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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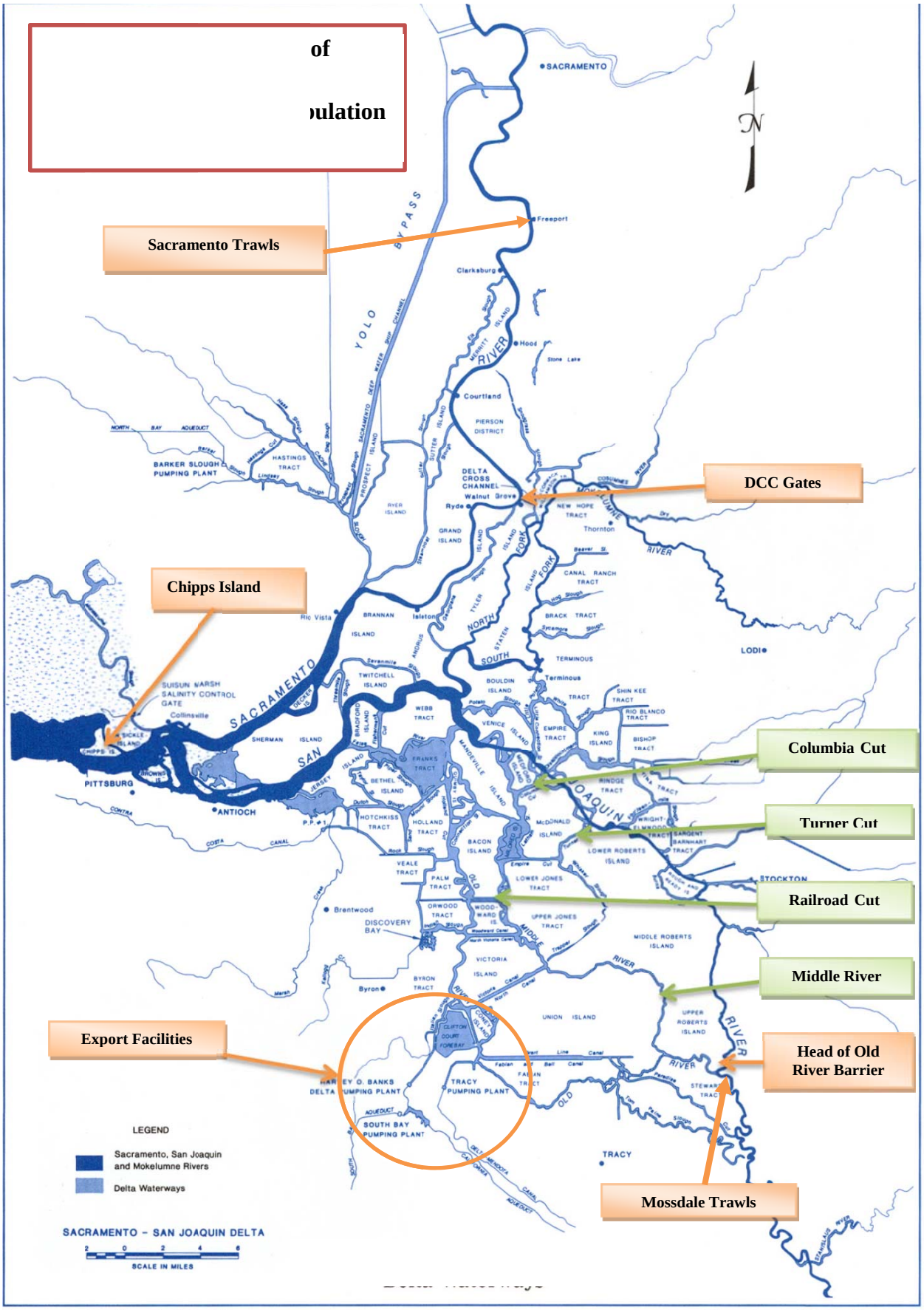
Acronyms and Abbreviations

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*
Pat Brandes
Roger Guinee*

National Marine Fisheries Service (NMFS)
Barb Byrne*
Bruce Oppenheim*
Jeff Stuart
Garwin Yip

California Department of Fish and Game (CDFG)
Chad Dibble
Bob Fujimura*
Joe Johnson*
Jason Roberts
Robert Vincik*

Department of Water Resources (DWR)
Andy Chu*
Mike Ford
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).

