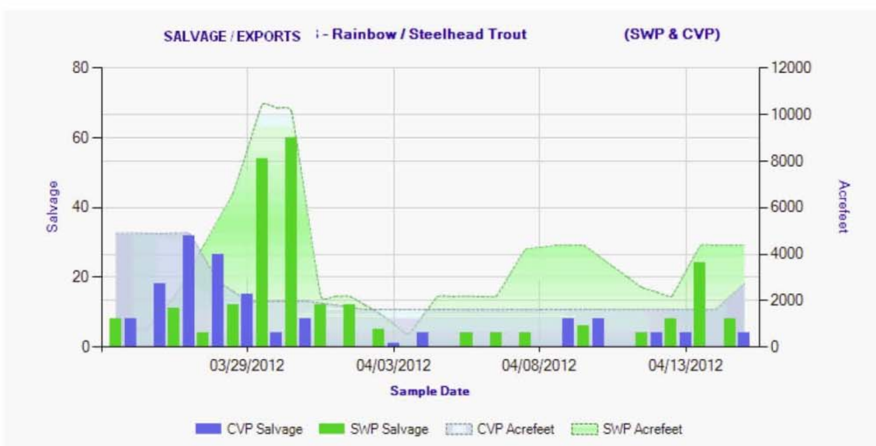

Figure 4. Daily salvage of steelhead and water exports from the state and federal fish salvage facilities during March 25 through April 15, 2012. Graph obtained from the DFG salvage monitoring web-page: http://www.dfg.ca.gov/delta/apps/salvage/SalvageExportCalendar.aspx

Figure 5.1. Example of reported steelhead daily loss densities and exports.

5.2 Mill and Deer Creek Monitoring

RPA section 11.2.1.3 calls for adult and juvenile monitoring of spring-run Chinook salmon, winter-run Chinook salmon, and steelhead on Mill and Deer creeks (see Figure 5.4). DOSS uses the rotary screw trap (RST) data from Mill and Deer creeks to get a sense of the timing of yearling-sized spring-run Chinook salmon emigration. DOSS uses the information gained from these data as a first alert for the DCC gate operations and to inform CNFH on the timing of late-fall-run Chinook releases for spring-run Chinook surrogate groups; however, for WY 2012, the RSTs on Mill and Deer creeks were not operated because of concerns regarding incidental mortality, trapping difficulties, and a desire by CDFG to conduct a review of this element. Therefore, DOSS evaluated various data from the RST monitoring locations at Tisdale Weir and Knights Landing (see Figure 5.4) in an effort to determine whether these data could be used as a first alert for DCC gate operations or for the timing of the spring-run Chinook surrogate releases.

To evaluate these data, a subgroup of DOSS analyzed at the 2010/11 Mill and Deer Creek and Tisdale Weir RST data (Figure 5.2). These data show that non-clipped (wild) older juvenile Chinook salmon were sampled outmigrating from natal creeks many weeks earlier than their presence on the mainstem Sacramento River. In addition, the presence at Tisdale Weir of older juveniles appears to capture outmigration from natal streams earlier in the migration period quite well, suggesting that if these fish are detected at Tisdale Weir, a majority have already left natal creeks upstream.

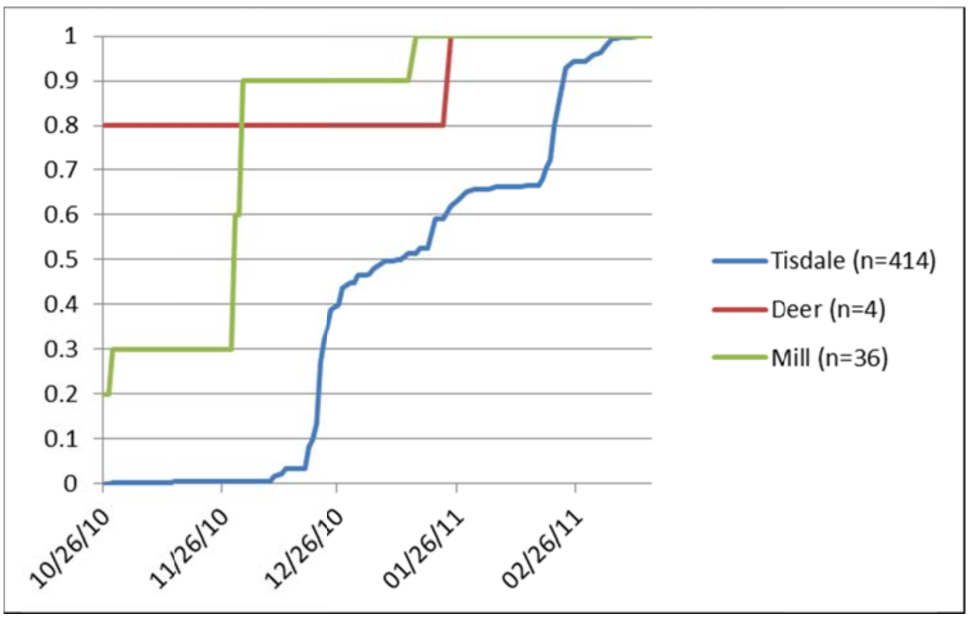

Figure 5.2. Daily cumulative frequency (expressed as a percent) of non-clipped older juvenile Chinook salmon sampled at RSTs on the Sacramento River and Mill and Deer creeks.

Furthermore, DOSS reviewed the 2011/12 data at Tisdale and Knights Landing to compare the actual recoveries of older juvenile Chinook salmon with the recoveries of the spring-run Chinook surrogates at these monitoring locations. For WY 2012, CNFH released three separate spring-run surrogate groups of adipose-clipped late-fall-run Chinook salmon into the Sacramento River at Battle Creek on 12/23/11, 1/13/12, and 1/20/12 (Table 5.3).

Table 5.3. Coleman NFH release information for spring-run Chinook surrogates.*

Release Date	CWT Race	Release Site	Release Type	Number Released
12/23/2011	LF	Battle Creek	Spring Surrogate	62,400
1/13/2012	LF	Battle Creek	Spring Surrogate	80,800
1/20/2012	LF	Battle Creek	Spring Surrogate	20,000**

*Preliminary, subject to revision
** This number is an estimate since 2/3 of the release may have been stranded before entering Battle Creek.

At the time of each surrogate release, the recoveries of older juvenile Chinook salmon were low at both Tisdale Weir and Knights Landing (Figure 5.3); however, most of the recoveries of the spring-run Chinook surrogates in late January were consistent with the timing of the older juvenile Chinook salmon recoveries at both Tisdale Weir and Knights Landing. Despite this preliminary result, not all of the spring-run Chinook surrogate recoveries coincided with the recoveries of older juvenile Chinook salmon. As an example, the first spring-run Chinook surrogate recoveries from the 12/23/11 release occurred before the peak period of the older juvenile recoveries at Tisdale Weir. In addition, the last spring-run surrogate recoveries from the 1/20/12 release occurred after the peak period of older juvenile recoveries at Tisdale Weir. Nonetheless, many of the spring-run surrogates were recovered during the same week as the peak of older juvenile Chinook salmon recoveries; therefore, the timing of spring-run surrogates was a good indicator of the emigration timing of older juvenile Chinook salmon on the mainstem Sacramento River.

DOSS would like to compare multiple years of the spring-run Chinook migration timing observed at Mill and Deer creeks to that observed at Tisdale and Knights Landing as these data become available. CDFG is working to summarize the last several years' worth of RST data from Mill and Deer creeks, and when this is available, DOSS will review results to evaluate whether tributaries, mainstem flows and/or turbidity affect older juvenile Chinook outmigration. The decision on whether to replace Mill and Deer creek monitoring sites will be made through the Implementing Management Team with input from the Central Valley Salmon Project Work Team.

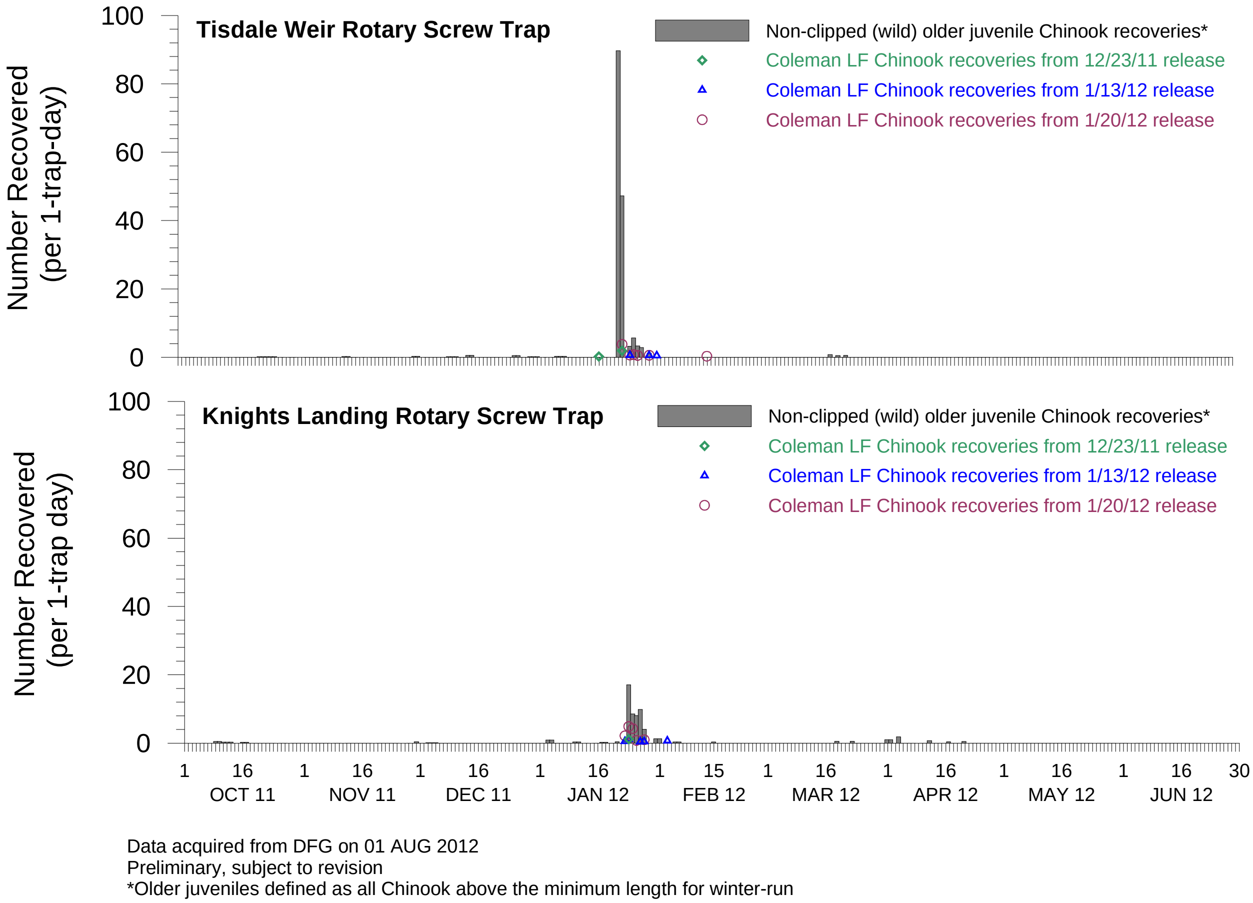

Figure 5.3. Older juvenile Chinook salmon and spring-run surrogate recoveries at Tisdale Weir and Knights Landing RST between October 2011 and June 2012.

5.3 Sacramento River New Juvenile Monitoring Station (RPA Section 11.2.1.3 [8]c)

This action required a new monitoring station between Red Bluff Diversion Dam (RBDD) and Knights Landing to: (1) provide early warning of fish movement downstream, and (2) determine survival of ESA-listed fish leaving the spawning areas.

In 2011, CDFG added a new RST monitoring station at Tisdale (Figure 5.4) to replace the former RST site at the Glenn-Colusa Irrigation District (GCID) diversion on the Sacramento River and meet the NMFS monitoring requirement for a new station. DOSS recommended continuing monitoring at the Tisdale location for use in managing the DCC gate operations until it could decide on a more expansive sampling objective that focused on the methods and getting the most out of the data. It was noted that the NMFS RPA action required only one additional monitoring station.

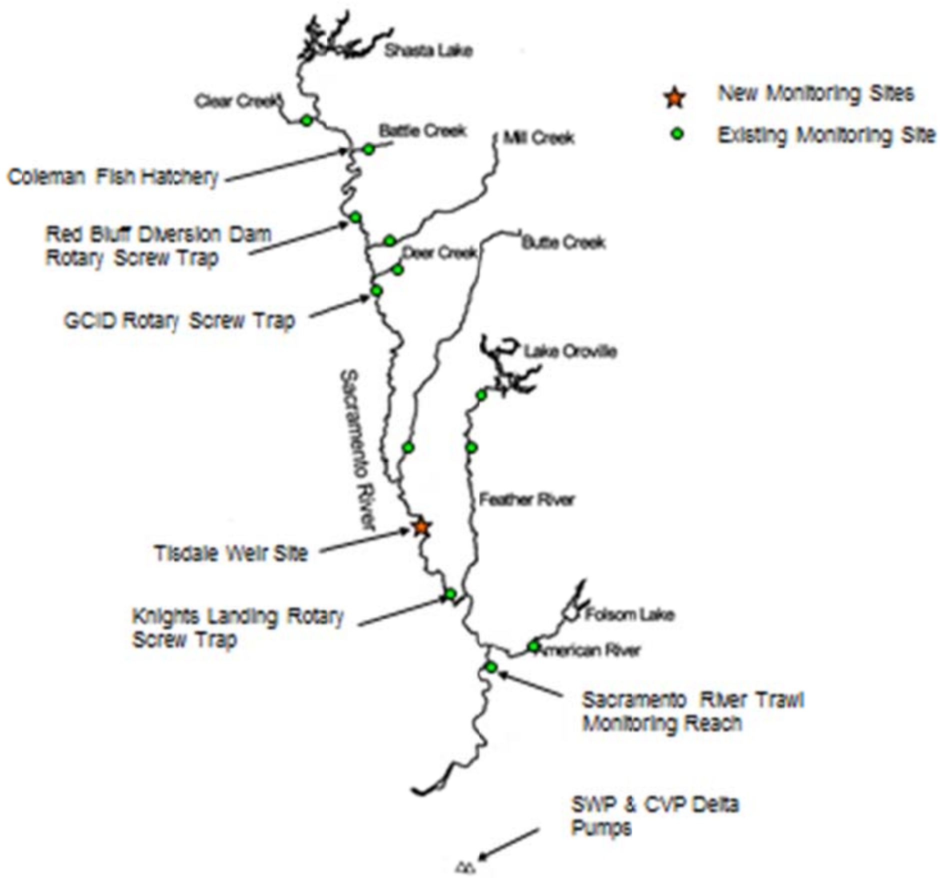

Figure 5.4. Monitoring sites in the upper Sacramento River watershed.

Chapter 6 –Effectiveness of RPA Actions

6.1 Operational Effects on Winter-Run Chinook Salmon

In 2012, DOSS successfully implemented RPA actions in the Delta pertaining to the operation of the CVP/SWP export facilities. The DCC gates were closed, OMR flow targets were met, triggers based on older juvenile loss density were implemented in real time, and improvements in monitoring were initiated (*e.g.*, enhanced monitoring, new sturgeon protocols, and sensitivity analysis for the loss equation). Real-time is used to mean, at minimum, 3 days after a trigger is met because of the time it takes to report and implement a change in operations. The ability to assess the effectiveness of these RPA actions in terms of biological responses to fish is constrained by a lack of tools and data such as routing models and specific reach survival estimates; however, we can compare on an annual basis fish losses at the CVP/SWP export facilities, survival of specific hatchery releases (*e.g.*, spring-run surrogates), and routing of acoustically tagged fish to make some inferences about fish responses.

Looking first at entrainment, based on historical salvage numbers or percentages, one would have expected higher salvage and loss of ESA-listed salmonids because of dry conditions and fish movement correlated with flow events (storms). In 2012, winter-run Chinook loss (*i.e.*, 2,079) was less than the historical average over the last 10 years, wild steelhead salvage was very low, and no green sturgeon were salvaged at the CVP/SWP export facilities. This could have been a result of implementation of the RPA actions, or it could just reflect low population levels (*e.g.*, CVP/SWP export facilities are considered by some biologists to be representative monitoring sites for the south Delta). The winter-run Chinook juvenile production in 2012 was one of the lowest estimated in the last 10 years because only 824 adults (424 females) spawned in 2011. Unlike fall-run Chinook salmon, which have rebounded since 2009, winter run have been in steady decline since 2006 (Figure 6.1). It is unknown what the population size is for steelhead and green sturgeon; therefore, it is difficult to reach any conclusions about these species.

Since the RPA was implemented in 2009, the loss of juvenile winter-run Chinook at the CVP/SWP export facilities has varied from 1,461 to 4,360, but is, in general, lower than the historical average since 1993 (Figure 6.2). Although there are less winter-run juveniles now compared to the pre-2009 population, the operations in the last 2 years have taken a higher proportion of the juvenile production entering the Delta as incidental take (Table 6.1). Typically, loss of winter-run Chinook juveniles averaged less than 1 percent of the juvenile production estimate in the 10 years preceding implementation of the RPA (*i.e.*, 0.723 from 2001 through 2010); however, the loss in the last 2 years (2011 and 2012) has averaged 1.295 percent of the juvenile production (Table 6.1). Since DOSS cannot compare what would have been the loss absent the RPA, it is difficult to assess the effectiveness of the RPA.

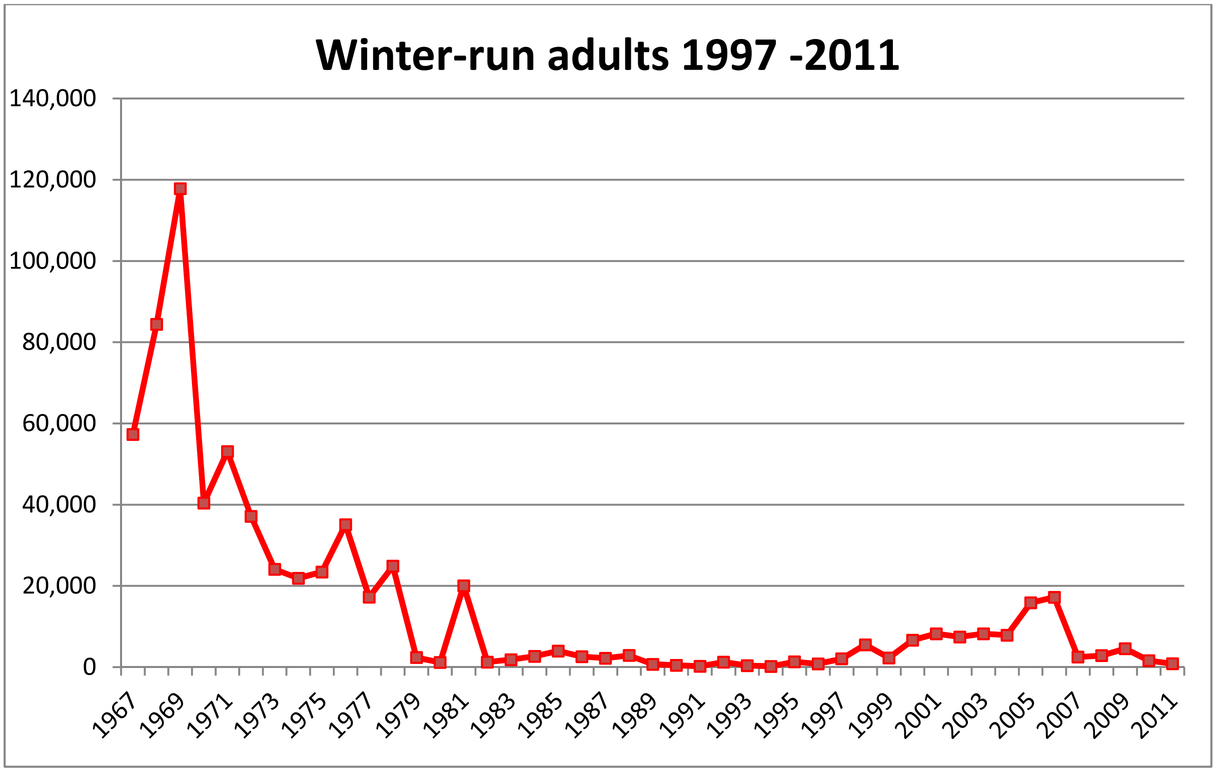

Figure 6.1. Sacramento River winter-run Chinook adult counts based on Red Bluff Diversion Dam ladder counts from 1967 through 1995 and carcass surveys from 1996 through 2011.

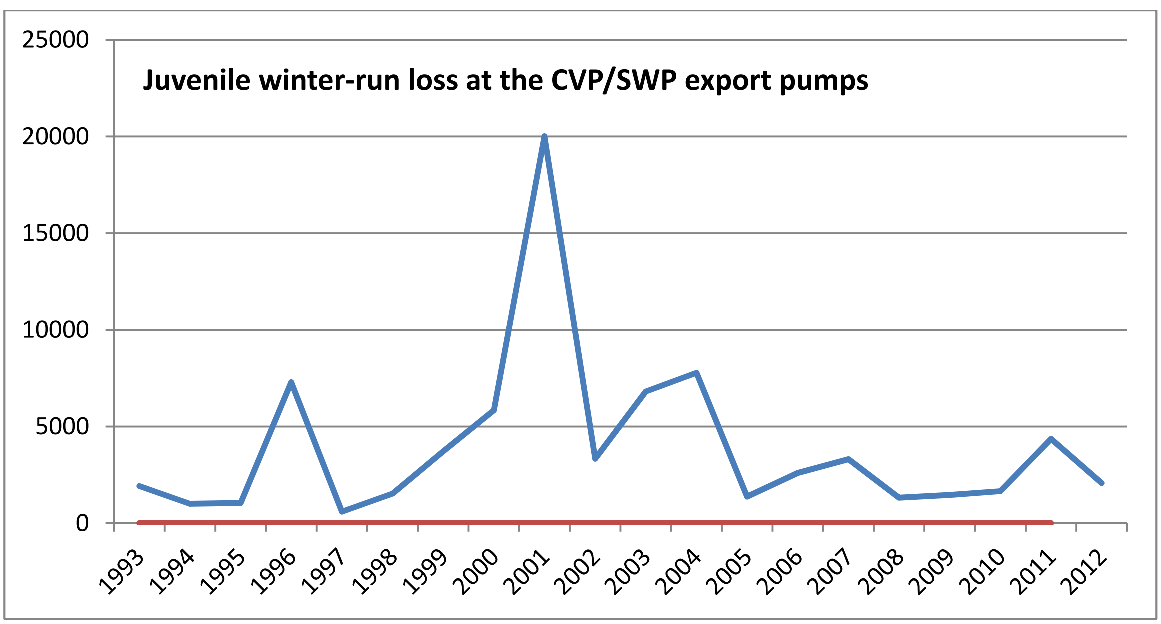

Figure 6.2. Historical winter-run Chinook loss at the CVP/SWP export pumps.

Operationally, one would expect losses of winter-run juveniles at the pumps to decrease if the RPA actions were effective. Closure of the DCC gates earlier in December should reduce the number of juveniles entering the interior Delta and export cuts based on winter-run loss densities should reduce periods of high winter-run losses; however, this does not seem to be the case. Actual losses at the pumps increased relative to the population size as compared to percent of the JPE in the years before 2009 (Table 6.1 and Figure 4 in Appendix A). Many factors influence winter-run loss at the CVP/SWP export facilities besides the RPA actions such as hydrology, delta conditions, predation rates, louver efficiency, and emergence timing (*e.g.*, in 2012, juvenile winter-run spawning was at least a month later than normal). The use of available models such as DSM2, PTM, and water volume fingerprinting can give DOSS only a cursory view of how these factors impact how many fish are diverted to the CVP/SWP export facilities. A better tool for evaluating the sensitivity of the system is needed to determine the effectiveness of the RPA actions.

Table 6.1. Winter-run juvenile production estimates and losses compared to entrainment at the Central Valley Project/State Water Project (CVP/SWP) export facilities.

Year	JPE to Delta	Take Limit	Loss at CVP/SWP	Percent of Take Limit	Percent of JPE
1992	40100	400			
1993	273100	2731	1922	70.4	0.70
1994	90500	905	1004	110.9	1.11
1995	74500	1490	1044	70.1	1.40
1996	338107	6762	7296	107.9	2.16
1997	165069	3301	603	18.3	0.37
1998	138316	2766	1536	55.5	1.11
1999	454792	9095	3715	40.8	0.82
2000	289724	5794	5843	100.8	2.02
2001	370221	7404	20008	270.2	5.40
2002	1864802	39823	3338	8.4	0.18
2003	2136747	42735	6816	15.9	0.32
2004	1896649	37933	7779	20.5	0.41
2005	881719	17634	1373	7.8	0.16
2006	3831286	76626	2601	3.4	0.07
2007	3739069	74781	3315	4.4	0.09
2008	589911	11798	1316	11.2	0.22
2009	617783	12356	1461	11.8	0.24
2010	1179633	23593	1657	7.0	0.14
2011	332012	6640	4360	65.7	1.31
2012	162051	3241	2079	64.1	1.28

So, what kind of flows did winter run encounter in the interior Delta from December through April? The NMFS RPA was controlling OMR flows to no more negative than -5,000 cfs as of

1/1/12; however, OMR flows were not positive so juvenile winter run that entered the interior Delta were still being cued to move in a southerly direction toward the export facilities (Figure 4.2).

Looking upstream at when juvenile winter run entered the Delta, the Knights Landing RST data showed peak passage in the second half of January (Figure 6.3); therefore, the DCC gates were already closed and OMRs were already managed at the required flow level when winter run entered the Delta. The only routes into the Delta were through Georgiana Slough, Three Mile Slough or around Sherman Island. Previous studies (Vogel 2004, 2008) on the DCC gates have shown that closing the gates tends to increase the number of fish that go through Georgiana Slough and the sloughs to the north of the DCC (*i.e.*, Sutter and Steamboat sloughs) and the survival through these routes (Perry et al. 2010).

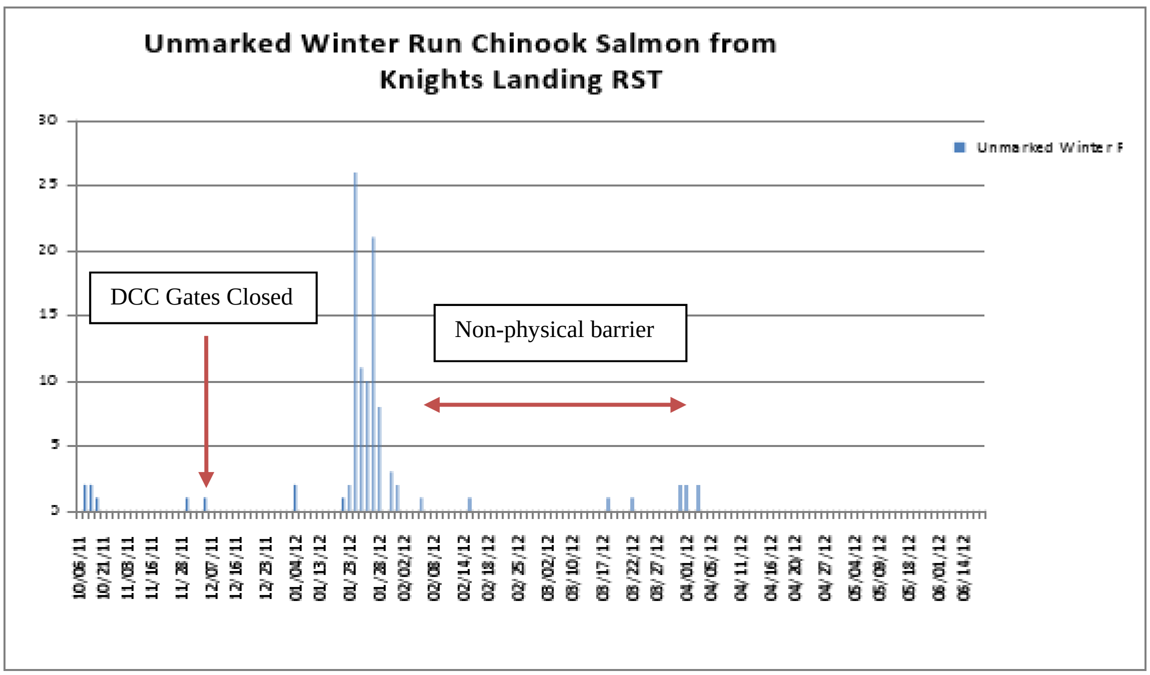

Figure 6.3. Juvenile winter-run Chinook passage at Knights Landing (CDFG, preliminary data).

