UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

JAN 16 2014

Mr. Ron Milligan
Operations Manager, Central Valley Project
U.S. Bureau of Reclamation
3310 El Camino Avenue, Suite 300
Sacramento, California 95821

Dear Mr. Milligan:

This letter provides the U.S. Bureau of Reclamation (Reclamation) with the estimated number of juvenile Sacramento River winter-run Chinook salmon (winter-run, *Oncorhynchus tshawytscha*) expected to enter the Sacramento-San Joaquin Delta (Delta) during water year 2015. In order to provide incidental take for the combined operation of the Central Valley Project (CVP) and the State Water Project (SWP), NOAA's National Marine Fisheries Service (NMFS) calculates a juvenile production estimate (JPE), pursuant to the June 4, 2009, biological opinion on the long-term operations of the CVP and SWP (CVP/SWP Opinion). This estimate is used to determine the authorized level of incidental take, under section 7 of the Endangered Species Act (ESA), for winter-run while operating the CVP/SWP Delta pumping facilities in water year 2015.

The winter-run adult escapement estimate for 2014 was derived from carcass surveys conducted in the upper Sacramento River by the California Department of Fish and Wildlife (CDFW). This information was provided to NMFS via a letter dated December 23, 2014 (enclosure 1). The CDFW estimate of total winter- run escapement in 2014 was **3,015** spawners, which includes 388 collected for hatchery broodstock at the Keswick trap. The 2014 return declined 47 percent from the previous year (6,404 adults in 2013) and was lower than the 16-year average of 6,139 adults (figure 1). The cohort replacement rate, which is a measure of the population's growth rate, was positive for the last two years (figure 2). This indicates that the population is on an improving trend from low abundance in 2010 and 2011. The 2011 adult escapement that the 2014 return originated from was 827 adults, resulting in a 4.13 increase in the population growth rate. The methodology (*i.e.*, Cormack-Jolly-Seber Model) used by CDFW to calculate winter-run escapement in 2014 was the same as in 2013. This method allows the calculation of confidence intervals, which at the 90 percent confidence level were 2,741 to 3,290 fish.

This year's JPE reflects a number of significant changes as a result of: (1) the Independent Review Panel (IRP) review of the JPE in November 2014 (DSP 2014), (2) the Winter-Run Project Work Team (WRPWT) technical review of the survival terms used to calculate the JPE (enclosure 2), and (3) internal discussions with the NMFS-Southwest Fisheries Science Center. Both the IRP and the WRPWT found that the JPE methodology did not adequately represent mortality due to upstream water temperatures and, therefore, overestimates the number of juveniles entering the Delta. This year, based on recommendations from the IRP, we are providing several different methods of calculating the JPE.

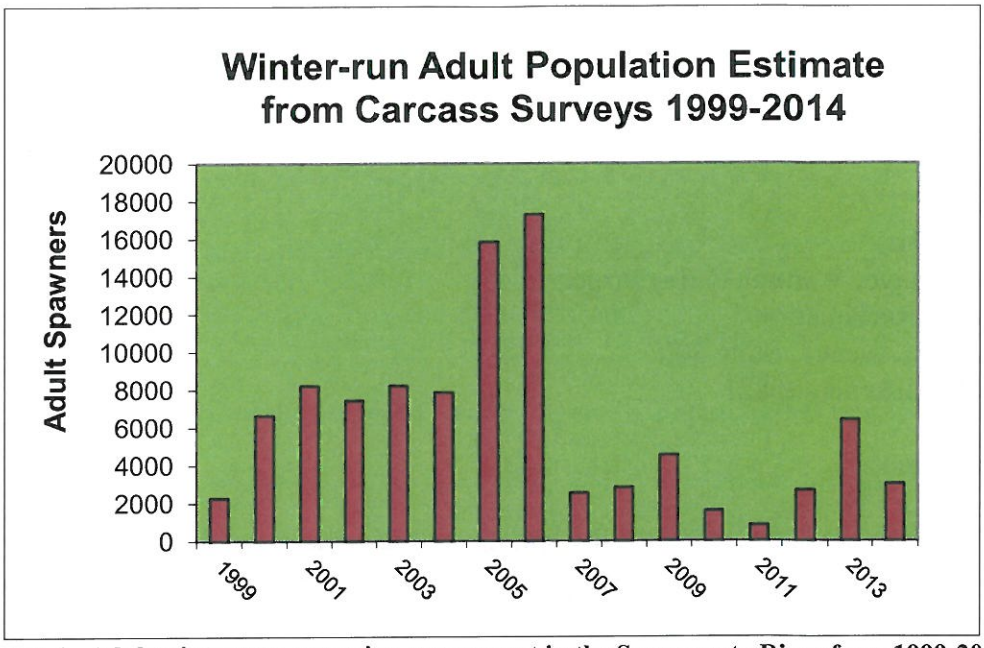

Figure 1. Adult winter-run spawning escapement in the Sacramento River from 1999-2014.