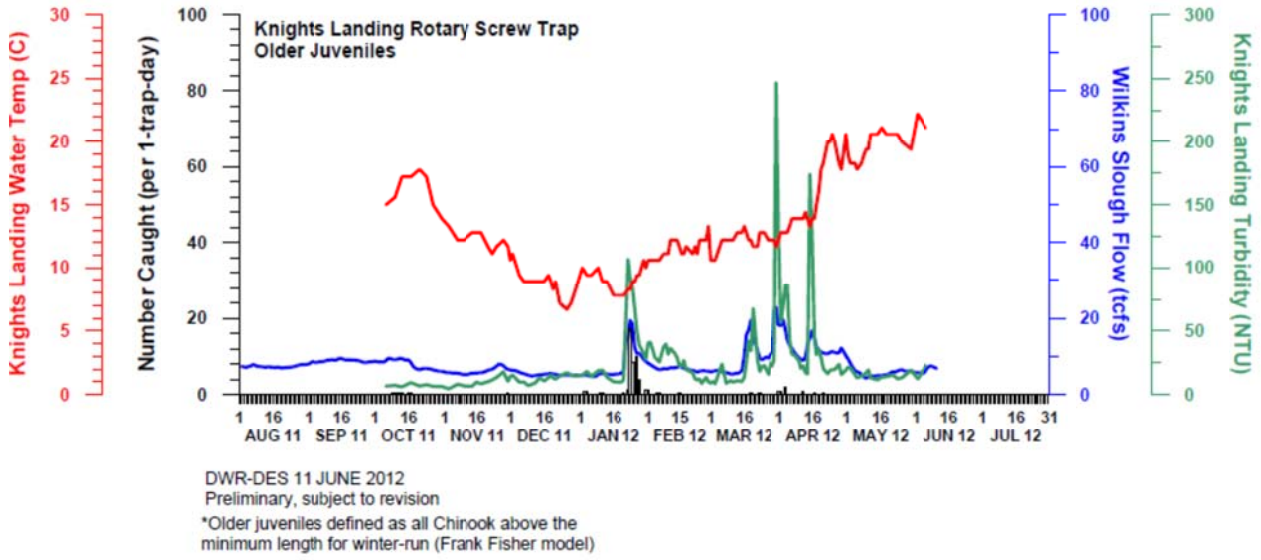


Figure 3.1. Knights Landing weekly data report to DOSS including older juvenile Chinook, water temperatures, turbidity, and flows based on preliminary CDFG data on 6/11/12.

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.

