2015/2016
SALMONID AND GREEN STURGEON
INCIDENTAL TAKE AND MONITORING REPORT

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2015/2016 SALMONID AND GREEN STURGEON INCIDENTAL TAKE AND MONITORING REPORT

This annual report is required under the terms and conditions of the 2009 National Marine Fisheries Service (NMFS) Biological Opinion and Conference Opinion on the Proposed Long-Term Operations of the Central Valley Project and State Water Project (2009 NMFS Biological Opinion). This report summarizes the incidental take of winter-run Chinook Salmon (*Oncorhynchus tshawytscha*), spring-run Chinook Salmon (*O. tshawytscha*) surrogates, Central Valley steelhead (*O. mykiss*), and green sturgeon (*Acipenser medirostris*) at the State Water Project's (SWP) John E. Skinner Delta Fish Protective Facility and the Central Valley Project's (CVP) Tracy Fish Collection Facility (Delta fish facilities) for 2014/2015. This report also includes data from a wide geographic area including the Salmonid monitoring program for the lower Sacramento River and the Delta (Figure 1, pg 16), and the hydrologic conditions in the Delta.

In addition to this annual report, the California Department of Water Resources (DWR) 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 2015/2016 incidental take season. Preliminary analysis of the weekly data reports can be found in the weekly meeting notes that are posted on the DAT and DOSS websites:

DAT:
http://www.water.ca.gov/swp/operationscontrol/calfed/calfeddat.cfm
DOSS:
http://www.westcoast.fisheries.noaa.gov/central_valley/water_operations/doss.html

Data Acquisition

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

Methods for Measuring Incidental Take

Current Method

For this report, DWR quantified incidental take for the listed species to the nearest

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

Alternative Methods

As presented in the 2013/2014 report, there is still a high degree of uncertainty and poor documentation associated with the current methods used to estimate loss or incidental take of Chinook Salmon, steelhead, and green sturgeon. Reclamation is required to improve the quantification of loss by developing an alternative technique to quantify incidental take of listed anadromous species at the Delta fish facilities in compliance with Term and Condition 2a of the 2009 NMFS Biological Opinion. In the summer of 2013, Reclamation and DWR, with guidance from the interagency Term and Condition 2a (T&C 2a) Technical Work Team (technical team), drafted Anonymous (2013) to describe the proposed modifications to the current methods for estimating loss. Anonymous (2013) was drafted for independent review and consideration at the 2013 Long-Term Operations Biological Opinions (LOBO) Annual Review, and was based on various documents drafted for the T&C 2a process. These documents include:

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

However, the Independent Review Panel (IRP) for the 2013 LOBO review expressed concerns in their final report on the Jahn (2011) model for calculating point and confidence interval estimates of loss, which would also apply to the Anonymous (2013) approach and to the current methods (see Anderson et al. 2013 for concerns). The IRP's concerns include using fixed survival values in the equation, not accounting for probable losses from zero salvage, and using the error propagation method for characterizing uncertainty (Anderson et al. 2013). To address these concerns, the IRP provided recommendations on how to improve the loss and uncertainty estimates, including using a Bayesian method to account for probable losses from zero salvage and using a Monte Carlo simulation for estimating loss and its uncertainty (see

Anderson et al. 2013 for recommendations).

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

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

Task2: Provide Monte Carlo Script(s) from Teply and Ceder (2013) and Prepare Associated Report on Script(s).
No work was done on Task 2 yet as the technical team members have agreed to proceed with Task 3 instead.

Task3: Develop New Loss Method and Tool with Report.
Contractors have conducted the first workshop with technical team to review what the technical team needs for the new method and tool for estimating loss. The second workshop was conducted on October 8, 2015.

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

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

All of the above-mentioned tasks have been completed under the task order during the year 2015/2016. The technical team is currently testing the new Loss Method and Tool developed by the consultants. An analysis of the review might be given in the 2016/2017 incidental take report if available at the time of the report.

Observed Chinook Salmon Salvage

Figure 2 on page 16 describes the observed Chinook Salmon salvage at the Delta fish

facilities in 2015/2016 from normal salvage counts, special studies, and secondary flushes. However, Figure 2 does not depict any Chinook Salmon that cannot be classified using the Delta model length-at-date criteria. This includes Chinook Salmon that are larger than the length-at-date criteria considered in the model, and any Chinook Salmon that were not measured for length. In 2015/2016, fork lengths were obtained for all Chinook Salmon salvaged at the Delta fish facilities. At CVP, 10 sub-adults of an undetermined run of Chinook Salmon were salvaged that fell outside of the length-at-criteria (all greater than 500 mm fork length) and therefore no loss was calculated for those fish. No sub-adults of an undetermined run of Chinook were observed at SWP during the 2015/2016 season.

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

Overall, the number of observed non-clipped older juvenile Chinook Salmon was higher than in 2014/2015. In 2015/2016, all of the observed non-clipped older juvenile Chinook Salmon salvaged occurred between December and May, mostly during April and May 2015 (Figure 2). There was no noticeable trend between the number of non-clipped older juvenile salvage and export levels. In comparison, young-of-the-year (YOY) Chinook Salmon were first observed at the Delta fish facilities around mid-December which coincided with increased Sacramento and San Joaquin River flows and were salvaged until mid- May. A similar trend was also observed in the previous year 2014/2015.

Overall, the number of observed hatchery Chinook Salmon at the Delta fish facilities was also higher in 2015/2016 than in 2014/2015. Similar to the year 2014/2015, the Coleman Hatchery late fall-run brood year 2014 releases had the highest salvage out of all the hatchery fish observed in salvage. The number of observed Chinook Salmon of Spring run from San Joaquin River Restoration Program were also noticieable.

Observed Chinook Salmon Genetic Run Assignment

Juvenile Chinook Salmon were salvaged at the Delta fish facilities in WY16 between December 22, 2015, and May 19, 2016. Of the 111 non-clipped juvenile Chinook Salmon that were collected during routine salvage operations and predator removals, 108 underwent race confirmation by genetic analysis.

Of the 56 non-clipped juvenile Chinook salvaged at the CVP, genetic samples were

collected from 55 of them. One fish, salvaged at the CVP on April 17, 2016, with a measured forklength of 95mm, was not sampled for genetics and therefore its run assignment could not be confirmed nor denied. The resulting salvage number associated with this fish was 4.0, with a corresponding calculated loss of 3.27. Another juvenile Chinook, salvaged at the CVP on April 11, 2016, was sampled but not submitted due to an adipose fin not being observed during the genetic tissue collection step. The savage number associated with this fish was also 4.0, and with a corresponding loss of 3.27. Of the 55 collected samples, 7 were from fish designated as Winter-run Chinook Salmon by the Delta Model (Table 1, pg. 30). Of the 7 samples, 1 assigned to winter run. For viable samples, 14.3% that were intially classified as winter-run were actually winter-run by genotype. The percentage of viable samples that were assigned to winter-run in relation to the total observed Chinook Salmon was 1.8%. The one sample confirmed as a true winter-run was a 112 mm Chinook collected at the CVP on February 22, 2016, with a salvage number of 4.0 and aan expanded loss of 2.88.

At the SWP, 55 non-clipped juvenile Chinook Salmon were observed and 54 samples were collected for DNA analysis in 2015/2016. Of the 54 samples collected, 54 samples were provided for analysis and all but 7 provided usable DNA (Table 1, pg. 30). One fish, salvaged at the SWP on January 28, 2016, with a measured forklength of 77mm, was not sampled for genetics and therefore its run assignment could not be confirmed nor denied. The resulting salvage number associated with this fish was 2.0, with a corresponding calculated loss of 8.59.Of the 54 samples collected, 6 were classified as winter-run Chinook Salmon by the Delta Model. Of these 6, only 1 sample was assigned to winter-run.Chinook Salmon so approximately 16.7% of samples identified as winter-run Chinook Salmon by the Delta Model were actually winter-run by genotype. The percentage of viable samples that were assigned to winter-run, of the total juvenile Chinook Salmon observed at the SWP, was 2.1%. The one sample confirmed as a true winter-run was a 77 mm Chinook collected at the SWP on January 28, 2016, with a salvage number of 2.0 and aan expanded loss of 8.59. All samples that “failed” were classified as either Fall run or Spring run Chinook by the Delta model length-at-date criteria (n=5 and n=2 respectively).

In total, all but 2 of the juvenile Chinook Salmon salvaged at the CVP and SWP in WY16 were genetically identified as Spring, Fall, and Late-Fall runs (Table 2, page 30).

The incidental take level for natural production winter-run juveniles was set at 1,017, confirmed and expanded loss for Winter-run Chinook Salmon for WY16 was only 11.47, or 1.1% of the allowable take when set at 1% of the JPE (1,017).

Onset of Rapid Genetic Testing Protocol

Some of the action response triggers in Actions IV.2.3 and IV.3 of the NMFS BiOp are based on loss or loss density of unclipped “older juvenile” Chinook Salmon, defined based on Chinook race classifications made using length-at-date tables. These “older juvenile” triggers are primarily intended to protect natural-origin winter-run Chinook Salmon. Because race classification by genetics (especially for winter-run Chinook Salmon) is more accurate than the classification based on length-atdate tables (which can result in false positive assignments), in WY 2015 DWR and Reclamation piloted a rapid genetic testing protocol. The objective of the protocol is to process genetic samples that were collected from juvenile Salmonids salvaged at the SWP and CVP as soon as practicable after salvage to assess the race assignment that was based on the existing length-at date table in order to avoid or minimize the duration of export reductions that were triggered by loss of “older juveniles” (a size-based designation) that were not genetic winter-run. Reclamation and DWR more formally implemented this procedure again during WY 2016, in coordination with the DFW, FWS, and the NMFS. As in WY 2015, the procedure is a precautionary approach that is intended to avoid (or minimize the duration of) export reductions triggered based on older juveniles that are not genetic winter-run. Actions to reduce pumping at the CVP and SWP export facilities are initiated when the older juvenile Chinook Salmon trigger threshold is exceeded. However, if results of tissue genetic analysis indicate that the loss or loss density of genetic winter-run Chinook did not exceed the trigger threshold, then export reductions will be cancelled (as occurred in early January 2016; see section 3.3.3 (“Old and Middle River Flow management” for details). NMFS supported the use of this protocol, with the two additional conditions that all unclipped Chinook Salmon have tissue samples collected for subsequent analysis, and that the annual incidental take limit was set at 1% of natural winter-run (the 2% of the JPE for incidental take assumes 50% misclassification of winter-run Chinook based on the length-at-date tables). Results from genetic testing during WY 2016 will be provided in the 2015/2016 Incidental Take Report (not yet available, see Appendix B for details).