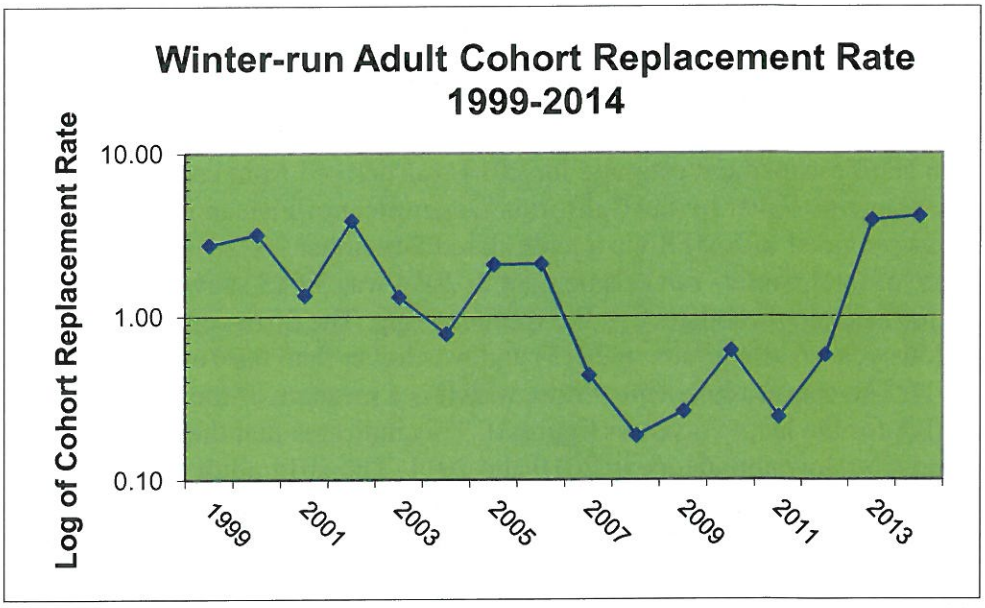

Figure 2. Cohort replacement rate for adult winter-run Chinook salmon from 1999-2014.

JPE methods considered:

1. NMFS spreadsheet model: same as 2013 methodology, however, with different survival terms
2. Cramer Fish Sciences (CFS) model: a systems dynamics computer simulation model that includes Monte Carlo stochastic simulations (CFS 2010)
3. Juvenile Production Index (JPI) method: based on real-time passage estimates at Red Bluff Diversion Dam (RBDD) rotary screw traps, which includes fry-to-smolt survival

Changes this year to the JPE included the survival rate from egg-to-fry (S1). Historically, the S1 survival rate has been based on an average over the last 15 years (*i.e.*, 0.27). This rate was calculated from the adult escapement and passage estimates at RBDD. However, due to the extreme hydrologic conditions in 2014, mortality was very high at this early life-stage and S1 survival was calculated at 0.05 (or 95% mortality) based on the JPI (enclosure 2). Since neither the NMFS nor CFS models accurately represent the extreme conditions and associated loss of juveniles due to high temperatures that occurred in 2014, NMFS decided that using the JPI method was a better fit to the actual hydrologic conditions that winter-run experienced.

In addition, each of the three methods, above, was calculated using three different survival estimates to the Delta (S2) based on the latest winter-run acoustic tag information, for a total of nine separate JPE estimates (Table 1). The method and the survival rate to the Delta (S2) were chosen before seeing the results of the JPE calculations in Table 1. The survival rates were obtained from 2013 and 2014 releases made in February at Caldwell Park near Redding. These survival data represent an improvement over previously-used late-fall run Chinook surrogate releases, which behave differently than winter-run as they migrate downstream.

The survival of juvenile winter-run in the Sacramento River varies depending on in-river conditions (*e.g.,* flows, turbidity, and temperature) and is not known until after the JPE is calculated. Therefore, for this year, based on recommendations from the IRP report (DSP 2014), each of the three methods were used with the following three survival rates (S2) to the Delta as measured from Salt Creek (3 miles downstream of RBDD) to the Tower Bridge (Sacramento) from enclosure 2 (Table 1).

0.16 = survival of juvenile winter-run acoustic tags in 2013
0.29 = average of 2013 and 2014 juvenile winter-run acoustic tags (0.16+0.42/2)
0.42 = survival of juvenile winter-run acoustic tags in 2014

Last year, S2 survival to the Delta was calculated using both 5 years of data from acoustically tagged late-fall run Chinook and one year of data from winter-run acoustic tags. This year because there are now two years of data from winter-run acoustic tags, NMFS chose to use the winter-run data per the advice of the WRPWT technical team. The rationale for this is that winter-run behave differently than the late-fall run Chinook, they are smaller in size at release, and they migrate later in the year (enclosure 2).

Table 1. Winter-run JPE estimates using three methods and three survival estimates to the Delta (S2). Adults and viable eggs estimated based on CDFW escapement estimates. Juvenile Production Index (JPI) based on U.S. Fish and Wildlife Service (USFWS) passage estimates at RBDD up to December 23, 2014.