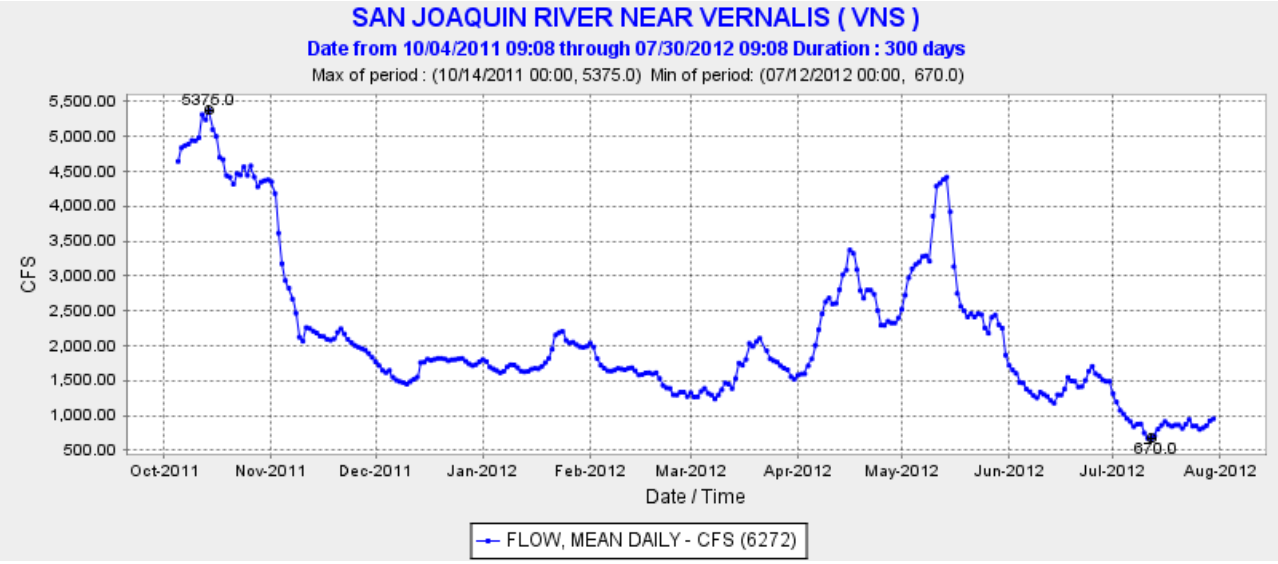


Figure 4.1. San Joaquin River flows at Vernalis October 2011 to July 2012.

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.

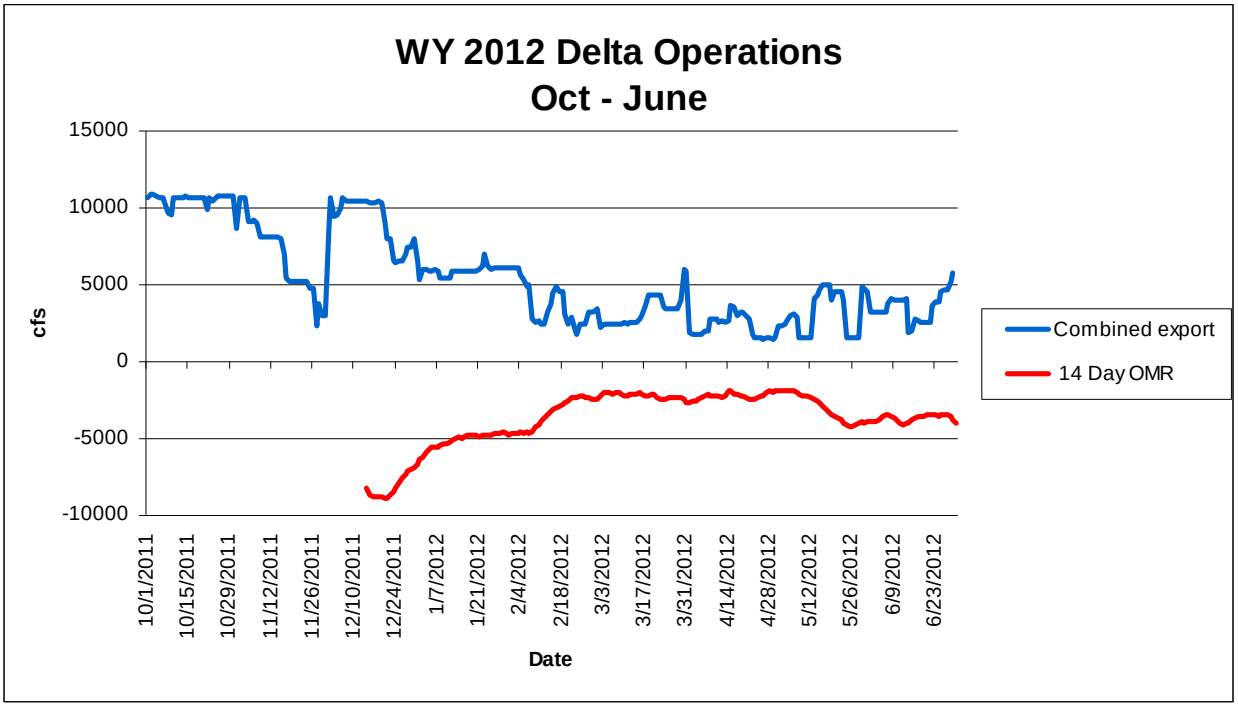


Figure 4.2. OMR operations October 2011 through June 2012.

