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



October 19, 2018

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

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

Dear Ms. Rea:

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

- A summary of the incidental take of natural and hatchery winter-run Chinook salmon (Oncorhynchus tshawytscha), spring-run Chinook salmon (O. tshawytscha) surrogates, Central Valley steelhead (O. mykiss), and green sturgeon (Acipenser medirostris) at the State Water Project's John E. Skinner Delta Fish Protective Facility and the Central Valley Project's Tracy Fish Collection Facility.
- 2. A summary of the data acquired through the salmonid monitoring program for the lower Sacramento River and the Delta, along with a summary of the Delta hydrologic conditions.

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

Sincerely,

Am L. Mm

Dean F. Messer, Chief Division of Environmental Services

Enclosure

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

October 19, 2018

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

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

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

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

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

DOSS:

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

In addition to those sites, during 2017/2018 season, fish monitoring data were reviewed from SacPAS website:

http://www.cbr.washington.edu/sacramento

Data Acquisition

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

Methods for Measuring Incidental Take

Current Method

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

Alternative Methods

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

- 1) Jahn (2011), which describes an alternative technique for estimating point and confidence interval estimates of loss;
- 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
- 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).

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

- Task 1: Complete Second Opinion Report on IRP Recommendations
 - The final copy of the second opinion report was received from the consultants on August 11, 2015 and was accepted by the technical team members
- Task 2: Provide Monte Carlo Script(s) from Teply and Ceder (2013) and Prepare Associated Report on Script(s).
 - No work was done on Task 2 yet as the technical team members have agreed to proceed with Task 3 instead.
- Task 3: Develop New Loss Method and Tool with Report.
 - Contractors have conducted the first workshop with technical team to review what the technical team needs for the new method and tool for estimating loss. The second workshop was conducted on October 8, 2015.
- Task 4: Complete Study Design Recommendation Report.
 - Contractors have recommended some additional studies during the first workshop and provided more as Task 3 progressed.
- Task 5: Project Management.
 - Contractor provided general project management, including coordination of staff, administrative support, and contract administration throughout the execution of the Task Order.

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

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

Observed Chinook Salmon Salvage

Figure 2 describes the observed Chinook Salmon salvage at the Delta fish facilities in 2017/2018 from normal salvage counts, special studies, and secondary flushes. However, Figure 2 does not include any Chinook Salmon whose run cannot be classified using the Delta model length-at-date criteria (LAD)

(https://water.ca.gov/LegacyFiles/aes/docs/ValidatingLength-at-

DateRunassignments.pdf) . This includes Chinook Salmon that are larger than the length-at-date criteria considered in the model, and any Chinook Salmon that were not measured for length. In 2017/2018, fork lengths were obtained for all Chinook Salmon salvaged at the Delta fish facilities. Total juvenile Chinook Salmon salvage was 19,137, with an expanded combined loss of 33,631. Overall, the number of sub-adults observed at Delta fish facilities were lower than the previous year. At CVP, 96 sub-adults of an undetermined run of Chinook Salmon were salvaged that fell outside of the length-at-date criteria (greater than 500 mm fork length) during 2016/2017 season and no sub-adults were observed during 2017/2018 season. At SWP, 6 sub-adults of an undetermined run of Chinook were observed during the 2016/2017 season and 4 sub-adults were observed during 2017/2018 season. All observed sub-adults were greater than 500 mm of fork length and therefore no loss was calculated for those fish.

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

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

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

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

Observed Chinook Salmon Genetic Run Assignment

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

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

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

Rapid Genetic Testing Protocol

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

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

Winter-run Chinook Salmon

Winter-run Chinook Salmon Incidental Take

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

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

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

More detailed information on rationales provided by NMFS for this year's JPE estimation can be found at:

http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Delta%20Operations%20for%20Salmonids%20and%20Sturgeon/DOSS%20WY%20 2018/Winter-run_juvenile_production_estimate_jpe_for_brood_year_2017_-_january_29__2018__1_.pdf

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

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

Hatchery Winter-run Chinook Salmon Incidental Take

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

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

Spring-Run Chinook Salmon

Under the 2009 NMFS Biological Opinion, NMFS uses hatchery-reared subyearling Late Fall-run Chinook Salmon as surrogates for yearling Spring-run Chinook Salmon emigrating from the upper Sacramento River and tributaries into the Delta. According to NMFS, these late Fall-run Chinook Salmon are used as surrogates because they are generally released and begin their smoltification and emigration and passage through the Delta at approximately the same time, and at a similar size, as wild Spring-run. The Coleman National Fish Hatchery (CNFH) releases a percentage of the total CNFH Late Fall-run Chinook Salmon production as these surrogate release groups.

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

Measuring Incidental Take

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

First Surrogate Release Group and Incidental Take

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

Second Surrogate Release Group and Incidental Take

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

Third Surrogate Release Group and Incidental Take

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

Fry/Smolt Chinook Salmon Loss

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

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

Chinook Salmon Monitoring in the Sacramento River and the Delta

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

Spring-Run Chinook Salmon Surrogate Monitoring

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

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

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

Hatchery Winter-Run Chinook Salmon Monitoring

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

Central Valley Steelhead

Steelhead Incidental Take

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

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

Green Sturgeon Incidental Take

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

Delta Hydrology

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

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

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

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List of Figures



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

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

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



Preliminary data from CDEC, CDFW, CDRW, and BOR; subject to revision. Key: Location-Observation Type (#total estimate:#released for observed). www.cbr.washington.edu/sacramento/ Chinook not measured for length and Chinook outside of the length-at-date criteria (Delta model) are not included. 06 Sep 2018 07:09:04 PDT

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



Older juvenile Chinook defined as matching winter run length-at-date criteria (Delta Model) up to max length-at-date size. 06 Sep 2018 07:09:18 PDT



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

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



Fry/smolt Chinook defined as all Chinook less than the minimum winter run length-at-date criteria (Delta Model). 06 Sep 2018 15:31:15 PDT

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



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

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

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

Preliminary data from CDFW; subject to revision.

www.cbr.washington.edu/sacramento/ 06 Sep 2018 15:32:34 PDT

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

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

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

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

06 Sep 2018 15:32:34 PDT

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

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

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

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

Delta fingerprint figures from DWR-Operations Control Office.

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

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

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

Facility	Unknown CWT Loss ⁵	Unread CWT Loss ⁶	Unknown Hatchery Loss ⁷	Acoustic Tag Loss ⁸	Number of Unassigned CWTs ⁹
SWP	296.14	11	111		
CVP	16.02				
TOTAL	312.16	- Q		2	

⁵Adipose-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). ⁶Adipose-fin clipped Chinook was collected during fish count and has not been processed yet.

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

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

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

Table 3. Monthly averages of hydrologic parameters in the Sacramento-San Joaquin River Delta, October2017 through July 2018.

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

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

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

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

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