Methods	Adults	Viable Eggs Estimated	Survival to RBDD (S1)	Juveniles passing RBDD	Survival to Delta (S2)	Juveniles to Delta (JPE)	Annual Take Limit
NMFS[1]	3,015	8,922,854	.27	2,409,171	.16	385,467	7,709
	3,015	8,922,854	.27	2,409,171	.29	698,659	13,973
	3,015	8,922,854	.27	2,409,171	.42	1,011,852	20,237

CFS model[2]	3,015	8,922,854	.20	n/a	.16	278,569	5,571
	3,015	8,922,854	.20	n/a	.29	506,710	10,134
	3,015	8,922,854	.20	n/a	.42	733,850	14,677
JPI at RBDD[3]	3,015	8,922,854	.05	505,506	.16	47,437	949
	3,015	8,922,854	.05	505,506	.29	85,979	1,720
	3,015	8,922,854	.05	505,506	.42	124,521	2,490

1/ NMFS spreadsheet model same as methodology in 2013, S1 is based on 15-year average
2/ Cramer Fish Science (CFS) winter-run production model using temperature data at Clear Creek gage and Freeport flows. S1 is approximate value, varies daily depending on exponential relationship with observed water temperatures (CFS 2010). JPE values to the Delta are at the 95% CI level.
3/ Juvenile Production Index (JPI) is the number of fry equivalents at RBDD, accounting for 95% mortality due to high temperatures, S1 is based on 2014 conditions (enclosure 2).
n/a = not available from the CFS model

An in-river survival rate (S2) of 0.42 was used for broodyear 2014 based on the advice of the WRPWT and the rationale that high flows in December most likely caused the majority of juvenile winter-run to emigrate to the Delta instead of holding upstream [see Delta Operations for Salmonids and Sturgeon (DOSS) technical team notes dated December 30, 2014 (http://www.westcoast.fisheries.noaa.gov/publications/Central_Valley/Water%20Operations/Delta%20Operations%20for%20Salmonids%20and%20Sturgeon/DOSS%20WY2015/2014.12.23_final_doss_notes.pdf); >90 percent of winter-run are now in the Delta]. Using the JPE as defined in the CVP/SWP Opinion (*i.e.*, survival to the Delta but not through the Delta), and based upon the best available information, NMFS estimates that 124,521 natural origin juvenile winter-run will enter the Delta during water year 2015 (enclosure 3). The emigration period for winter-run into the Delta typically runs from November through April, based upon CDFW historical monitoring data at Knights Landing rotary screw traps.

An additional approximately 640,000 hatchery-reared juvenile winter-run propagated at Livingston Stone National Fish Hatchery (LSNFH) will be released into the upper Sacramento River near Redding in January or February, 2015. The hatchery production in 2014 was increased to compensate for the expected losses in natural production due to drought conditions (*i.e.*, low cold water pool volume at Shasta Reservoir, resulting in high water temperatures in the Sacramento River). All hatchery-produced winter-run will be coded-wire tagged and marked with an adipose fin clip, so that they can be identified from other hatchery fish. Since the hatchery fish have not been released yet, the survival rate to the Delta (S2) is unknown. NMFS used the average of the 2013 and 2014 winter-run acoustic releases (S2 = 0.29) to estimate how many hatchery fish would enter the Delta (enclosure 2). NMFS estimates that approximately 188,500 juveniles from LSNFH will survive to enter the Delta during water year 2015 (enclosure 3).

The authorized incidental take limit for the combined CVP/SWP Delta pumping facilities includes both the natural (wild) and hatchery-produced juvenile Sacramento River winter-run Chinook salmon, as both are considered necessary components of the population for survival and recovery of the species. The authorized incidental take for naturally-produced Sacramento River winter-run Chinook salmon has been established as 2 percent of the JPE [The incidental take

limit is actually 1 percent of the JPE based on genetically determined winter-run, however, a 50 percent allowance is provided due to the uncertainties in the length-at-date criteria and difficulty in identifying juveniles of other races (*i.e.*, fall-run, late-fall run, and spring-run Chinook salmon)]. The incidental take for hatchery winter-run is set at one percent of the LSNFH release because all are marked with CWTs and the race is known. Therefore, the authorized level of incidental take (*i.e.*, reported as loss) under the ESA for the combined CVP/SWP Delta pumping facilities from October 1, 2014, through June 30, 2015, is set at **2,490 natural (non-clipped or wild)**, and **1,885 hatchery-produced** Sacramento River winter-run Chinook salmon. If the incidental take exceeds 1 percent of the natural production entering the Delta (*i.e.*, 1,245) or 0.5 percent of the hatchery production (*i.e.*, 943), Reclamation and the California Department of Water Resources (DWR) must immediately convene the Water Operations Management Team (WOMT) to consider actions to minimize incidental take, pursuant to the CVP/SWP Opinion.