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

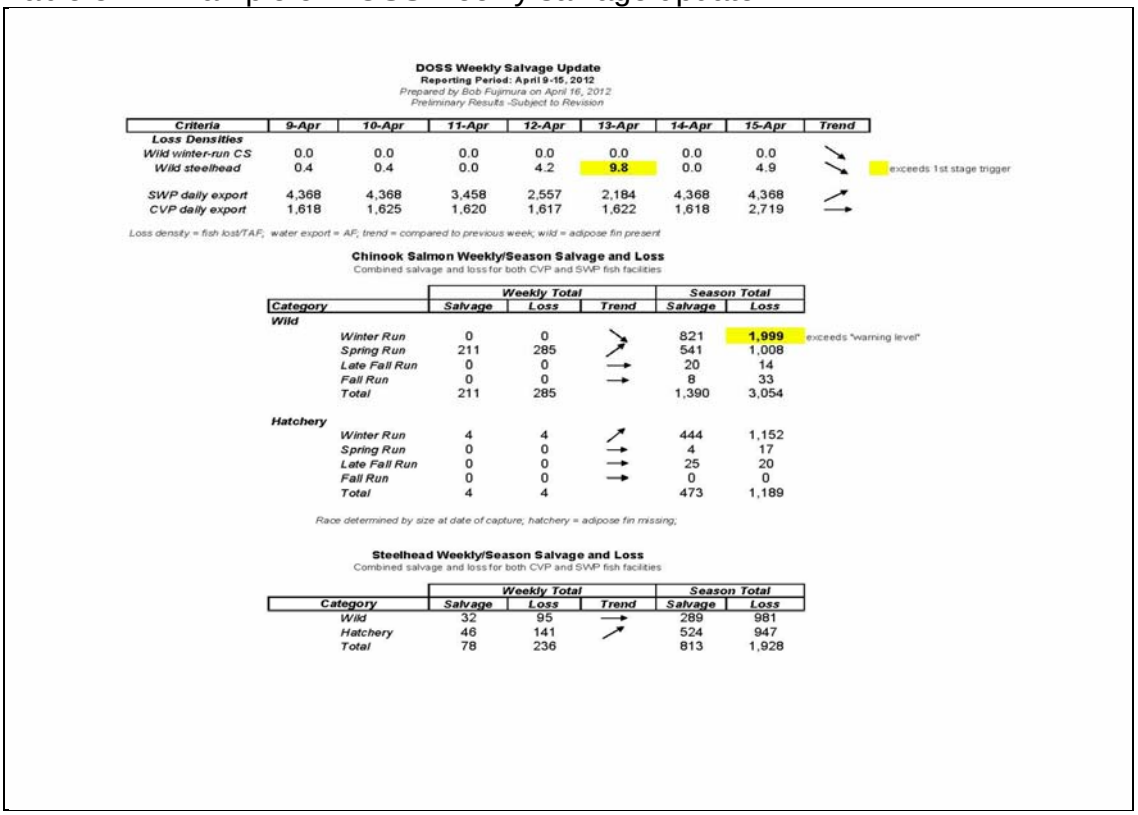
Prepared by Geir Aasen *Report Date:* 9/14/2012 10:35

	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	↘
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	→

exceeds 1st stage trigger

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
	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

exceeds "warning level"

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

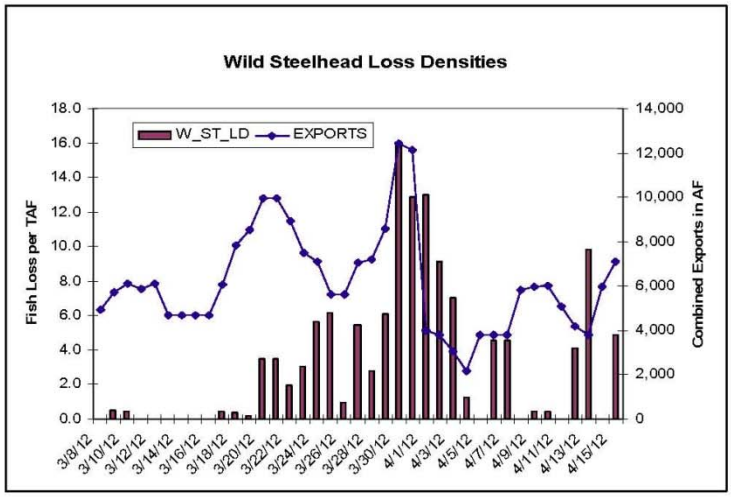


Figure 3. Wild steelhead loss densities and exports for the combined CVP and SWP facilities from March 8 through April 15, 2012. Information from DFG daily steelhead and smelts summary tables (G. Aasen; 4/16/12). Prepared by Bob Fujimura on April 16, 2012.

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.