In addition, an experimental non-physical barrier (lights, sound, and noise) was being operated at Georgiana Slough in 2012. This barrier may have deterred (results are still pending) juvenile fish migrating down the mainstem Sacramento River from entering the interior Delta; however, most juvenile winter-run migrated past the barrier before it was installed (Figure 6.3). Since the non-physical barrier at Georgiana Slough was installed from February through April, it may have prevented some juvenile steelhead and spring-run Chinook, which emigrate in February and March, from reaching the CVP/SWP export facilities.

Using a smolt-to-adult (SAR) return rate for Central Valley hatcheries to normalize entrainment, approximately 1 percent of those fish lost at the CVP/SWP export facilities would have returned as adults; therefore, using the loss this year (2,079 x 0.01), there would be 21 fewer adults returning in 2015 (assuming a 3-year life cycle). Of course not all of these fish were lost because of the export facility operations; some would have naturally turned into the interior Delta, and this dynamic is complex given the influence of tides and flows on fish when they are passing through junctions into alternate interior Delta routes. If the population remains at 824 adults, as it was last year, the effect at the population level is a reduction in spawners of 2.5 percent (21/824 x 100).

6.2 Operational Effects on Spring-Run Surrogates and Other Hatchery Releases

Of the three CNFH late-fall-run releases used as surrogates for spring-run Chinook salmon incidental take at the CVP/SWP export pumps, DOSS decided to only use two (one released on 12/23/11 and one on 1/13/12) for tracking purposes because of the accident that occurred while releasing the third group on 1/20/12 that stranded approximately two-thirds of the fish in the gravel. Tracking hatchery releases such as the spring-run surrogates and winter run released from Livingston-Stone National Fish Hatchery (LSNFH) gave DOSS an additional monitoring tool by which to determine when ESA-listed species were most likely to be present in the Delta and what their survival was to the Delta (unknown what proportion took the interior route); however, we do not know what survival was to Chipps Island for the non-diverted fish (stayed in mainstem). Real-time CWT analysis at the CVP/SWP export facilities allowed DOSS to use this information in the decision-making process. Results of recoveries from hatchery fish at the pumps are summarized in Table 1 in Appendix A and in Appendix B.

The spring-run surrogates appeared at the CVP/SWP export facilities within the first 2 weeks of January, indicating that they migrated down the Sacramento River quickly. Some of the spring-run surrogates from the last release on 1/20/12 did make it to the Delta and were observed in February, indicating that they too moved quickly down the Sacramento River. All surrogate and winter-run releases were under the 0.5% loss (first level of concern); therefore, none of these releases triggered a change in operations (see Table 1, Appendix A). The releases did give an early warning as to when the wild fish would be arriving in the Delta. It is interesting to note that, compared to previous years, very few of the winter run from LSNFH were salvaged at the CVP/SWP export facilities. This might have been because of the dry hydrologic conditions and low flows that occurred on the Sacramento River (*i.e.*, higher mortality in dry years). Only one tagged winter run was observed at SWP in March for an expanded loss of approximately 17 (Figure 5, Appendix A). Both trawl recoveries occurred in late March when the bulk of wild winter run were salvaged at the export facilities (Figure 5 in Appendix A), indicating that, at least for hatchery winter-run, they moved through the Delta quickly.

6.2.1 Steelhead Triggers

Juvenile steelhead monitoring showed very few wild steelhead emigrating out of the Sacramento and San Joaquin rivers. There were 16 in the Sacramento trawl, 7 acoustically tag and 10 wild in the Mossdale trawl, and 6 at Chipps Island. The majority of steelhead observed from the Sacramento and Chipps Island trawls were of hatchery origin (see Appendix A). In 2012, a combined total of 332 (243 at SWP and 89 at CVP) wild steelhead were salvaged. This is the lowest reported annual salvage in the last 9 years. New for this year, steelhead loss was expanded for the first time based on salmon loss factors used at CVP/SWP export facilities. This allowed DOSS to calculate a daily loss density for wild steelhead (see steelhead table in Appendix B). The daily loss triggers of 8 fish/TAF and 12 fish/TAF were exceeded in March and April, which led to export curtailments to control OMR flows (Figures 15–20, Appendix A).

6.3 Summary

Given the tools and data available, DOSS was able to minimize losses of older juvenile Chinook and wild steelhead at the CVP/SWP export facilities. It is unknown how effective the RPA actions were in reducing losses and/or increasing juvenile survival through the Delta. DOSS was able to provide weekly advice to NMFS and WOMT because of implementation of the enhanced web-based monitoring system for reporting fish loss densities and CWT data in real time (*i.e.*, daily reporting). The RPA actions did reduce the number of other ESA-listed species (*e.g.*, delta smelt and longfin smelt) entrained at the CVP/SWP export facilities. Had the RPA actions not been taken, the losses at the facilities would have been higher. Whether the RPA had a quantifiable impact at the population level remains to be seen. As models are developed, these impacts can be better assessed.

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Appendix A

2011/2012
SALMONID AND GREEN STURGEON
INCIDENTAL TAKE AND MONITORING REPORT

September 28, 2012

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APPENDIX

2011/2012 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) Final Biological Opinion and Conference Opinion of the Proposed Long-Term Operations of the Central Valley Project and State Water Project (2009 NMFS Biological Opinion). This report summarizes the incidental take of winter-run Chinook salmon (*Oncorhynchus tshawytscha*), spring-run Chinook salmon (*O. tshawytscha*) surrogates, Central Valley steelhead (*O. mykiss*), and green sturgeon (*Acipenser medirostris*) at the State Water Project's (SWP) John E. Skinner Delta Fish Protective Facility and the Central Valley Project's (CVP) Tracy Fish Collection Facility (Delta fish facilities) for 2011/2012. Furthermore, this report includes data from the salmonid monitoring program for the lower Sacramento River and the Delta, and summarizes the hydrologic conditions in the Delta. The geographic range of the data used in this report is presented in Figure 1, page 19.

For this report, the California Department of Water Resources (DWR) and the United States Bureau of Reclamation (Reclamation) quantified incidental take for the listed species using the current methods that are described in the 2009 NMFS Biological Opinion. However, there is a high degree of uncertainty associated with the current methods used to quantify incidental take. As a result, DWR and Reclamation are conducting a two-year study intended to adapt and refine a proposed loss equation suggested in Jahn (2011) that could be used to quantify incidental take at the Delta fish facilities. As part of the study, a comparison of the estimated loss using the current and proposed loss equations for Chinook salmon and steelhead is documented at the end of this report. For presentation and comparison purposes, the loss estimated using the different methods are rounded to nearest whole fish. Lastly, this report also includes an update on DWR and Reclamation's current progress towards adapting and refining the proposed loss equation in response to Term and Condition 2a.

DWR and Reclamation acquired data from the California Department of Fish and Game (DFG), 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. Because of this, these data presented in this report are preliminary and subject to revision.

In addition to this annual report, DWR and Reclamation also prepared preliminary weekly data reports for the Data Assessment Team (DAT) and the Delta Operations for Salmonids and Sturgeon technical working group (DOSS) during the 2011/2012 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.swr.noaa.gov/ocap/doss.htm

Chinook Salmon Salvage

In 2011/2012, older juvenile Chinook salmon were salvaged at the Delta fish facilities beginning in early December (Figure 2, page 20). Based on the 2009 NMFS Biological Opinion, DWR and Reclamation defined naturally produced older juvenile Chinook salmon as all non-adipose fin clipped Chinook salmon greater than the minimum winter-run length using the Delta Model length-at-date criteria. Older juvenile Chinook salmon included yearling fall-run, yearling spring-run, yearling late fall-run, and winter-run length Chinook salmon. Most of the older juvenile Chinook salmon were salvaged between mid-February and the end of March 2012. Additionally, there was an increase in salvage of hatchery late-fall run Chinook salmon in late January, which coincided with increased Sacramento and San Joaquin River flows.

Young-of-the-year (YOY) Chinook salmon were observed at the Delta fish facilities starting in March 2012, coinciding with increasing flows. Similar to 2010/2011, nearly all of the observed YOY Chinook salmon salvage occurred between late March and June during the highest combined mainstem flows of the salmonid outmigration period. During this time, fall-run hatchery Chinook salmon were salvaged in May and June, and a majority of these fish originated from the Merced Hatchery. Very few hatchery fall-run Chinook salmon from the Sacramento Basin were observed at the Delta fish facilities.

Winter-Run Chinook Salmon

Winter-Run Chinook Salmon Incidental Take

In 2011, DFG estimated a total adult escapement of 824 winter-run spawners to the upper Sacramento River. Based on this escapement, NMFS estimated that 162,051 juvenile winter-run Chinook salmon would enter the Delta. Based on this juvenile production estimate (JPE), the incidental take level from October 1, 2011 through June 30, 2012 for the Delta fish facilities was 3,241 wild (non-adipose fin clipped) winter-run Chinook salmon, equal to 2% of the natural winter-run production entering the Delta. In 2011, the methodology used to calculate the JPE was updated to include new information about juvenile in-river survival (IEP PWT 2011). 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 DFG (2006).

Winter-run Chinook salmon loss occurred at both Delta fish facilities for an expanded loss of 1,702 at the SWP and 377 at the CVP. The highest loss occurred between late February and early April (Figure 3, page 21). During this period, the daily older juvenile Chinook loss density triggers of 2.5 fish per thousand acre-feet (TAF) and 5 fish/TAF were exceeded on 28 days, which required reduced Old and Middle River flows toward the SWP and CVP pumps (Figure 3). Outside of this period, the loss density triggers were exceeded only on two days.

The combined expanded loss of winter-run Chinook salmon was 2,079 for the season; about 64% of the incidental take permitted. This was the second consecutive year since 2002/2003 where the incidental take level exceeded the 1% level of concern for naturally produced winter-run Chinook salmon (Figure 4, page 22).

Hatchery Winter-Run Chinook Salmon Incidental Take and Monitoring

On February 9, 2012, an estimated 185,281 winter-run smolts from Livingston Stone National Fish Hatchery (LSNFH) were released in the Sacramento River at Caldwell Park near Redding, California. NMFS estimated that 96,525 hatchery fish would enter the Delta. NMFS set the incidental take level at 1% of the total hatchery production entering the Delta, or 965 winter-run hatchery Chinook salmon from October 1, 2011, through June 30, 2012. One hatchery winter-run Chinook salmon was identified at the Delta fish facilities at the end of March for an expanded loss of 17 when using the current loss equation from DFG (2006). This estimated confirmed loss is about 0.018% of the total number of winter-run hatchery Chinook salmon entering the Delta and is well below the 1% incidental take level (see Table 1, page 14 and Figure 5, page 23).

Recoveries of hatchery winter-run Chinook salmon in the Delta monitoring trawls and seines were very low. The USFWS Delta Juvenile Fish Monitoring Program (DJFMP) recovered hatchery winter-run Chinook salmon from LSNFH in the Sacramento Kodiak trawl in March for an expanded catch[1] of 13. During March 2012, USFWS also recovered older juvenile Chinook salmon at the Sacramento Kodiak trawl (Figure 5). Similarly, the USFWS recovered hatchery winter-run Chinook salmon from LSNFH in the Chipps Island midwater trawl for an expanded catch of 10 (Figure 5). These fish were recovered in late March and early April when older juvenile Chinook salmon were observed at this monitoring site. In contrast, USFWS did not recover hatchery winter-run Chinook salmon in the Delta beach seines.

Spring-Run Chinook Salmon

Under the 2009 NMFS Biological Opinion, NMFS uses surrogate groups of hatchery reared late-fall Chinook salmon to best represent yearling spring-run Chinook salmon emigrating from the upper Sacramento River and tributaries into the Delta. Late fall-run Chinook salmon are used as a surrogate because spring-run Chinook salmon cannot be easily distinguished from the other races of salmon based upon size. The incidental take level for the combined operation of the Delta pumping plants is equal to 1% of any individual Coleman National Fish Hatchery (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 DFG (2006). However, there are occasions when the hatchery of origin for the coded wire tagged (CWT) Chinook salmon could not be confirmed due to lost, missing, or damaged tags. For this reason, the

[1] Catch is expanded to represent the number of tows or seines conducted per day.

actual loss could be higher than what is confirmed. Approximately six CWT Chinook salmon could not be determined this water year. The expanded unknown loss of these six CWT Chinook salmon was about 63 (Table 2, page 14).

The CNFH releases a percentage of the total CNFH late-fall Chinook salmon production into surrogate release groups. For 2011/2012, CNFH released approximately 16% of the late fall-run production as spring-run Chinook salmon surrogates. CNFH made the first release in late December, while the second and third releases were made in January. CNFH released all of the surrogate groups into the Sacramento River at Battle Creek.

Releases are typically associated with storm events and attempts are made for the releases to coincide with an increase in yearling juvenile Chinook salmon in the spring-run tributaries, such as Mill and Deer creeks. In the past, DWR and Reclamation used the rotary screw trap data from Mill and Deer creeks to evaluate the timing of each surrogate release group in this annual report. However, DFG did not operate the rotary screw traps on Mill and Deer creeks this year due to concerns regarding incidental mortality, trapping difficulties, and a desire to conduct a review of this monitoring requirement (DOSS 2012). Therefore, DWR and Reclamation could not evaluate whether the surrogate groups were released at the same time and size as the older juvenile Chinook salmon at Mill and Deer creeks. Nevertheless, a preliminary data analysis in DOSS (2012) suggests that surrogate presence was similar with older juvenile Chinook salmon presence at the mainstem Sacramento River rotary screw traps at Tisdale Weir and Knights Landing.

First Surrogate Release Group and Incidental Take

The first surrogate group of approximately 62,400 CNFH late fall-run Chinook salmon was released on December 23, 2011. Two surrogates from this release were observed at the CVP in January (Figure 6, page 24). The expanded loss for the season was approximately 3 or 0.005% of the total hatchery release, which is well below the 1% incidental take level (Table 1; Figure 6). The surrogate loss occurred during the time when older juvenile Chinook salmon loss at the Delta fish facilities was low (Figure 6).

Second Surrogate Release Group and Incidental Take

The second surrogate group of approximately 80,800 CNFH late fall-run Chinook salmon was released on January 13, 2012. Eight surrogates, three at the SWP and five at the CVP, were observed at the Delta fish facilities between the end of January and mid-February. The expanded loss for the season was approximately 52 or 0.064% of the total hatchery release, which is well below the 1% incidental take level (Table 1; Figure 6). The surrogate loss usually occurred around the time when older juvenile Chinook salmon loss was also observed at the Delta fish facilities (Figure 6).

Third Surrogate Release Group and Incidental Take

On January 20, 2012, CNFH planned to release the third surrogate group of approximately 61,613 late-fall run Chinook salmon into Battle Creek. However, a pipe broke when CNFH released the salmon into Battle Creek and most of the fish ended up stranded on the stream bank. CNFH assumed that about 20,000 fish made it into the water of Battle Creek, but this number was only an estimate and a final number was not available at the time of this report. Because of this error, an incidental take level was not applied for the third surrogate release group and the release group was only tracked for monitoring purposes.

Ten surrogates, six at the SWP and four at the CVP, were observed at the Delta fish facilities between late January and late March. The expanded loss for the season was approximately 101 or 0.505% of the total hatchery release (Table 1; Figure 6). Interestingly, the third surrogate release group had the highest loss rate of all the surrogate releases. It is possible that these surrogates survived better with the higher flows that occurred around this time, and thus more were salvaged at the Delta fish facilities. In addition, the surrogate loss usually occurred around the time when older juvenile Chinook salmon loss was also observed at the Delta fish facilities (Figure 6).

Spring-Run Chinook Salmon Surrogate Monitoring

The USFWS DJFMP 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. USFWS recovered one surrogate from the first surrogate release, four surrogates from the second surrogate release, and two surrogates from the third surrogate release in the Sacramento River trawl (Figure 6). All of the surrogates USFWS recovered were from late January and were recovered during a small pulse of older juvenile Chinook salmon at the monitoring site. The pattern of surrogate recoveries at the Sacramento River trawl for all three release groups was similar to the pattern of older juvenile Chinook loss at the Delta fish facilities (Figure 6).

Additionally, USFWS recovered one surrogate from the second surrogate release from the central Delta seines at Sandy Beach in February, and two surrogates from the third surrogate release from the Sacramento River seine route at Elkhorn and Miller Park in late January. No surrogates were recovered from the first surrogate release group in the beach seines.

Lastly, a midwater trawl survey was conducted at Chipps Island. USFWS recovered surrogates at Chipps Island for an expanded catch of one surrogate for the first surrogate release, seven surrogates for the second surrogate release, and one surrogate for the third surrogate release (Figure 6). The majority of these surrogates were caught in January and early February, before the peak of older juvenile catch that occurred at Chipps Island. The timing of recoveries at Chipps Island for all three-surrogate releases is consistent with the timing of older juvenile Chinook salmon loss at the Delta fish facilities.

Fry/Smolt Chinook Salmon Loss

The combined expanded loss of fry/smolt Chinook salmon salvaged between October 2011 and July 2012 was 4,733 (Figure 7, page 25). Using the Delta Model length criteria, DWR and Reclamation defined fry/smolts as all non-adipose fin clipped Chinook salmon smaller than the minimum winter-run length-at-date criteria. Most of the fry/smolt Chinook loss occurred between March and June, with the highest monthly loss in May. The loss was notably low when compared to the last nine water years (Figure 8, page 26). In particular, fry/smolt Chinook loss in 2011/2012 decreased considerably when compared to 2010/2011, where the annual loss was at 86,781.

Unlike 2011, modeled volumetric water fingerprints derived from the Delta Simulation Model 2 (DSM2) did not indicate an overwhelming influence of the San Joaquin River at the export facilities in 2012. Between April and June 2011, greater than 90% of the water at the Clifton Court Forebay (SWP) and the Jones Pumping Plant (CVP) originated from the San Joaquin River (DWR 2011). During the same period in 2012, only about 18 to 43% of the water at the Clifton Court Forebay and about 17 to 73% of the water at the Jones Pumping Plant originated from San Joaquin River (Figure 9 and 10, page 27).

A stronger influence of the San Joaquin River at the export facilities in May 2012 (Figure 9 and 10) was supported by observations of high salvage of Merced Hatchery fall-run Chinook salmon that were released in the San Joaquin Basin (Figure 2). Similarly, a high salvage of fry/smolt Chinook salmon was also observed in May (Figure 2). Modeled water fingerprints at the export facilities and the salvage trend of hatchery Chinook salmon during this time suggests that a fraction of the fry/smolt Chinook salmon observed at the Delta fish facilities may be fall-run Chinook salmon from the San Joaquin River.

Chinook Salmon Monitoring in the Sacramento River and the Delta

For the USFWS Sacramento River and Delta surveys, DWR and Reclamation separated non-adipose fin clipped older juvenile Chinook salmon from fry/smolts using the Frank Fisher model. To facilitate data summarization of the beach seine data, DWR and Reclamation divided the beach seine monitoring program into different regions: 1) lower Sacramento River, 2) north Delta, 3) central Delta, and 4) south Delta (Figure 1). For comparison purposes across different water years, DWR and Reclamation only used the beach seine sites that have been active since August 2002.

Between August 2011 and July 2012, the total number of older juvenile and fry/smolt Chinook salmon caught in the beach seines was highest in the lower Sacramento River and north Delta when compared to the central and south Delta (Figure 11 and 12, page 28). However, the total number of Chinook salmon recoveries in the lower Sacramento River and the north Delta was lower than in 2010/2011.

In the Sacramento River trawl, the number of older juvenile Chinook salmon caught increased slightly from the same period in 2010/2011 (Figure 13, page 29). During 2011/2012, 29 older juvenile Chinook salmon were caught compared to 22 in 2010/2011. Similarly, the number of fry/smolt Chinook salmon caught in the Sacramento River trawl for 2011/2012 increased slightly from 2010/2011 (Figure 14, page 29).

In the Chipps Island trawl, 58 older juvenile Chinook salmon were caught in 2011/2012 (Figure 13). The number of older juvenile Chinook salmon caught in the Chipps Island trawl decreased when compared to 2010/2011. Overall, in comparison to the last nine water years, older juvenile Chinook salmon catch at Chipps Island was low. In addition, the catch for 2011/2012 from the Chipps Island trawl decreased from 2010/2011(Figure 14). The number of fry/smolt Chinook salmon increased in the Chipps Island trawl when compared to 2007/2008, but was relatively low when compared to the other water years since 2002/2003.

Central Valley Steelhead

Steelhead Incidental Take

From October 2011 to July 2012, greater than 70% of the wild (non-adipose fin clipped) steelhead salvage occurred at the SWP. For wild steelhead, the CVP salvaged a total of 89 and the SWP salvaged a total of 243, with the most salvage occurring in March and April (Figure 15, page 30). During March and April, the daily wild steelhead loss density triggers of 8 fish/TAF and 12 fish/TAF were exceeded on 5 days, which triggered a restriction of the Old and Middle River flows toward the SWP and CVP pumps (Figure 19, page 32). The loss density triggers were not exceeded outside of March and April.

The SWP and CVP total expanded salvage of wild steelhead was 332 and remained below the incidental take limit of 3,000 fish for the water year (Figure 15). The annual salvage of wild steelhead decreased slightly from 2010/2011, which had a total salvage of 738. Overall, the seasonal salvage for wild steelhead was the lowest in the past nine water years (Figure 17, page 31).

Salvage of hatchery (adipose fin clipped) steelhead peaked in March. From October 2011 to July 2012, the CVP salvaged a total of 405 and the SWP salvaged a total of 200 for a combined total seasonal salvage of 605 steelhead (Figure 16, page 30). Overall, the seasonal salvage for hatchery steelhead was the lowest in the past nine water years (Figures 18, page 31).

Steelhead Monitoring

From October 2011 to July 2012, the catch of steelhead from the USFWS DJFMP was predominantly hatchery origin fish at the Sacramento River trawl, the Chipps Island trawl, and the beach seines. The highest number of recoveries occurred in the Sacramento River trawl with a total of 16 wild steelhead and 118 hatchery steelhead (Figure 20, page 33). In the Chipps Island trawl, USFWS DJFMP recovered a total of 6 wild steelhead and 31 hatchery steelhead (Figure 20). Lastly, a total of 5 wild steelhead and 8 hatchery steelhead were recovered from the beach seines (Figure 20).

In contrast, the majority of the steelhead recovered from the Mossdale trawl were of wild origin (Figure 20). Between October 2011 and July 2012, 10 wild steelhead and 7 hatchery steelhead were recovered at the Mossdale trawls. Field observations from the Mossdale trawls indicated that all the hatchery steelhead recoveries were adipose fin clipped and had sutures, which implied that the steelhead were acoustically tagged (Figure 20).

Green Sturgeon Incidental Take

The incidental take level for green sturgeon is currently based on the historical salvage of 74 for the water year. Between October 2011 and July 2012, no green sturgeon were observed at the Delta fish facilities. This differs from 2010/2011 when the green sturgeon salvage was 14.

Delta Hydrology

Water year 2012 was drier than last year in both the Sacramento and San Joaquin basins (Figure 21, page 34). The Sacramento Valley was classified as a “below normal” water year, while the San Joaquin Valley was classified as a “dry” water year. Table 3 on page 15 is a monthly average summary of SWP and CVP exports, Sacramento and San Joaquin River flows, Delta outflow, and western Delta flows.

Comparison of Loss Estimation between Current and Proposed Loss Equation

DWR and Reclamation did not exceed the incidental take limits that were permitted for 2011/2012 when using the current methods to quantify incidental take for winter-run Chinook salmon, spring-run Chinook salmon surrogates, Central Valley steelhead, and green sturgeon. However, there is currently a high degree of uncertainty associated with the current methods used to quantify incidental take. As an example, incidental take of steelhead and green sturgeon are currently based on historical salvage and not loss since there are no known population estimates for these species that could be used to quantify an appropriate level of incidental take. Moreover, there is still uncertainty with calculating loss even when a population estimate is known, such as with Chinook salmon. For instance, the current loss equation (i.e., DFG 2006) used to quantify incidental take includes an expansion for salvage, and accounts for louver efficiency, pre-screen loss and survival during transport. However, the current loss equation is specific to Chinook salmon and currently does not include error terms that are needed to calculate confidence limits for the loss estimate.

In comparison, the proposed loss equation (i.e., Jahn 2011) reduces some of the uncertainty by accounting for overall facility survival and can provide a point estimate with a lower and upper confidence limit for various listed salmonids. The proposed loss equation is intended to be used for steelhead and Chinook salmon under different survival rates. A range of survival rates is needed to account for the uncertainty related to the accuracy of the overall facility survival estimate for each species.

In theory, the proposed loss equation could also be applied to green sturgeon, but there are currently no parameter estimates that could be used for such an equation. The results from 2011/2012 using this proposed loss equation for winter-run Chinook salmon, spring-run Chinook salmon surrogates, and steelhead are documented below for comparative purposes. For the documentation, DWR and Reclamation assumed that each fish facility entrained fish independently. For this reason, our sampling domain excluded any days that did not produce a count of the species at a given facility. Consideration by DOSS in 2012/2013 about how these calculations may influence annual take, daily loss, and daily loss density calculations will be documented in the 2012/2013 Salmonid and Green Sturgeon Incidental Take and Monitoring Report.

Winter-Run Chinook Salmon Proposed Loss Calculation Estimates

Between October 2011 and June 2012, the estimated loss using the current equation for non-adipose fin clipped winter-run Chinook salmon was 1,702 at the SWP and 377 at the CVP for a combined loss of 2,079 (Table 4, page 15). If the proposed loss equation were used, then the combined estimated loss with 95% confidence limits would have been 7,242 $\pm$ 5,760 for the low survival rate, 3,128 $\pm$ 1,582 for the medium survival rate, and 1,549 $\pm$ 362 for the high survival rate (Table 5, page 15). As a result, DWR and Reclamation would have exceeded the incidental take limit of 3,241 for this water year if the low survival rate were used. However, the margin of error for the low survival rate was high and the combined lower confidence limit of 1,482 would have been below the incidental take limit.

Additionally, DWR and Reclamation would have nearly exceeded the incidental take limit if the medium survival rates were used. With the medium survival rate, the sum of the SWP and CVP loss estimate would have been 3,128 $\pm$ 1,582, which is about 97% of the incidental take limit. If taking the upper confidence limit into account, then DWR and Reclamation may have exceeded the incidental take limit for the medium survival rate since the upper confidence limit puts the estimated loss at 4,710 (Table 5). Lastly, the combined loss using the high survival rate was lower than what was estimated from the current loss equation. Based on these results, DWR and Reclamation will need to seek input from DOSS on the appropriate survival rate assumptions and how confidence limits would be incorporated into the incidental take limit.

The data set from the CVP for winter-run Chinook salmon met the definition of a time series from March 9 to March 30, 2012. However, the results presented in Table 5 were not corrected for autocorrelation. For comparison purposes, a correction for autocorrelation was applied to this data set and the results are presented in Table 6 on page 16. Overall, the correction for autocorrelation slightly lowered the lower confidence limit and slightly raised the upper confidence limit for all survival rates. Looking at the results, the correction for autocorrelation did not make a considerable difference to the adjustment of the standard error that was used to calculate the 95% confidence limit of the loss estimate. For this reason, DWR and Reclamation will be requesting DOSS input on whether the correction for autocorrelation from the proposed loss equation is necessary and for rationale of why it should be used.