Winter-Run Chinook Salmon

Winter-Run Chinook Salmon Incidental Take

In 2015, DFW estimated a total adult escapement of 3,439 winter-run spawners to the upper Sacramento River, which is actually 14% higher than it was in 2014 but lower than the 16-year average of 6,139 adults. In 2014, the number was also low and it was thought to be impacted greatly by the temperature management challenge due to drought conditions. The number in 2015 remained low despite the efforts in 2015 to adjust the temperature management plan for the upper Sacramento River. The methodology (Cormack-Jolly-Seber Model) used in 2015 to calculate the annual winter-run escapement was the same as was used in 2014. This Cormack-Jolly-Seber model allowed for an estimation of a 90% confidence interval, which ranged from 2,741 to 3,290 fish. Based on the point estimate of escapement, NMFS calculated the juvenile

production estimate (JPE) of natural (non-clipped) winter-run Chinook Salmon entering the Delta in 2014/2015. NMFS has considered the recommendations of the Independent Review Panel (IRP) and the advice of the Winter-Run Project Work Team (WRPWT) to calculate the number for the winter-run 2015 brood year. NMFS has chosen the JPI method to calculate the winter-run JPE from brood year 2015 because it was more closely represented the actual hydrologic conditions experienced by winter-run egg and fry in 2015. The NMFS or CFS models were not chosen because they did not accurately account for the loss of juveniles due to higher water temperatures that occured in 2015.

For the water year 2016, NMFS estimated that 101,716 natural origin juvenile winter-run Chinook Salmon would enter the Delta. Based on this JPE, the incidental take level from October 1, 2015, through June 30, 2016, for the Delta fish facilities was 1,017 non-clipped winter-run Chinook Salmon, which is equal to 1% of the natural winter-run production entering the Delta. For tracking incidental take, winter-run Chinook Salmon are classified by length according to the Delta Model length-at-date criteria and the measurement of winter-run Chinook Salmon incidental take is based on loss using the current loss equation from DFW (2013).

More detailed information on rationales provided by NMFS for this year's JPE estimation can be found at:
http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/20160116_nmfs_winter-run_juvenile_production_estimate_nr.pdf

Loss of winter-run Chinook Salmon, based on the Delta Model, occurred at both Delta fish facilities for an expanded loss of approximately 35 fish at the SWP and approximately 21 fish at the CVP. The combined expanded loss of winter-run sized Chinook Salmon was 56 for the season, which is approximately 5.5% of the permitted incidental take. Overall, the combined annual winter-run sized Chinook Salmon loss was higher than in the previous water year even though the total loss was significantly lower than in the previous water year. The lowest loss in the past nine water years occurred in Water Year 2014/2015 (Figure 4, pg. 19) and the combined incidental take for DWR and Reclamation was well below the authorized incidental take limit set for 2015/2016.

In 2015/2016, the combined older juvenile Chinook Salmon loss density trigger (NMFS RPA Action IV.2.3) was exceeded only once, and exports were reduced in response for the protection of non-clipped winter-run Chinook Salmon. However, the reduction in exports was discontinued before the five days specified by the RPA had elapsed because genetic testing later showed that the older juvenile was a fall-run Chinook, not a winter-run Chinook (Figure 5, pg. 20).

Hatchery Winter-Run Chinook Salmon Incidental Take

On February 17-18, 2015, an estimated 420,000 winter-run smolts from Livingston Stone National Fish Hatchery (LSNFH) were released in the Sacramento River at Caldwell Park near Redding, California. According to the Hatchery data, the release group was 100% adipose fin clipped with a CWT. The hatchery production group was significantly increased in 2015, as was the case in 2014, to compensate for the loss in natural production due to extreme drought conditions and subsequent poor in-river egg survival of natural origin Chinook. Based on preliminary release information and an updated survival term, NMFS estimated that 148,000 hatchery fish would enter the Delta. NMFS set the incidental take level at 1% of the total hatchery production entering the Delta, or 1,554 hatchery winter-run Chinook Salmon from October 1, 2015, through June 30, 2016. There was a confirmed estimated loss of 11.19 for hatchery winter-run Chinook Salmon at the Delta fish facilities, which was only 0.003% of the authorized take level (Table 3 pg. 31). Therefore, DWR and Reclamation were well below the authorized incidental take level.

Coded Wire Tagged fish salvaged at the SWP and CVP are carefully handled at the salvage facilities, in accordance with the Standard Operations Protocol, On occassion tag loss, or damage does occur, in addtion to some tags simply being unreadable due to tag imperfections. On these occasions, the fork lengths of the CWT fish are recorded and the loss is calculated and recorded under the 'unknown' category. For 2015/2016 year, the unknown loss was estimated at 7.95 and reported as 'Unknown CWT Loss'. (Table 4, pg. 32). At SWP, the unknown loss for 2015/2016 was estimated as 35.30 (Table 4, pg. 32). The combined unknown CWT loss at both facilities for the season was 43.25 (Table 4, pg. 32).

Spring-Run Chinook Salmon

Under the 2009 NMFS Biological Opinion, NMFS uses hatchery-reared subyearling Late Fall-run Chinook Salmon as surrogates for yearling Spring-run Chinook Salmon emigrating from the upper Sacramento River and tributaries into the Delta. 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 their size in the lower Sacramento River and Delta. The Coleman National Fish Hatchery (CNFH) releases a percentage of the total CNFH Late Fall-run Chinook Salmon production into surrogate release groups.

In water year 2015/2016, CNFH released three groups of Late Fall-run Chinook Salmon uniquely marked as Spring-run Chinook Salmon surrogates into Battle Creek: 1) 77,000 on 12/11/15, 2) 68,000 on 12/22/15, and 3) 67,700 on 1/12/16. In addition to these surrogate releases, CNFH also released 434,227 Late Fall-run Chinook Salmon into

Sacramento river on 6/11/15-6/12/15 and 261,213 Late Fall-run Chinook Salmon into Battle Creek on 12/9/15 as part of its production release. Prior to these releases, DOSS provided input to the CNFH on the release schedule of the Spring-run Chinook Salmon surrogates based on the information that the production release would occur during the first significant precipitation event in December. However, DOSS also noted that a potential benefit of not releasing the surrogates with a rainfall event would give the fish time to mingle with naturally produced Spring-run before a major flow event and may lead both natural and surrogate fish to migrate downstream resulting in elevated mortality. DOSS members have also discussed the release timing for the Late Fall-run production release. DOSS provided the guidance to release the production group in early December based on the thought that releasing the production group prior to the surrogate release might better represent natural Spring-run survival. A summary of more specific inputs provided from DOSS to CNFH is described in the annual DOSS report (2016).

Measuring Incidental Take

The incidental take level for the combined operation of the Delta pumping plants is equal to 1% of any individual CNFH Late-Fall Chinook Salmon surrogate release group. Measurement of incidental take for each surrogate release group is based on loss using the current loss equation from DFW (2013). However, there are occasions when the hatchery of origin for the CWT Chinook Salmon could not be confirmed due to lost, missing, or damaged tags, or due to the accidental release of CWT fish. For this reason, the actual loss could be higher than what is confirmed in Table 3. For the 2015/2016 season, the total Unknown loss due to Damaged Tags or Tags not found was 43.25 (Table 4, Pg. 32).

First Surrogate Release Group and Incidental Take

The first Spring-run Chinook Salmon surrogate hatchery group of approximately 77,000 CNFH Late Fall-run Chinook Salmon was released on December 11, 2015. A total confirmed loss of 128.05 was estimated from this group from the fish salvaged at Delta fish facilities (Table 3, pg.31 28). The percent loss was calculated to be 0.166%, which was below the exceedance level according to NMFS BiOp.

Second Surrogate Release Group and Incidental Take

On December 22, 2015, CNFH released the second Spring-run Chinook Salmon surrogate hatchery group of approximately 68,000 Late Fall-run Chinook Salmon into Battle Creek. A total confirmed loss of 188.93 was estimated from this group from the fish salvaged at Delta fish facilities (Table 3, pg. 31). The percent loss was calculated to be 0.278%, which was below the exceedance level according to NMFS BiOp.

Third Surrogate Release Group and Incidental Take

On January 2, 2016, CNFH released the third Spring-run Chinook Salmon surrogate hatchery group of approximately 67,700 Late Fall-run Chinook Salmon into Battle Creek (Table 3, pg. 31). A total confirmed loss of 278.65 was estimated from this group from the fish salvaged at Delta fish facilities (Table 3, pg. 31). The percent loss was calculated to be 0.412%, which was below the exceedance level according to NMFS BiOp.

Fry/Smolt Chinook Salmon Loss

The combined expanded loss of fry/smolt Chinook Salmon salvaged between October 2015 and July 2016 was approximately 522 (Figure 5, pg. 20). Using the Delta Model length-at-date criteria, DWR and Reclamation defined fry/smolts as all non-clipped Chinook Salmon smaller than the minimum winter-run length-at-date criteria. The Delta Model categorizes two different brood years of winter-run Chinook Salmon in July. For this month, DWR and Reclamation used the minimum winter-run length-at-date criteria for the older brood year.

Most of the fry/smolt Chinook loss occurred during May. Similar to 2014/2015, fry/smolt Chinook Salmon were salvaged earlier in the season starting mid-February. The annual loss in 2015/2016 was higher than 2014/2015 season but lower compared to 2006 to 2013.

Chinook Salmon Monitoring in the Sacramento River and the Delta

The Delta Juvenile Fish Monitoring Program (DJFMP) conducted by USFWS operates under the auspices of the Interagency Ecological Program (IEP). The DJFMP has been conducting juvenile salmon monitoring in the Delta since the early 1970s with the goals of gaining information on potential management actions that could improve the survival of juvenile salmon rearing and migrating through the Delta, and to document non-salmonid temporal and spatial distributions. For the USFWS Sacramento River and Delta surveys, DWR and Reclamation separated non-clipped older juvenile Chinook Salmon from fry/smolts using the Frank-Fisher Model, which categorizes two different brood years of winter-run Chinook Salmon in July and August. DWR and Reclamation used the minimum length of the dominant brood year of a reporting period for categorizing older juveniles and fry/smolts.

Spring-Run Chinook Salmon Surrogate Monitoring

The USFWS conducted a midwater and Kodiak trawl survey on the Sacramento River at Sherwood Harbor to gauge the relative abundance and timing of juvenile Chinook Salmon entering the Delta. USFWS recovered 3 surrogates from the first surrogate release, 1 surrogate from the second release group, and 2 surrogates from the third release group (Figure 7, pg. 22). The number of recovered surrogates was similar to previous year. The surrogate catch occurred during late-December of 2015 to early January 2016, which coincided with the catch of older juvenile Chinook Salmon at the Sacramento trawl.

In addition, a midwater trawl survey was conducted at Chipps Island, which is the most downstream trawl survey location in the legal Delta. USFWS recovered surrogates at Chipps Island for a catch of 12 surrogates from the first surrogate release, a total of 17 from the second surrogate release in February, and 22 surrogates for the third surrogate release. The total numbers of recovered surrogates were higher in 2015/2016 compared to the previous year. A similar trend has been observed when 2014/2015 numbers were compared to 2013/2014. The timing of recoveries at Chipps Island for all three surrogate releases was consistent with the timing of older juvenile Chinook Salmon catch at Chipps Island.