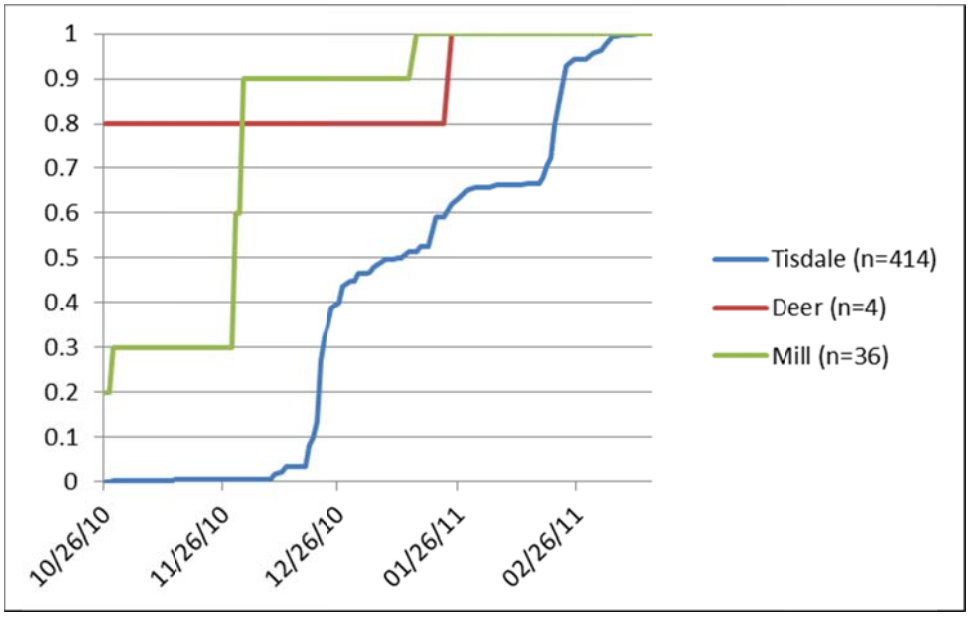


Figure 5.2. Daily cumulative frequency (expressed as a percent) of non-clipped older juvenile Chinook salmon sampled at RSTs on the Sacramento River and Mill and Deer creeks.

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).

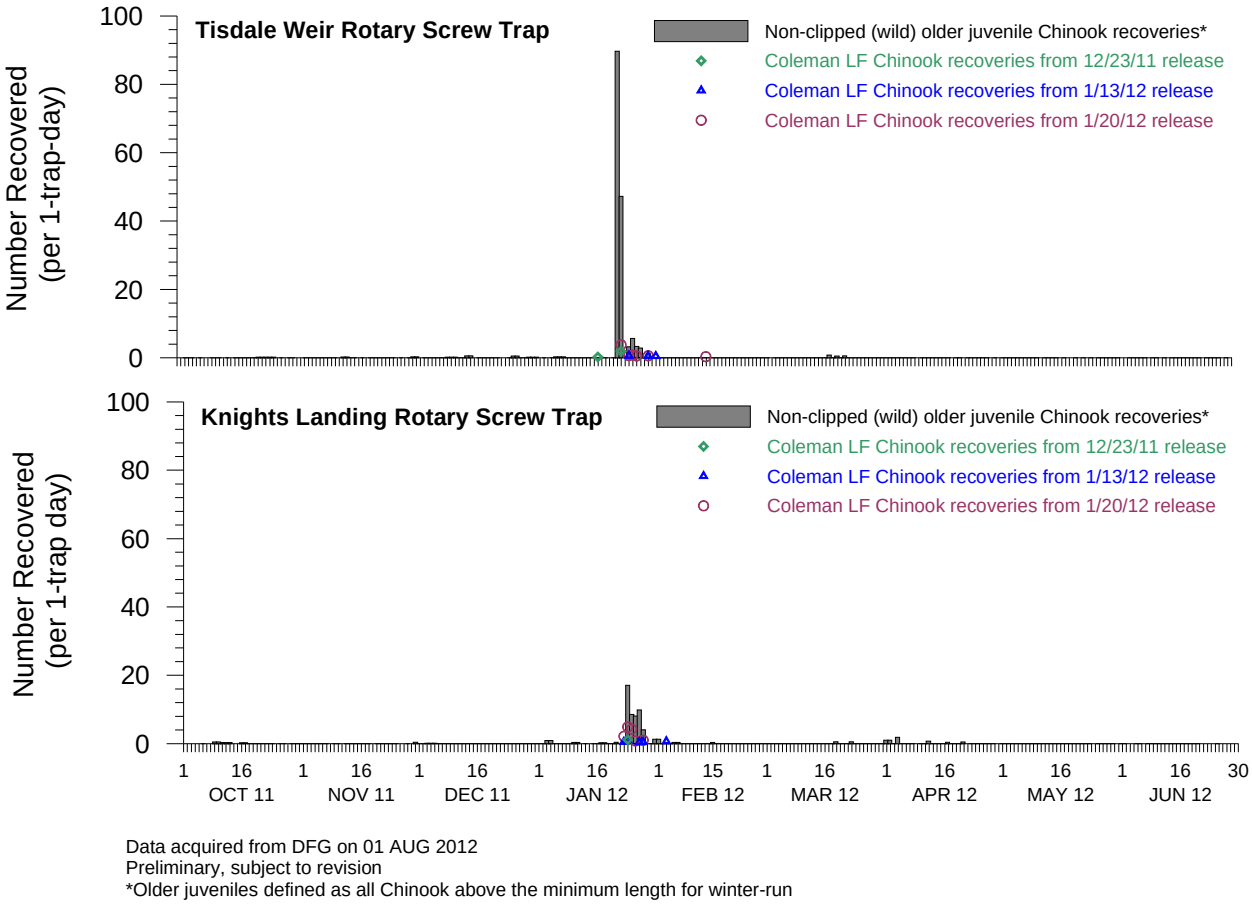
Table 5.3. Coleman NFH release information for spring-run Chinook surrogates.*