Hatchery Winter-Run Chinook Salmon Proposed Loss Calculation Estimates

Hatchery winter-run Chinook salmon from LSNFH were only recovered at the SWP fish facility. The estimated loss was 17 when using the current loss equation or about 0.018% of the hatchery winter-run Chinook salmon entering the Delta (Table 1). If the proposed loss equation were used, then the loss estimate with the 95% confidence limits would have been 46 $\pm$ 84 (0.048% loss) for the low survival rate, 27 $\pm$ 46 (0.028% loss) for the medium survival rate, and 12 $\pm$ 20 (0.012%) for the high survival rate (Table 7, page 16). Interestingly, the lower confidence limit was negative under all survival rates due to the small sample size used to estimate loss. Because of this unexpected result, DWR and Reclamation will be requesting input from DOSS on how confidence limits that are negative would be evaluated for daily and seasonal incidental take reporting.

Overall, the loss estimated from the proposed equation using the low and medium survival rates was higher than the estimated loss from the current equation. However, the loss using the high survival rate was lower than what was estimated from the current equation. Nevertheless, DWR and Reclamation would not have exceeded the 1% incidental take level that NMFS permitted for 2011/2012 even if the proposed equation were used.

Spring-Run Chinook Salmon Surrogate Proposed Loss Calculation Estimates

Spring-run Chinook salmon surrogates for the first release group were only recovered at the CVP. The estimated loss was about 3 when using the current loss equation or about

0.005% of the total number released for the group (Table 1). If the proposed loss equation were used, then the estimated loss with 95% confidence limits would have been 22 ± 30 (0.035% loss) for the low survival rate, 4 ± 5 (0.006% loss) for the medium survival rate, and 3 ± 4 (0.005% loss) for the high survival rate (Table 8, page 16). Based on these results, the proposed loss equation estimated a higher loss using the low survival rate and estimated similar values for the medium and high survival rates. DWR and Reclamation would not have exceeded the 1% incidental take level permitted for the first release group when using either equation.

For the second surrogate release group, the estimated loss using the current loss equation was about 44 at the SWP and 8 at the CVP for a combined loss of 52 or about 0.064% of the number of fish released for the group (Table 1). If the proposed loss equation were used, then the combined estimated loss with 95% confidence limits would have been 183 ± 218 (0.226% loss) for the low survival rate, 80± 84 (0.099% loss) for the medium survival rate, and 39 ± 37 (0.048% loss) for the high survival rate (Table 9, page 17). Therefore, DWR and Reclamation would not have exceeded the 1% incidental take level permitted for the second release group when using either equation.

The third surrogate release group had the highest estimated loss of all the surrogate groups when using the current loss equation. However, an incidental take level was not applied for the third surrogate release since there was an equipment malfunction that stranded a large portion of the release into the stream bank. Nonetheless, the loss estimates from both loss equations are presented in Table 1 and Table 10 (page 17) for informational purposes.

The estimated loss using the current equation for the third surrogate release was 92 at the SWP and 9 at the CVP for a combined loss of 101 (Table 1). If the proposed loss equation were used, then the combined estimated loss with 95% confidence limits would have been 297 ± 321 for the low survival rate, 152 ± 131 for the medium survival rate, and 71 ± 52 for the high survival rate (Table 10). Overall, the loss estimated from the proposed equation using the low and medium survival rates was higher than the estimated loss from the current equation. In contrast, the loss using the high survival rate was lower than what was estimated from the current equation.

Steelhead Proposed Loss Calculation Estimates

The current incidental take level of 3,000 for wild (non-adipose fin clipped) steelhead is based on historical salvage since a distinct population segment-wide estimate of Central Valley steelhead abundance is currently not available. Therefore, DWR and Reclamation could not compare the estimated loss from the proposed loss equation with the incidental take level based on historical salvage. In the future, it may be necessary to adjust the incidental take limit for steelhead if the proposed loss equation is implemented. As an alternative, DWR and Reclamation made a comparison of steelhead loss between the proposed loss equation and the interim loss equation described in DOSS (2011) that calculated steelhead loss based on Chinook salmon loss estimates.

From October 2011 to July 2012, the estimated loss for wild steelhead using the interim loss equation was 1,052 at the SWP and 61 at the CVP for a combined loss of 1,113 (Table 11, page 17). If the proposed loss equation were used, then the combined estimated loss with 95% confidence limits would have been 2,029 ± 695 for the low survival rate, 1,179 ± 394 for the medium survival rate, and 541 ± 153 for the high survival rate (Table 12, page 18). In general, the combined loss estimated from the proposed loss equation using the low and medium survival rates was higher than the estimated loss from the interim loss equation. However, the combined estimated loss using the medium survival rate was only slightly higher than what was estimated using the interim equation. In contrast, the loss using the high survival rate was lower than what was estimated from the interim equation.

Summary and Update on Current Progress

In summary, it appears that the implementation of the proposed loss equation to monitor take of Chinook salmon or steelhead may result in higher levels of loss under the low or medium survival rates when compared to the amount of loss estimated using the current methods. However, the uncertainties related to the accuracy of the survival rates usually led to large differences of loss among the different survival rates for the proposed loss equation. As a result, DWR and Reclamation will need to conduct additional studies to strengthen the current parameters used in the proposed loss equation. To help guide future studies, DWR and Reclamation are currently working with Cramer Fish Sciences on a sensitivity analysis for the proposed loss equation. This sensitivity analysis will help identify the most influential parameters of the proposed loss equation and will help quantify the contribution of various factors to the loss uncertainty.

In the meantime, DWR and Reclamation are also working on other studies that will help refine the proposed loss equation for Chinook salmon and steelhead. First of all, Reclamation is currently in the process of completing a two-year study on steelhead survival at the CVP fish facility. For the proposed loss equation, Jahn (2011) applied SWP experiments on steelhead survival to the survival rates used for the CVP fish facility. Secondly, Reclamation is working to incorporate the known reductions in louver efficiency during cleaning at the CVP fish facility for the loss equation. Lastly, DWR and Reclamation are working on evaluating the genetic Chinook-run assignment methods that could be incorporated into the proposed technique.

DWR and Reclamation are also in the process of developing a plan that will evaluate louver efficiency and predation risk to green sturgeon. Results from this plan may help define parameters for a green sturgeon loss equation. A draft study briefing to evaluate louver efficiency and predation risk to green sturgeon is contained in the appendix of this report.

Overall, DWR and Reclamation have made significant progress with evaluating and refining the proposed loss equation. For the next water year, DWR and Reclamation will continue to review and identify issues related the proposed loss equation and the use of the confidence limits. The information gathered for water year 2012 and 2013 will be presented at the 2013 Integrated Annual Review Workshop for independent consideration and refinement of the proposed loss equation.

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Table 1. Hatchery (adipose fin clipped) Chinook salmon loss at the Delta fish facilities using the current loss equation (DFG 2006), October 2011 through June 2012.

Release Date	CWT Race	Hatchery	Release Site	Release Type	SWP Confirmed Loss	CVP Confirmed Loss	Confirmed Total Loss	Number Released	Total Entering Delta	% Loss[1]	First Concern Level	Second Concern Level	Date of First Loss	Date of Last Loss
4/21/2011	F	Feather River Hatchery	San Joaquin @ Merced	Experimental	9	0	9	1,231	n/a	0.731	n/a	n/a	4/18/2012	4/18/2012
10/27/2011	F	Mokelumne Hatchery	Mokelumne River	Production	203	32	235	100,215	n/a	0.234	n/a	n/a	2/3/2012	4/1/2012
12/16/2011	LF	Coleman NFH	Battle Creek	Production	105	30	135	394,700	n/a	0.034	n/a	n/a	1/11/2012	3/31/2012
12/23/2011	LF	Coleman NFH	Battle Creek	Spring Surrogate	0	3	3	62,400	n/a	0.005	0.5%	1.0%	1/18/2012	1/31/2012
1/3/2012	LF	Coleman NFH	Battle Creek	Production	546	107	653	448,600	n/a	0.146	n/a	n/a	1/19/2012	5/7/2012
1/13/2012	LF	Coleman NFH	Battle Creek	Spring Surrogate	44	8	52	80,800	n/a	0.064	0.5%	1.0%	1/31/2012	2/18/2012
1/20/2012	LF	Coleman NFH	Battle Creek	Spring Surrogate[2]	92	9	101	20,000	n/a	0.505	n/a	n/a	1/30/2012	3/29/2012
2/9/2012	W	Livingston Stone NFH	Caldwell Park	Production	17	0	17	185,281	96,525	0.018	0.5%	1.0%	3/31/2012	3/31/2012
4/30/2012	F	Coleman NFH	Battle Creek	Production	19	5	24	1,360,273	n/a	0.002	n/a	n/a	5/15/2012	5/20/2012
5/8-5/9/2012	F	Nimbus Hatchery	American River	Production	0	8	8	802,783	n/a	0.001	n/a	n/a	5/14/2012	5/16/2012
*	F	Merced Hatchery	*	*	260	77	337	*	n/a	*	n/a	n/a	5/14/2012	5/27/2012

Table 2. Unknown hatchery (adipose fin clipped) Chinook salmon loss at the Delta fish facilities using the current loss equation (DFG 2006), October 2011 through June 2012.

Facility	Unknown Tag Code Loss[3]
SWP	56
CVP	7
Total	63

For Chinook loss from 10/1/2011 through 6/30/2012

SWP coded-wire tags read 10/1/2011 through 6/30/2012

CVP coded-wire tags read 10/1/2011 through 6/30/2012

Preliminary, subject to revision. Loss rounded to the nearest whole number.

[1]LF and F % Loss = (Confirmed Loss/Number Released)*100; W % Loss = (Confirmed Loss/Total Entering Delta)*100
[2]Because of the equipment malfunction that stranded a large proportion of the release, this 3rd surrogate release is tracked for monitoring purposes only

[3]Tag code cannot be determined (damaged tag, lost tag, no tag or released fish)

* Information not yet available

Table 3. Monthly averages of hydrologic parameters in the Sacramento-San Joaquin River Delta, October 2011 through July 2012.

Month	SWP Average Exports af	SWP Average Exports cfs	CVP Average Exports af	CVP Average Exports cfs	Sacramento R. Average cfs	San Joaquin R. Average cfs	Delta Outflow Average Flow cfs	Q West Average Flow cfs
October	13025	6567	7915	3990	17681	4668	11706	271
November	6872	3464	6599	3327	12821	2406	8207	1396
December	10272	5179	7725	3894	14591	1694	5598	-5296
January	7347	3704	4523	2280	15062	1822	11232	-1031
February	3580	1805	3759	1895	13290	1587	11257	353
March	2899	1461	3726	1879	19598	1608	19504	3134
April	2651	1337	1826	921	25670	2484	28416	6193
May	3237	1632	2880	1452	13966	2952	13503	1810
June	2952	1488	4064	2049	13412	1445	8281	1113
July	11224	5659	8099	4083	20227	881	7817	-3715

Table 4. Loss of wild (non-adipose fin clipped) winter-run Chinook salmon using the current loss equation (DFG 2006), October 2011 through June 2012.

Facility	Total Loss
SWP	1702
CVP	377
Combined	2079

Table 5. Loss estimates with 95% confidence limits for wild (non-adipose fin clipped) winter-run Chinook salmon under a range of loss parameter (S) estimates using the proposed loss equation (Jahn 2011) and not corrected for autocorrelation, October 2011 through June 2012.

Parameter/Result	SWP			CVP		
Survival Rate	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
S	0.08	0.13	0.25	0.14	0.46	0.54
SE(S)	0.03	0.03	0	0.047	0.043	0.043
Loss	4462	2597	1164	2780	531	385
lcl	843	1196	928	639	350	259
ucl	8081	3998	1400	4921	712	511

Table 6. Loss estimates with 95% confidence limits for wild (non-adipose fin clipped) winter-run Chinook salmon under a range of loss parameter (S) estimates using the proposed loss equation (Jahn 2011) and corrected for autocorrelation, October 2011 through June 2012.

Parameter/Result	CVP: Corrected for autocorrelation		
Survival Rate	**Low**	**Medium**	**High**
S	0.14	0.46	0.54
SE(S)	0.047	0.043	0.043
Loss	2780	531	385
lcl	615	338	250
ucl	4945	724	520

Table 7. Loss estimates with 95% confidence limits for Livingston Stone Hatchery winter-run Chinook salmon under a range of loss parameter (S) estimates using the proposed loss equation (Jahn 2011), October 2011 through June 2012.

Parameter/Result	SWP			CVP		
Survival Rate	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
S	0.08	0.13	0.25	0.14	0.46	0.54
SE(S)	0.03	0.03	0	0.047	0.043	0.043
Loss	46	27	12	*	*	*
lcl	-38	-19	-8	*	*	*
ucl	130	73	32	*	*	*

Table 8. Loss estimates with 95% confidence limits for the first spring-run Chinook salmon surrogate release group under a range of loss parameter (S) estimates using the proposed loss equation (Jahn 2011), October 2011 through June 2012.

Parameter/Results	SWP			CVP		
Survival Rate	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
S	0.08	0.13	0.25	0.14	0.46	0.54
SE(S)	0.03	0.03	0	0.047	0.043	0.043
Loss	*	*	*	22	4	3
lcl	*	*	*	-8	-1	-1
ucl	*	*	*	52	9	7

Table 9. Loss estimates with 95% confidence limits for the second spring-run Chinook salmon surrogate release group under a range of loss parameter (S) estimates using the proposed loss equation (Jahn 2011), October 2011 through June 2012.

Parameter/Result	SWP			CVP		
Survival Rate	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
S	0.08	0.13	0.25	0.14	0.46	0.54
SE(S)	0.03	0.03	0	0.047	0.043	0.043
Loss	115	67	30	68	13	9
lcl	-28	-6	1	-7	2	1
ucl	258	140	59	143	24	17

Table 10. Loss estimates with 95% confidence limits for the third spring-run Chinook salmon surrogate release group under a range of loss parameter (S) estimates using the proposed loss equation (Jahn 2011), October 2011 through June 2012.

Parameter/Result	SWP			CVP		
Survival Rate	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
S	0.08	0.13	0.25	0.14	0.46	0.54
SE(S)	0.03	0.03	0	0.047	0.043	0.043
Loss	242	141	63	55	11	8
lcl	-10	21	19	-14	0	0
ucl	494	261	107	124	22	16

Table 11. Loss of wild (non-adipose fin clipped) steelhead using the interim loss equation (DOSS 2011), October 2011 through July 2012.

Facility	Total Loss
SWP	1052
CVP	61
Combined	1113

Table 12. Loss estimates with 95% confidence limits for wild (non-adipose fin clipped) steelhead under a range of loss parameter (S) estimates using the proposed loss equation (Jahn 2011), October 2011 through July 2012.

Parameter/Result	SWP			CVP		
Survival Rate	**Low**	**Medium**	**High**	**Low**	**Medium**	**High**
S	0.13	0.18	0.33	0.18	0.55	0.65
SE(S)	0.013	0.017	0.013	0.017	0.035	0.035
Loss	1626	1107	493	403	72	48
lcl	1082	740	357	252	45	31
ucl	2170	1474	629	554	99	65

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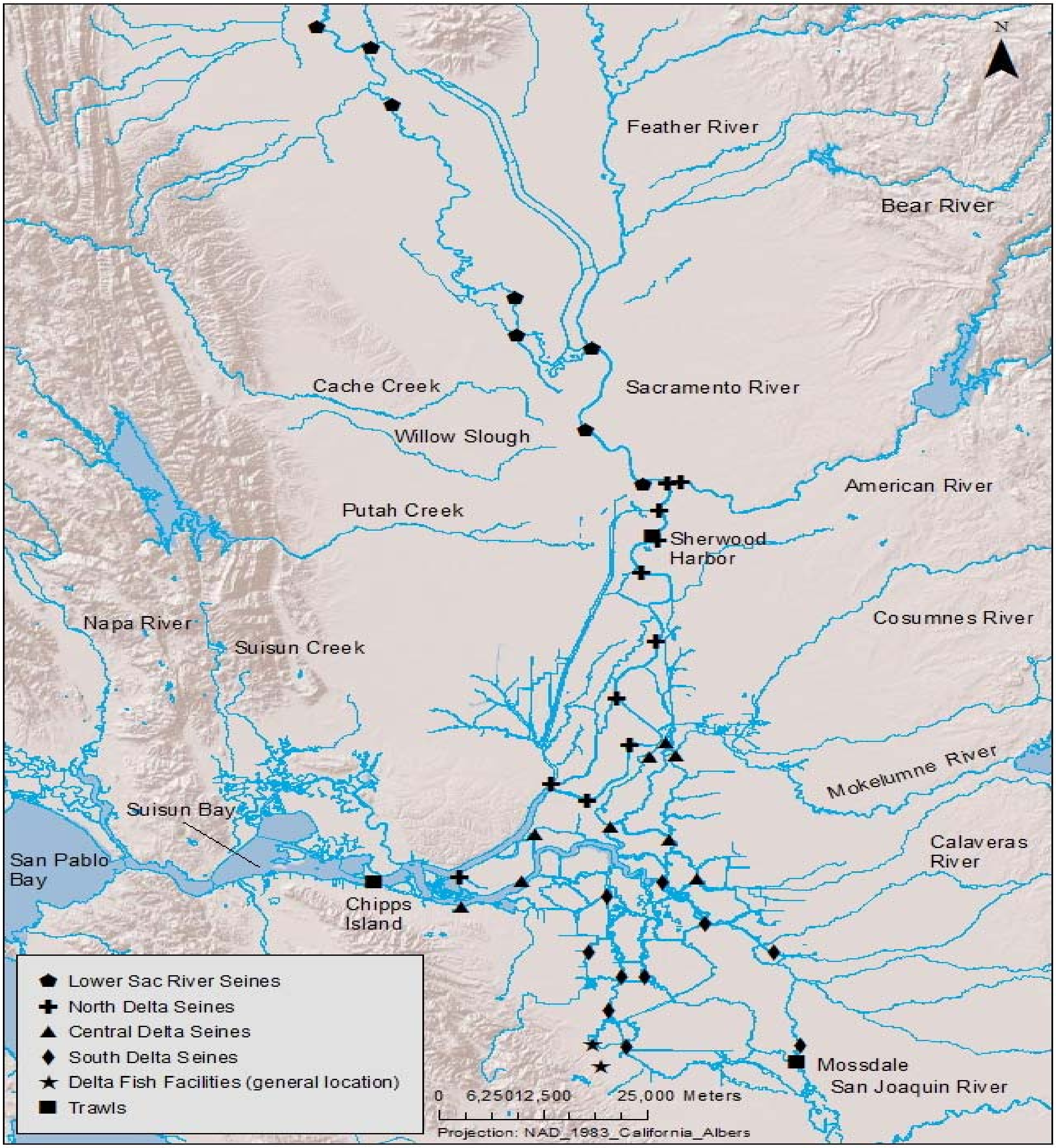

Figure 1. Map of monitoring sites used in this report. Base map from ESRI and GPS coordinates provided by USFWS. Only seine sites that have been active since August 2002 are presented.

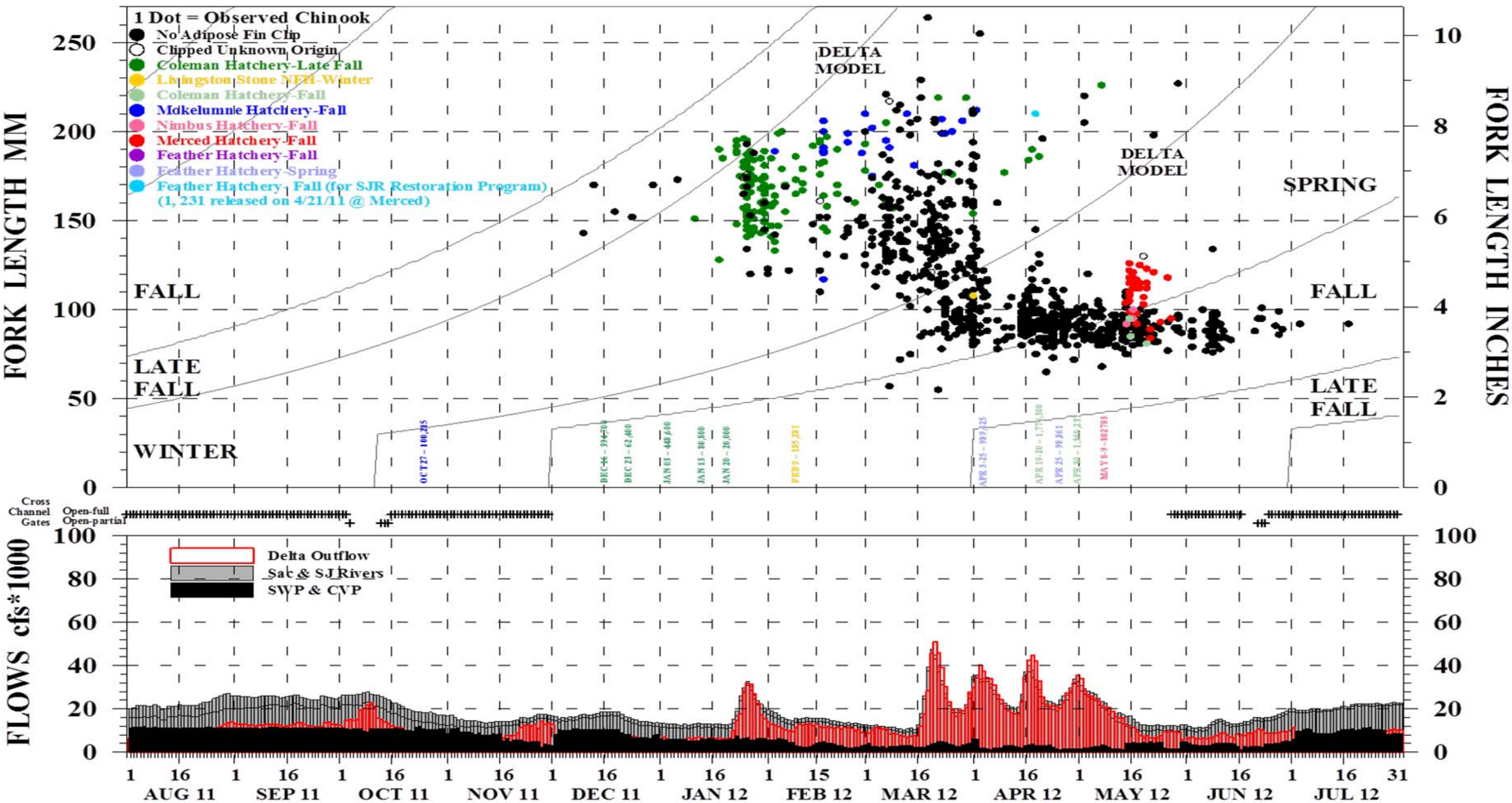

Figure 2. Observed Chinook salvage at the Delta fish facilities with Delta hydrology, August 1, 2011, through July 31, 2012.

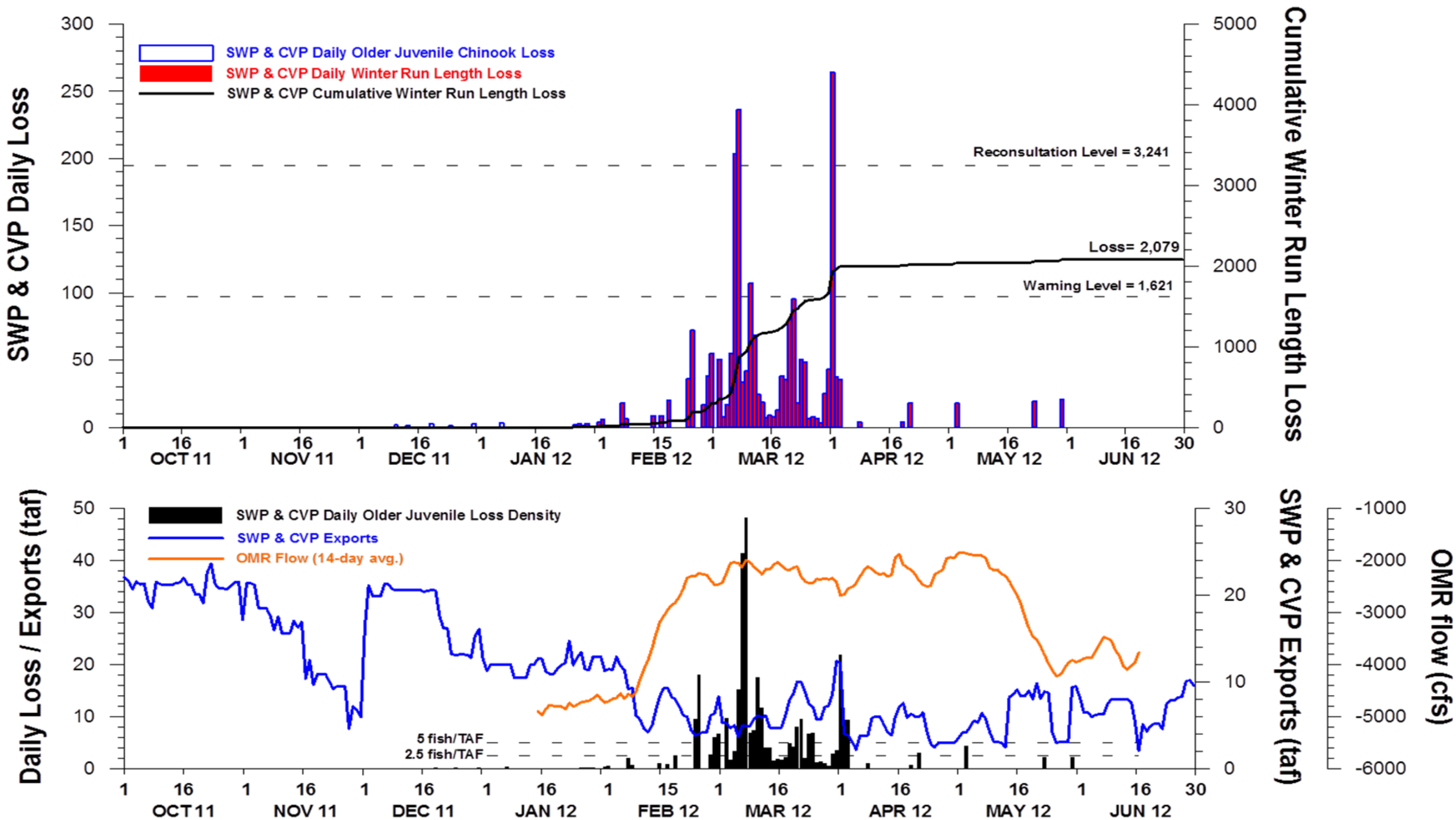

Figure 3. Daily loss and loss density of wild (non-adipose fin clipped) winter-run length and older juvenile Chinook salmon at the Delta fish facilities using the current loss equation (DFG 2006), October 1, 2011, through June 30, 2012.