Hatchery Winter-Run Chinook Salmon Monitoring

Recoveries of hatchery Winter-run Chinook Salmon from LSNFH in the Delta monitoring trawls were lower than 2014/2015. Between late February and late March of 2016, the USFWS recovered 17 hatchery Winter-run Chinook Salmon from LSNFH. A total of 89 hatchery Winter-run Chinook Salmon from LSNFH were recovered in the Chipps Island midwater trawl (Figure 8, pg. 23). Overall recoveries were lower than previous water years where USFWS caught 84 hatchery Winter-run Chinook Salmon in the Sacramento Trawls and 80 hatchery Winter run from LSNFH at Chipps Island trawls.

Central Valley Steelhead

Steelhead Incidental Take

Between October 2015 and July 2016, the CVP salvaged a total of 16 non-clipped steelhead, and the SWP salvaged a total of 20, (Figure 13, pg. 26). Comparing the

numbers salvaged at each facility individually, it was a more even split, unlike the previous year in which 81% of total non-clipped steelhead salvage occurred at SWP. However, DWR and Reclamation did not exceed any steelhead loss triggers from January to June 2015 for more restrictive Old and Middle River flow limits (Figure 9, pg. 24). The daily steelhead loss triggers were calculated by multiplying combined exports in TAF on a given day by either 8 fish/TAF or 12 fish/TAF. The overall seasonal salvage for hatchery steelhead was extremely low compared to the data from the past nine water years (Figure 14, pg. 27).

The SWP and CVP total expanded salvage of non-clipped steelhead was approximately 58 and 61, which is well below the incidental take level of 3,000 fish for the water year (Figure 9, pg. 24). The annual salvage of non-clipped steelhead for 2015/2016 was slightly decreased from 2014/2015, which was 185 (Figure 9, pg. 24).
The SWP and CVP salvage of hatchery (adipose fin clipped) steelhead increased in 2013/2014 compared to the previous year. From October 2014 to July 2015, the CVP salvaged a total of 590 and the SWP salvaged a total of 234 for a combined total annual salvage of 824 steelhead (Figure 10, pg. 24). Overall salvagesalvage of hatchery steelhead was higher than the 2013/2014 total of 523, however unlike in the previous year more hatchery steelhead were salvaged theatCVP than the SWP. The overall seasonal salvage for hatchery steelhead was higher compared to the data from the past nine water years (Figure 12, pg. 25).

Green Sturgeon Incidental Take

The incidental take level for green sturgeon was set at 74 fish for water year 2016 and is based on historical salvage. In the 2015/2016 period, 1 Green Sturgeon was observed at the State Water Facility on 1/22/16, with a forklength of 596 mm. There was no Green Sturgeon observed at the federal facility. Interestingly, it was the first Green Sturgeon observed since 2010/2011(Figure 14, pg. 27).

Delta Hydrology

Water Year 2016 marked the fifth consecutive year of California's drought. On January 17, 2014, California State Governor declared a drought state of emergency and it has since continued. As of March 30, 2016, The California Department of Water Resources measured the statewide snowpack to be at 87% of the normal for the date. As of June 13, 2016, the statewide snow water level was 6% of the normal for the date. More information on drought can be found at http://ca.water.usgs.gov/data/drought/.

Overall, average exports for Sacramento River and San Joaquin River were both higher in 2015/2016 than they were in 2014/2015. Water year 2015 was classified as a "below normal" water year type for the Sacramento Valley, and as a "critical" water year type for San Joaquin Valley. Table 5 33shows a monthly average summary of SWP and CVP exports, Sacramento and San Joaquin River flows, and Delta outflow.

Modeled volumetric water fingerprints derived from the Delta Simulation Model 2 (DSM2) at Clifton Court Forebay (SWP) and at the Jones Pumping Plant (CVP) are presented in Figure 16 and 17. Data for the month of Ocotber could not be included in the Figures as the fingerprints were not produced until November, 2015 due to modeling difficulties. Overall, these fingerprints show that the majority of the water from the SWP typically came from the Sacramento River, which is similar to the previous year. In 2013/2014 water, water at CVP was more evenly split between the Sacramento and the San Joaquin Rivers, but this year and in thelast year slightly more water was from the Sacramento River (Fig 17, pg. 29).

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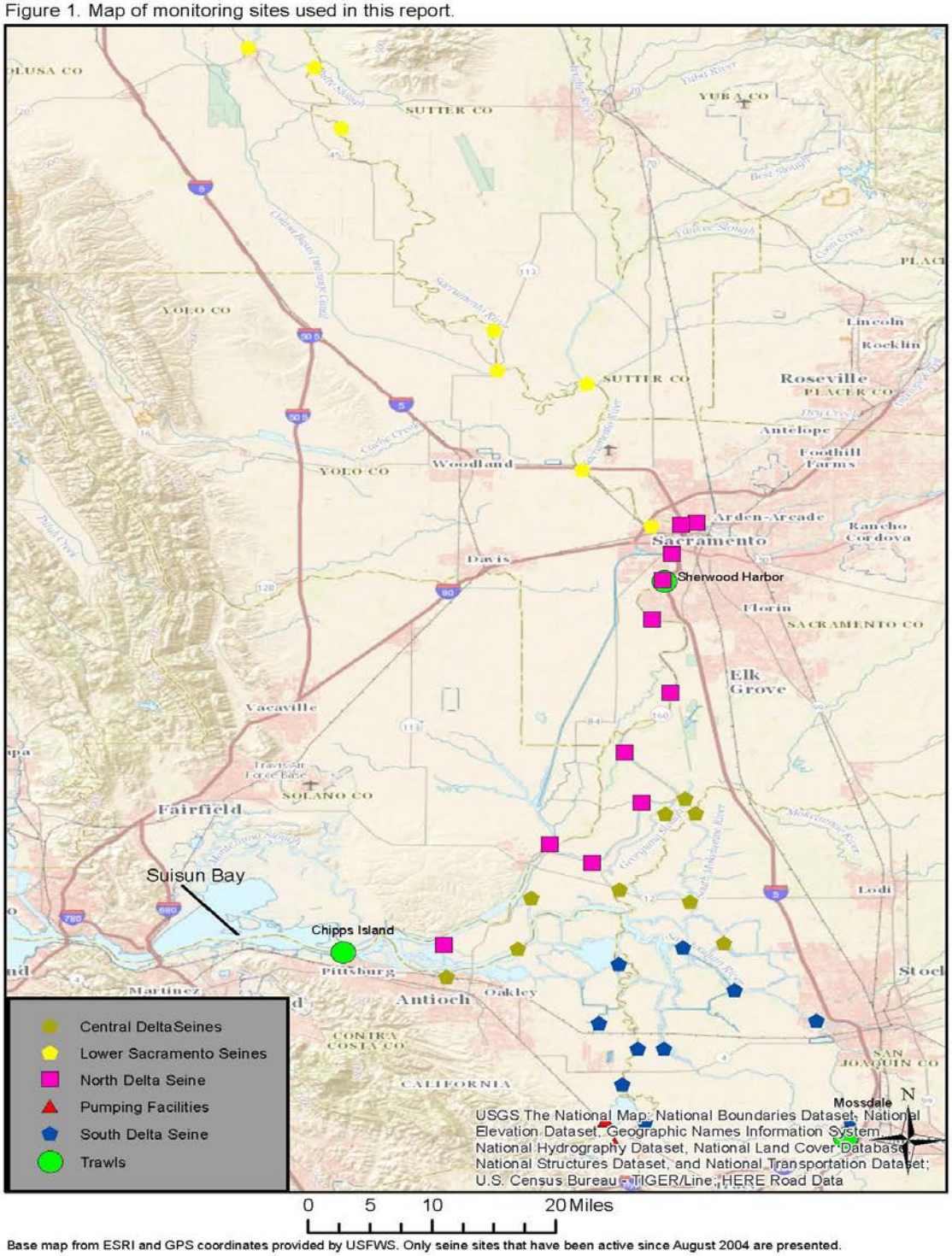
Figure 1. Map of monitoring sites used in this report.



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

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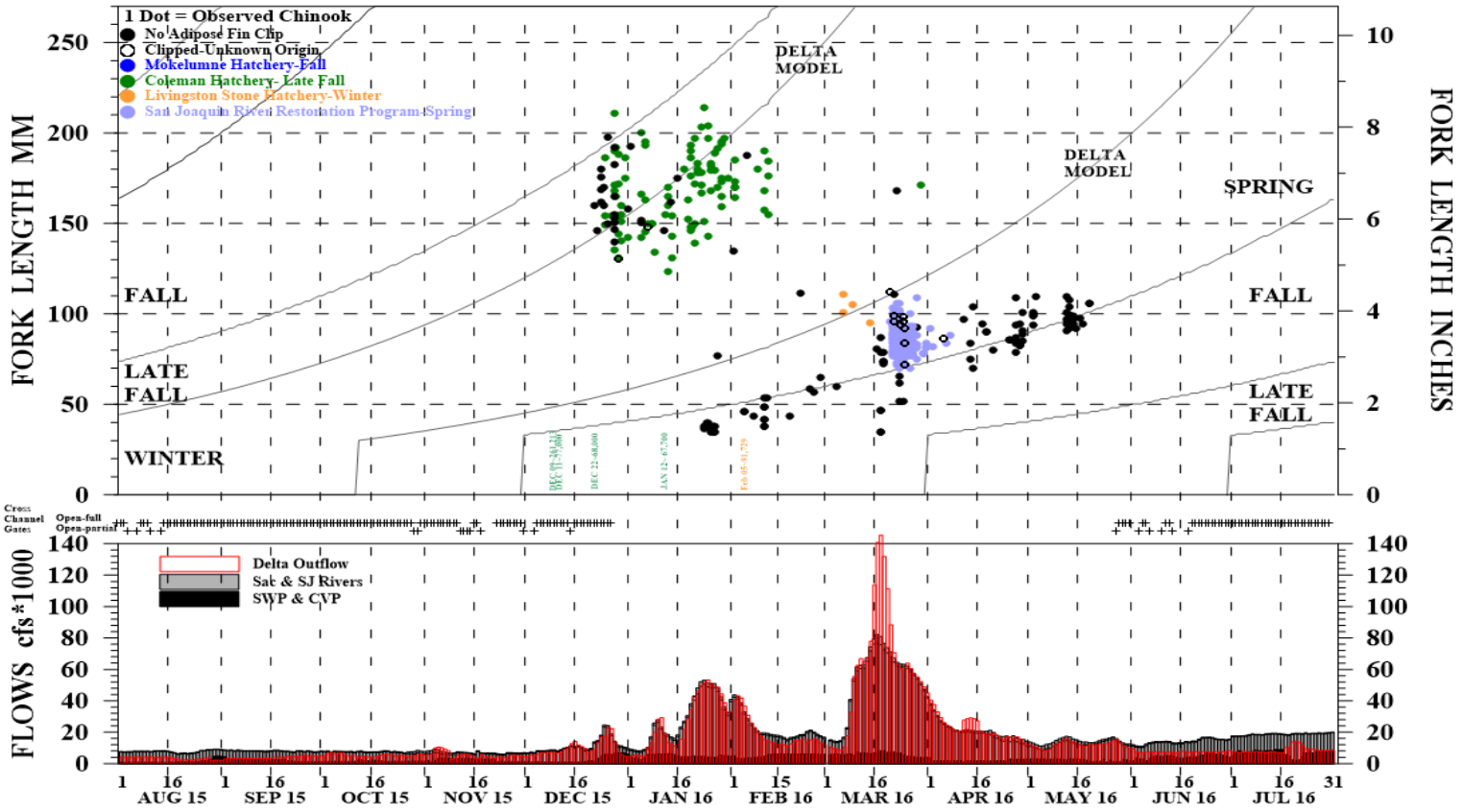