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.



Data acquired from DFG on 01 AUG 2012
Preliminary, subject to revision
*Older juveniles defined as all Chinook above the minimum length for winter-run

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.

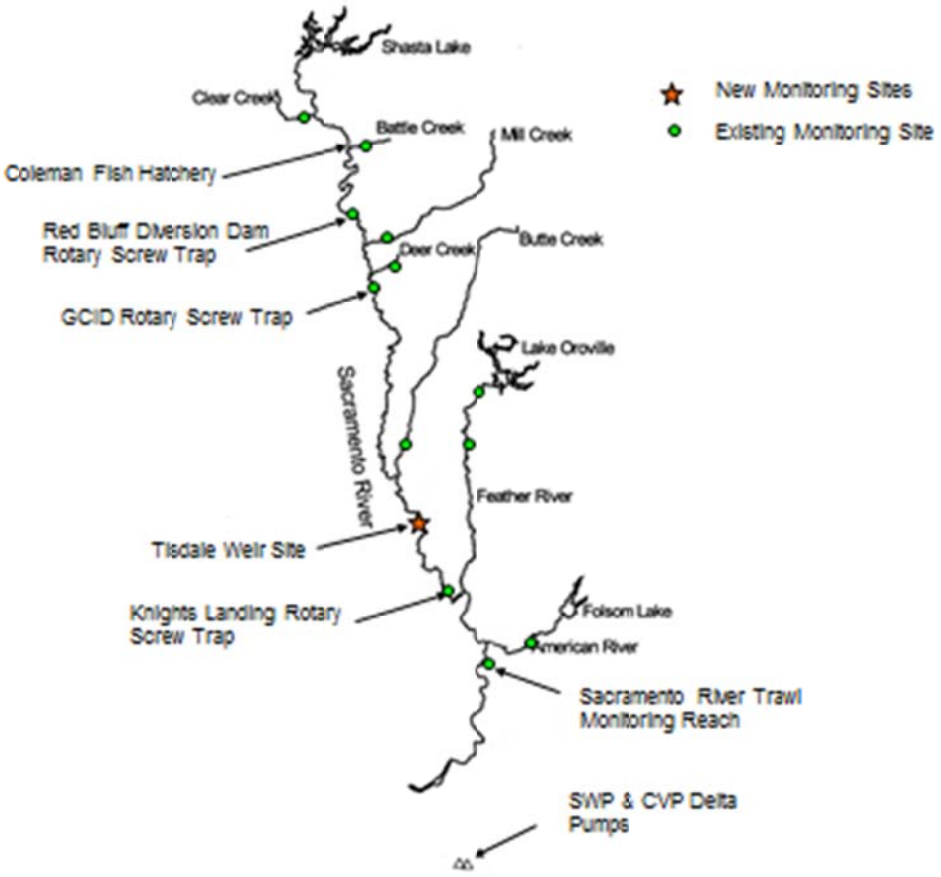


Figure 5.4. Monitoring sites in the upper Sacramento River watershed.