Old and Middle River flow management Action IV.2.3 in the reasonable prudent alternative (RPA) of NMFS' CVP/SWP Opinion includes an action trigger based on the JPE. Specifically, one of the triggers is when the daily SWP/CVP older juvenile Chinook salmon loss density [fish per thousand acre-feet (taf) exported] is greater than incidental take limit divided by 2000 (2 percent WR JPE ÷ 2000). For juvenile winter-run in broodyear 2014, the first stage JPE-based action trigger would have been a combined loss density of 1.25 (2,490/2000) older juvenile Chinook salmon per taf exported. However, during the development of the RPA action, NMFS provided flexibility in establishing a minimum loss density of 2.5 fish per taf exported for the first stage trigger before an action response is warranted. This minimum loss density would allow for more water to be exported before a loss density trigger is exceeded.

The initial identification of naturally-produced (non-clipped) winter-run Chinook salmon at the CVP/SWP Delta fish facilities shall be based on the length-at-date criteria for the Delta developed by the USFWS in cooperation with CDFW and DWR. As additional information becomes available through genetic analysis of tissue samples and other fisheries monitoring programs (*e.g.*, acoustical tag studies) in the Central Valley, estimates of the incidental take at the Delta fish facilities may be adjusted, if deemed scientifically sound by NMFS.

NMFS will continue to monitor daily salvage and loss, and loss densities of Sacramento River winter-run Chinook salmon and other ESA-listed species at the Delta fish salvage facilities through participation in the DOSS technical team and the WOMT. We appreciate the opportunity to provide Reclamation and DWR with information related to the juvenile production of Sacramento River winter-run Chinook salmon.

NMFS acknowledges that additional research using acoustically-tagged winter-run (both hatchery and wild) is necessary to provide a more robust estimate of in-reach survival of winter-run in the Sacramento River, and would provide direct calculation of survival, and greatly improve the accuracy of the JPE. We support the continuation of acoustic tag studies on winter-run to provide data on survival rates over a range of hydrologic conditions, and are encouraged that Reclamation has provided funding to continue these studies.

If you have any questions regarding this correspondence, or if NMFS can provide further assistance, please contact Mr. Bruce Oppenheim at (916) 930-3603, or via email at bruce.oppenheim@noaa.gov.

Sincerely,

Garvin Y J

FOR
Maria C. Rea
Assistant Regional Administrator

References cited:

Cramer Fish Sciences (CFS) 2010. A revised Sacramento River Winter Chinook Juvenile Production Model. Prepared for NOAA, Auburn, CA. 30 pages.

Delta Science Program (DSP). 2014. Letter transmitting Independent Review Panel (IRP) Report for the 2014 Long-term Operations Biological Opinions (LOBO) Annual Science Review. A report to the Delta Science Program of the Delta Stewardship Council. December 2014. 47 pages.

NMFS 2009. Biological and conference opinion on the long-term operations of the Central Valley Project and State Water Project. Long Beach, California. June 4. 844 pg. Plus appendices.

Enclosures:

1. CDFW letter to NMFS, dated December 23, 2014
2. Letter from the Interagency Ecological Program, Winter-Run Project Work Team to NMFS, dated December 22, 2014
3. NMFS winter-run juvenile production estimate based on the 2014 spawning escapement

cc: Copy to file: ARN 151422SWR2006SA00268

Electronic Copy Only:

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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

December 23, 2014

Mr. Will Stelle
Regional Administrator, West Coast Region
National Marine Fisheries Service
7600 Sand Point Way Northeast
Seattle, WA 98115

Dear Mr. Stelle:

Winter-run Chinook Salmon Escapement Estimates for 2014

The California Department of Fish and Wildlife (Department) has developed Sacramento River winter-run Chinook salmon escapement estimates for 2014. These estimates were developed from data collected in the Upper Sacramento River Winter-run Chinook Salmon Escapement Survey (carcass survey) by Department and U.S. Fish and Wildlife Service (USFWS) personnel.

Escapement estimates based on the application of the Cormack Jolly Seber mark-recapture population model to the upper Sacramento River winter-run carcass survey data for 2014 are shown below:

Estimated Total In-river Escapement (hatchery and natural origin)	**2,627**
Estimated In-river Escapement (hatchery origin)	**455**
Estimated Number of In-river Adult Females (hatchery and natural origin)	**1,698**

These estimates include naturally spawning winter-run Chinook in the upper Sacramento River. In addition, 388 winter-run Chinook were collected at the Keswick trap site upstream from RBDD for spawning at Livingston Stone National Fish Hatchery (LSNFH). These fish are not included in the above estimate of naturally spawning winter-run Chinook. The total winter-run spawning escapement estimate in 2014, including in-river spawners and fish collected for normal hatchery broodstock, is **3,015** fish. The 90% confidence interval on this total estimate is from **2,741 to 3,290** fish. To see how this estimate relates to past escapement estimates, please see Attachment 1.