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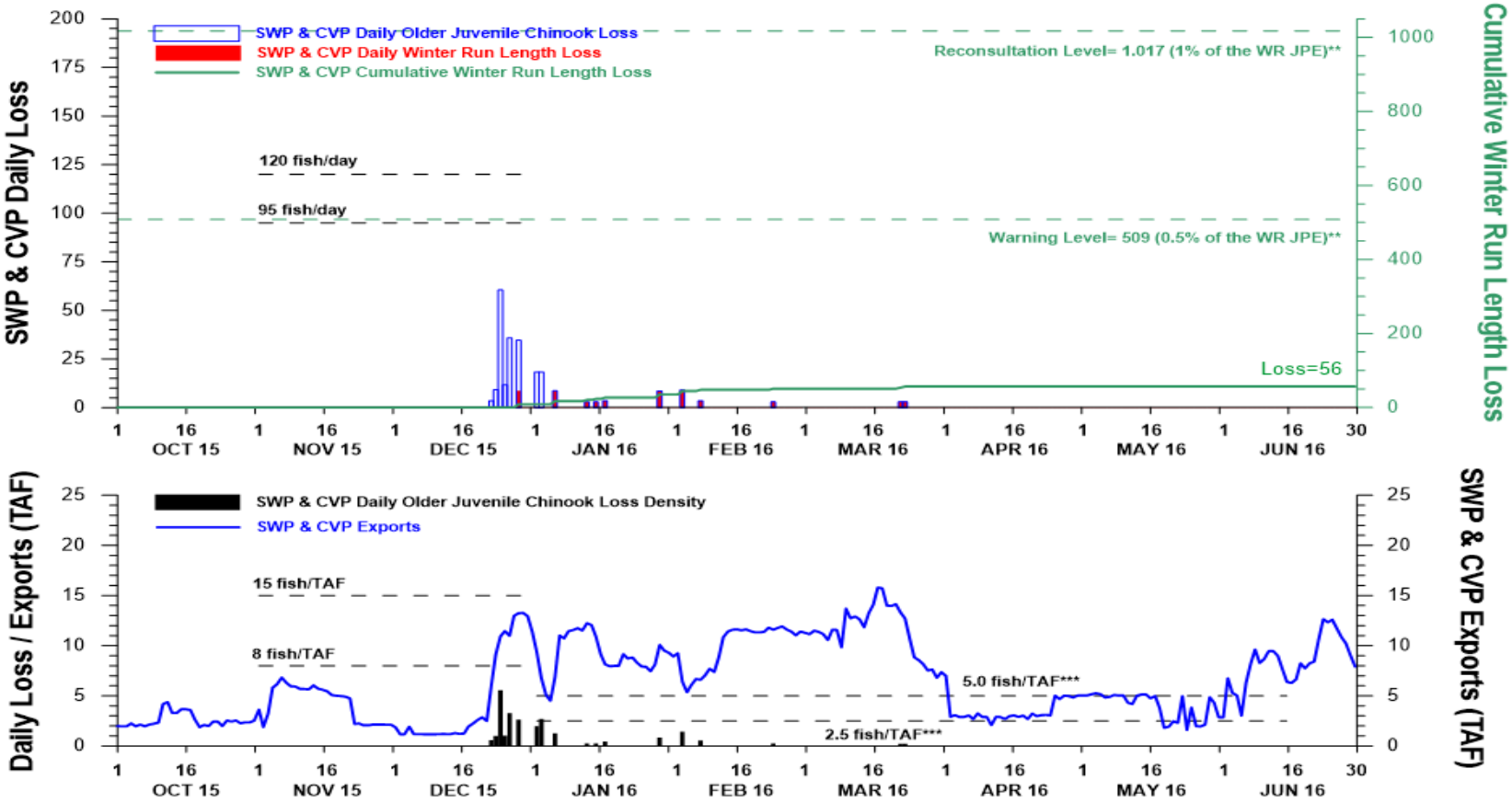


Figure 4. Non-clipped winter-run length Chinook Salmon loss at the Delta fish facilities from October to June using the current loss equation (DFW 2013), water years 2005 through 2016.

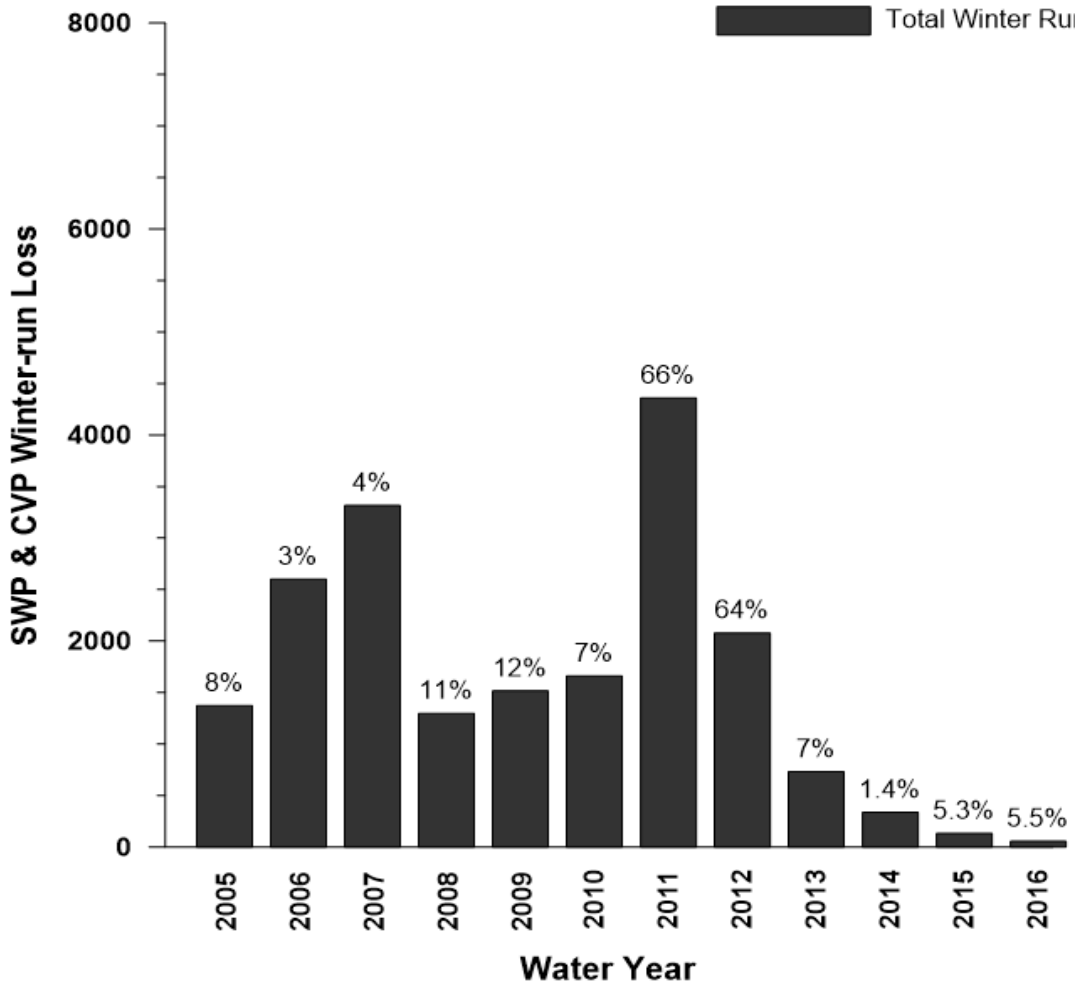
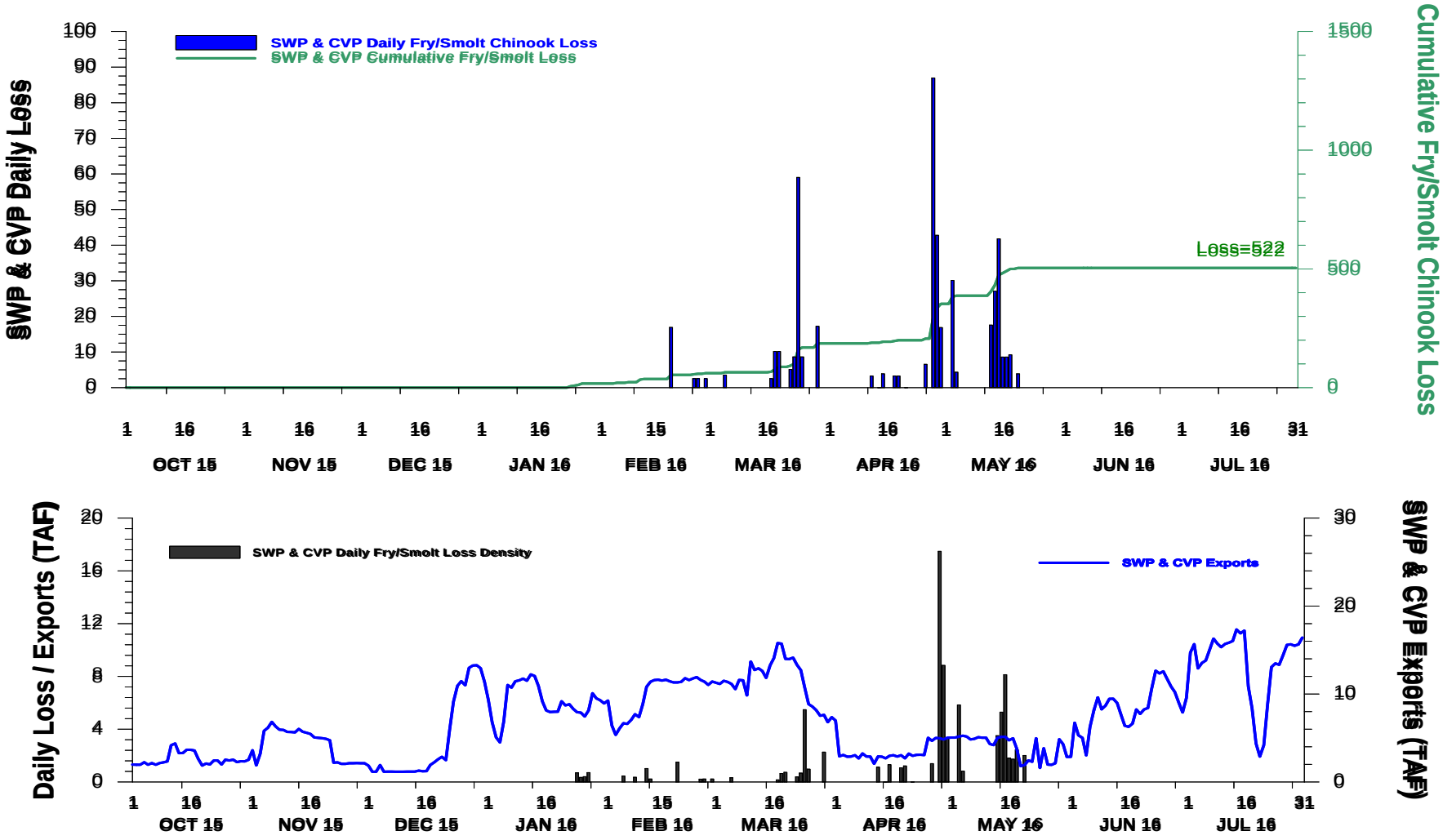


Figure 5. Daily loss and loss density of non-clipped fry/smolt Chinook Salmon at the Delta fish facilities using the current loss equation (DFW 2013), October 1, 2015, through July 31, 2016.