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.

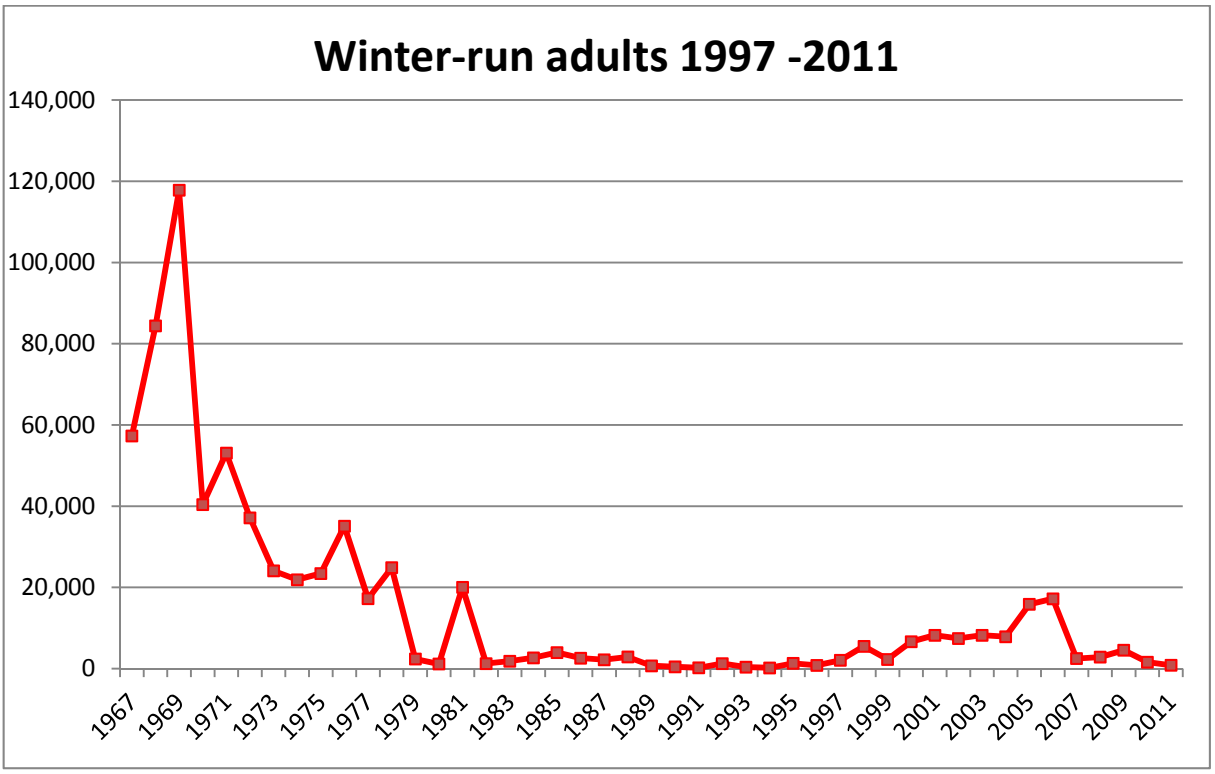


Figure 6.1. Sacramento River winter-run Chinook adult counts based on Red Bluff Diversion Dam ladder counts from 1967 through 1995 and carcass surveys from 1996 through 2011.