This year, the escapement estimate was again calculated from the carcass survey data using a different statistical model than used in some previous years. From 2003-2011, the escapement estimate had been based on application of the Jolly-Seber model. Based on the recommendations of the *Central Valley Chinook Salmon In-River Escapement Monitoring Plan* (DFG 2012), starting in 2012, the winter-run carcass survey used field and analysis methods consistent with application of the Cormack Jolly Seber (CJS) model. In simulation studies performed in the development of the Monitoring Plan, the CJS model was shown to more accurately estimate escapement based on mark-recapture data than any other available model. Due to its similarity to the Jolly Seber model previously used to estimate winter-run escapement, we consider the data for 2013 to be directly comparable for trend analysis with escapement estimates from 2003 through 2012. The CJS model allows the calculation of confidence intervals; we began reporting confidence intervals on our total estimate for the first time in 2012 and continue doing so this year. The escapement number above is the winter-run total estimate modelled to date and is a final number subject to revision. This estimate is subject to revision if additional data become available after the date of this letter. The additional data would then be used in the CJS Model to recalculate the final escapement number. The most up to date modelled estimate calculation can be found in the GrandTab spreadsheet which is updated periodically after this letter is sent in the event that new information is received.

In the spring of 2014 the Department and the other Fisheries Agencies recognized the continuing severity of the drought in California. To maximize survival of adult winter-run given the uncertainty of sufficiently cold water in the upper Sacramento River later in the year, the LSNFH was permitted to take additional winter-run brood stock. In prior years LSNFH was permitted to take 120 adults for hatchery brood stock, but given the emergency drought conditions, the LSNFH staff removed 388 fish in 2014 including 137 natural-origin and 251 hatchery-origin fish.

We look forward to further discussion and collaboration with NOAA Fisheries staff regarding the application of this information. Inquiries regarding the methodology and development of the estimates in this letter should be directed to Mr. Douglas Killam, Doug.Killam@wildlife.ca.gov or Mr. Daniel Kratville, Daniel.Kratville@wildlife.ca.gov and at the address and phone number above.

Sincerely,

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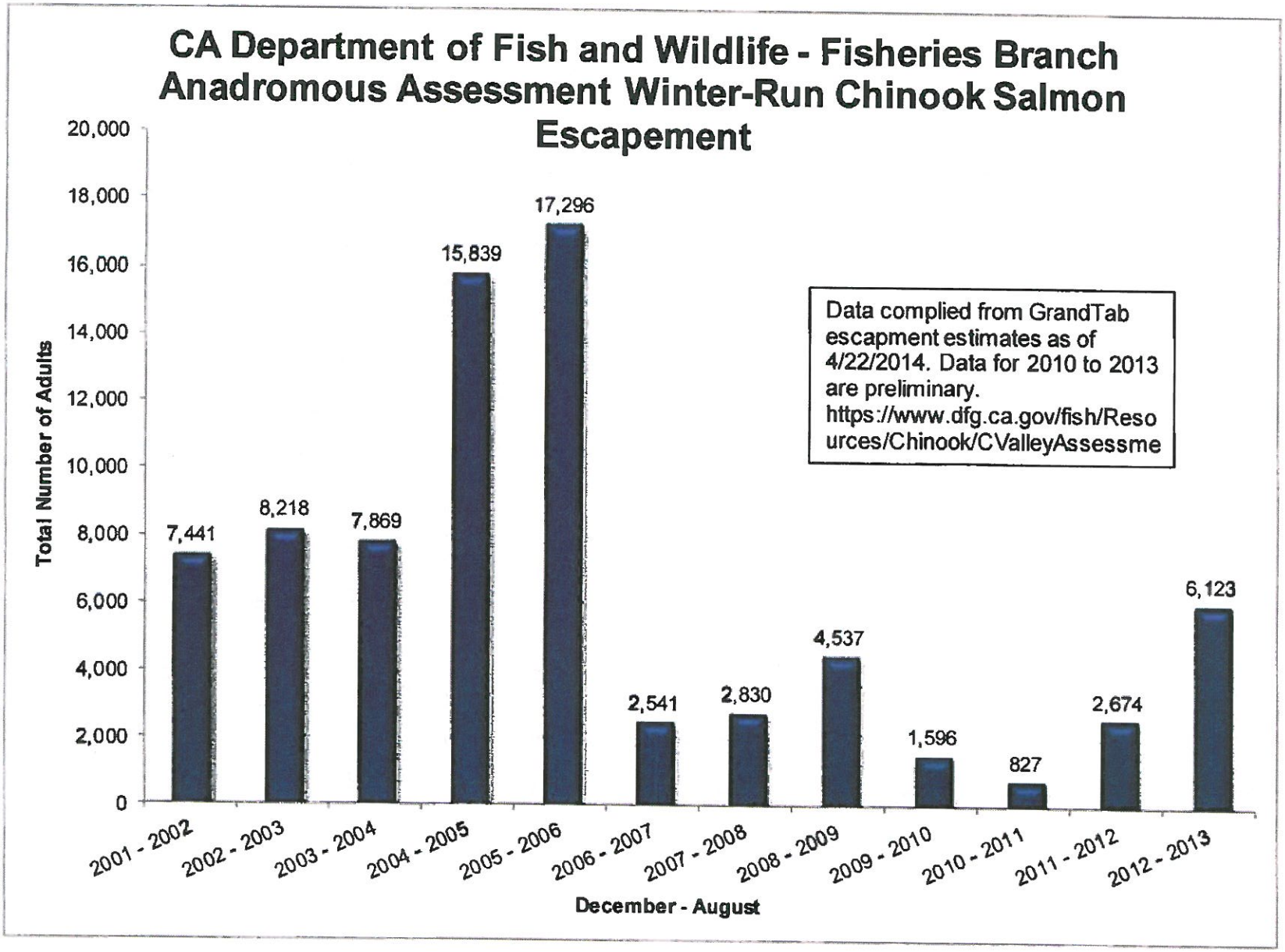
Attachment 1