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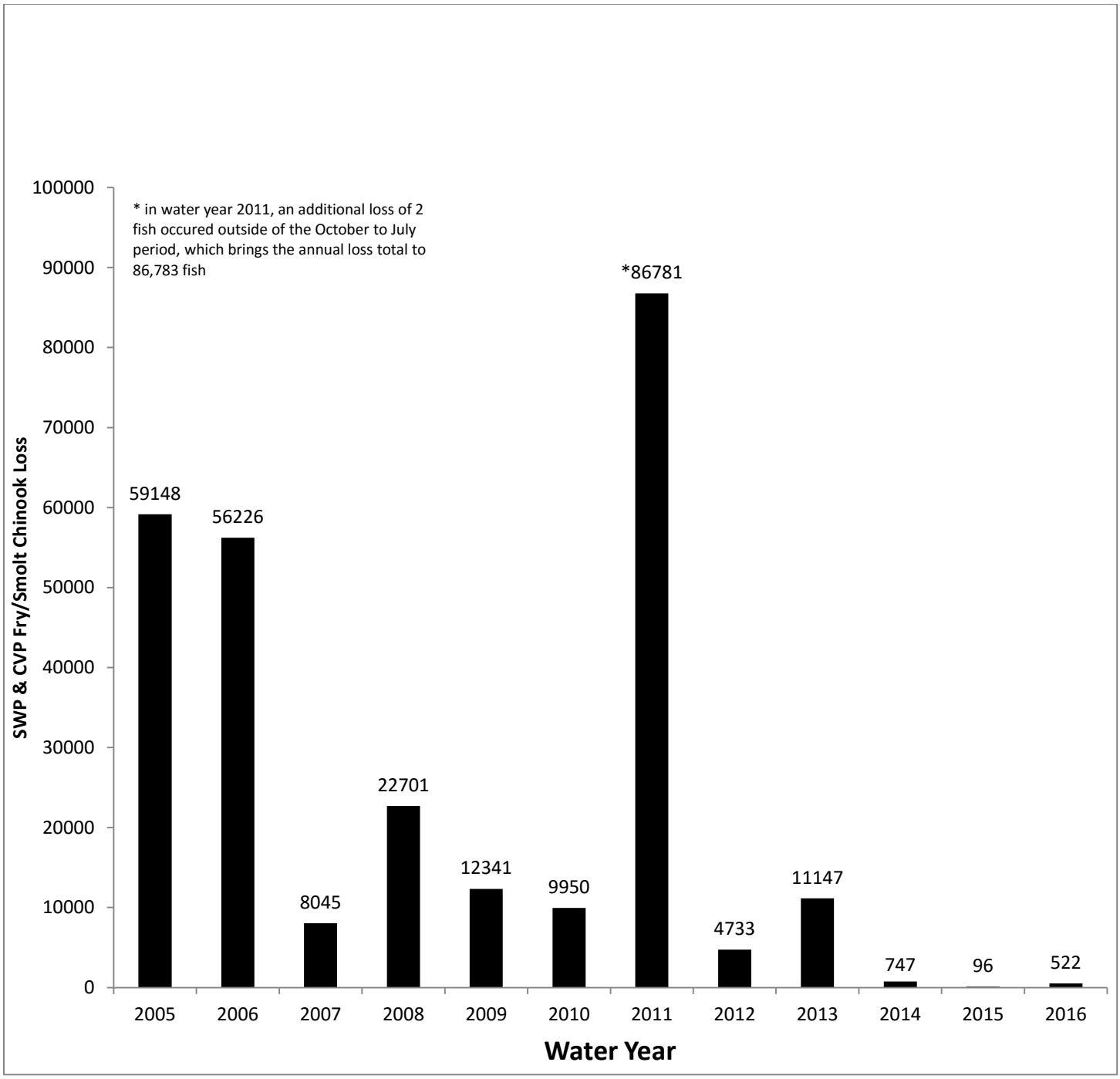

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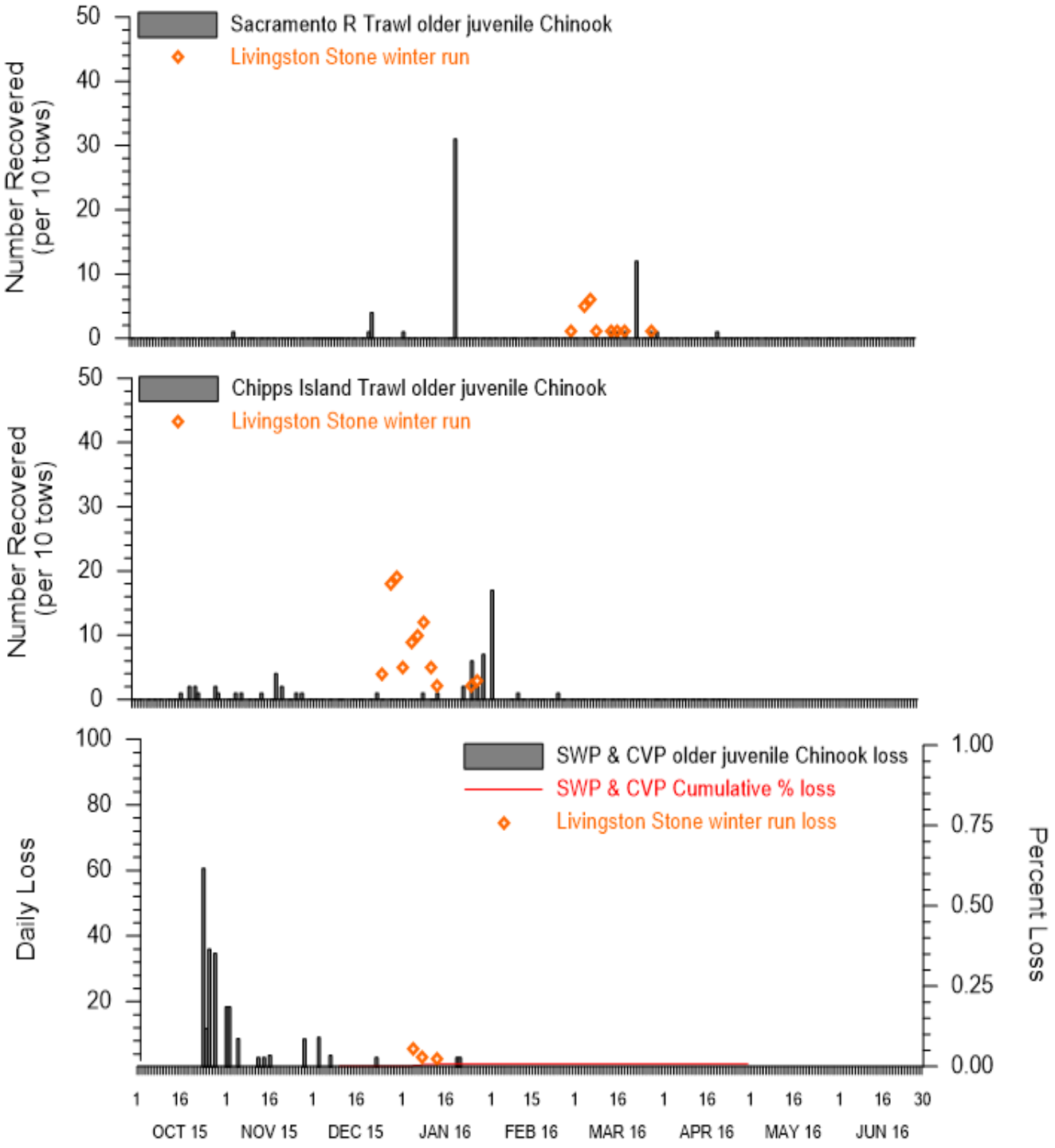

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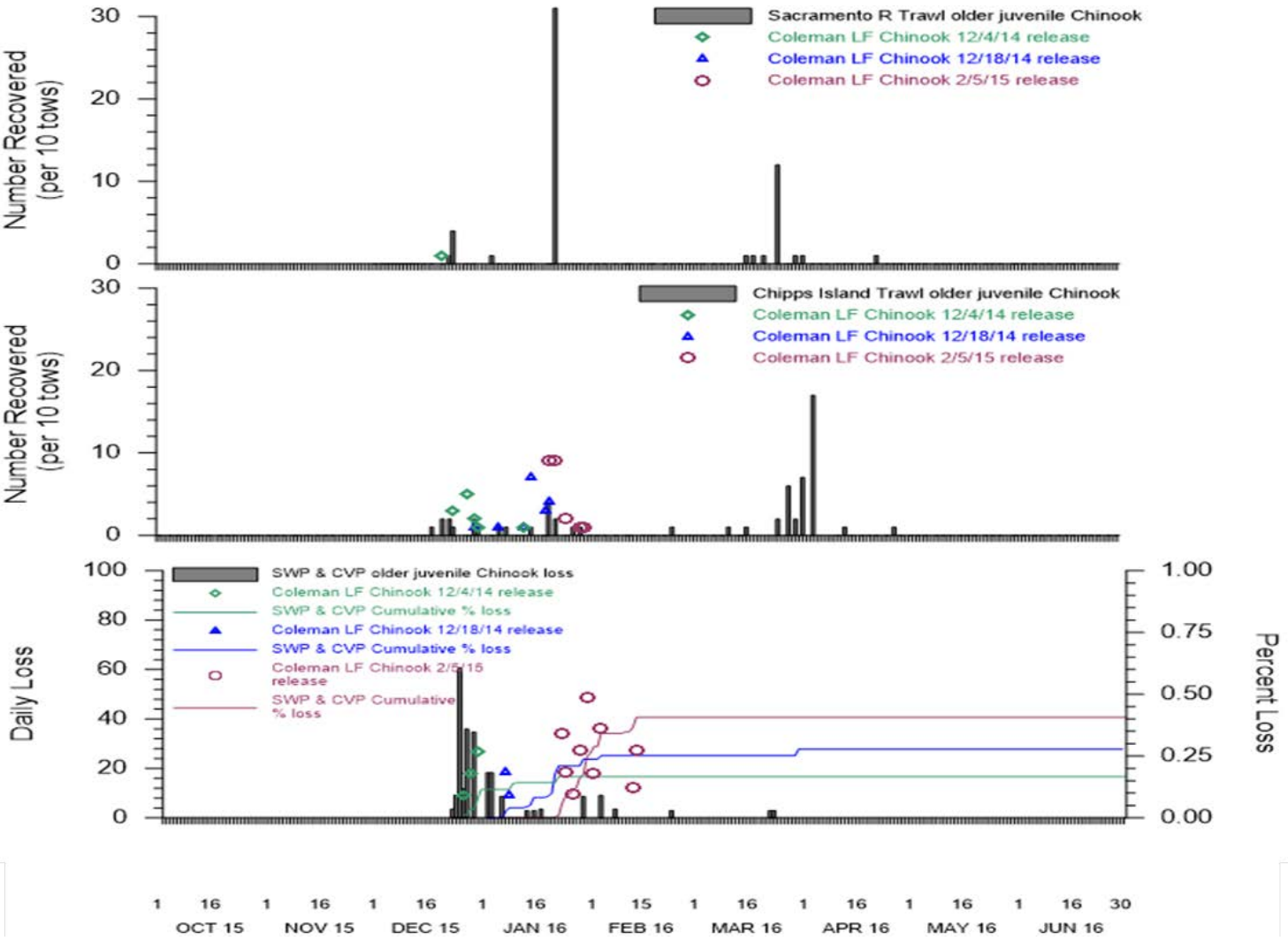