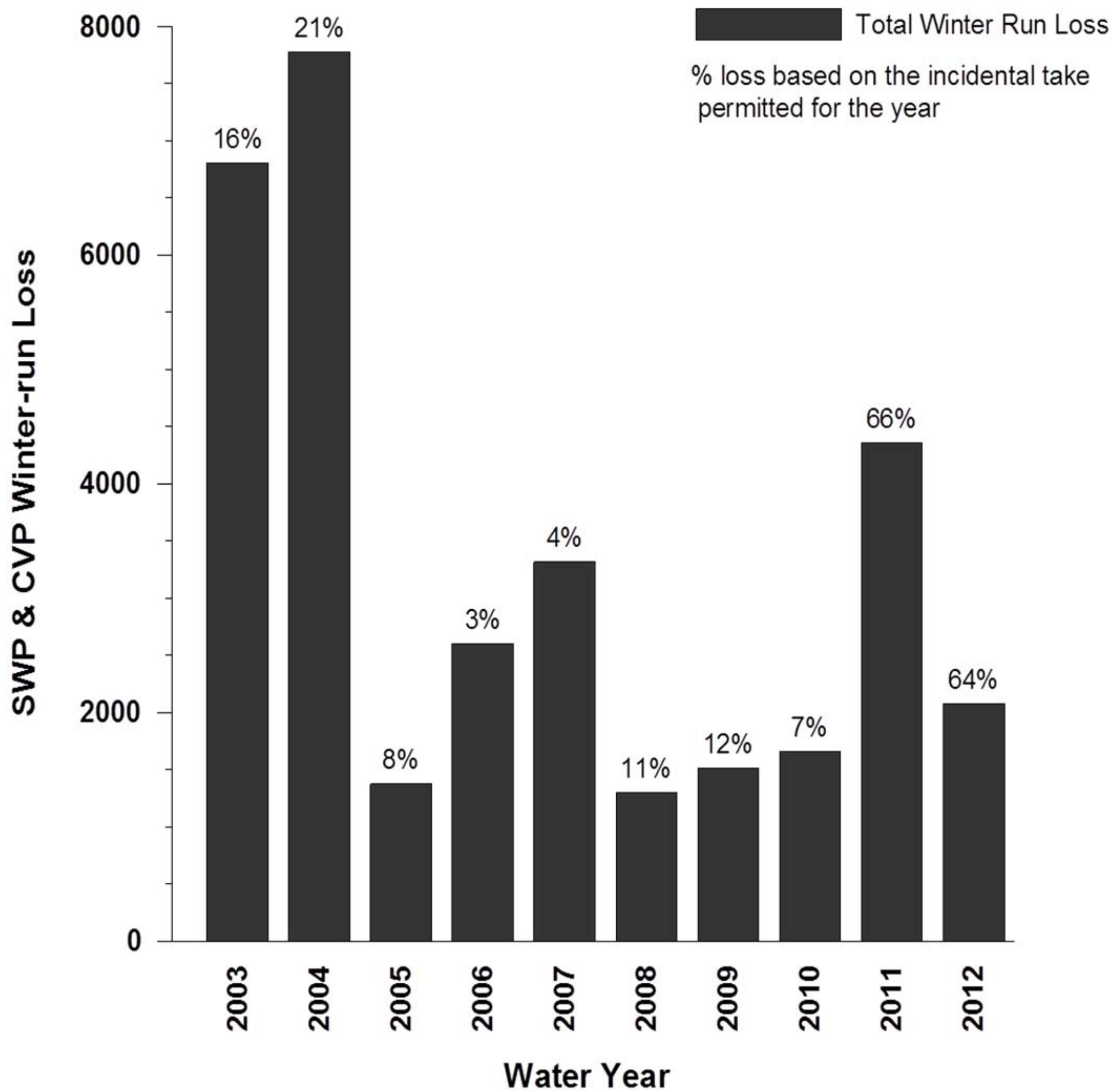

Figure 4. Wild (non-adipose fin clipped) winter-run length Chinook salmon loss at the Delta fish facilities from October to June using the current loss equation (DFG 2006), water years 2003 through 2012.

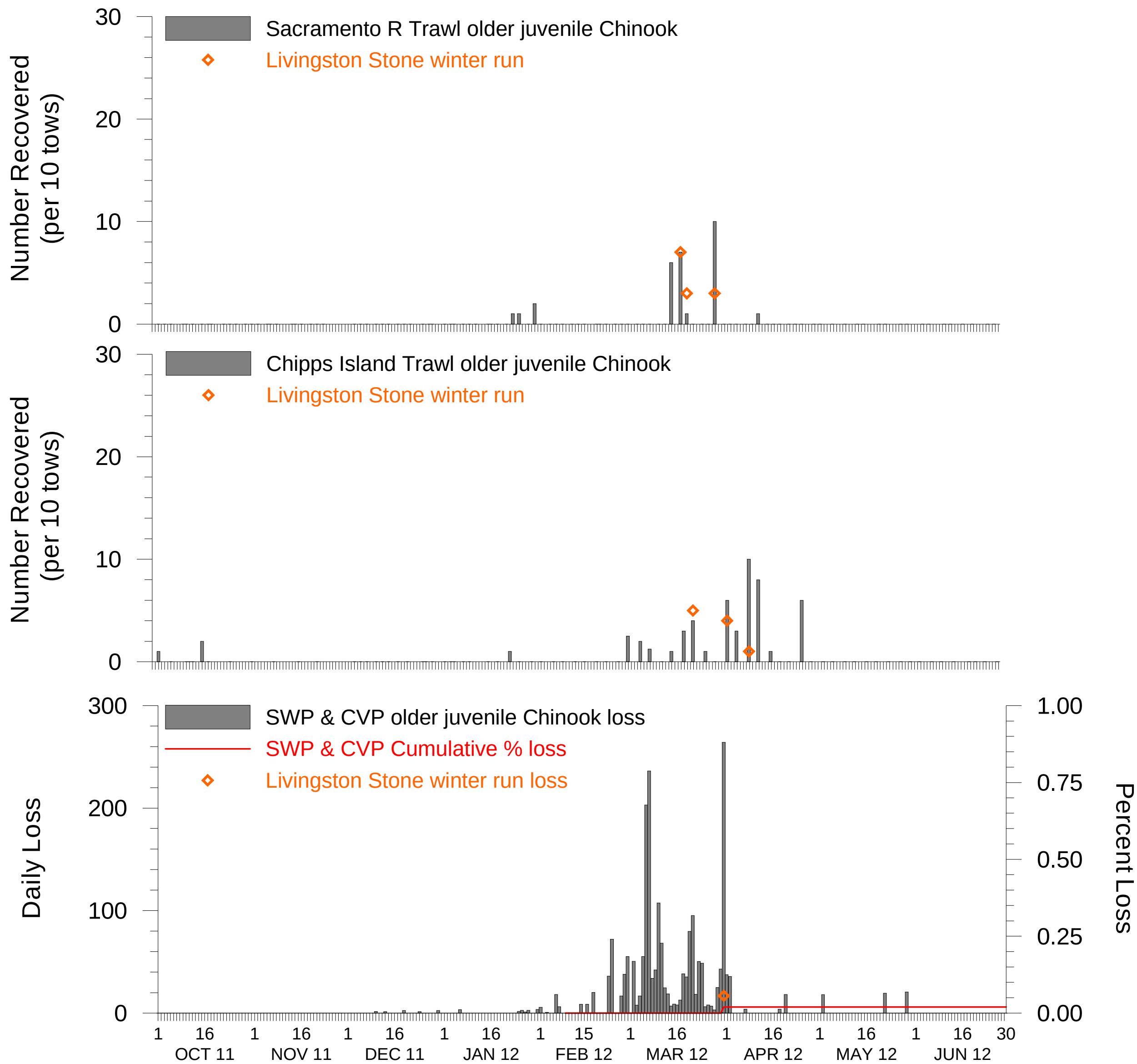

Figure 5. Older juvenile Chinook salmon and Livingston Stone Hatchery winter-run Chinook salmon recoveries from the Delta monitoring program and loss at the Delta fish facilities, October 1, 2011, through June 30, 2012.

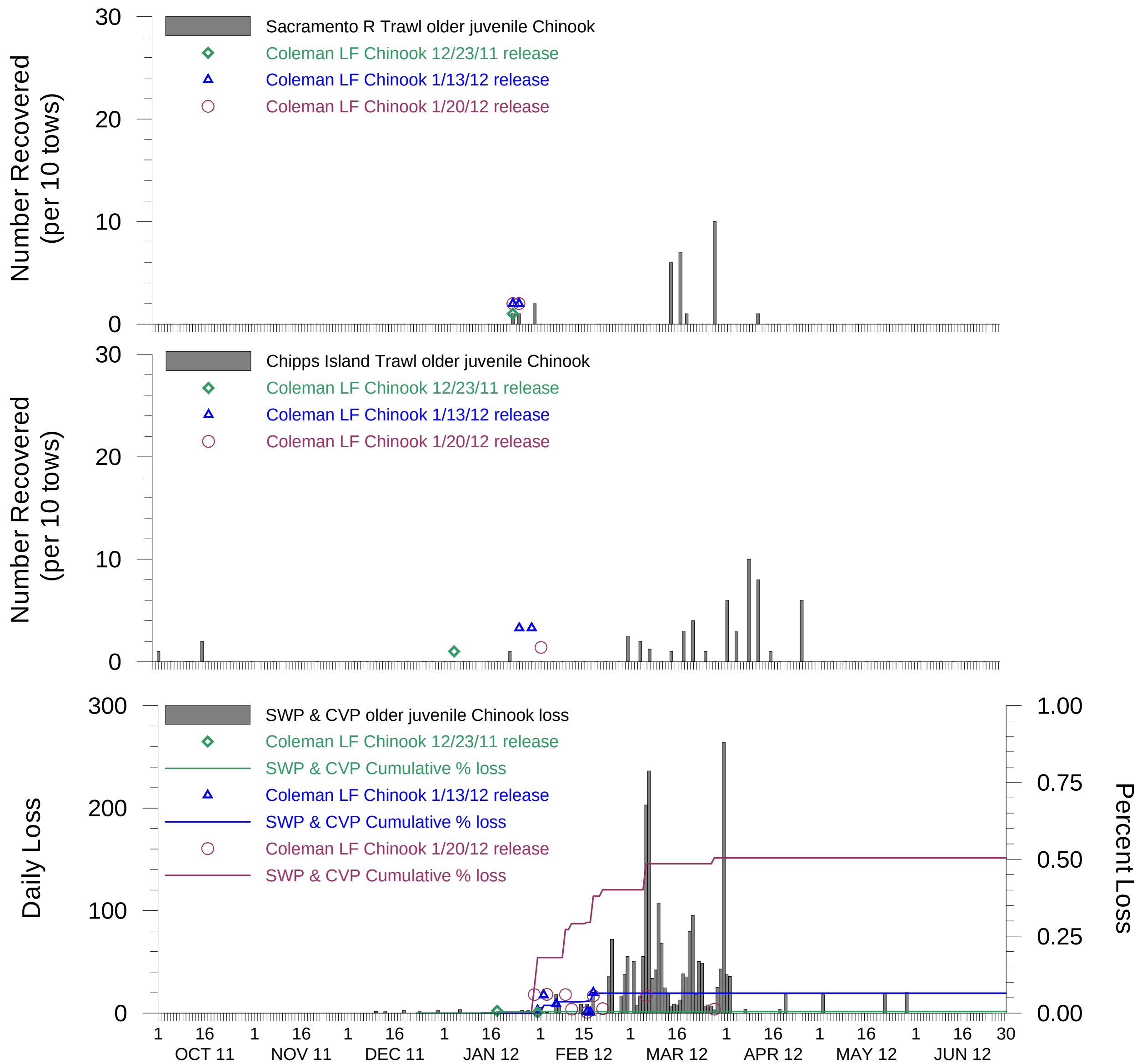

Figure 6. Older juvenile Chinook salmon and Coleman Hatchery late-fall Chinook salmon (spring-run surrogate) recoveries from the Delta monitoring program and loss at the Delta fish facilities, October 1, 2011, through June 30, 2012.

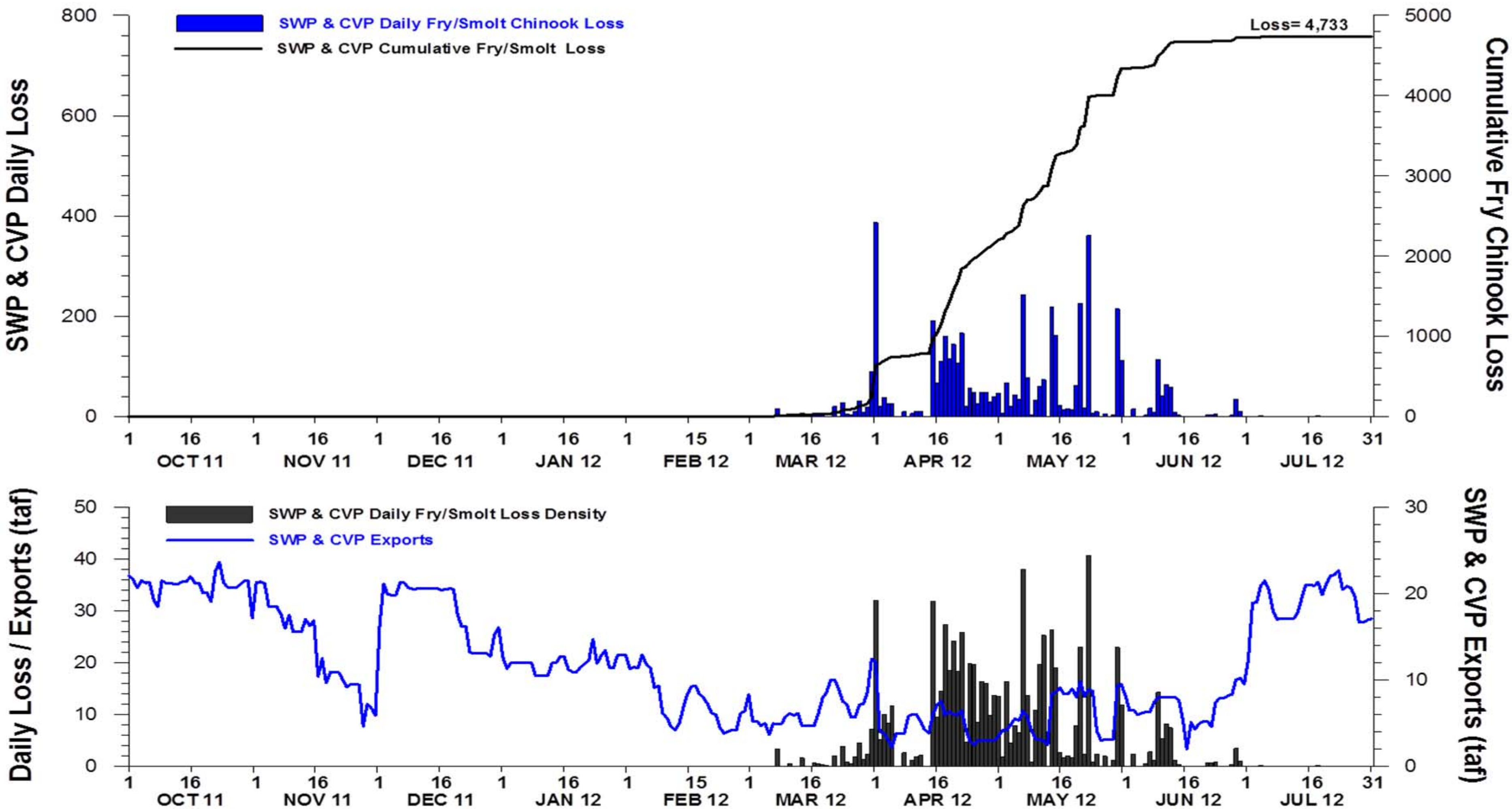

Figure 7. Daily loss and loss density of wild (non-adipose fin clipped) fry/smolt Chinook salmon at the Delta fish facilities using the current loss equation (DFG 2006), October 1, 2011, through July 31, 2012.

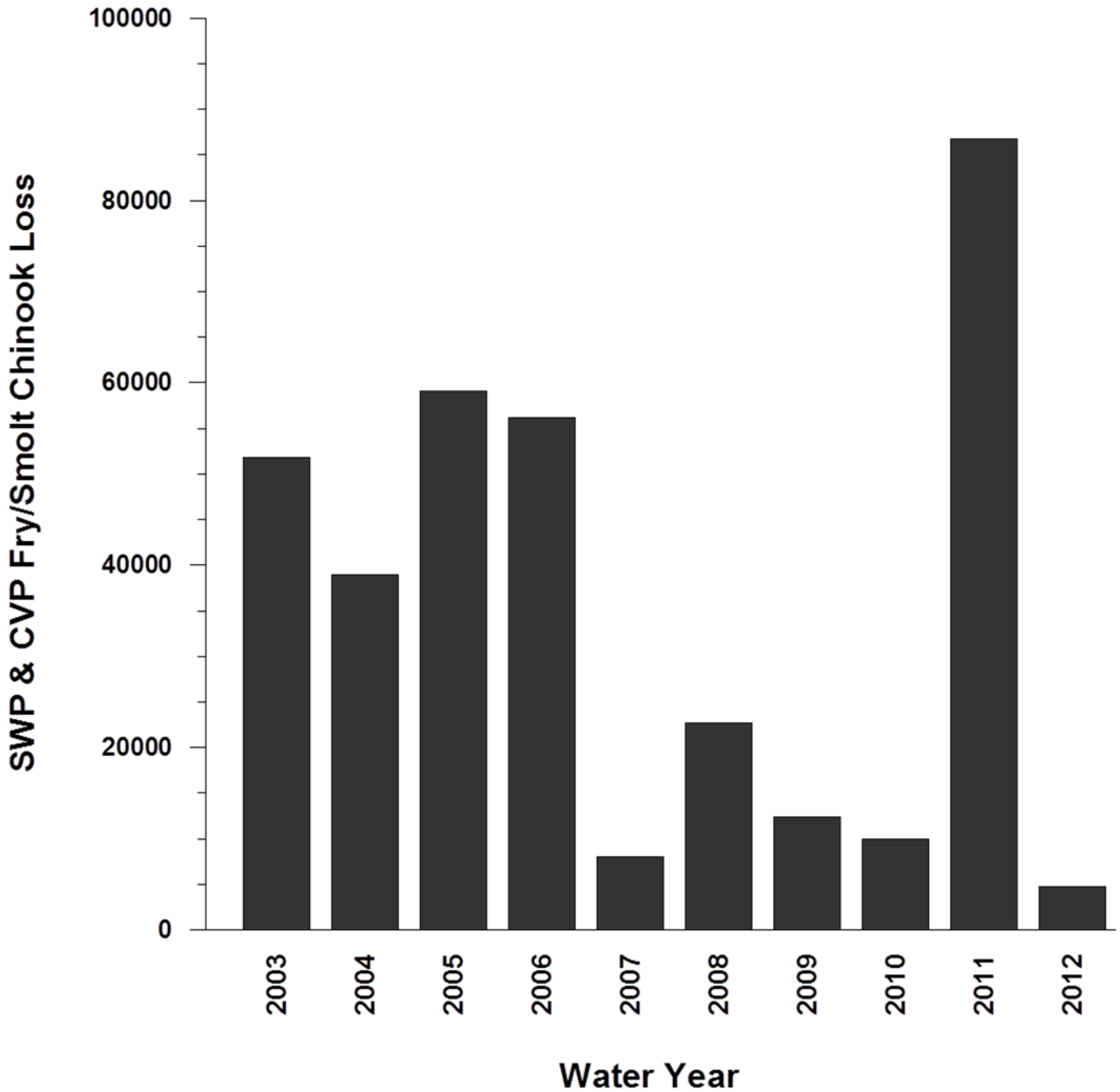

Figure 8. Fry/smolt Chinook (non-adipose fin clipped) salmon loss at the Delta fish facilities from October to July using the current loss equation (DFG 2006), water years 2003 through 2012.

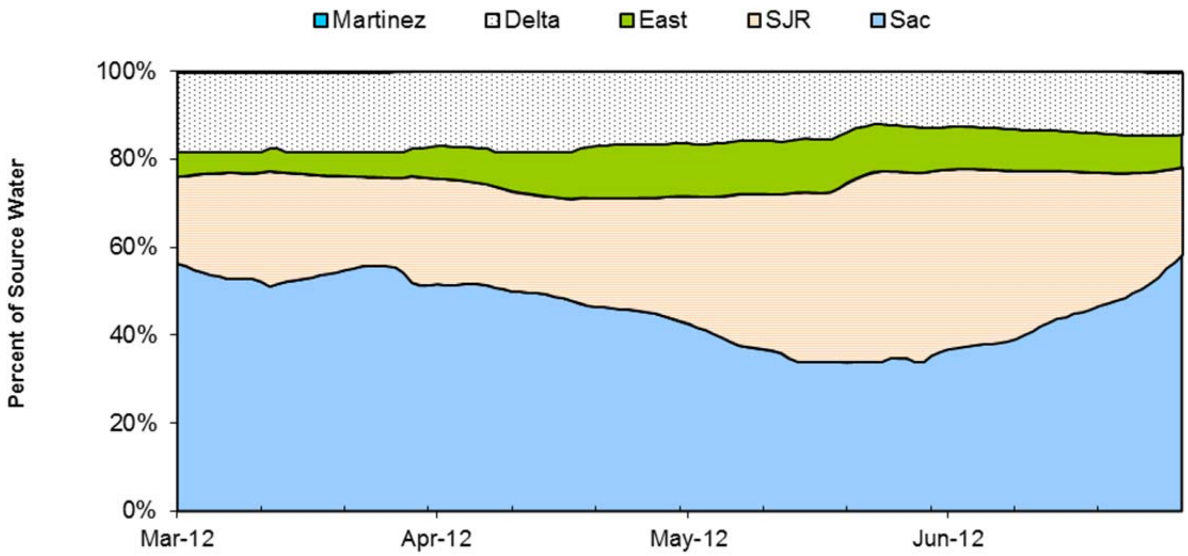

Figure 9. Modeled volumetric water fingerprint for the Clifton Court Forebay (SWP) as derived from DSM2. Figure from the DWR-Operations Control Office.

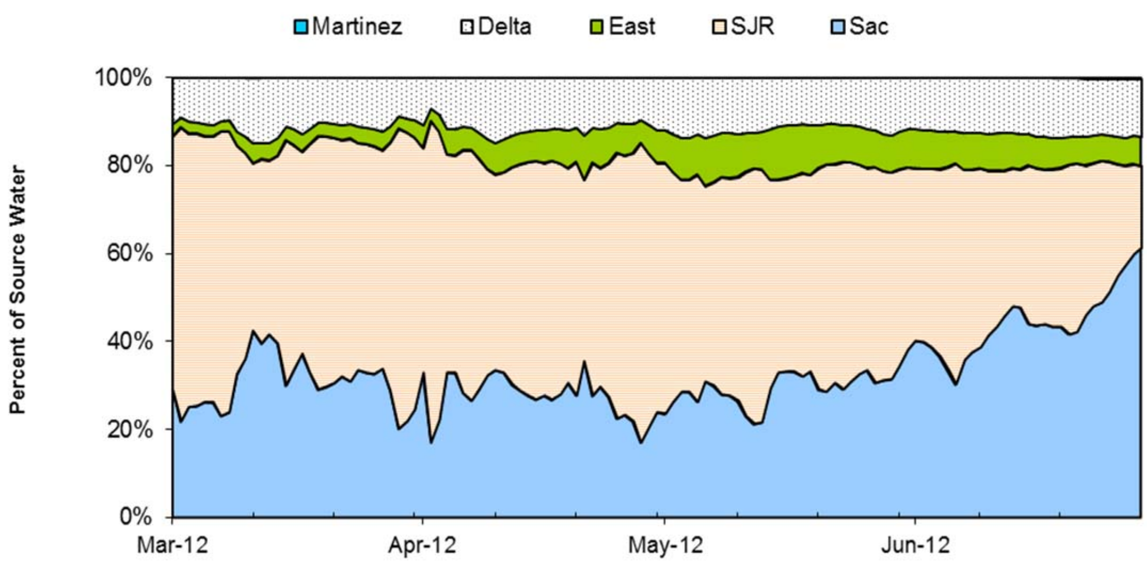

Figure 10. Modeled volumetric water fingerprint for the Jones Pumping Plant (CVP) as derived from DSM2. Figure from the DWR-Operations Control Office.

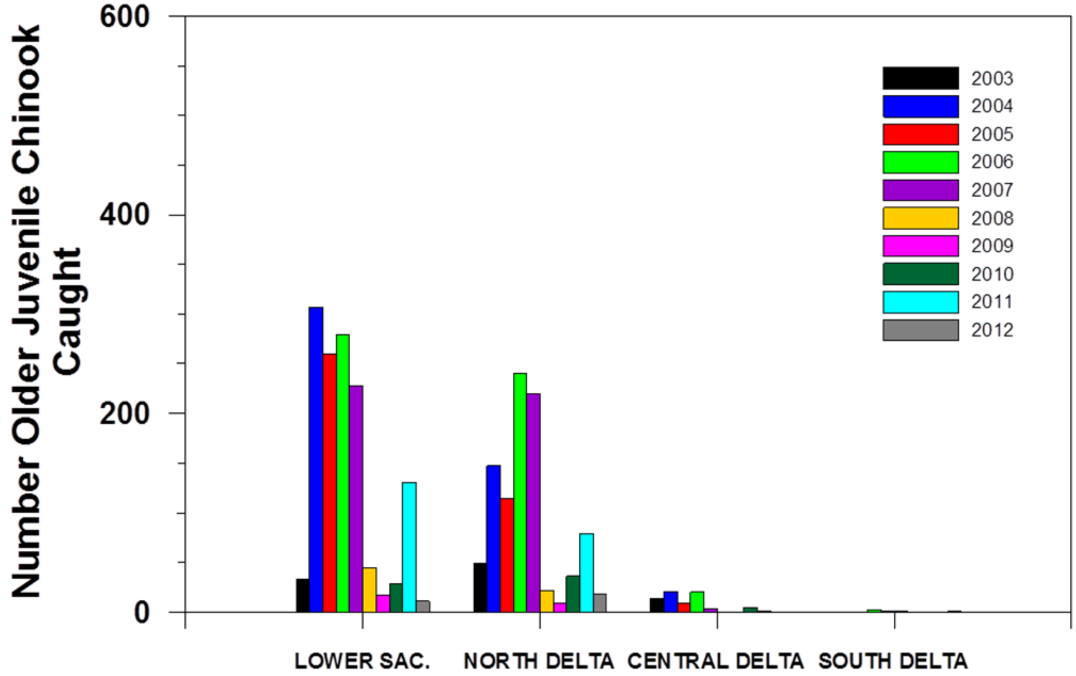

Figure 11. Number of wild (non-adipose fin clipped) older juvenile Chinook salmon caught in the lower Sacramento River and the Delta beach seines from August 1 through July 31, water years 2003 to 2012.

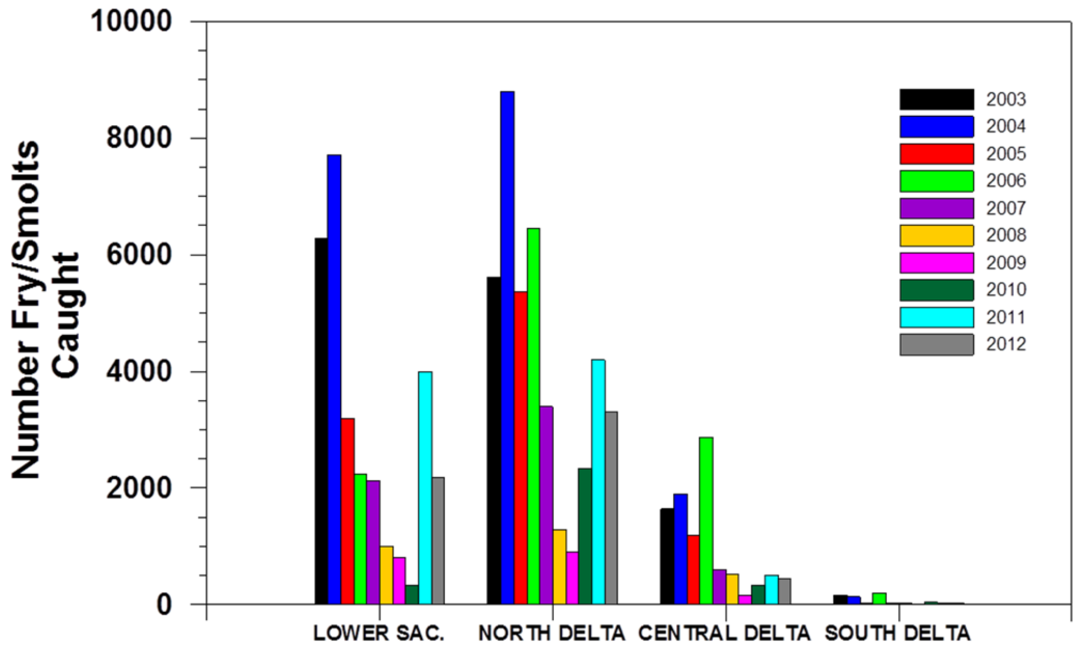

Figure 12. Number of wild (non-adipose fin clipped) fry/smolt Chinook salmon caught in the lower Sacramento River and the Delta beach seines from August 1 through July 31, water years 2003 to 2012.