State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Fisheries Branch
830 S Street
Sacramento, CA 9581

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

December 22, 2014

Mr. Garwin Yip
National Marine Fisheries Service
650 Capital Mall, Suite 5-100
Sacramento, CA 95814

Dear Mr. Yip:

Last year, the Interagency Ecological Program's Winter-Run Project Work Team (WRPWT) recommended that the NOAA Fisheries Juvenile Production Estimate (JPE) be revisited annually and updated as needed with any available, new or improved information. A sub-team of the WRPWT team met on December 3 to review the factors in the JPE for estimating incidental take of endangered winter-run Chinook salmon at the State Water Project and Central Valley Project. In addition, the sub-team reviewed the preliminary findings of the JPE review conducted by the Delta Science Program on November 6-7, 2014.

The WRPWT sub-team identified four terms in the JPE that they would advise changing for calculating the JPE for the 2014 broodyear (Water Year 2015): 1) the estimated number of fry passing Red Bluff Diversion Dam (RBDD) 2) the survival of fry to smolts, 3) the survival of smolts from RBDD to the Delta (Sacramento) and 4) the estimate of survival of the winter-run hatchery fish to be released in January or February of 2015. In 2014, a preliminary estimate of 2,627 winter-run returned to the upper river and were counted as in-river escapement in the JPE (Table 1). Of those, 64.6 percent were female, for a total adult female escapement estimate of 1,698 (Table 1). Pre-spawning adult mortality was estimated at 1 percent resulting in 1,681 adult female winter- run estimated to have spawned (Table 1). The average fecundity in 2014 was measured at 5,308 eggs per female resulting in 8,922,854 total eggs laid in 2014 (Table 1). Due to high water temperatures this year in July and August, eggs and alevins experienced extremely low survival while in the gravel. The loss due to water temperature is not accurately represented in the current JPE methodology which uses the number of redds below the temperature compliance location to assess mortality of eggs due to water temperature. No redds were observed downstream of the temperature compliance point in 2014 but temperatures were not in compliance during periods of the incubation, hatching and rearing season. Without a sufficient method (e.g. currently used models like USBR, Swank and CFS under-estimate mortality) to estimate impacts to egg and alevin survival from high water temperatures and other stressors, the WRPWT sub-team advises that the USFWS Juvenile Production Index (JPI; based on fry equivalents

at RBDD) be incorporated into the JPE for 2014-2015. The JPI seasonal estimate as of December 3, 2014 was 502,506 (B. Poytress, USFWS, personal communication) (Table 1). With this estimate of fry production at RBDD, the estimated mortality due to water temperatures and other stressors can be best represented.

A second change the WRPWT sub-team advises is inclusion of a term to account for survival between the fry and smolt lifestage (i.e. missing the parr and pre-smolt life-stages). The value of 0.59, based on fall run survival from fry to smolt has been used for winter-run since 1993 (based on Hallock, undated and confirmed through a literature review in 1995; B. Poytress, USFWS, personal communication). Without this survival term, survival from fry to smolts is assumed to be 100%, which is unrealistic. This estimate of fry to smolt survival is intended to cover the time period between October, the observed peak of fry passage at RBDD, and December (two months) through February/March (four months), depending on the timing of migration into the Delta. It also covers the difference in location from RBDD (or Salt Creek release location) to the smolt stage, so there is no overlap in survival terms between the fry to smolt survival and the smolt survival from RBDD to the Delta.