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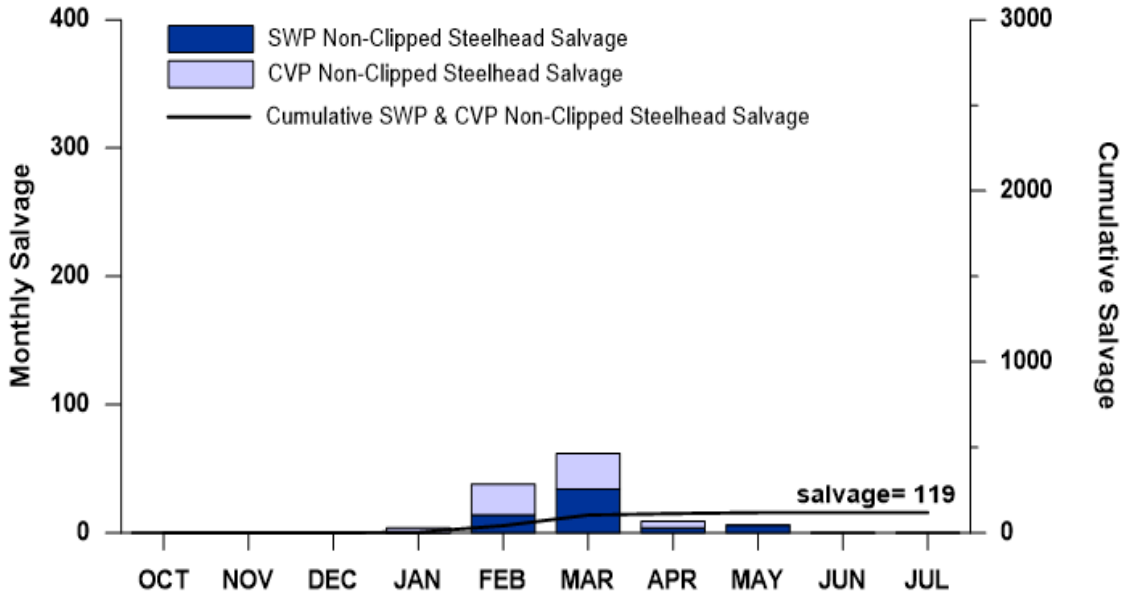
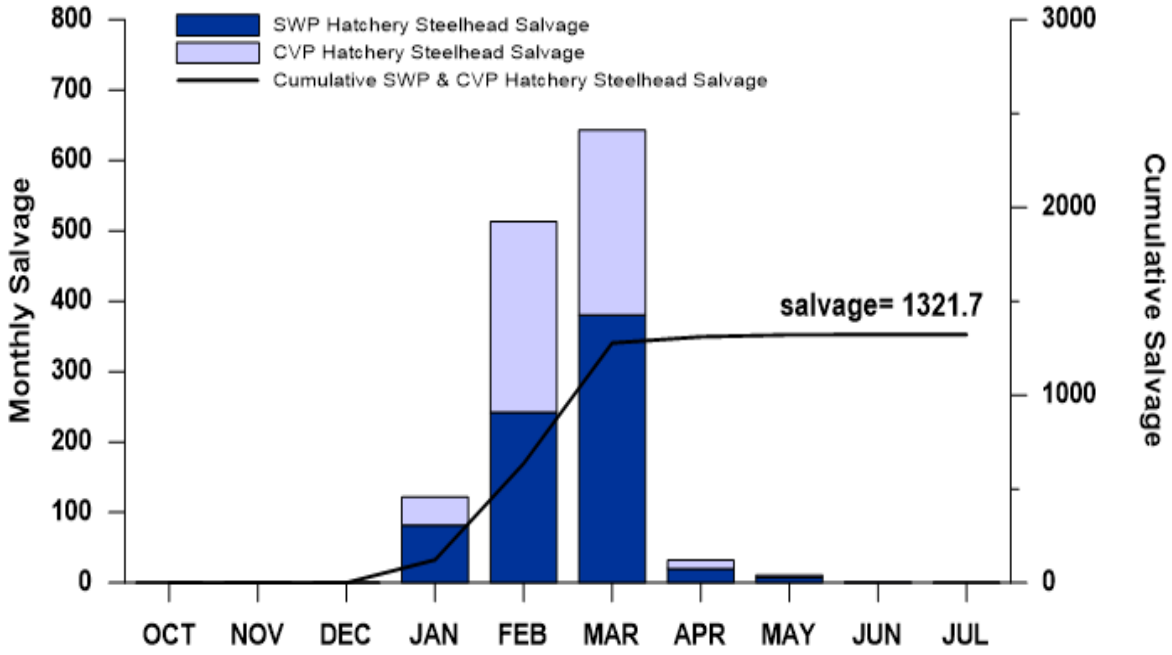


Figure 10. Hatchery (adipose fin clipped) steelhead salvage at the Delta fish facilities, October 2015 through July 2016.



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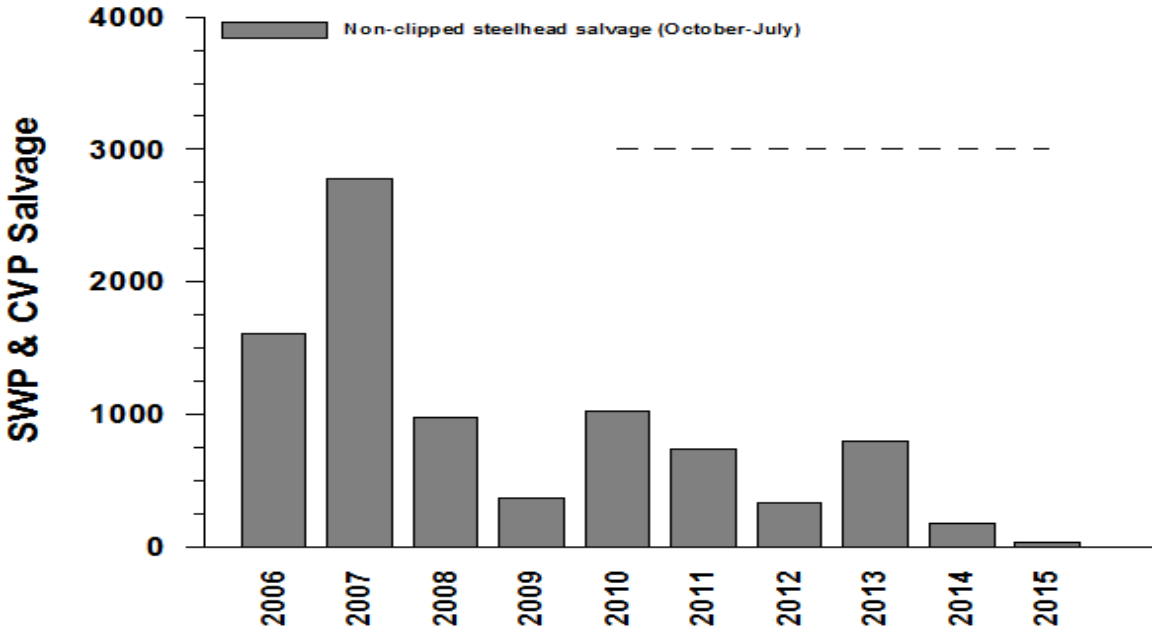

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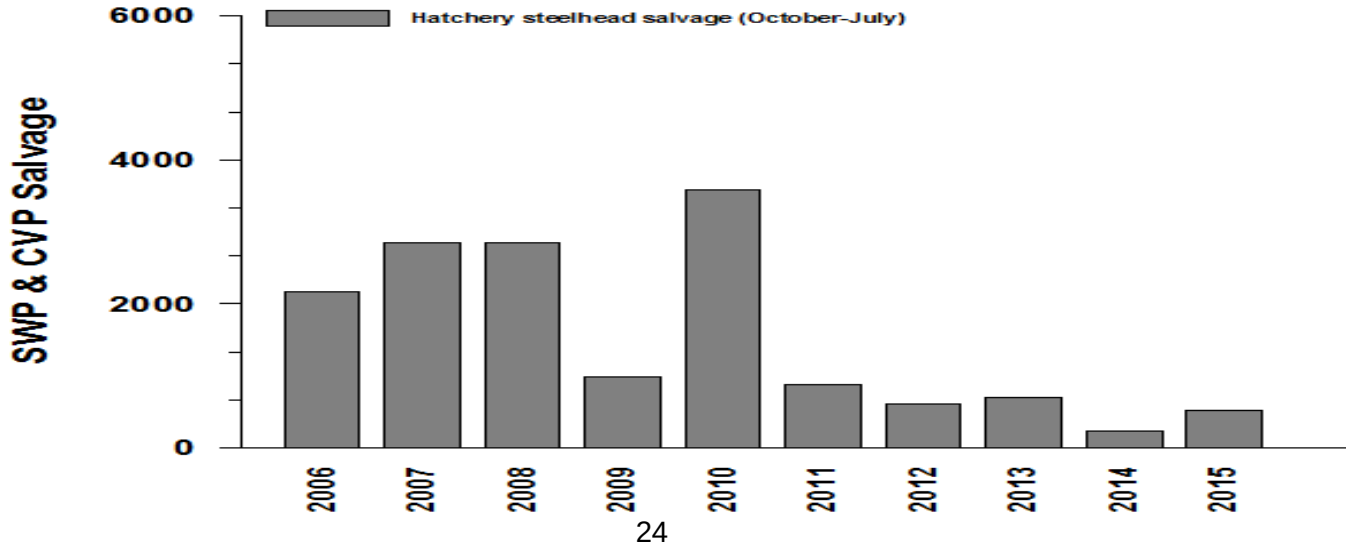