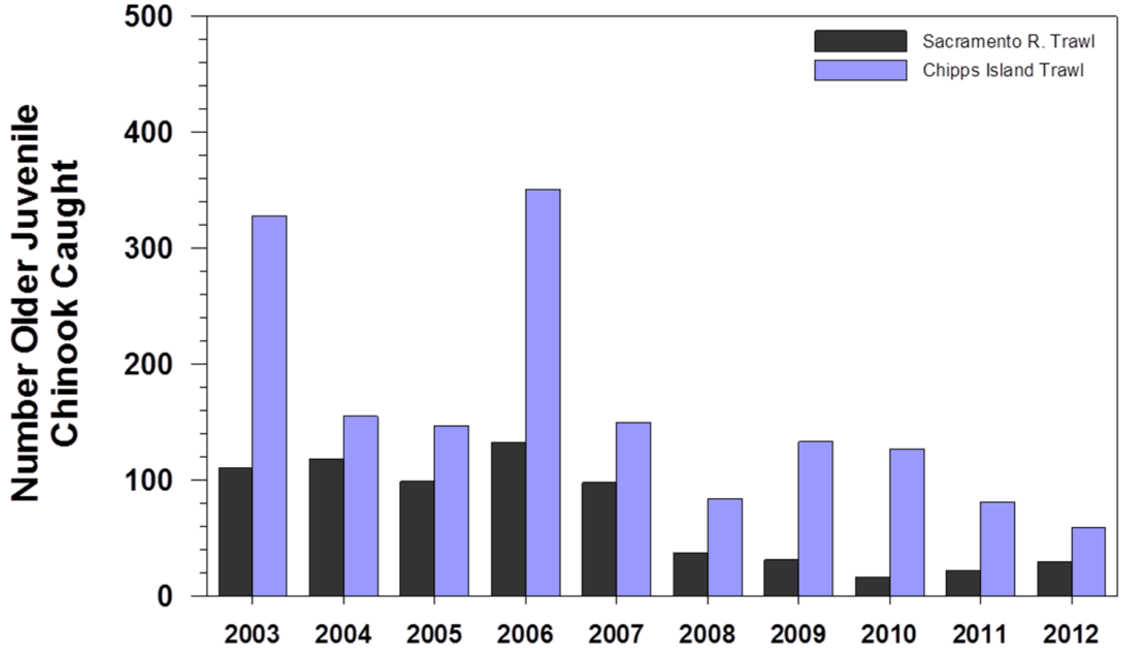

Figure 13. Number of wild (non-adipose fin clipped) older juvenile Chinook salmon caught in the Sacramento River and Chipps Island trawls from August 1 to July 31, water years 2003 through 2012.

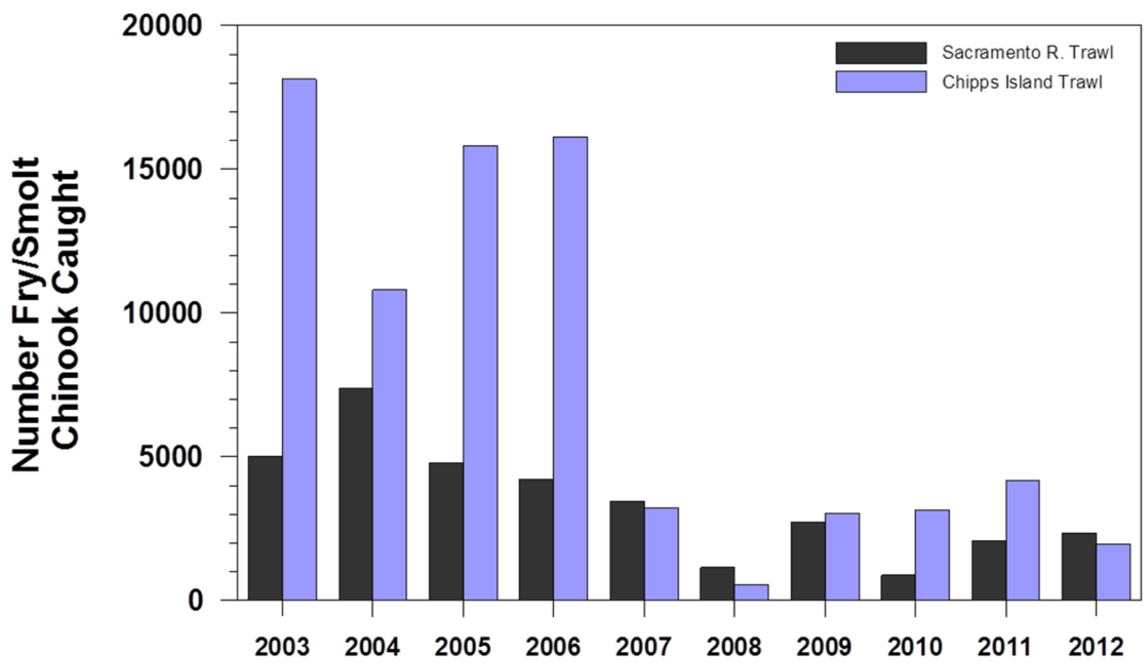

Figure 14. Number of wild (non-adipose fin clipped) fry/smolt salmon caught in the Sacramento River and Chipps Island trawls from August 1 to July 31, water years 2003 through 2012.

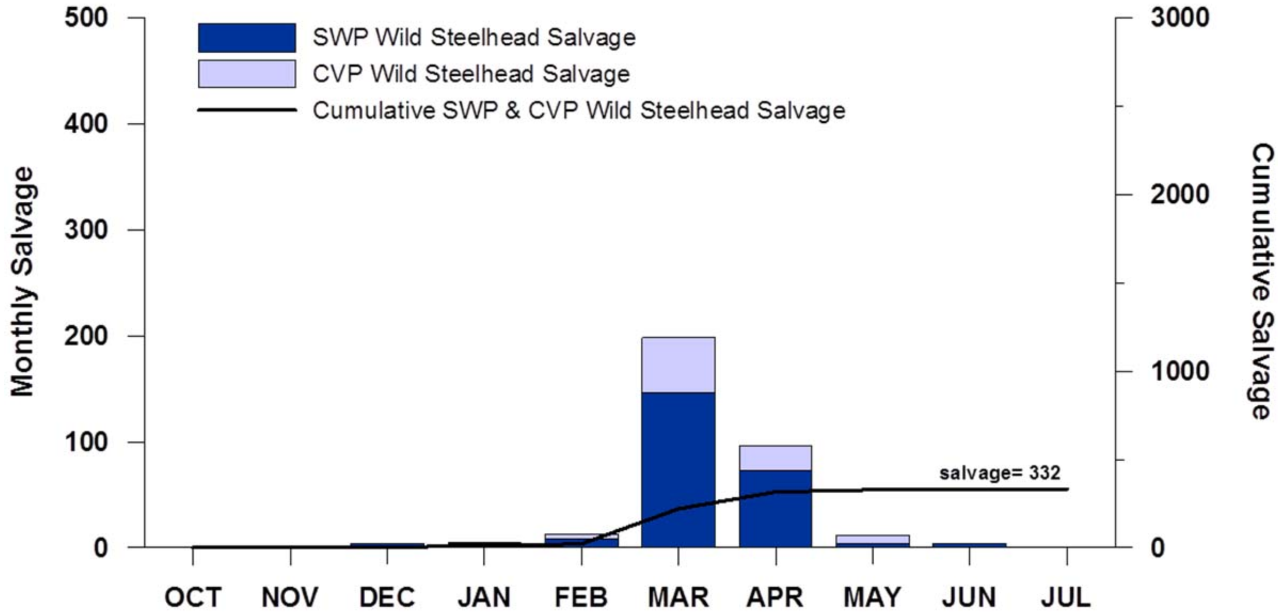

Figure 15. Wild (non-adipose fin clipped) steelhead salvage at the Delta fish facilities, October 2011 through July 2012.

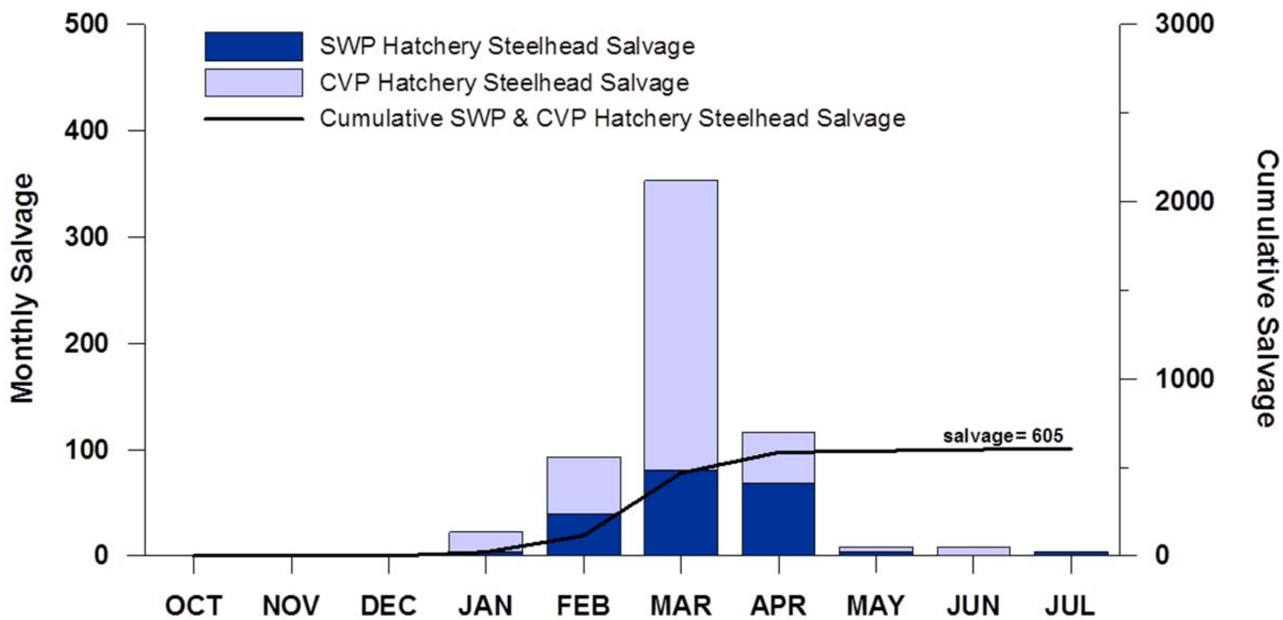

Figure 16. Hatchery (adipose fin clipped) steelhead salvage at the Delta fish facilities, October 2011 through July 2012.

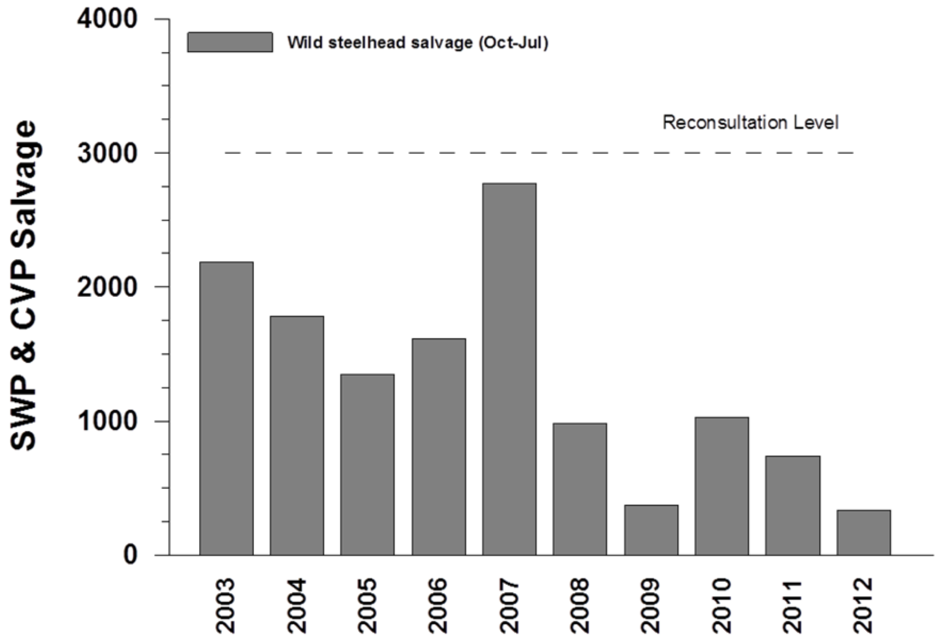

Figure 17. Wild (non-adipose fin clipped) steelhead salvage at the Delta fish facilities from October to July, water years 2003 through 2012.

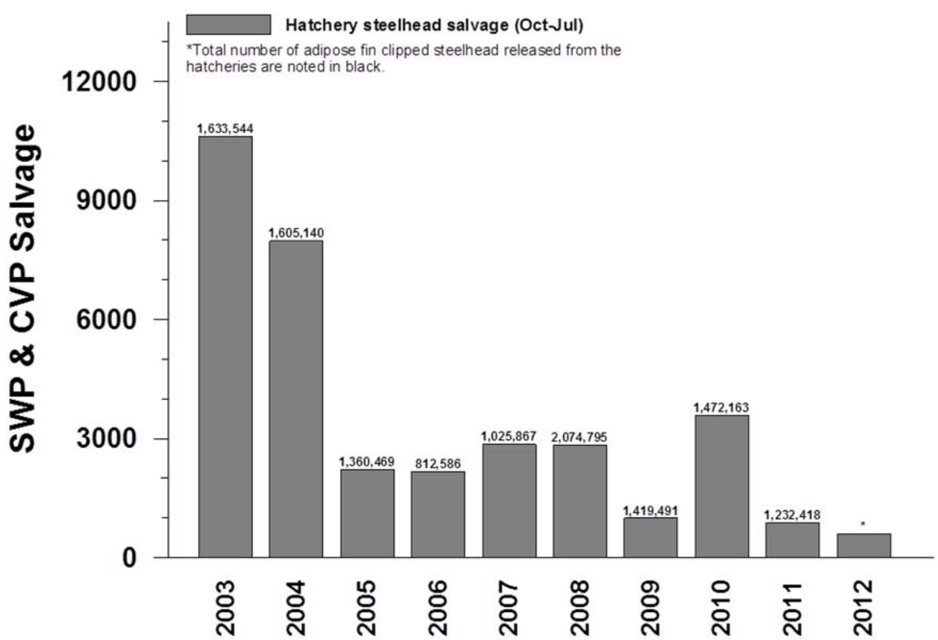

Figure 18. Hatchery (adipose fin clipped) steelhead salvage at the Delta fish facilities from October to July, water years 2003 through 2012

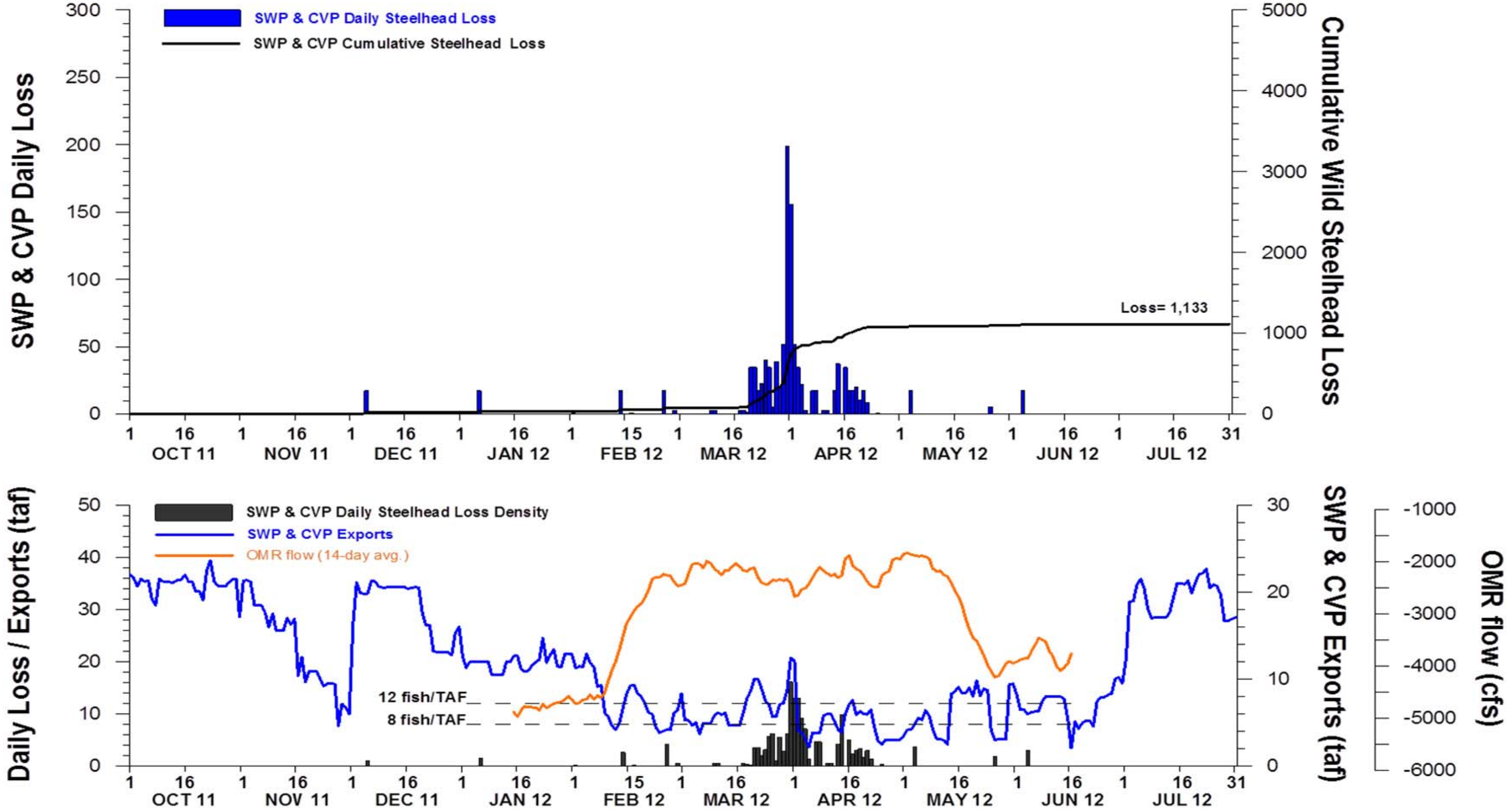

Figure 19. Daily loss and loss density of wild (non-adipose fin clipped) steelhead at the Delta fish facilities using the interim loss equation (DOSS 2011), October 1, 2011, through July 31, 2012.

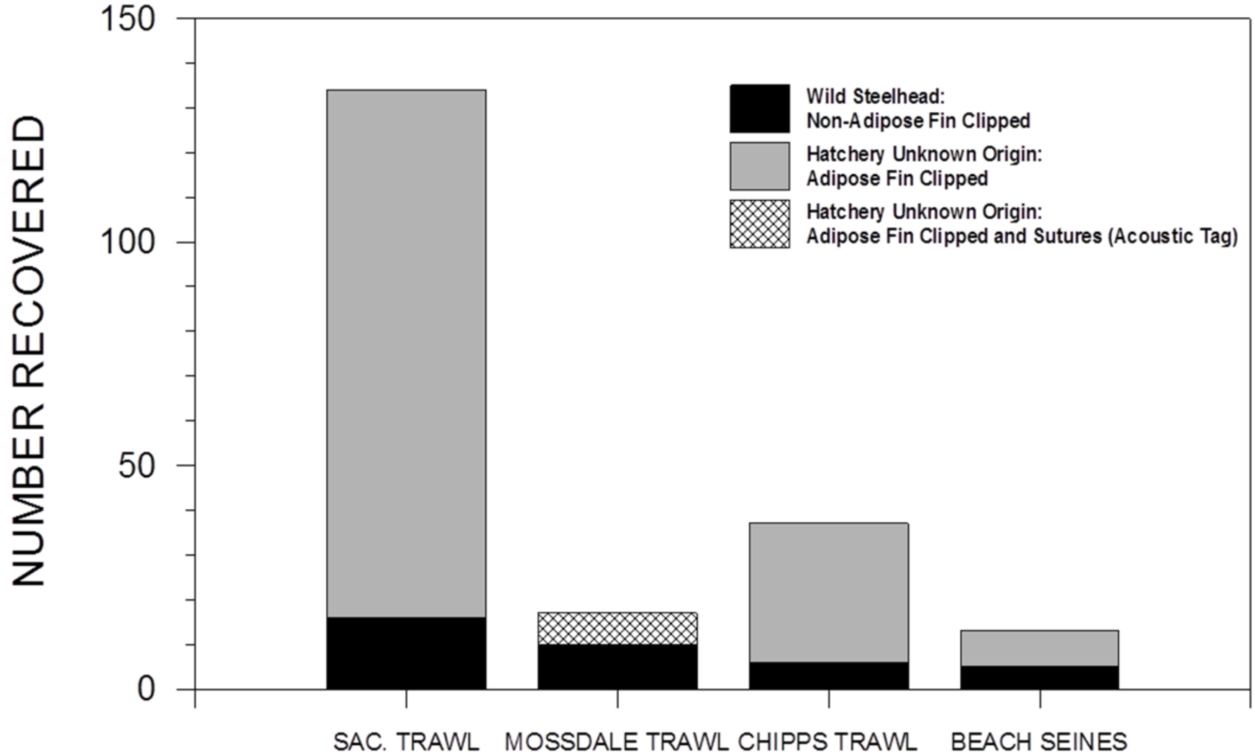

Figure 20. Number of hatchery (adipose fin clipped) and wild (non-adipose fin clipped) steelhead recovered in the Delta monitoring program, October 2011 through July 2012.

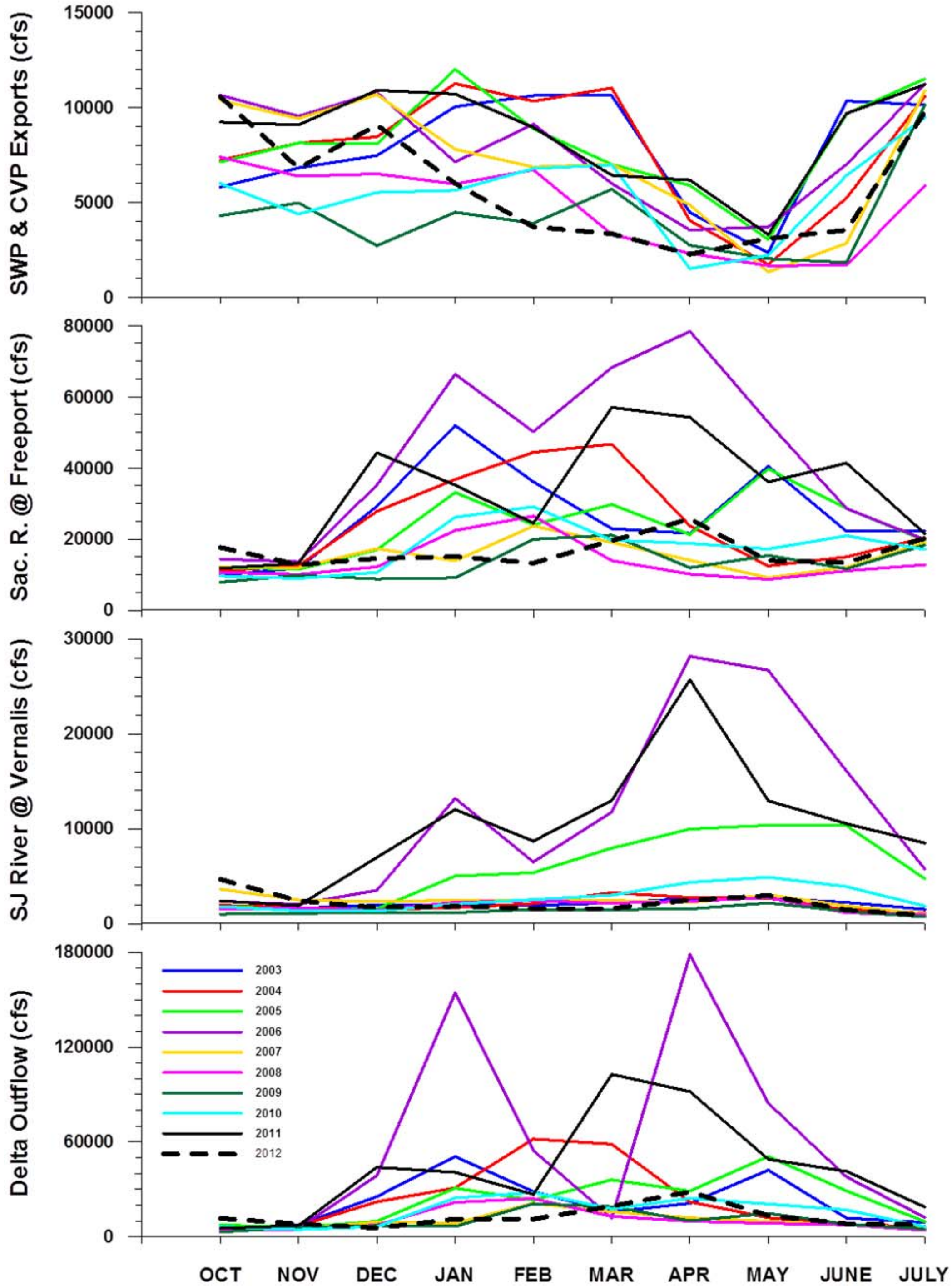

Figure 21. Monthly averages of Delta hydrology, water years 2003 through 2012.

APPENDIX

Term and Condition 2a Draft Study Briefing: Green Sturgeon Laboratory Based Evaluations to Determine Louver Efficiency and Predation Risk

September 28, 2012

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Term and Condition 2a Draft Study Briefing:

Green Sturgeon Laboratory Based Evaluations to Determine Louver Efficiency and Predation Risk

Introduction

This briefing paper outlines the status of laboratory based investigations for green sturgeon louver efficiency based on a compliance measure that was appended to the 2009 Biological Opinion on the long-term operations of the Central Valley Project and State Water Project (BiOp). The measure was received in a response letter from NOAA's National Marine Fisheries Service (NMFS) dated January 26, 2012, regarding compliance with Term and Condition 2a and directed DWR and Reclamation to "expeditiously design and conduct laboratory based evaluations of louver efficiency and predation on captive juvenile green sturgeon (Northern or Southern DPS fish)."

Background

Loss at the state and federal export facilities is estimated based on calculations used to extrapolate loss of fish within the export facilities based on numbers of salvaged fish. Both the current equation, and the proposed equation developed by Jahn (2011), include a series of parameters including louver efficiency, prescreen losses, and mortality which vary based upon species, size, and flow. These parameters have been developed for salmonids based on a number of investigations of pre-screen losses and salvage efficiency evaluations. In the case of juvenile green sturgeon (and white sturgeon), no such estimates for these parameters exist. Given current concerns regarding utilization of hatchery-reared green or white sturgeon (as surrogates) in field experiments to estimate these parameters, laboratory based investigations provide the most feasible opportunity to investigate the behavior of sturgeon when exposed to louvers.

One element of the 2009 BiOp Reasonable and Prudent Alternative (RPA) was a suite of green surgeon studies described in an appendix to the BiOp (2009 BiOp Appendix 2-B, pp 22-26). Included in these studies was a laboratory investigation meant to provide foundational information on the effect of water diversions on juvenile green sturgeon, to evaluate the suitability of other sturgeon species (white sturgeon) as surrogates for green sturgeon through a comparison of swimming performance, and to evaluate the effect of stimuli such as vibration or strobe lights for improving the effectiveness of fish protective devices (screens/louvers). Furthermore, in response to concerns about the feasibility of conducting an in situ evaluation louver efficiency for green sturgeon at the south delta fish facility in accordance with Term and Condition 2a and RPA IV.4, DWR and Reclamation were advised to expeditiously design and conduct laboratory-based evaluations of louver efficiency as an alternative.