The third change the WRPWT sub-team advises is the smolt survival term for survival from RBDD to the Delta. Acoustic tagging of hatchery winter-run from Livingston Stone National Fish Hatchery (LSNFH) was done in 2013 and 2014 with survival estimated to the Delta of 0.16 in 2013 and 0.42 in 2014 (A. Ammann, NMFS, personal communication). In 2013, there were no large pulses of flow after the acoustic tagged fish were released and the tagged fish remained upstream in the Sacramento River for approximately 40 days before migrating downstream while in 2014 there were large flow pulses soon after release and the tagged fish moved downstream in approximately 25 days (J. Hassrick, USBR, personal communication). Survival of the acoustically tagged hatchery-origin winter-run, released in February, was higher in 2014 than it was in 2013 because they did not reside as long in-river (J. Hassrick, USBR, personal communication). The WRPWT sub-team advises using the survival estimate of 0.42 which was the survival of acoustically tagged winter-run smolts between Salt Creek (approximately 3 miles downstream of RBDD) and Tower Bridge in Sacramento in 2014, for the smolt survival term from RBDD to the Delta in this years' JPE. The rationale for using this 2014 survival estimate in the 2014-2015 JPE is because it is predicted to better represent a shorter rearing period of winter-run juveniles prior to entering the Delta in WY 2015. Due to the frequency and magnitude of recent precipitation, most of the winter-run juveniles will likely enter the Delta by the end of December in 2014 (DOSS, 12/9/14) rather than delaying their migration. If most of the winter run arrive in the Delta by December, their survival from RBDD to the Delta (Sacramento) is predicted to be higher than if they migrated into the Delta later. In contrast, survival through the Delta will likely be lower in WY 2015 because the bulk of

the winter run are entering the Delta in December and will likely reside there until March (del Rosario et al 2013). Under this scenario, survival through the Delta is predicted to be lower than if the winter-run had remained upstream and migrated into the Delta later, but still migrated from the Delta in March as in most years (del Rosario et al 2013).

To check the advised JPE changes, the WRPWT sub-team used actual expanded catch data from the JPI at RBDD and the estimated number of genetic winter-run migrating from the Delta at Chipps Island in 2008, 2009, 2010 and 2011 (Pyper et al, 2013) to determine if the resulting estimates of winter-run survival to and through the Delta were similar to those observed from the winter run acoustic tagging (A. Ammann, personal communication; Table 2). To account for three different migration patterns into the Delta, we applied the higher of the two observed estimates of survival to the Delta of acoustically tagged winter run (0.42) in the years when we expected the majority of winter run to have entered the Delta in December (2011), whereas we applied the lower of the two observed survival estimates of survival to the Delta (0.16) when we expected winter run to migrate into the Delta later in the year (2008 and 2009 (Table 2). For years which were considered intermediate in their migration timing to the Delta (2010) we applied the average of the two survival estimates to the Delta (0.16+0.42/2 = 0.29). By multiplying the fry to smolt survival of 0.59 and then varying the estimate of smolt survival to the Delta (0.16, 0.29, or 0.42) we calculated estimates of the number of winter run entering the Delta at Sacramento in those years.

For the next step, we used the estimates of winter run at Chipps Island from Pyper et al (2013) divided by the number of smolts estimated to have entered the Delta at Sacramento to get an estimate of smolt survival through the Delta in each of the four years (2008-2011) to see how they compared to estimates of smolt survival through the Delta from acoustically tagged winter-run in 2013 and 2014 (Table 2). We predicted that survival rates through the Delta would be higher in dry years and more similar to those estimated in 2013 and 2014 than in years when fish entered the Delta earlier, due to the shorter residence time in the Delta. The average survival rate through the Delta in 2013 and 2014 from the acoustically tagged fish was 0.32 (0.32 in 2013 and 0.33 in 2014; A. Ammann, NMFS, personal communication) and was similar to our calculated average survival rate through the Delta of 0.35 in 2008 and 2009 (0.29+0.40/2 =0.35) (Table 2). Our calculated estimate of survival through the Delta in 2010 (0.07) and 2011 (0.16) was lower than that calculated for 2008 and 2009 and consistent with our conceptual model that survival through the Delta is a function of residence time (Table 2).

The fourth term we suggest changing is the survival of hatchery fish term to estimate the total production of hatchery fish entering the Delta (Table 1). Last year, it was a weighted average of the survival estimates from results of five years of late-fall and one

year of winter- run acoustic tagging studies. This year we have two estimates of winter-run survival to the Delta from the acoustic tagging studies in 2013 (0.16) and 2014 (0.42) and advise using an average of these two estimates (0.29) for the JPE in 2014-2015. Survival of the two estimates of winter run survival is better than using estimates from late-fall as they are from true winter run and not from a different race (late-fall). In addition, we do not yet, know what conditions the hatchery fish will experience when they are released in January or February. If it turns dry, it is possible they will hold upstream longer as fish did in 2013, or they could move downstream quickly as the acoustic tag fish did in 2014. An average of the two estimates seems to be the best approach for the estimate of hatchery fish survival in 2015.

While we acknowledge uncertainty in this new JPE estimate and the survival components within it, it is likely to be more accurate than a JPE based on the methodology used in 2013-2014, because it is based on actual observed data at RBDD in 2014, information from acoustically tagged winter- run survival and estimated abundance of winter run at Chipps Island. To reduce the uncertainty in the JPE in future years, we suggest NMFS facilitate additional field work and analyses, specific to winter run in the next year.