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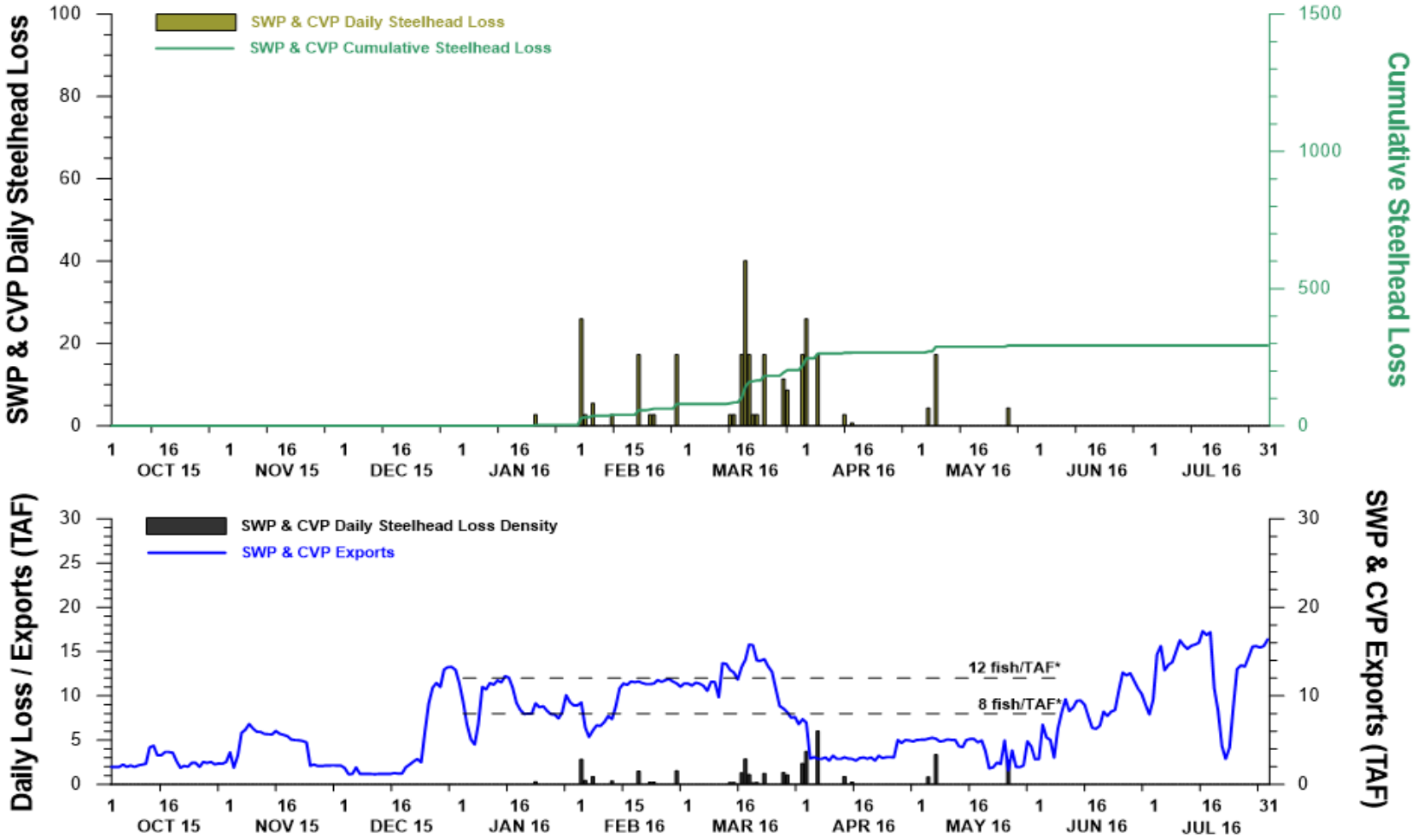

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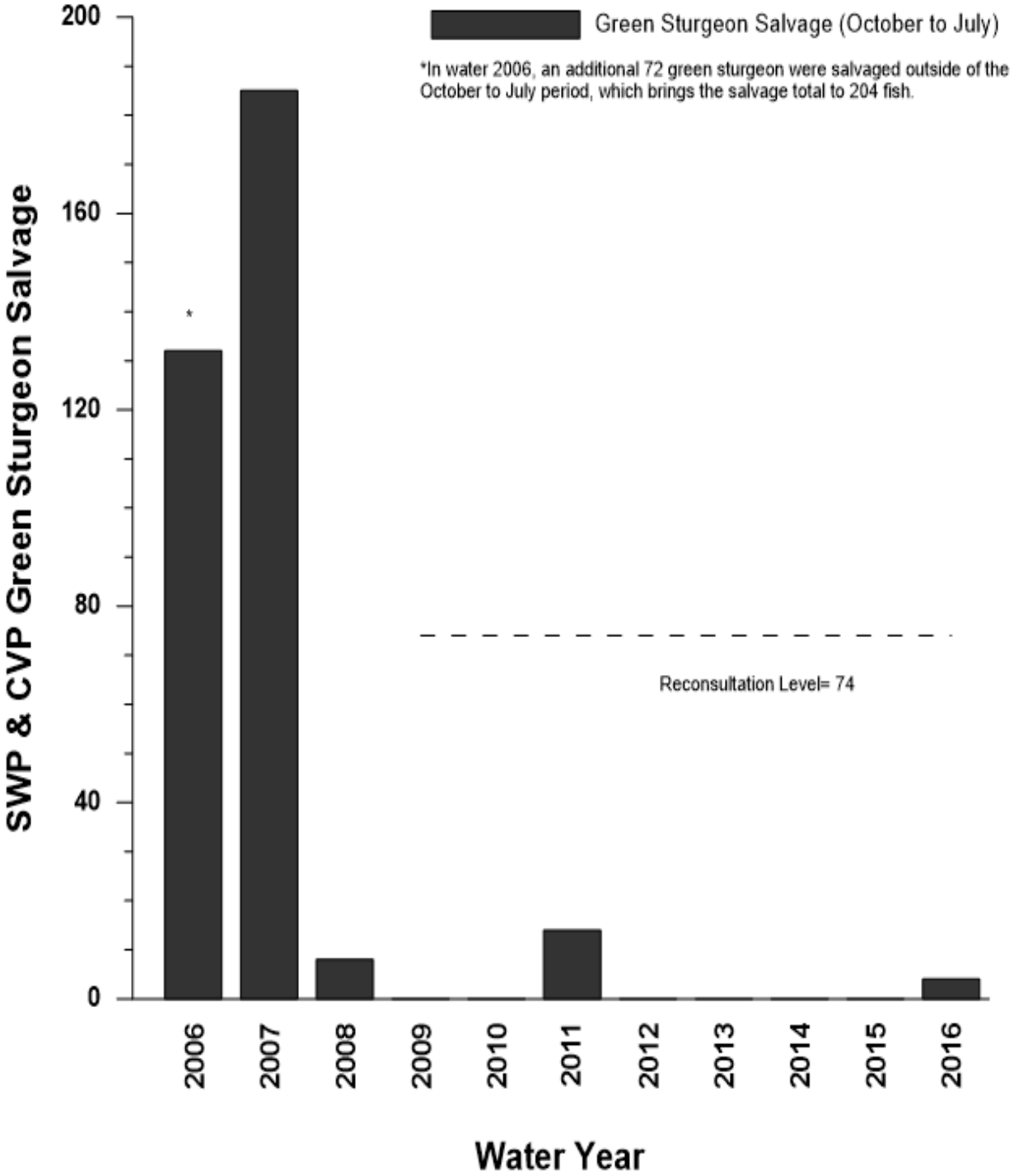
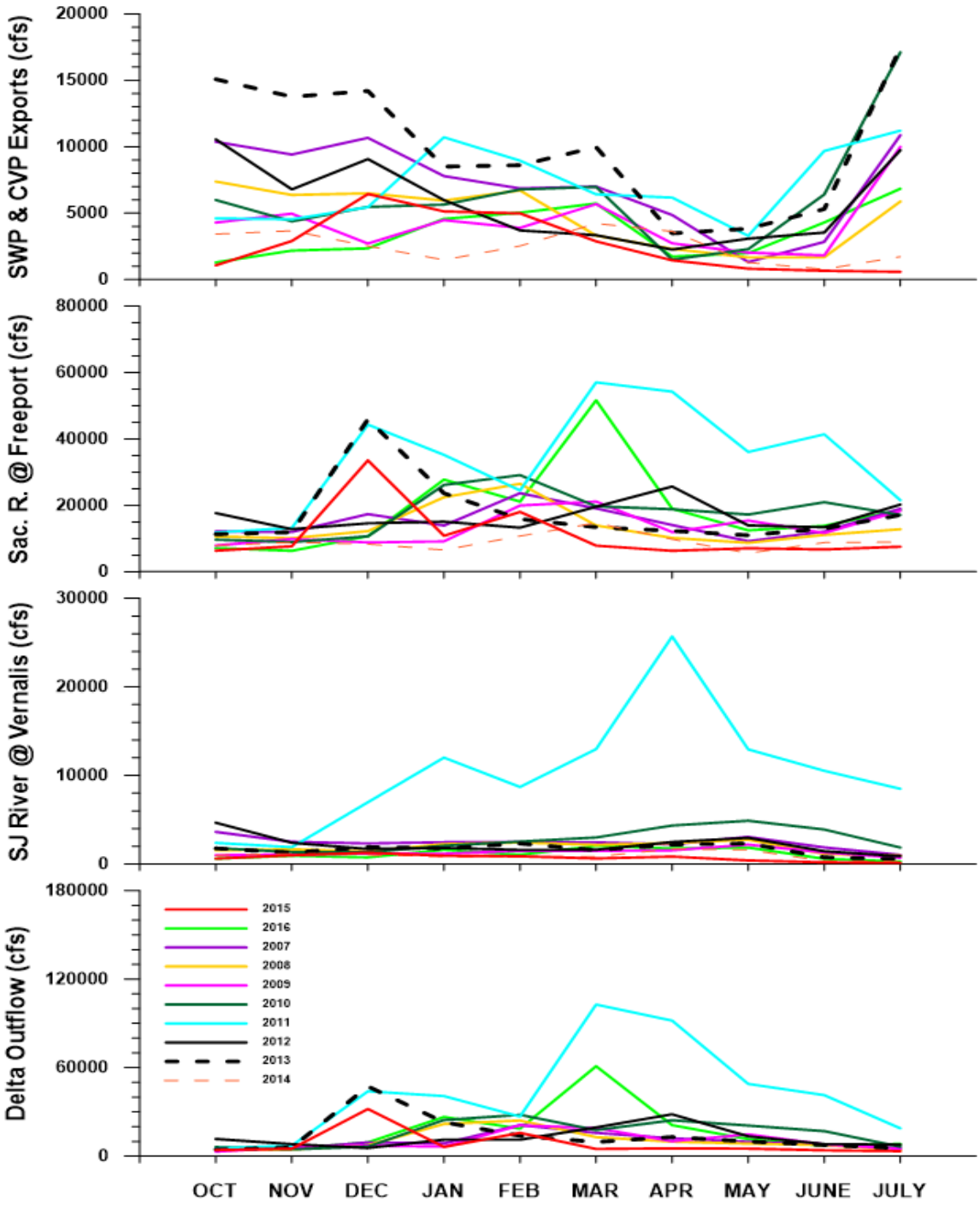


Figure15. Monthly averages of Delta hydrology from October to July, water years 2007 through 2016.