In response to the initial BiOp, Reclamation entered into an agreement with researchers at the University of California, Davis (UC Davis) to conduct laboratory based investigations to examine the swimming performance and behavior of juvenile green sturgeon in response to fish protection screens and louvers. These studies will be used to provide foundational information to design comprehensive laboratory evaluations of juvenile green sturgeon louver efficiency as directed by NMFS in their response letter to Reclamation and DWR regarding Term and Condition 2a.

Summary of Existing Data

Under the direction of Dr. Nann Fangue, Principle Investigator of the Fish Conservation Physiology Laboratory at UC Davis, a series of investigations with both juvenile green and white sturgeon have been conducted. Generally, three main types of investigations have been conducted to date, including:

1. Critical Swimming Velocity (Ucrit) tests;
2. Evaluations of interactions with screens in a small flume; and
3. Evaluations of interactions with louvers in a small flume.

The Ucrit evaluations were conducted in specialized swim tunnels where the investigators could increase water velocity stepwise until an experimental endpoint (fish exhaustion). The louver and screen trials were conducted in a small flume that has a 1.0 m x 1.5 m swimming section and a water depth of 0.3 m. In the small flume investigations, video data was collected to quantify: 1) the time spent in different sections of the flume to assess the fish's response to the screens or louvers, 2) the frequency of fish contact on the louvers or screens, and 3) the passage rate of sturgeon through or past the louver array. Within each type of test, fish species (green or white), fish size, flume water velocity, and acclimation water velocity (exercise conditioning) were varied (Table 1) Furthermore, during some of the screen/louver tests, vibratory or visual stimuli were also tested to examine possible mechanisms to improve fish deterrence or guidance.

Data analysis is currently underway and results are anticipated in the latter part of 2013. In the interim, an examination of the scope of data collected and some of the preliminary findings were used to 1) evaluate the data gaps between the collected data and actual field conditions at the salvage facilities, and 2) to develop a conceptual framework for an expanded laboratory evaluation of juvenile green sturgeon responses to louvers.

Key Data Gaps

1. *Experimental Scale*
    - The scale of the experiments conducted to date is quite small; the louver array being tested is only 1.8 m long. The small scale limits the ability to test some of the higher velocities typically encountered at the salvage facilities.

2. *Temperature*
    - Most of the experiments have been conducted at 18°C, however green sturgeon have been collected at the salvage facilities year round and at wide variety of temperatures.

3. *Size of Fish*
    - Most of the data has been collected on fish 20-40 cm FL for Ucrit and screen trials, and 10-15 cm for louver trials. Additional louver data for fish in the 20-40 cm FL class is valuable because it represents the size class of the bulk of the fish typically salvaged at the facilities.

4. *Water Velocities*
    - Water velocities tested ranged from 20-60 cm/s (0.33 ft/s – 2 ft/s). In contrast, actual regulatory “criteria” for the salvage facilities ranges from 30.5 – 107 cm/s (1 – 3.5 ft/s) and may range from less than 30.5 cm/s to in excess of 137 cm/s (1 ft/s to 4.5 ft/s) during some situations at the Tracy Fish Collection Facility (Brent Bridges, personal communication).
    - No attempt was made to simulate or manipulate bypass ratios in the flume. Bypass ratio, defined as the ratio of the water velocity entering the bypass openings to the average channel velocity, is known to be a critical factor affecting the guidance of fish into the bypass openings (Bates and Vinsonhaler, 1957; CDWR, 1973).

5. *Sturgeon Species*
    - While limited data on direct comparisons of sized matched green and white sturgeon are available and data analysis is still underway, preliminary Ucrit data suggest that white sturgeon would not be suitable surrogates for green sturgeon. The preliminary data suggests that juvenile green sturgeon are relatively poor swimmers when compared to similar sized white sturgeon (Dr. Fangue, Personal Communication).

6. *Time of Day*
    - Limited tests were conducted during night, and no tests were conducted with turbid water. Green sturgeon are known to be quite active at night and there are known differences between day and night louver efficiency for various fish species (CDWR 1973).

Framework for Expanded Laboratory Based Investigations of Louver Efficiency

In an effort to expand upon the data collected during these small scale laboratory experiments with sturgeon, DWR and Reclamation have begun devoting resources towards developing an investigation to evaluate the response of juvenile sturgeon to a louver array. The investigation will include:

I. A larger scale experimental apparatus (flume)

II. Species
    a. If a viable source of fish for experimentation becomes available (progeny of captive spawned fish), the experiments should utilize southern DPS green sturgeon.
    b. In the absence of southern DPS fish, northern DPS green sturgeon from the Klamath River brood stock should be utilized.
    c. Experimental trials utilizing captive bred white sturgeon should also be conducted. These trials would provide valuable information for further evaluating their utility as a surrogate species, and could provide information about the behavior and salvage efficiency for this native species.
    d. Experiments should utilize experimental fish in the 50-500 mm size range. While the majority of the juvenile green sturgeon captured in the monitoring trawls or in the salvage are in the 200-500 mm size range (CDFG 2002), there is some concern that the absence of fish below this size range could potentially be due to some inherent inability of the collection facilities or the trawls to capture these size classes (e.g. a salvage efficiency of 0% for these size classes).

III. Velocities
    a. Experimental trials should be conducted over the full range of approach velocities encountered at the salvage facilities (from less than 30.5 cm/s to in excess of 137 cm/s).
    b. The experimental apparatus should incorporate provisions to manipulate the bypass velocity and bypass ratio. Bypass ratio has been shown to

have a significant effect on louver efficiency (Bates and Vinsonhaler, 1957; CDWR, 1973; Sutphin and Bridges, 2008).

IV. Environmental Conditions

a. Trials should be conducted under a wide range of temperature conditions. If feasible, low (<12 °C), moderate (12-18 °C), and high (19-25 °C) temperature conditions should be tested to evaluate their performance under the wide range of conditions during which they may be salvaged at the export facilities. Temperature is known to have an influence over fish physiology and behavior and could affect how fish respond to fish guidance devices such as louvers.
b. Experiments should be conducted during day and night conditions. Sturgeon are known to be more active at night and salvage efficiency for various species is known to differ based on day/night conditions (CDWR, 1973).
c. Flume experiments should be conducted with known Delta predatory fish to evaluate predation risk of different size classes of green sturgeon associated with louvers.

In the 2013 water year, DWR and Reclamation anticipate working with NMFS to develop a full study plan to suit the requested studies outlined in the NMFS January 26, 2012, letter. The study plan will also be developed in collaboration with, and reviewed by, the Central Valley Fish Facilities Review Team (CVFFRT) and/or Tracy Technical Advisory Team (TTAT) to ensure that the study findings are applicable to conditions encountered at the state and federal fish salvage facilities.

Table 1-Summary of treatments and data collected to date during sturgeon laboratory studies by the UC Davis Fish Conservation Physiology Laboratory

Treatment	Species	Temp, C	Flume Velocity (cm/s)	Mass (g ±SE)	FL (cm ±SE)	Treatment Types	Sample Size	Total # Experiments	Type(s) of Data Quantified
Screen-Day	GS	18	20 and 40	123.7 ±4.26	28.1 ± 0.29	Control, Flash, Vib inside, Vib Outside, Flash + Vib	18 per treatment and velocity	180	Screen contacts and time spent in sections
Screen-Night	GS	18	20	161.9±5.15	30.8 ± 0.35	Control, Flash, Vib inside, Vib Outside, Flash + Vib	14 per treatment and velocity	70	Screen contacts and time spent in sections
Screen-Day	WS	18	20 and 40		~25	Control, Flash, Vib inside, Vib Outside, Flash + Vib	20 per treatment and velocity	200	Screen contacts and time spent in sections
Screen-Night	WS	18	20 and 40		~28	Control, Flash, Vib inside, Vib Outside, Flash + Vib	12 per treatment and velocity	120	Screen contacts and time spent in sections
Angle Louver-Day	GS	11	20, 40, 60	~20	~15	Control 20, Flash 20, Control 40, Flash 40, Control 60, Flash 60	35 per treatment and velocity	210	Screen contacts, time spent, and passage through or around
Angle Louver-Day	GS	18	20, 40, 60	~10	~10	Control 20, Flash 20, Control 40, Flash 40, Control 60, Flash 61	40 per treatment and velocity	240	Screen contacts, time spent, and passage through or around
Angle Louver-Day	WS	18	20, 40, 60	~25	~14	Control 20, Flash 20, Control 40, Flash 40, Control 60, Flash 62	35 per treatment and velocity	210	Screen contacts, time spent, and passage through or around
Ucrit*	GS	18		452.67 ± 25.30	43.86±0.79	Traditional stepwise velocity increases	17	17	Ventilation Frequency, Tailbeats, Ucrit
Exercise Conditioning Ucrit	GS	18		~50	~20-24	Traditional stepwise velocity increases	25 control, 25 conditioned	50	Ventilation Frequency, Tailbeats, Ucrit
Exercise Conditioning Ucrit	WS	18		61.6	21.3	Traditional stepwise velocity increases	25 control, 25 conditioned	50	Ventilation Frequency, Tailbeats, Ucrit

*Ucrit data for white sturgeon is available in the literature (Geist et al, 2005; Counihan and Frost, 1999)

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Bates, D.W., and R. Visonhaler, 1957. *Use of Louvers for Guiding Fish*. Transactions of the American Fisheries Society 86: 38–57.

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Geist D.R. and Brown, R.S. 2005. *Movement, swimming speed, and oxygen consumption of juvenile white sturgeon in response to changing flow, water temperature, and light level in the Snake River, Idaho.* Transactions of the American Fisheries Society 134:803-816.

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Sutphin, Z., and B.B. Bridges. 2008. *Increasing Juvenile Fish Capture Efficiency at the Tracy Fish Collection Facility: An Analysis of Increased Bypass Ratios During Low Primary Velocities. Tracy Fish Collection Facility Studies, California, Volume 35.* Bureau of Reclamation, Denver Technical Service Center, Denver, Colorado.

Appendix B

Advice from the Delta Operations for Salmonids and Sturgeon (DOSS) subgroup regarding possible modification of sampling at the Chipps Island trawl station

October 20, 2011

Background:

Mid-water trawl sampling at the Chipps Island fish monitoring station typically occurs three to seven times per week, throughout the year. Because of concerns about exceeding the delta smelt take limit associated with the Chipps Island fish monitoring, the U.S. Fish & Wildlife Service (FWS) is considering modifications to the sampling protocol at Chipps Island from October through December 2011, the end of the current "take period." FWS Stockton staff participating in the 10/18/2011, DOSS call requested feedback from the DOSS group about how sampling modifications would affect data needs for salmonids.

A conference call was scheduled for 10/20/2011 to allow a subgroup of DOSS to discuss this issue. The subgroup considered the pros and cons of a number of sampling modifications that might reduce the take of delta smelt such as: reducing the number of sampling days per week, reducing the number of tows per sampling day, reducing the time of each tow, sampling in a new location, sampling on flood tides only, implementing a daily take limit, and various combinations of the above.

Subgroup Advice (from 10/20/2011 call)
A review of historical data (2001-2010) from Chipps Island showed that Chinook salmon (of any race) were seldom observed in the Chipps trawls before December, and steelhead were seldom observed before January (data provided in Attachment 1).

For the months remaining in calendar year 2011, the group identified December as the month during which the sampling at Chipps Island is most critical for monitoring juvenile Chinook salmon. Sampling during October and November (for Chinook salmon and steelhead) or December (for steelhead) was identified as being less critical, since few Chinook salmon or steelhead are expected to be passing Chipps Island during those months. More specifically, the group's advice is that sampling through the end of 2011 not fall below the minimum sampling effort described below:

MONTH	MINIMUM SAMPLING EFFORT
October	1 sampling day per week, with the number of tows to be limited by a daily delta smelt take "limit[1]" to be determined by FWS.
November	1 sampling day per week, with the number of tows to be limited by a daily delta smelt take "limit" to be determined by FWS.
December	1 sampling day per week (preferably 2 or 3 days per week), with the number of tows on a given sampling day to be limited by a daily delta smelt take "limit" to be determined by FWS.

[1] In conjunction with the reduction in the frequency of sampling, this daily take "limit" would provide an additional control on delta smelt take and help ensure continued sampling through the end of 2011.

ATTACHMENT 1

Chinook salmon and steelhead data from Chipps Island reviewed by the DOSS subgroup on 10/20/2011

(charts were excerpted from the salmonid incidental take and monitoring program annual data reports produced by DWR for the years 2001-2010)

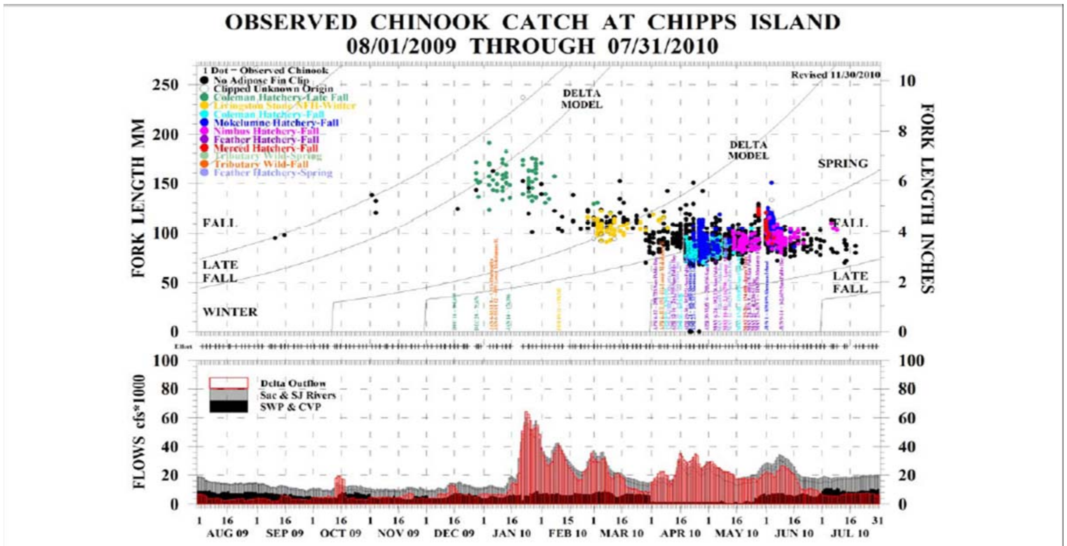

Figure 13. Juvenile Chinook caught in the Chipps Island trawl, August 2009 through July 2010.

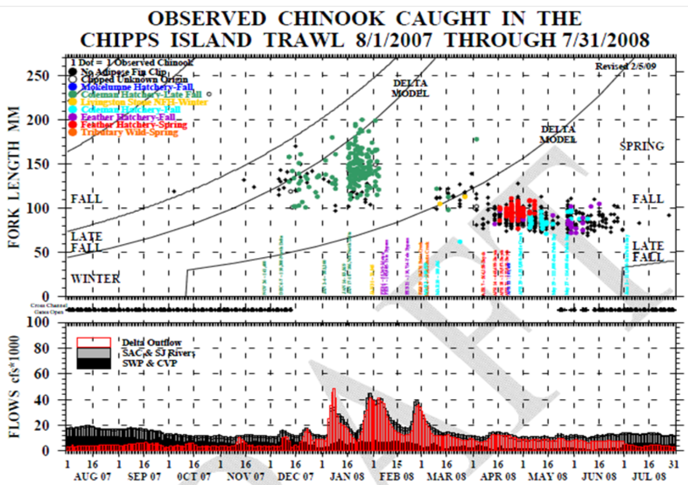

Figure 13. Juvenile Chinook caught in the Chipps Island trawl, August 2007 through July 2008.

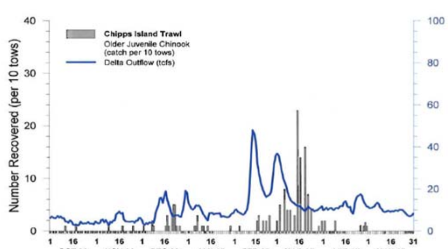

Figure 13. Number of older juvenile Chinook recovered in the Chipps Island Trawl, October 2006-May 2007

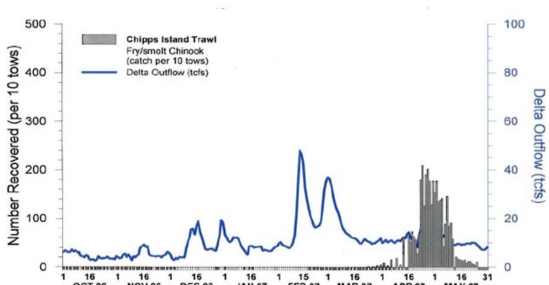

Figure 15. Number of fry/smolt Chinook recovered in the

Figure 1?. Number of fry/smolt Chinook recovered in the
Chipps Island Trawl, October 2006-May 2007

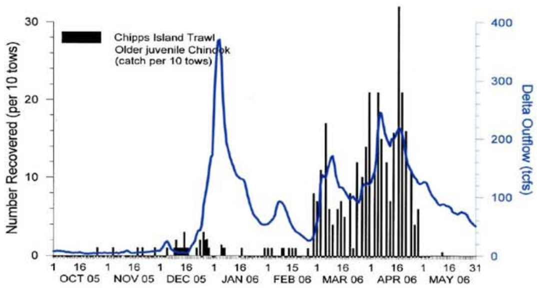

Figure 13. Number of older juvenile Chinook recovered in the Chipps Island Trawl, October 2005-May 2006

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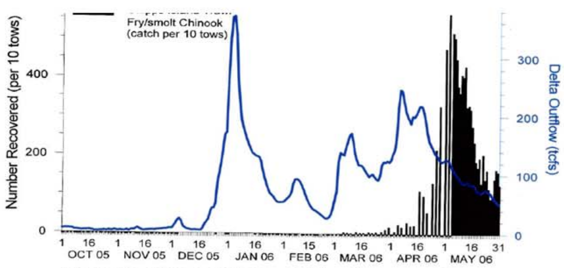
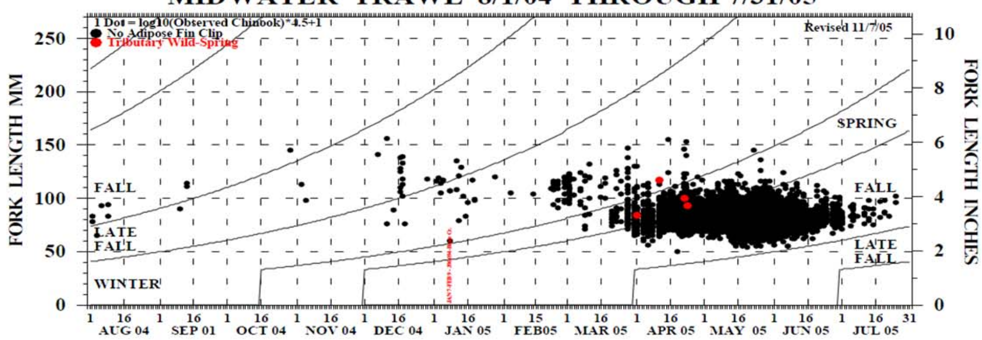


Figure 15. Number of fry/smolt Chinook recovered in the Chipps Island Trawl, October 2005-May 2006

CHINOOK MEASURED IN THE CHIPPS ISLAND MIDWÂTER TRAWL 8/1/04 THROUGH 7/31/05



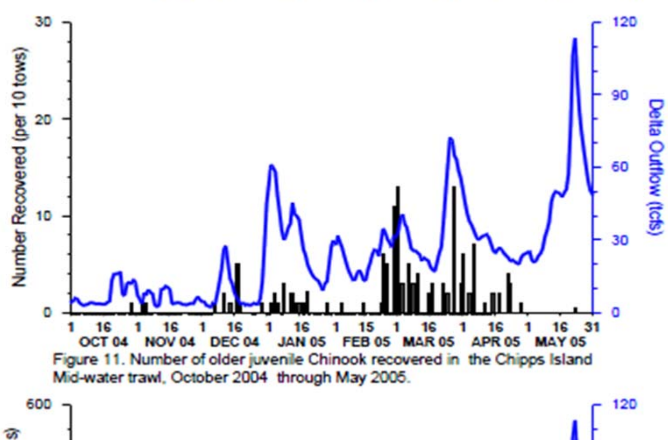


Figure 11. Number of older juvenile Chinook recovered in the Chipps Island Mid-water trawl, October 2004 through May 2005.

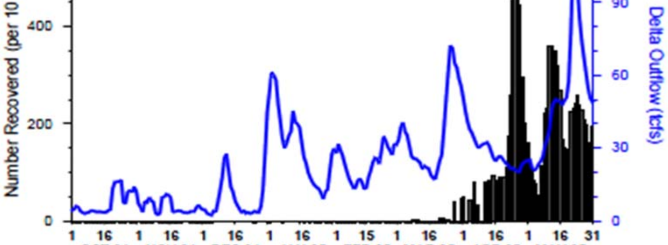


Figure 12. Number of fry/smolt Chinook recovered in the Chipps Island Mid-water trawl, October 2005 through May 2005.

Figure 9. Number of older juvenile Chinook recovered in the Chipps Island mid-water trawl, October 2003 - May 2004

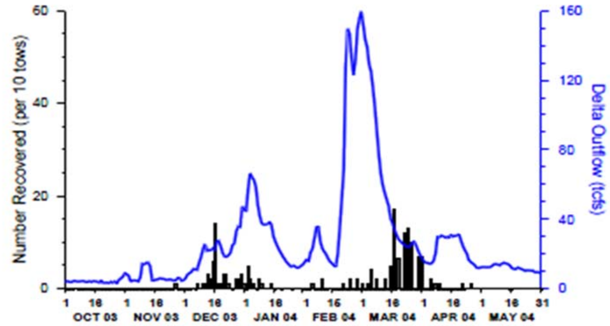


Figure 10. Number of fry/smolt Chinook recovered in the Chipps Island mid-water trawl, October 2003 - May 2004

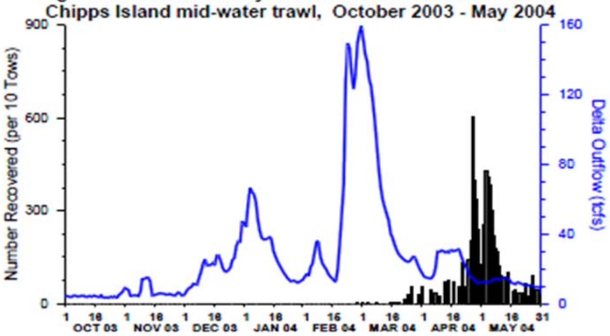


Figure 7. Number of older juvenile Chinook recovered in the Chipps Island mid-water trawl, October 2002 - May 2003

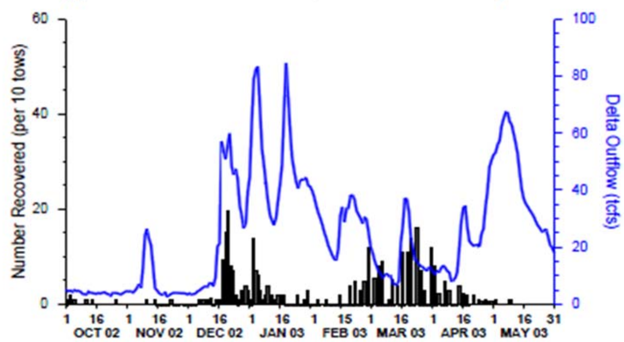


Figure 8. Number of fry/smolt Chinook recovered in the Chipps Island mid-water trawl, October 2002 - May 2003

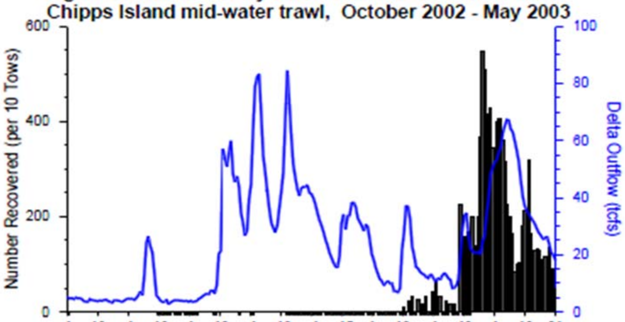


Figure 7. FRY/SMOLTS RECOVERED PER TIME TRAWLED AT CHIPPS ISLAND, OCTOBER THROUGH MAY

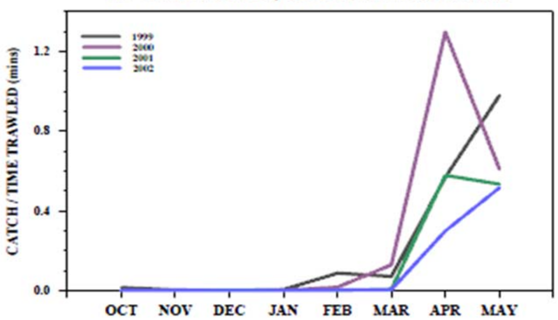


Figure 8. OLDER JUVENILES RECOVERED PER TIME TRAWLED AT CHIPPS ISLAND, OCTOBER THROUGH MAY

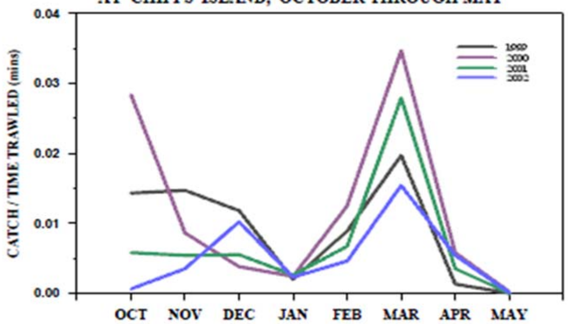


Figure 7. NUMBER OF FRY/SMOLTS RECOVERED AND CATCH PER UNIT EFFORT AT CHIPPS ISLAND, OCTOBER THROUGH MAY

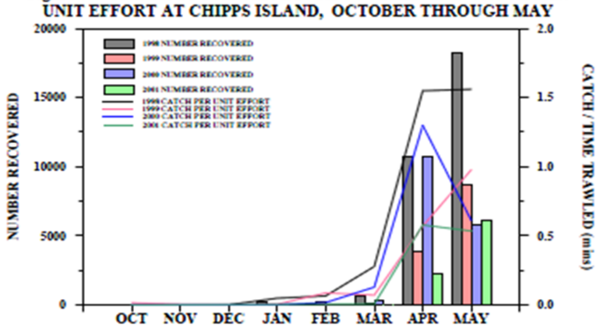
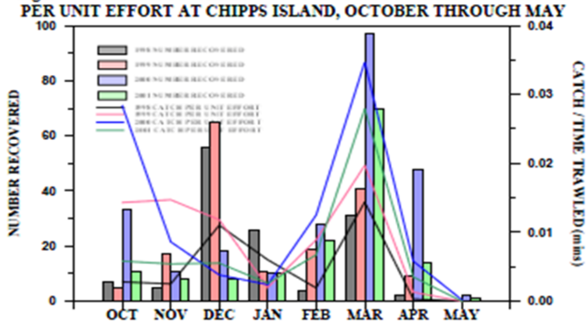


Figure 8. NUMBER OF OLDER JUVENILES RECOVERED AND CATCH PER UNIT EFFORT AT CHIPPS ISLAND, OCTOBER THROUGH MAY



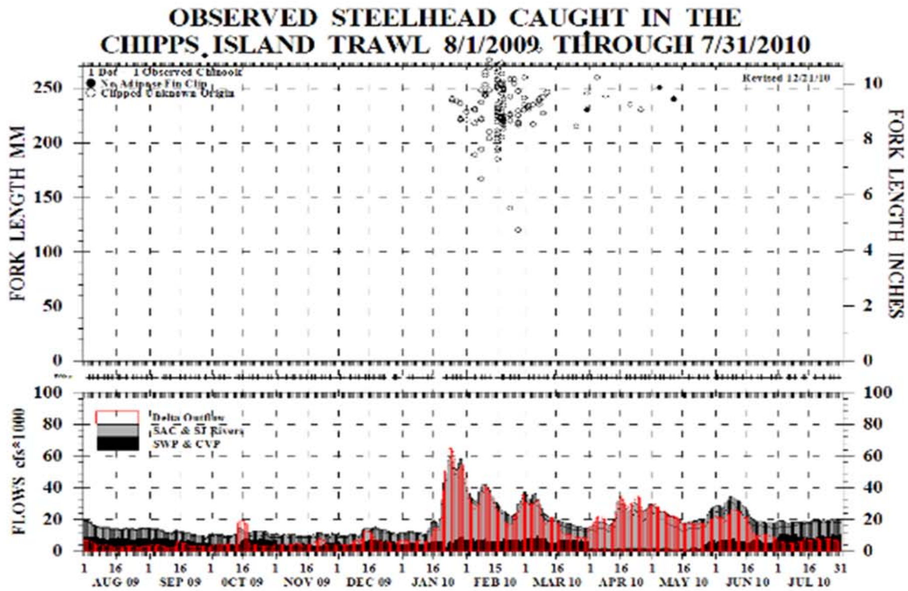


Figure 23. Juvenile steelhead caught in the Chipps Island trawl, August 2009 through July 2010.