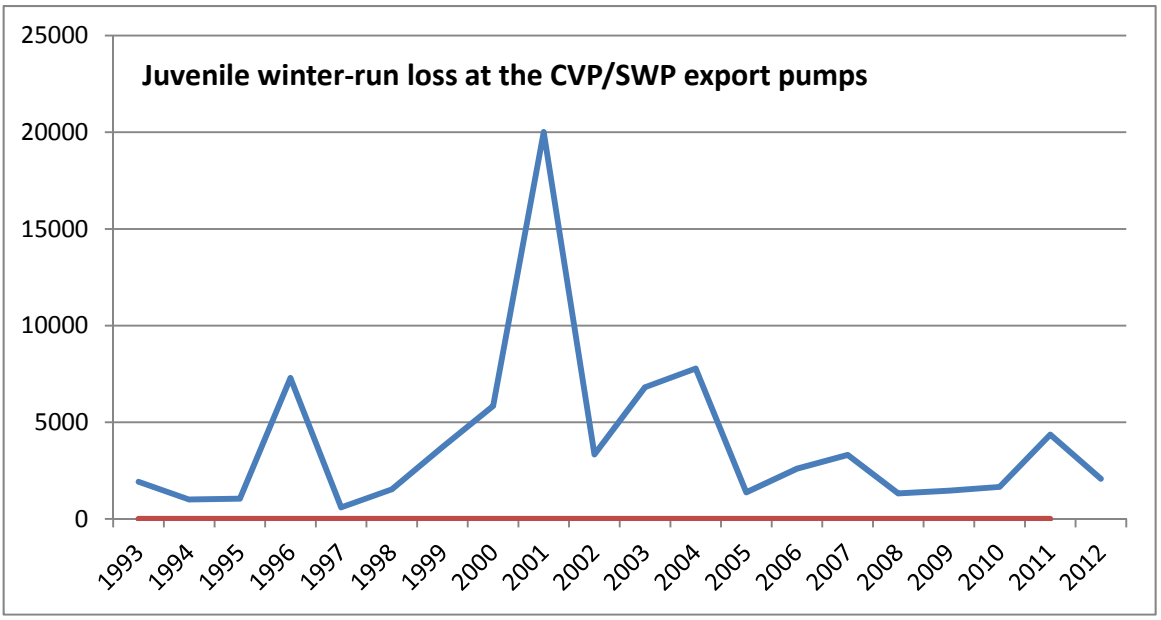


Figure 6.2. Historical winter-run Chinook loss at the CVP/SWP export pumps.

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).

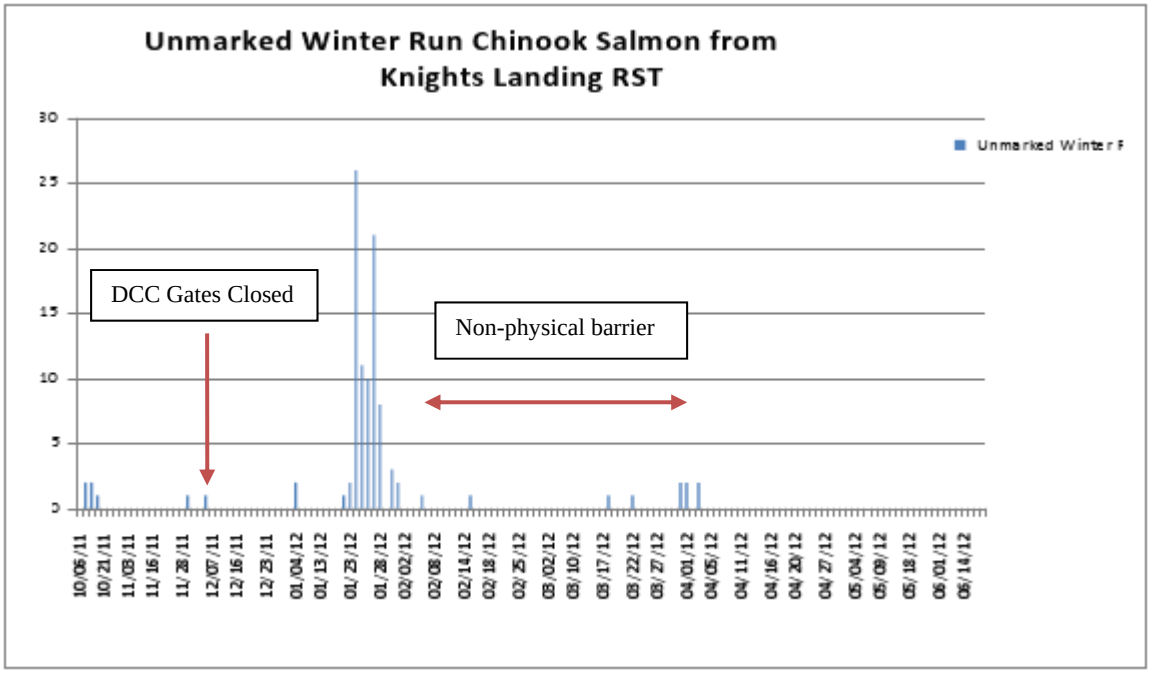


Figure 6.3. Juvenile winter-run Chinook passage at Knights Landing (CDFG, preliminary data).

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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