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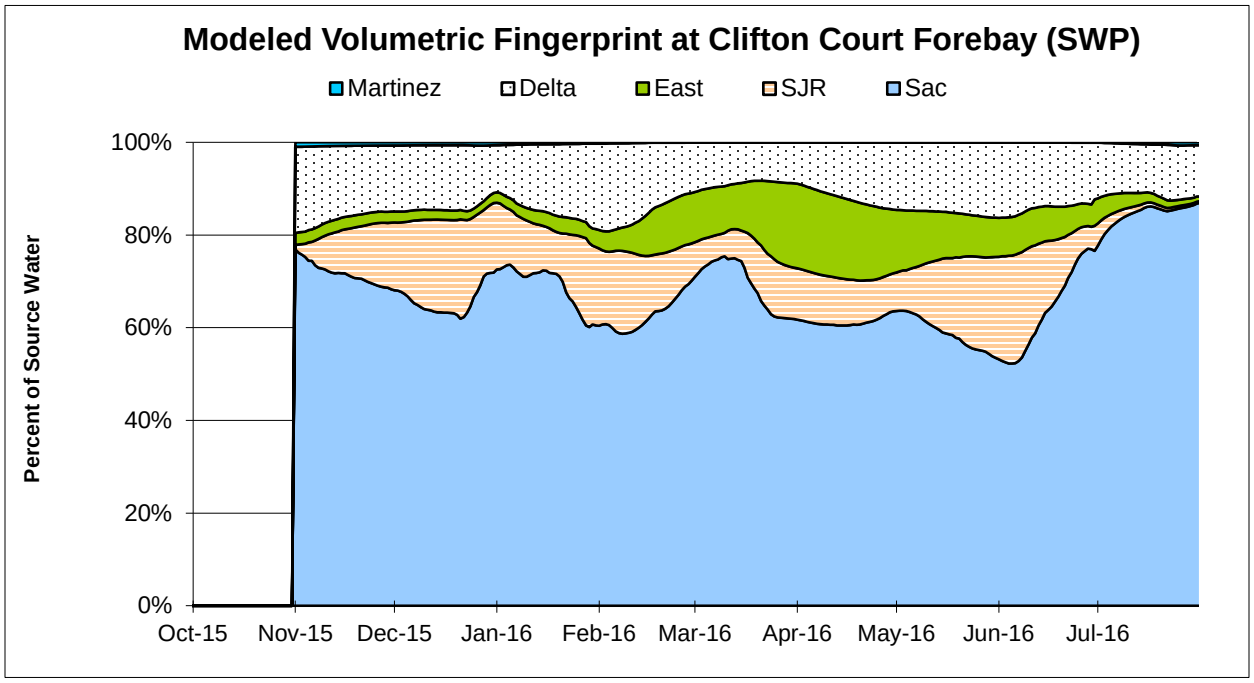
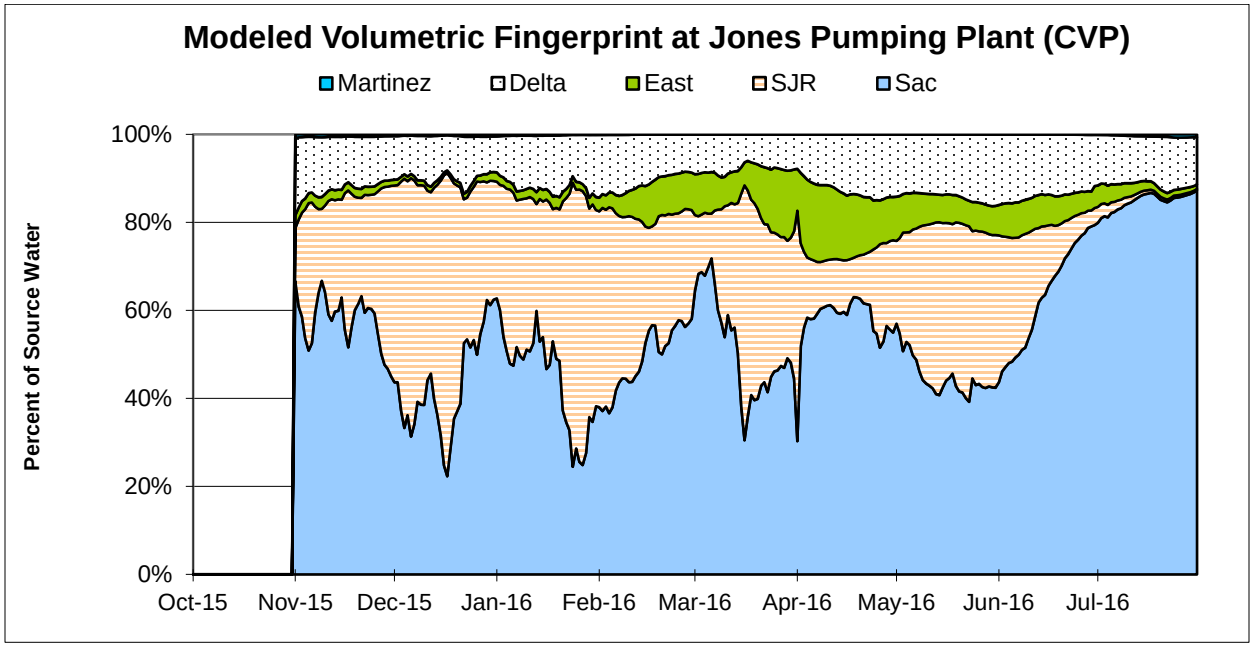


Figure 17. Modeled volumetric water fingerprint for the Jones Pumping Plant (CVP) as derived from DSM2, October 2015 through July 2016.



Delta fingerprint figures from DWR-Operations Control Office.

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Table 1. Juvenile Chinook Salmon Salvage Genetic Samples October 2015 through June 2016.

Salvage Record						
	Count	**Samples Collected**	**Samples processed**	**Successful Samples**	**Failed**	
SWP	55	54	54	47	7	1 not collected.
CVP	56	55	54	54	0	1 not collected, 1 collected but not submitted.

Table 2. Juvnile Chinook Salmon October 2015 through June 2016

	Fall	**Late-Fall**	**Winter**	**Spring**	
	LAD/GA	**LAD/GA**	**LAD/GA**	**LAD/GA**	
SWP	15/40	15/5	19/1	6/1	7 failed samples.
CVP	20/46	2/1	27/6	7/1	0 failed samples

Table 3. Hatchery (adipose fin clipped) Chinook Salmon loss at the Delta fish facilities using the current loss equation (DFW 2014), October 2015 through June 2016.

Release Date	CWT Race	Hatchery	Release Site	Release Type	Confirmed Loss	Number Released[1]	Total Entering Delta	% Loss of Number Released[2]	% Loss of Total Entering Delta[3]	First Concern Level	Second Concern Level	Date of First Loss[4]	Date of Last Loss[4]
6/11/2015 to 6/12/2015	LF	Coleman NFH	Balls Ferry Boat Ramp, Sacramento River	Production	0.00	434,227	n/a	0.000	n/a	n/a	n/a	*	*
12/9/2015	LF	Coleman NFH	Battle Creek	Production	305.22	261,213	n/a	0.117	n/a	n/a	n/a	12/25/2015	2/12/2016
12/11/2015	LF	Coleman NFH	Battle Creek	Spring Surrogate	128.05	77,000	n/a	0.166	n/a	0.5%	1.0%	12/25/2015	1/21/2016
12/22/2015	LF	Coleman NFH	Battle Creek	Spring Surrogate	188.93	68,000	n/a	0.278	n/a	0.5%	1.0%	1/6/2016	3/29/2016
1/12/2016	LF	Coleman NFH	Battle Creek	Spring Surrogate	278.65	67,700	n/a	0.412	n/a	0.5%	1.0%	1/20/2016	2/12/2016
2/17/2016 to 2/18/2016	W	Livingstone NFH	Sacramento River	Winter Run Production	11.19	420,006	155400	0.003	0.07190	0.5%	1.0%	3/6/2016	3/14/2016
3/14/2016	F	Coleman NFH	Battle Creek	Fall run Production	0.00	864,486	n/a	0.000	n/a	n/a	n/a	*	*
3/18/2016	S	River Restoration	San Joaquin River	River restoration program	439.33	45,000	n/a	0.976	n/a	n/a	n/a	3/20/2016	4/6/2016
3/19/2016	S	Feather River Hatchery	San Joaquin River	River restoration program	82.156	60,000	n/a	0.136	n/a	n/a	n/a	3/21/2016	4/7/2016
2/1/2016	F	Coleman NFH	Yolo bypass inundated Rice fields at Knaggs Ranch	special study	0.00	6,145	n/a	0.000	n/a	n/a	n/a	*	*
3/1/2016	F	Feather River Hatchery	Yolo bypass at Toe drain and Sacramento river at Elkhorn	special study	0.00	94,000	n/a	0.000	n/a	n/a	n/a	*	*

Table 4. Unknown hatchery (adipose fin clipped) Chinook Salmon loss at the Delta fish facilities using the current loss equation (DFW 2014), October 2015 through June 2016.

Facility	Unknown CWT Loss[5]	Unread CWT Loss[6]	Unknown Hatchery Loss[7]	Acoustic Tag Loss[8]	Number of Unassigned CWTs[9]
SWP	35.30	0.00	0.00	0.00	0
CVP	7.95	0.00	0.00	0.00	0
TOTAL	43.25	0.00	0.00	0.00	0

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

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

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

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

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

Table 5. Monthly averages of hydrologic parameters in the Sacramento-San Joaquin River Delta, October 2015 through July 2016.

	SWP Average Exports		CVP Average Exports		Sacramento River Average Flow	San Joaquin River Average Flow	Delta Outflow Average Flow
Month	taf	cfs	taf	cfs	cfs	cfs	cfs
Oct	15	246	64	1045	7140	613	4957
Nov	40	675	89	1501	6321	939	5126
Dec	76	1244	68	1110	10717	754	9398
Jan	137	2221	145	2353	27760	1612	26596
Feb	123	2139	166	2892	21106	1043	18684
Mar	162	2633	190	3094	51648	2036	61061
Apr	44	731	59	994	18995	1761	21052
May	57	920	66	1074	12481	1862	11649
Jun	192	3228	64	1075	13855	592	7153
Jul	361	5875	59	963	18646	291	8379