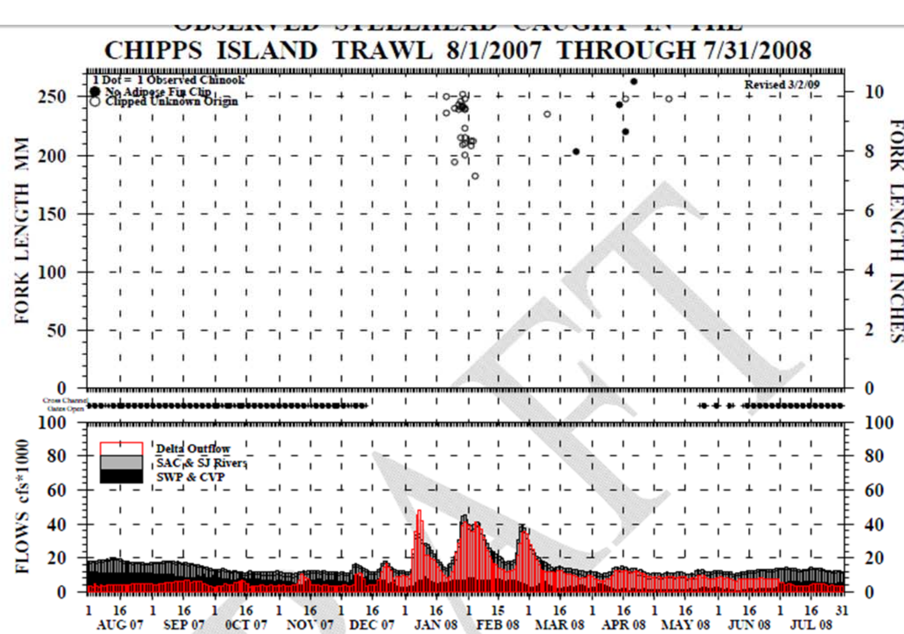


Figure 21. Juvenile steelhead caught in the Chipps Island trawl, August 2007 through July 2008.

Steelhead - Daily Summary Table

California Department of Fish and Game - Results Subject to Revision

Prepared by Geir Aasen *Report Date:* 7/9/2012 *Report Time:* 12:39 PM

	STATE WATER PROJECT						CENTRAL VALLEY PROJECT							
	NON-CLIPPED			CLIPPED			NON-CLIPPED			CLIPPED			LENGTH	LOSS
DATE	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	CATCH	SALVAGE	LOSS	(FL mm)	DENSITY
12/5/11	1	4	17.32										239	0.87
1/5/12	1	4	17.32										238	1.45
1/25/12										1	4	2.72	223	
1/26/12										2	2	1.36	225 - 358	
1/27/12				1	4	17.32				1	4	2.72	237 - 250	
1/29/12										2	6.5	4.42	228 - 232	
1/31/12							1	1	0.68	2	2	1.36	200 - 235	0.06
2/1/12				1	4	17.32				1	1	0.68	220 - 325	
2/5/12				1	4	17.32							198	
2/6/12										1	4	2.72	257	
2/7/12				1	4	17.32				2	2	1.36	219 - 254	
2/9/12										2	2	1.36	212 - 254	
2/13/12	1	4	17.32										291	2.58
2/15/12				1	4	17.32				1	1	0.68	219 - 233	
2/16/12				3	12	51.96	1	1	0.68	4	7	4.76	201 - 266	0.07
2/17/12										6	6	4.08	172 - 250	
2/18/12										2	8	5.44	196 - 262	
2/19/12										2	8	5.44	210 - 241	
2/21/12				1	1	4.33							270	
2/22/12										2	7	4.76	260 - 262	
2/23/12										1	4	2.72	215	
2/24/12				1	4	17.32				4	4	2.72	210 - 254	
2/25/12	1	4	17.32										232	4.16
2/27/12				2	4	17.32							205 - 372	
2/28/12							1	4	2.72				320	0.43
2/29/12				1	2	8.66							241	
3/2/12										6	6	4.08	231 - 255	
3/4/12										1	4	2.72	237	
3/5/12				1	4	17.32							221	
3/7/12				2	8	34.64							243 - 278	
3/8/12				2	8	34.64							231 - 247	
3/9/12				2	8	34.64	1	4	2.72	3	12	8.16	201 - 282	0.48
3/10/12				1	4	17.32	1	4	2.72	3	12	8.16	239 - 276	0.45
3/11/12										2	8	5.44	233 - 248	
3/12/12										1	4	2.72	210	
3/14/12										4	14	9.52	238 - 274	
3/15/12										1	3	2.04	226	
3/16/12										17	21.7	14.76	210 - 276	
3/17/12							1	4	2.72	4	14	9.52	245 - 259	0.45
3/18/12				2	8	34.64	1	4	2.72	4	15	10.20	248 - 358	0.35
3/19/12				1	2	8.66	1	2	1.36	16	25	17.00	191 -287	0.16
3/20/12	2	8	34.64							2	14	9.52	228 - 277	3.48
3/21/12	2	8	34.64	1	4	17.32							192 - 333	3.48
3/22/12	1	4	17.32							2	7	4.76	228 - 340	1.95
3/23/12	1	4	17.32				4	8	5.44	7	11	7.48	220 - 323	3.05
3/24/12	2	8	34.64				4	8	5.44	2	8	5.44	225 - 308	5.66
3/25/12	2	8	34.64							2	8	5.44	200 - 275	6.14
3/26/12							2	8	5.44	3	10	6.8	233 - 315	0.97
3/27/12	2	8	34.64	3	3	12.99	3	6	4.08	16	26	17.68	222 - 305	5.47
3/28/12	1	4	17.32				1	4	2.72	6	22.5	15.30	207 - 390	2.78
3/29/12	3	12	51.96							4	15	10.20	225 - 295	6.06
3/30/12	13	46	199.18	2	8	34.64				1	4	2.72	218 - 331	16.06
3/31/12	9	36	155.88	7	24	103.92				2	8	5.44	173 - 382	12.87
4/1/12	3	12	51.96										262 - 269	13.00
4/2/12	2	8	34.64	1	4	17.32							240 - 311	9.12
4/3/12	2	5	21.65							1	1	0.68	261 - 439	7.04
4/4/12							1	4	2.72				290	1.26
4/6/12	1	4	17.32										268	4.56
4/7/12	1	4	17.32										274	4.56
4/8/12				1	4	17.32							291	
4/9/12							1	4	2.72	1	4	2.72	260 - 265	0.45
4/10/12				3	6	25.98	1	4	2.72	1	4	2.72	205 - 405	0.45
4/12/12	1	4	17.32							1	4	2.72	268 - 367	4.15
4/13/12	2	8	34.64				1	4	2.72				237 - 254	9.82
4/14/12				6	24	103.92							199 - 271	
4/15/12	2	8	34.64							1	4	2.72	230 - 290	4.89
4/16/12	1	4	17.32										303	2.30
4/17/12	1	4	17.32	5	12	51.96				5	20	13.60	220 - 321	2.95
4/18/12	1	4	17.32				1	4	2.72				255 - 323	3.20
4/19/12	1	2	8.66				1	2	1.36	1	2	1.36	226 - 286	1.68
4/20/12	1	4	17.32							1	1	0.68	255 - 266	2.93
4/21/12	1	2	8.66	1	4	17.32							273 - 372	1.34
4/22/12				1	4	17.32							226	
4/23/12				2	8	34.64				3	6	4.08	243 - 271	
4/24/12							1	1	0.68	1	1	0.68	224 - 280	0.28
4/25/12				1	2	8.66							285	
4/26/12										1	1	0.68	229	
5/2/12										1	4	2.72	216	
5/3/12	2	4	17.32										248 - 431	3.63
5/25/12							2*	8	5.44				257 - 295	1.86
5/30/12				1	4	17.32							227	
6/3/12	1	4	17.32										305	2.92
6/8/12										1	4	2.72	270	
6/29/12										1	4	2.72	267	
7/7/12				1	4	17.32							253	

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)
* One NON adipose clipped steelhead had sutures

Chinook Salmon - Daily Summary Table

California Department of Fish and Game - Results Subject to Revision

Prepared by Geir Aasen *Report Date:* 7/18/2012 *Report Time:* 13:01 PM

	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
12/10/11							1	3	1.63				143	LF		0.08
12/13/11							1	2	1.41				170	LF		0.07
12/19/11							1	4	2.60				155	LF		0.13
12/24/11							1	2	1.30				152	LF		0.10
12/30/11							1	4	2.60				170	LF		0.16
1/6/12							1	4	3.52				173	LF		0.29
1/11/12										1	4	3.52	151	W	LF	
1/18/12										2	6	4.84	128 - 190	LF, W	LF	
1/19/12										1	4	3.52	185	LF	LF	
1/23/12										5	17	13.55	148-195	LF, W	LF	
1/24/12										1	4	3.19	175	W	LF	
1/25/12							1	2.5	1.80	7	28	20.48	157 - 196	W, LF	LF**	0.13
1/26/12							4	4	2.88	26	26	16.77	134 - 195	W, LF	LF**	0.25
1/27/12				2	8	35.80	2	2	1.14	7	14	9.48	144 - 188	W	LF	0.10
1/28/12				4	16	72.72	1	4	2.88	4	20	14.40	120 - 189	W	LF	0.22
1/30/12				4	16	72.37				3	12	8.64	143 - 185	W	LF	
1/31/12				3	6	26.67	2	5	3.60	15	27	19.44	144 - 189	W	LF	0.32
2/1/12							2	8	5.76				120 - 123	W	LF	0.50
2/2/12				6	24	105.24							141 - 185	W	LF	
2/3/12				4	16	73.21	1	1	0.72	1	4	2.88	133 - 200	W	F, LF	0.06
2/4/12				2	8	36.36							147 - 199	W	LF	
2/5/12				2	8	36.31							179 - 200	W	LF	
2/6/12	1	4	18.19	2	4	18.12							155 - 170	W	LF	2.0
2/7/12							2	8	6.37				122	W		0.69
2/9/12				2	8	36.14				1	1	0.88	165 - 186	W	LF	
2/11/12										3	12	11.64	167 - 179	W	LF	
2/14/12	2	2	8.66	1	1	4.33							139 - 192	W	LF	1.05
2/16/12				1	4	18.11	3	10.8	8.64	3	3	2.40	110 - 195	W	LF**	0.93
2/17/12				3	12	53.03				8	8.5	6.79	117 - 206	W	F, LF	
2/18/12	1	4	16.90	2	8	33.85	1	4	3.19	1	4	3.19	131 - 197	W	LF	2.53
2/21/12				3	3	12.99							165 - 190	W	LF	
2/23/12	2	8	36.02										130 - 141	W		9.49
2/24/12	4	16	71.96	2	8	35.89							143 - 199	W	F	17.98
2/26/12				1	4	18.18							160	W	LF	
2/27/12	1	4	16.77										150	W		2.68
2/28/12	3	9	37.91	1	4	16.82							147 - 188	W	F	5.94
2/29/12	4	12	55.20	3	12	54.77							125 - 210	W	F,LF	6.66
3/2/12	3	10	45.73	1	2	9.15	2	5	4.85	1	4	3.52	136 - 202	W	F	9.68
3/3/12							2	8	7.76				113 - 121	W		1.68
3/4/12	1	4	16.87	1	4	16.74							124 - 170	W	LF	3.40
3/5/12	5	12	55.22										137 - 187	W		15.10
3/6/12	15	48	203.11	3	9	38.21							121 - 221	W	F,LF	41.30
3/7/12	14	56	236.21	2	8	33.79				1	3.5	3.40	57 - 217	W,F	F,LF**	48.11
3/8/12	2	8	33.90	1	4	16.92							130 - 157	W	LF	6.91
3/9/12	3	8	35.13				2	8	7.02				140 - 212	W		7.37
3/10/12	5	20	90.64				7	23	19.73				72 - 215	W,S		17.58
3/11/12	3	12	54.19				4	16	14.08				116 - 139	W		11.65
3/12/12							7	28	24.64	1	3	2.64	106 - 210	W	F	4.03
3/13/12	4	4	17.32				3	10.5	8.73				75 - 205	W,S		4.00
3/14/12							2	8	7.04	1	4	3.52	118 - 181	W	F	1.50
3/15/12							3	10	8.80				165 - 207	W		1.88
3/16/12							8	13	10.93				85 - 229	W,S		1.69
3/17/12							5	20	15.52				87 - 155	W,S		2.11
3/18/12							13	52	41.04				100 - 264	W,S		4.89
3/19/12							14	45.5	36.14	2	6.5	5.18	87 - 168	W,S	LF**	4.15
3/20/12	8	17	76.67				1	4	3.19				129 - 207	W		8.02
3/21/12	4	16	71.57	1	4	18.08	14	55.2	43.56				55 - 219	W,F,S	LF	9.57
3/22/12							6	23	18.32	2	7	5.58	113 - 207	W	F**	2.06
3/23/12	3	12	54.61				18	31	23.87	2	5	3.99	87 - 199	W,S	F,LF	6.75
3/24/12	2	8	35.86	1	4	17.96	6	24	18.71				84 - 177	W,S	F	6.87
3/25/12							3	12	9.12	2	8	6.38	95 - 200	W,S	F,LF	1.13
3/26/12							11	24	17.63				86 - 136	W,S		1.41
3/27/12	2	5	21.45				9	24	16.89				89 - 182	W,S		0.95
3/28/12							7	16	11.90	1	4	3.88	88 - 206	W,S	F	0.44
3/29/12	2	6	26.82				8	19	17.21	1	4	3.88	91 - 219	W,S	F	2.92
3/30/12	7	28	117.77				6	16	14.30				90 - 172	W,S		3.47
3/31/12	42	156	651.11	4	16	67.76							80 - 212	W,S	W,F,LF	21.81
4/1/12	2	8	34.85	1	4	17.91	7	24	22.67				82 - 212	W,S	F,LF	9.34
4/2/12	3	12	53.67				12	22	19.97				87 - 255	W,S		9.42
4/3/12	1	4	17.86				2	8	7.76				107 - 122	S		
4/4/12							7	28	25.33				88 - 117	S		
4/7/12							4	16	13.69				78 - 160	W,S		1.02
4/9/12							2	8	6.54	1	4	3.88	83 - 177	W,S	LF	

4/10/12							3	12	10.42				85 - 102	S		
4/11/12							3	12	10.42				85 - 107	S		
4/14/12	6	24	104.99				26	104	85.61				80 - 103	S		
4/15/12	2	8	34.16				11	43	33.36				85 - 108	S		
4/16/12	4	16.0	68.38				13	52	41.17	1	4	3.52	86 - 184	W,S	LF	
4/17/12	14	35	153.94	1	2.0	9.03	2	8	6.54				82 - 190	W,S	LF	
4/18/12	7	26	112.78	1	2.0	9.08	2	8	7.15				75 - 210	W,F,S	LF	0.62
4/19/12	10	32	137.56	1	4	18.16	4	8	6.85				83 - 186	W,S	LF	
4/20/12	6	24	103.55				13	29	22.32				82 - 196	W,S,F		3.07
4/21/12	10	34	145.15				12	28	21.56				65 - 116	S,F		
4/22/12	1	4	16.959				1	4	3.27				91 - 96	S		
4/23/12	3	8	34.93				17	26.0	21.46				73 - 111	S,F		
4/24/12	3	10	42.94				3	6	4.91				82 - 107	S,F		
4/25/12	1	4	17.06				3	9	8.12				91 - 104	S		
4/26/12	3	6	26.07				16	28	22.89				82 - 111	S,F		
4/27/12	3	10	42.63				3	6	4.91				80 - 99	S,F		
4/28/12	2	6	25.56				1	4	3.27				91 - 99	S		
4/29/12	3	8	33.99				2	8	6.54				72 - 99	S,F		
4/30/12	4	10	43.01				2	4	3.27				80 - 101	S,F		
5/1/12	1	1	4.33				1	4	3.27				86 - 94	S,F		
5/2/12	9	18	78.47				2	8	6.54				83 - 220	W,S,F		4.37
5/3/12	2	4	17.00				1	4	3.88				86 - 120	S,F		
5/4/12	3	6	25.47				12	21	17.16				83 - 99	S,F		
5/5/12	2	8	33.88										84 - 96	S,F		
5/6/12	10	56	242.55										80 - 105	S,F		
5/7/12	5	16	67.80	1	4	17.94	10	12	9.81				81 - 226	W,S,F	LF	
5/8/12							1	4	3.27				85	F		
5/9/12	3	6	25.21				3	10	8.17				81 - 92	F		
5/10/12	4	12	50.48				3	12	9.81				84 - 97	S,F		
5/11/12	4	16	67.23				2	8	6.54				79 - 97	S,F		
5/13/12	11	50	211.4				2	8	6.54				78 - 97	S,F		
5/14/12	7	26	109.51				20	78	52.28	2	8	6.15	75 - 110	S,F	F	
5/15/12				1	2	9.80	10	39	22.91	12	48	30.11	84 - 126	S,F	F	
5/16/12							6	24	13.95	7	28	17.39	80 - 121	S,F	F	
5/17/12							7	28	16.28	5	20	12.46	85 - 117	S,F	F	
5/18/12							6	24	13.95	3	12	7.81	81 - 125	S,F	F	
5/19/12	3	12	57.52	1	4	20.92	2	8	4.651	2	8	5.21	87 - 130	S,F	F	
5/20/12	9	48	225.78	4	16	80.73							82 - 123	S,F	F	
5/21/12	1	4	18.03	2	16	72.17							84 - 89	F	F	
5/22/12	6	84	380.14	1	24	116.25							82 - 198	W,S,F	F	2.19
5/23/12							2	8	6.54				82 - 90	F		
5/24/12	1	2	9.49							1	4	3.27	89 - 93	F	F	
5/26/12							2	7	5.72	1	4	3.88	77 - 118	S,F	F	
5/27/12										1	4	3.27	95	F	F	
5/28/12							1	4	3.27				90	F		
5/29/12	5	49	232.08				1	4	3.27				88 - 227	W,F		2.21
5/30/12	1	24	111.91										87	F		
6/2/12							5	20	15.03				79 - 94	F		
6/5/12							1	4	3.01				100	F		
6/6/12	1	3	14.05				1	4	3.01				77 - 88	F		
6/7/12							6	12	8.29				80 - 92	F		
6/8/12	3	12	56.03				21	83	57.43				76 - 134	F,S		
6/9/12	1	6	28.05				5	20	13.82				80 - 98	F		
6/10/12	1	12	56.03				3	12	8.29				78 - 92	F		
6/11/12	1	12	55.99				1	4	2.76				85 - 88	F		
6/12/12	1	2	9.35										84	F		
6/13/12							1	4	2.76				83	F		
6/20/12							1	4	3.01				88	F		
6/21/12							1	4	3.01				95	F		
6/22/12							2	8	5.95				95 - 101	F		
6/26/12							1	4	2.76				91	F		
6/27/12	2	7	33.99										86 - 99	F		
6/28/12	1	2	9.70										89	F		
7/3/12							1	4	2.33				92	F		
7/17/12							1	4	2.33				92	F		

Non-clipped = adipose fin present; Clipped = adipose fin removed; Race: S = spring run, F = fall run,LF = late fall run, W = winter run
**Race of clipped (hatchery) salmon reported in this report is determined by length of the fish at date criteria on date of salvage. Actual race determination will be determined from the coded wire tag data once the tag has been read (if available).*
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)
** One or more adipose fin clipped Chinook salmon were missing CWT tag and race could not be verified

Joint Stipulation Study Tag Results

Data downloaded from CDEC on 6/14/2012 for: OMR, CLC, TRP, and VNS

Experimental period	Date	Day of period	notes	# new tags detected in download on row's date	Cumulative # tags detected as of download on row's date	Target ops per stipulation (actual, not as in tech memo)	Vernalis flow CDEC station (cfs)	OMR flow CDEC station (cfs)	SWP Clifton Court inflow from CLC CDEC station (cfs)	CVP Tracy inflow from TRP CDEC station (cfs)	Combined exports (CLC+TRP)	Factor controlling exports
1st: 4/15-4/30	4/15/2012	1	fish release begin	0	0	-3,500 cfs OMR	3085	-1360	2289	1371	3660	100% of Vernalis flow per D-1641
1st: 4/15-4/30	4/16/2012	2	fish release end	0	0	-3,500 cfs OMR	3373	-2846	1997	1596	3593	100% of Vernalis flow per D-1641
1st: 4/15-4/30	4/17/2012	3		0	0	-3,500 cfs OMR	3325	-2719	1989	1044	3033	100% of Vernalis flow per D-1641
1st: 4/15-4/30	4/18/2012	4		5	5	-3,500 cfs OMR	3091	-2376	2390	812	3202	100% of Vernalis flow per D-1641
1st: 4/15-4/30	4/19/2012	5	trigger (9) exceeded	8	13	-3,500 cfs OMR	2792	-2399	2394	813	3207	100% of Vernalis flow per D-1641
1st: 4/15-4/30	4/20/2012	6		2	15	-3,500 cfs OMR	2682	-2510	1793	1221	3014	100% of Vernalis flow per D-1641
1st: 4/15-4/30	4/21/2012	7		12	27	-3,500 cfs OMR	2799	-2914	1194	1631	2825	100% of Vernalis flow per D-1641
1st: 4/15-4/30	4/22/2012	8		3	30	1500 cfs combined exports	2798	-2932	696	1060	1756	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/23/2012	9		7	37	1500 cfs combined exports	2739	-2635	696	826	1522	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/24/2012	10		5	42	1500 cfs combined exports	2504	-332	695	821	1516	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/25/2012	11		2	44	1500 cfs combined exports	2294	-1549	697	822	1519	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/26/2012	12		1	45	1500 cfs combined exports	2293	-1774	663	823	1486	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/27/2012	13		1	46	1500 cfs combined exports	2353	104	691	819	1510	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/28/2012	14		2	48	1500 cfs combined exports	2325	-858	698	816	1514	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/29/2012	15		1	49	1500 cfs combined exports	2325	-1584	680	815	1495	1500 cfs combined exports per stipulation
1st: 4/15-4/30	4/30/2012	16		0	49	1500 cfs combined exports	2399	-1501	686	857	1543	1500 cfs combined exports per stipulation
2nd: 5/1-5/15	5/1/2012	1	fish release begin	nd	nd	-5,000 cfs OMR	2521	-2468	1342	949	2291	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/2/2012	2	fish release end	3	3	-5,000 cfs OMR	2725	-2898	1345	976	2321	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/3/2012	3		14	17	-5,000 cfs OMR	2973	-2714	1495	978	2473	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/4/2012	4	trigger (24) exceeded	10	27	-5,000 cfs OMR	3103	-3038	1645	979	2624	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/5/2012	5		14	41	-5,000 cfs OMR	3163	-3030	1990	983	2973	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/6/2012	6		2	43	-5,000 cfs OMR	3200	-3134	2098	983	3081	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/7/2012	7		2	45	-5,000 cfs OMR	3279	-3251	1943	992	2935	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/8/2012	8		2	47	1500 cfs combined exports	3290	-2987	507	1004	1511	1500 cfs combined exports per stipulation
2nd: 5/1-5/15	5/9/2012	9		1	48	1500 cfs combined exports	3211	-2229	635	874	1509	1500 cfs combined exports per stipulation
2nd: 5/1-5/15	5/10/2012	10		0	48	1500 cfs combined exports	3858	-1614	692	816	1508	1500 cfs combined exports per stipulation
2nd: 5/1-5/15	5/11/2012	11		1	49	1500 cfs combined exports	4289	-1015	697	817	1514	1500 cfs combined exports per stipulation
2nd: 5/1-5/15	5/12/2012	12		0	49	1500 cfs combined exports	4328	-1293	696	816	1512	1500 cfs combined exports per stipulation
2nd: 5/1-5/15	5/13/2012	13		0	49	-5,000 cfs OMR	4381	-3164	3299	817	4116	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/14/2012	14		0	49	-5,000 cfs OMR	4418	-3575	1595	2699	4294	100% of Vernalis flow per D-1641
2nd: 5/1-5/15	5/15/2012	15	fish release begin	2	51	-5,000 cfs OMR	3920	-4149	654	3996	4650	100% of Vernalis flow per D-1641
3rd: 5/16-5/31	5/16/2012	1	fish release end	0	0	-5,000 cfs OMR	3135	-5204	794	4200	4994	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/17/2012	2		4	4	-5,000 cfs OMR	2750	-5959	793	4201	4994	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/18/2012	3		3	7	-5,000 cfs OMR	2565	-5770	791	4213	5004	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/19/2012	4		12	19	-5,000 cfs OMR	2500	-5072	2194	1791	3985	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/20/2012	5		6	25	-5,000 cfs OMR	2413	-4016	3698	816	4514	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/21/2012	6	trigger (31) exceeded	9	34	-5,000 cfs OMR	2460	-5096	3699	817	4516	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/22/2012	7		4	38	-5,000 cfs OMR	2413	-5232	3690	817	4507	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/23/2012	8		2	40	-5,000 cfs OMR	2460	-4621	3195	817	4012	*-5,000 cfs OMR per stipulation?*
3rd: 5/16-5/31	5/24/2012	9		1	41	1500 cfs combined exports	2448	-3373	703	818	1521	1500 cfs combined exports per stipulation
3rd: 5/16-5/31	5/25/2012	10		0	41	1500 cfs combined exports	2254	-2529	699	830	1529	1500 cfs combined exports per stipulation
3rd: 5/16-5/31	5/26/2012	11		0	41	1500 cfs combined exports	2180	-929	695	814	1509	1500 cfs combined exports per stipulation
3rd: 5/16-5/31	5/27/2012	12		0	41	1500 cfs combined exports	2408	-1697	692	812	1504	1500 cfs combined exports per stipulation
3rd: 5/16-5/31	5/28/2012	13		0	41	1500 cfs combined exports	2440	-1747	691	813	1504	1500 cfs combined exports per stipulation
3rd: 5/16-5/31	5/29/2012	14		1	42	-5,000 cfs OMR	2301	-3580	3491	1359	4850	*close call between -5,000 cfs OMR per stipulation and 35% of delta inflow per D-1641?*
3rd: 5/16-5/31	5/30/2012	15		0	42	-5,000 cfs OMR	2252	-5659	3199	1632	4831	*close call between -5,000 cfs OMR per stipulation and 35% of delta inflow per D-1641?*
3rd: 5/16-5/31	5/31/2012	16		0	42	-5,000 cfs OMR	1865	-5641	2989	1586	4575	*close call between -5,000 cfs OMR per stipulation and 35% of delta inflow per D-1641?*

Appendix C

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards			
10/1/2011	E	4,013	6,670	O								
10/2/2011	E	4,172	6,674	O								
10/3/2011	E	4,164	6,670	O								
10/4/2011	E	4,159	6,663	C								
10/5/2011	E	4,006	6,664	C								
10/6/2011	E	4,045	6,663	C								
10/7/2011	E	4,095	6,257	C								
10/8/2011	E	4,106	5,583	C								
10/9/2011	E	4,109	5,483	C								
10/10/2011	E	4,037	6,667	C								
10/11/2011	E	3,999	6,668	C								
10/12/2011	E	3,990	6,668	C								
10/13/2011	E	4,052	6,662	C								
10/14/2011	E	4,074	6,660	O								
10/15/2011	E	4,046	6,664	O								
10/16/2011	E	4,037	6,663	O								
10/17/2011	E	4,029	6,668	O								
10/18/2011	E	4,027	6,668	O								
10/19/2011	E	4,044	6,671	O								
10/20/2011	E	4,032	6,670	O								
10/21/2011	E	4,019	5,878	O								
10/22/2011	E	4,005	6,668	O								
10/23/2011	E	3,820	6,669	O								
10/24/2011	E	4,019	6,664	O								
10/25/2011	E	4,102	6,670	O								
10/26/2011	E	4,110	6,669	O								
10/27/2011	E	4,079	6,670	O								
10/28/2011	E	4,114	6,666	O								
10/29/2011	E	4,095	6,673	O								
10/30/2011	E	4,110	6,670	O								
10/31/2011	E	1,994	6,668	O								

Narrative for Oct 2011:

No ESA constraints affecting Projects exports in the Delta for the month of October 2011.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards			
11/1/2011	E	4,024	6,673	O				FWS **Fall X2**				FWS Fall X2
11/2/2011	E	4,046	6,664	O								
11/3/2011	E	3,958	6,665	O								
11/4/2011	E	4,118	4,990	O								
11/5/2011	E	4,099	4,989	O								
11/6/2011	E	4,259	4,988	O								
11/7/2011	E	4,032	4,994	O								
11/8/2011	E	4,113	3,987	O								
11/9/2011	E	4,098	3,998	O								
11/10/2011	E	4,117	3,993	O								
11/11/2011	E	4,105	3,991	O								
11/12/2011	E	4,119	3,991	O								
11/13/2011	E	4,110	3,993	O								
11/14/2011	E	4,102	3,990	O								
11/15/2011	E	4,052	3,994	O								
11/16/2011	E	4,040	2,987	O								
11/17/2011	E	3,488	1,990	O								
11/18/2011	E	3,251	1,960	O								
11/19/2011	E	3,250	1,990	O								
11/20/2011	E	3,257	1,991	O								
11/21/2011	E	3,250	1,995	O								
11/22/2011	E	3,247	1,989	O								
11/23/2011	E	3,260	1,990	O								
11/24/2011	E	3,269	1,991	O								
11/25/2011	E	3,264	1,491	O								
11/26/2011	E	3,249	1,492	O								
11/27/2011	E	815	1,492	O								
11/28/2011	E	822	2,995	O								
11/29/2011	E	-	2,996	O								
11/30/2011	E	-	2,988	O								

Narrative for Nov 2011:

During the month of November in 2011, Projects exports were restricted by US Fish & Wildlife Service's Biological Opinion for Fall X2 protection.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards			
12/1/2011	B	1,868	6,669	C								Smelt Working Group (SWG) Monitoring
12/2/2011	B	4,030	6,656	C								
12/3/2011	B	4,058	5,375	C								
12/4/2011	B	4,026	5,559	C								
12/5/2011	B	4,031	5,992	C								
12/6/2011	B	4,022	6,670	C								
12/7/2011	B	4,020	6,393	C								
12/8/2011	B	4,014	6,388	C								
12/9/2011	B	4,008	6,388	C								
12/10/2011	B	4,014	6,378	C								
12/11/2011	B	4,018	6,388	C								
12/12/2011	B	4,023	6,389	C								
12/13/2011	B	4,025	6,388	C								
12/14/2011	B	4,020	6,388	C								
12/15/2011	B	3,987	6,389	C								
12/16/2011	B	3,924	6,388	C								
12/17/2011	B	3,980	6,389	C								
12/18/2011	B	4,026	6,388	C								
12/19/2011	B	4,000	6,383	C								
12/20/2011	B	4,009	4,983	C								
12/21/2011	B	4,021	3,992	C								
12/22/2011	B	4,028	3,987	C								
12/23/2011	B	4,021	2,493	C								
12/24/2011	B	3,998	2,495	C								
12/25/2011	B	4,007	2,495	C								
12/26/2011	B	4,010	2,495	C								
12/27/2011	B	3,996	2,992	C								
12/28/2011	B	3,999	3,495	C								
12/29/2011	B	4,004	3,486	C								
12/30/2011	B	4,002	3,991	C								
12/31/2011	B	2,541	3,981	C								

Narrative for Dec 2011:

No controlling ESA constraints in place for the month of December 2011.
Smelt Working Group began to monitor smelts activities in the Delta.
Federal share of San Luis Storage was full as of end of December 2011.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards			
1/1/2012	B	1,952	3,409	C				NMFS BO **-5000 OMR**	NMFS BO - Action IV.2.3			Smelt Working Group (SWG) Monitoring
1/2/2012	B	1,955	3,991	C								
1/3/2012	B	1,957	3,991	C								
1/4/2012	B	1,950	3,991	C								
1/5/2012	B	1,950	3,991	C	-5247							
1/6/2012	B	1,953	3,991	C	-5497							
1/7/2012	B	1,952	3,990	C	-5267							
1/8/2012	B	1,950	3,491	C	-5124							
1/9/2012	B	1,945	3,491	C	-4962							
1/10/2012	B	1,946	3,491	C	-4785							
1/11/2012	B	1,946	3,491	C	-4552							
1/12/2012	B	1,943	3,989	C	-4469							
1/13/2012	B	1,937	3,991	C	-4482							
1/14/2012	B	1,937	3,989	C	-4551	-4889	-4799					
1/15/2012	B	1,937	3,996	C	-4752	-4973	-4832					
1/16/2012	B	1,932	3,995	C	-4768	-4852	-4826					
1/17/2012	B	1,933	3,991	C	-4679	-4776	-4820					
1/18/2012	B	1,936	3,982	C	-4860	-4794	-4813					
1/19/2012	B	1,938	3,981	C	-4991	-4798	-4804					
1/20/2012	B	1,942	3,996	C	-5016	-4801	-4794					
1/21/2012	B	1,954	3,992	C	-5281	-4857	-4779					
1/22/2012	B	2,481	3,693	C	-5011	-4736	-4808					
1/23/2012	B	2,708	4,290	C	-5010	-4811	-4887					
1/24/2012	B	2,709	3,496	C	-4697	-4766	-4911					
1/25/2012	B	3,044	2,989	C	-4337	-4724	-4924					
1/26/2012	B	3,155	2,981	C	-4055	-4709	-4919					
1/27/2012	B	3,151	2,981	C	-4366	-4695	-4912					
1/28/2012	B	3,141	2,982	C	-4094	-4648	-4907					
1/29/2012	B	3,141	2,993	C	-4232	-4581	-4904					
1/30/2012	B	3,151	2,994	C	-4571	-4653	-4904					
1/31/2012	B	3,160	2,990	C	-4730	-4727	-4905					

Narrative for Jan 2012:

Starting on January 1, 2012, US National Marine Fishery Service's Biological Opinion Action IV.2.3 of -5,000 cfs Old and Middle River target was in place for the protection of salmonids. Smelt Working Group continued to monitor smelts activities in the Delta.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards		
2/1/2012	B	3,165	2,992	C	-4898	-4708	-4912		NMFS BO - Action IV.2.3		Smelt Working Group (SWG) Monitoring
2/2/2012	B	3,162	2,992	C	-5007	-4654	-4917				
2/3/2012	B	3,167	2,992	C	-5183	-4640	-4927				
2/4/2012	B	2,627	2,993	C	-4997	-4552	-4910	Outflow for X2 **11,400 cfs**		D-1641 X2 Standard	
2/5/2012	B	2,395	2,993	C	-4799	-4651	-4870				
2/6/2012	B	2,394	2,492	C	-4609	-4565	-4754				
2/7/2012	B	2,469	2,492	C	-4581	-4613	-4701				
2/8/2012	B	1,963	797	C	-3985	-4514	-4516				
2/9/2012	B	1,724	797	C	-3282	-4276	-4300				
2/10/2012	B	1,203	1,490	C	-2769	-4081	-4094				
2/11/2012	B	1,000	1,489	C	-2279	-3917	-3868				
2/12/2012	B	998	1,496	C	-1649	-3690	-3640				
2/13/2012	B	1,673	1,585	C	-1513	-3422	-3460				
2/14/2012	B	1,969	1,789	C	-1658	-3179	-3312				
2/15/2012	B	1,974	2,494	C	-2089	-3077	-3210				
2/16/2012	B	2,360	2,489	C	-2294	-2948	-3144				
2/17/2012	B	2,521	1,992	C	-2857	-2860	-3053				
2/18/2012	B	2,526	1,995	C	-3285	-2811	-2992				
2/19/2012	B	2,135	998	C	-3440	-2694	-2853				
2/20/2012	B	1,978	494	C	-3109	-2542	-2702				
2/21/2012	B	1,905	992	C	-2867	-2336	-2568				
2/22/2012	B	1,118	992	C	-2413	-2298	-2525				
2/23/2012	B	813	992	C	-1858	-2302	-2483				
2/24/2012	B	917	1,489	C	-1503	-2242	-2473				
2/25/2012	B	998	1,489	C	-1496	-2262	-2489				
2/26/2012	B	996	1,490	C	-1487	-2278	-2506				
2/27/2012	E	1,277	1,988	C	-1753	-2384	-2525	NMFS BO **-2500 OMR**			
2/28/2012	E	1,742	1,496	C	-2113	-2465	-2510				
2/29/2012	E	1,883	1,493	C	-2695	-2458	-2451				

Narrative for Feb 2012:

Old and Middle River targets per US National Marine Fishery Service's Biological Opinion Action IV.2.3 continued into the month of Febuary. Meanwhile, standards related to CA Sate Water Resources Control Board's Decision 1641 also affected Projects' exports. Smelt Working Group continued to monitor smelts activities in the Delta.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards	
3/1/2012	E	1,903	1,488	C	-2750	-2425	-2364		NMFS BO - Action IV.2.3	Smelt Working Group (SWG) Monitoring
3/2/2012	E	1,250	994	C	-2733	-2233	-2224			
3/3/2012	E	996	1,493	C	-2358	-2053	-2102			
3/4/2012	E	998	1,492	C	-2228	-2032	-2076			
3/5/2012	E	1,000	1,493	C	-1966	-2050	-2091			
3/6/2012	E	1,003	1,486	C	-2023	-2124	-2081			
3/7/2012	E	999	1,493	C	-1741	-1993	-2126			
3/8/2012	E	997	1,488	C	-1808	-2035	-2189			
3/9/2012	E	1,689	789	C	-1779	-2131	-2212			
3/10/2012	E	1,978	591	C	-1878	-2186	-2232			
3/11/2012	E	1,900	592	C	-1881	-2264	-2242			
3/12/2012	E	1,979	592	C	-2236	-2166	-2203			
3/13/2012	E	1,984	591	C	-2481	-2166	-2168			
3/14/2012	E	1,988	591	C	-2562	-2083	-2120			
3/15/2012	E	1,987	796	C	-2316	-2031	-2068	NMFS BO **-3500 OMR**		
3/16/2012	E	1,983	991	C	-2264	-2097	-2099			
3/17/2012	E	2,594	993	C	-2365	-2168	-2153	NMFS BO **-5000 OMR**		
3/18/2012	E	2,849	1,490	C	-2278	-2184	-2247			
3/19/2012	E	2,832	1,497	C	-2117	-2137	-2336	NMFS BO **-3500 OMR**		
3/20/2012	E	2,823	1,494	C	-2250	-2112	-2427			
3/21/2012	E	2,822	1,487	C	-2321	-2304	-2512			
3/22/2012	E	2,828	1,485	C	-2459	-2401	-2594			
3/23/2012	E	2,573	988	C	-2485	-2436	-2629	NMFS BO **-2500 OMR**		
3/24/2012	E	2,469	992	C	-2688	-2427	-2660			
3/25/2012	E	2,468	988	C	-2563	-2355	-2702			
3/26/2012	E	2,465	989	C	-2409	-2366	-2743			
3/27/2012	E	2,469	1,009	C	-2307	-2339	-2784			
3/28/2012	E	1,429	1,990	C	-2361	-2364	-2829			
3/29/2012	E	992	2,992	C	-2069	-2338	-2910			
3/30/2012	E	992	4,992	C	-2439	-2418	-3115			
3/31/2012	E	994	4,843	C	-3211	-2668	-3272			

Narrative for Mar 2012:

Old and Middle River targets per US National Marine Fishery Service's Biological Opinion Action IV.2.3 continued into the month of March. Smelt Working Group continued to monitor smelts activities in the Delta.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards
4/1/2012	E	914	998	C	-3157	-2653	-3125	JSA **-1,800 OMR**	NMFS BO - Action IV.2.3; Joint Stipulation Agreement (JSA); Smelt Working Group (SWG) Monitoring
4/2/2012	E	815	996	C	-2592	-2534	-2978		
4/3/2012	E	816	971	C	-2716	-2505	-2827		
4/4/2012	E	817	999	C	-2377	-2438	-2680		
4/5/2012	E	815	998	C	-1445	-2306	-2530		
4/6/2012	E	814	1,189	C	-1166	-2182	-2436		
4/7/2012	E	813	1,197	C	-1504	-2111	-2337		
4/8/2012	E	815	1,989	C	-1628	-2171	-2280	JSA **-2,500 OMR**	
4/9/2012	E	816	1,995	C	-1818	-2226	-2214		
4/10/2012	E	819	1,997	C	-2219	-2275	-2141		
4/11/2012	E	817	1,794	C	-2523	-2240	-2053		
4/12/2012	E	815	1,797	C	-2621	-2308	-1930		
4/13/2012	E	818	1,788	C	-2722	-2272	-1677		
4/14/2012	E	816	1,797	C	-2416	-1942	-1425		
4/15/2012	E	1,371	2,287	C	-2046	-1878	-1558	VERNALIS **1:1**	D-1641 Vernalis 1:1
4/16/2012	E	1,596	1,995	C	-2138	-2078	-1694		
4/17/2012	E	1,044	1,988	C	-2237	-2137	-1790		
4/18/2012	E	812	2,388	C	-2109	-2177	-1896		
4/19/2012	E	813	2,392	C	-2340	-2262	-2010		
4/20/2012	E	1,221	1,792	C	-2570	-2379	-2107		
4/21/2012	E	1,631	1,193	C	-2584	-2463	-2199		
4/22/2012	E	1,060	696	C	-2626	-2494	-2173	JSA **-1,250 OMR**	
4/23/2012	E	826	695	C	-2678	-2484	-2138		
4/24/2012	E	821	694	C	-2265	-2278	-2110		
4/25/2012	E	822	696	C	-2072	-2218	-2101		
4/26/2012	E	823	662	C	-1844	-2186	-2089		
4/27/2012	E	819	691	C	-1237	-1963	-2079		
4/28/2012	E	816	697	C	-882	-1936	-2075		
4/29/2012	E	815	679	C	-1132	-1952	-1942		
4/30/2012	E	857	686	C	-1123	-1856	-1818		

Narrative for Apr 2012:

Joint Stipulation Agreement was in place instead of U.S. National Marine Fisheries Service's Biological Opinion Action IV.2.1 for the entire months of April and May. Also, pertaining to the CA State Water Resources Control Board's Decision 1641 Vernalis flow to export ratio is limited to 1:1 during April 15th to May 15th period. Smelt Working Group continued to monitor smelts activities in the Delta.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards
5/1/2012	E	949	1,340	C	-1261	-1838	-1792	VERNALIS 1:1	NMFS BO - Action IV.2.3; Joint Stipulation Agreement (JSA); D-1641 Vernalis 1:1; Smelt Working Group (SWG) Monitoring
5/2/2012	E	976	1,344	C	-1832	-1864	-1757		
5/3/2012	E	978	1,494	C	-2181	-1879	-1726		
5/4/2012	E	979	1,644	C	-2416	-1897	-1710		
5/5/2012	E	983	1,989	C	-2681	-1890	-1726		
5/6/2012	E	983	2,096	C	-2814	-1905	-1823		
5/7/2012	E	992	1,941	C	-2914	-1949	-1926		
5/8/2012	E	1,004	507	C	-2991	-2139	-1933	JSA -1,250 OMR	
5/9/2012	E	874	635	C	-2885	-2187	-1937		
5/10/2012	E	816	691	C	-2643	-2176	-1941		
5/11/2012	E	817	697	C	-2219	-2256	-1936		
5/12/2012	E	816	696	C	-1828	-2287	-1926		
5/13/2012	E	817	3,296	C	-1863	-2400	-2090		
5/14/2012	E	2,699	1,593	C	-2132	-2548	-2262		
5/15/2012	E	3,996	653	C	-2639	-2668	-2396		
5/16/2012	E	4,200	793	C	-3477	-2843	-2565	JSA -5000 OMR	
5/17/2012	E	4,201	792	C	-4410	-3083	-2740		
5/18/2012	E	4,213	790	C	-4931	-3298	-2915		
5/19/2012	E	1,791	2,192	C	-5231	-3458	-3003		
5/20/2012	E	816	3,694	C	-5204	-3521	-3121		
5/21/2012	E	817	3,695	C	-5183	-3653	-3250		
5/22/2012	E	817	3,687	C	-5037	-3813	-3473		
5/23/2012	E	817	3,192	C	-4807	-3984	-3663		
5/24/2012	E	818	703	C	-4468	-4110	-3683	JSA -1,500 OMR	
5/25/2012	E	830	698	O	-4170	-4218	-3713		
5/26/2012	E	814	694	O	-3337	-4192	-3752		
5/27/2012	E	812	692	O	-2630	-4087	-3617		
5/28/2012	E	813	691	O	-2055	-3957	-3466		
5/29/2012	E	1,359	3,488	O	-2096	-3916	-3525	JSA -5000 OMR	
5/30/2012	E	1,632	3,196	O	-2722	-3949	-3547		
5/31/2012	E	1,586	2,986	O	-3665	-3926	-3539		

Narrative for May 2012:

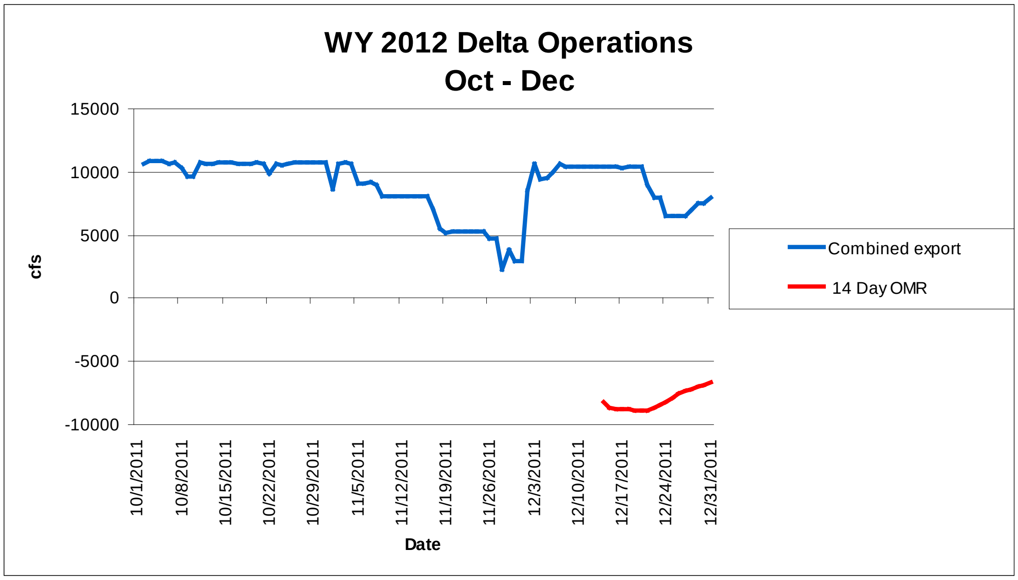
Joint Stipulation Agreement was in place instead of U.S. National Marine Fisheries Service's Biological Opinion Action IV.2.1 for the entire months of April and May. Also, pertaining to the CA State Water Resources Control Board's Decision 1641 Vernalis flow to export ratio is limited to 1:1 until May 15th. Smelt Working Group continued to monitor smelts activities in the Delta.

2012 CVP & SWP Operations & Delta Conditions

Date	Balance Excess	Jones PP (cfs)	Clifton Court export (cfs)	DCC	Mean 5-Day OMR (cfs)	Mean 14-Day OMR (cfs)	Mean 14-Day OMR Equation Calculation (cfs)	Controlling	Concern Standards			
6/1/2012	E	1,664	1,593	O	-4353	-3881	-3442	NMFS BO **-5000 OMR**	NMFS BO - Action IV.2.3			Smelt Working Group (SWG) Monitoring
6/2/2012	E	1,597	1,596	O	-4964	-3861	-3409					
6/3/2012	E	1,600	1,594	O	-5047	-3860	-3339					
6/4/2012	E	1,598	1,588	C	-4576	-3732	-3269					
6/5/2012	E	1,597	1,593	C	-4135	-3604	-3181					
6/6/2012	E	1,591	1,595	C	-3658	-3470	-3128					
6/7/2012	B	2,212	1,590	C	-3445	-3496	-3299	Outflow for X2 **7,100 cfs**		D-1641 X2 & EC Standards		
6/8/2012	B	2,470	1,596	C	-3290	-3546	-3488					
6/9/2012	B	2,464	1,591	C	-3302	-3720	-3675					
6/10/2012	B	2,458	1,595	C	-3268	-3832	-3863					
6/11/2012	B	2,458	1,596	C	-3593	-4020	-4054					
6/12/2012	B	2,463	1,588	C	-3767	-4093	-4017					
6/13/2012	B	2,467	1,590	C	-4085	-4032	-3980					
6/14/2012	B	1,250	684	C	-4332	-3958	-3823					
6/15/2012	B	821	1,197	C	-4180	-3770	-3755					
6/16/2012	B	1,585	1,188	C	-3933	-3652	-3740					
6/17/2012	B	1,601	995	C	-3644	-3592	-3711					
6/18/2012	B	1,605	995	C	-3328	-3586	-3670	Western Delta **0.45 EC**				
6/19/2012	B	1,601	988	C	-2882	-3511	-3653					
6/20/2012	B	1,598	989	C	-2822	-3471	-3639					
6/21/2012	B	1,597	988	O	-2859	-3442	-3566					
6/22/2012	B	2,174	1,496	O	-2872	-3443	-3547					
6/23/2012	B	2,412	1,482	O	-3055	-3498	-3548					
6/24/2012	B	2,411	1,490	O	-3320	-3529	-3546					
6/25/2012	B	2,582	1,992	O	-3603	-3475	-3587					
6/26/2012	B	2,689	1,998	O	-3792	-3451	-3633					
6/27/2012	B	2,729	1,991	O	-4181	-3477	-3678					
6/28/2012	B	2,718	2,498	O	-4393	-3520	-3897					
6/29/2012	B	2,735	2,995	O	-4826	-3759	-4143					
6/30/2012	B	2,724	2,992	O	-5461	-4021	-4334					

Narrative for Jun 2012:

U.S. National Marine Fisheries Service's Biological Opinion Action IV.2.3 resumes on June 1st and sunset on June 15th. In addition, standards related to CA Sate Water Resources Control Board's Decision 1641 began to affect Projects' exports more predominantly. Smelt Working Group continued to monitor smelts activities in the Delta.



WY 2012 Delta Operations
Oct - Dec
15000
10000
5000
0
-5000
-10000
cfs
10/1/2011
10/8/2011
10/15/2011
10/22/2011
10/29/2011
11/5/2011
11/12/2011
11/19/2011
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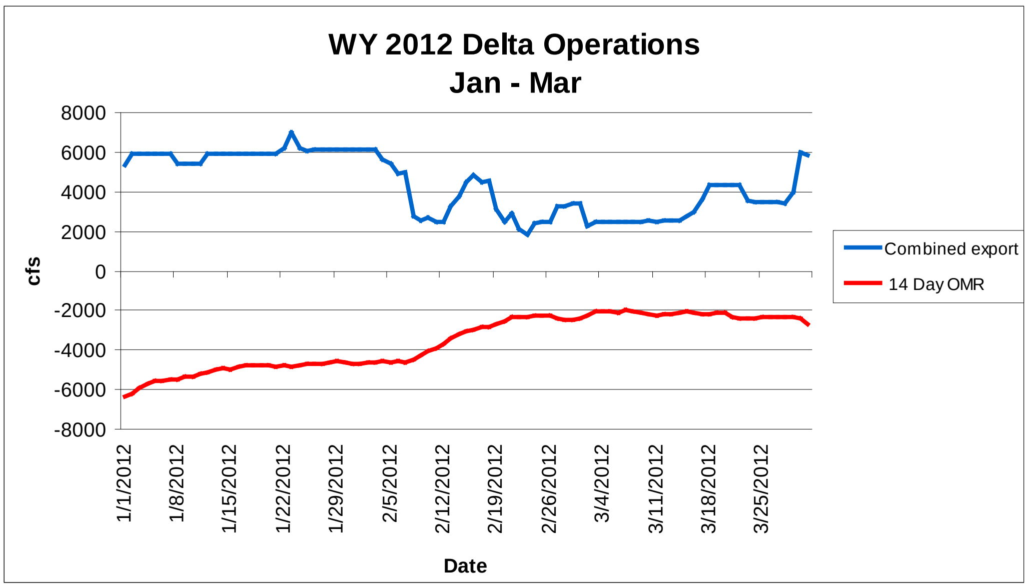
12/31/2011
Date
Combined export
14 Day OMR



WY 2012 Delta Operations
Jan - Mar
8000
6000
4000
2000
0
-2000
-4000
-6000
-8000
cfs
1/1/2012
1/8/2012
1/15/2012
1/22/2012
1/29/2012
2/5/2012
2/12/2012
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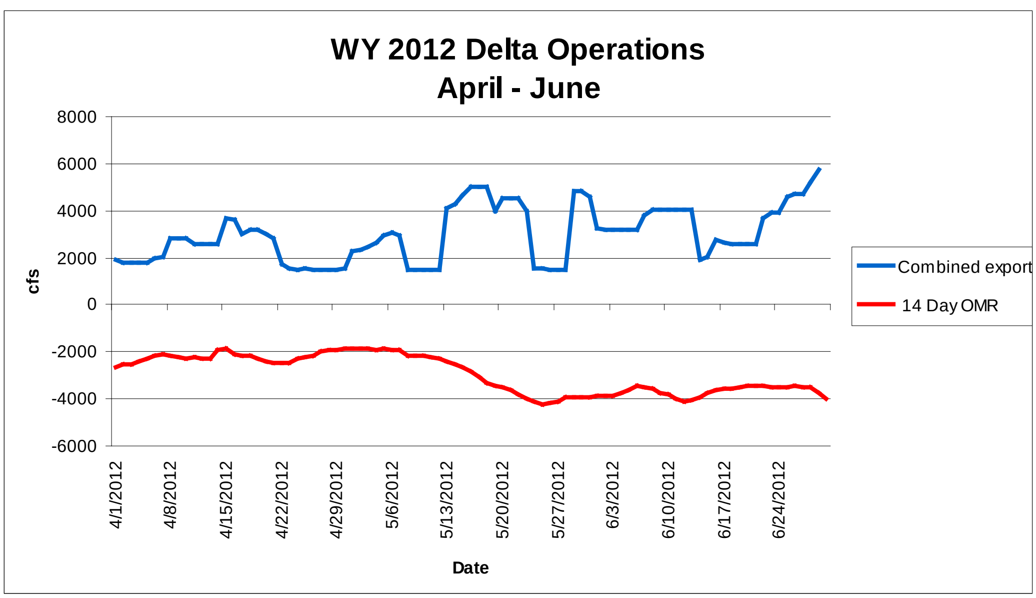
3/25/2012
Date
Combined export
14 Day OMR



WY 2012 Delta Operations
April - June
8000
6000
4000
2000
0
-2000
-4000
-6000
cfs
4/1/2012
4/8/2012
4/15/2012
4/22/2012
4/29/2012
5/6/2012
5/13/2012
5/20/2012
5/27/2012
6/3/2012
6/10/2012
6/17/2012
6/24/2012
Date
Combined export
14 Day OMR