In summary, we hope these additional analyses and advice from the technical sub-team of the Interagency Ecological Program's WRPWT will help improve the JPE and the incidental take limits for 2014-2015. The 2015 winter run have likely experienced significant mortality due to the drought and these improvements to the JPE would increase the accuracy of the take limits for the SWP and CVP in 2014-2015, to minimize any additional impacts on winter-run in the Delta associated with the water projects.

Sincerely,

Daniel Kratville
Winter Run PWT Chairperson

cc: Ms. Maria Rea, Sacramento Area Supervisor
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Winter-Run Team

Table 1: Factors in the Juvenile Production Estimate and the resulting estimates for 2014-2015, using the Winter Run PWT approach

	Factors	2014-2015 Result using suggested methodology
Total in-river escapement [1]		2,627
Adult female estimate [2]	0.646	1,698
Pre-spawn mortality [3]	0.01	1,681
Average Fecundity [4]	5308	8,922,854
Egg loss due to temperature [5] (below compliance point)	0	0
Total Viable Eggs		
In redd loss and fry loss upstream of RBDD due to temperature and other factors[6]	.944	
Estimated survival: egg to fry (at RBDD) [7]	.056	
Estimate of fry production at RBDD [8]		502,506
fry survival from October (peak at RBDD in most years) to smolt at RBDD [9]	0.59	296,479
Estimated smolt survival – RBDD to Delta [10]	0.42	124,521
Total natural production entering the Delta		124,521
Hatchery release [11]		640,000
Total hatchery production entering the Delta [12]	0.29	185,600
Level of concern for naturally produced fish (1%)		1,245
Level of concern for hatchery fish (0.5%)		3,200
Incidental Take level for Natural Production (2%)		2,490
Incidental Take level for hatchery production (1%)		6,400

Footnotes:

1/ Total in-river escapement from Cormack-Jolly Seber (CJS) model includes natural and hatchery origin

2/ The number of adult (age 3 or older) females is derived from carcass survey and then the number of males is derived using sex ratio at Keswick trap

3/ Pre-Spawn mortality was estimated from carcass surveys of females (CDFW)

4/ Average # eggs/female from 175 females (including females less than 3 years old) collected from the 2014 returns to Livingston Stone

5/ No redds observed downstream of Airport Rd, temperature compliance point, but temperatures were not in compliance during periods of the season in 2014

6/ Estimated loss between egg and fry upstream of Red Bluff based on numbers of fry equivalents at RBDD divided by total number of eggs laid

7/ Egg to fry survival based on 1- estimated loss on previous line

8/ Number of fry equivalents at RBDD – JPI – Bill Poytress, personal communication

9/ Estimate of fry to smolt survival based on fall run at Tehama Colusa Fish Facility (Hallock undated)

10/ Survival of acoustically tagged winter run in 2014 between Salt Creek and Tower Bridge – A. Ammann, personal communication

11/ LSNFH estimated release as of 12/3/14 (100% tagged and adipose clipped). Tripled production due to drought

12/ Average of acoustically tagged winter run survival in 2014 (0.42) and 2013 (0.16) between Salt Creek and Tower Bridge, (A. Ammann, per. comm).

Table 2: Estimate of fry equivalents at RBDD, fry to smolt survival, smolt survival from RBDD to the Delta (Sacramento), resulting number of winter run estimated at Sacramento, the estimated number of genetic winter run at Chipps Island and the estimated survival through the Delta in 2008, 2009, 2010 and 2011, given the genetic winter run estimates at Sacramento and Chipps Island.

Water year type	critical	dry	below normal	wet	
Year	2008	2009	2010	2011	
Fry equivalents at RBDD	1642575	1371735	4993787	1566507	Red Bluff estimate based on rotary screw trapping by USFWS
fry to smolt survival	0.59	0.59	0.59	0.59	Estimate from Tehema Colusa studies (Hallock undated)
RBDD to Delta (Sacramento) smolt survival	0.16	0.16	0.29	0.42	Varying "estimate" of survival to the Delta in dry, wet or intermediate water year types using the survival of acoustically tagged winter run to the Delta in 2013 (applied to critical and dry years) and 2014 (applied to the wet year) and the average of the two years (applied in the below normal year)
Estimated number of winter run entering the Delta at Sacramento	155059	129492	854437	386055	Generated from all previous entry's
Number of winter run at Chipps	44943	51228	63442	60051	genetics estimate; Pyper et al. 2013
smolt survival through the Delta (from Sacramento to Chipps)	0.29	0.40	0.07	0.16	Estimate of survival from Number at Chipps/Number at Sacramento

NMFS - Southwest Region

WINTER RUN JPE ESTIMATOR PROGRAM

Enclosure 3

Version 1

1/13/2014

DATA ENTRY HERE

Year Pair	*Broodyear*
2014/2015	2011

actually observed: 1,386

Females unspawned: 1.00% 3/

CDFG Carcass Survey: 2,627 1/

Female Percent: 64.63% 2/

LSNFH *Hatchery Release*: 650,000

Release Date: 02/01/15

WINTER RUN CHINOOK SALMON Juvenile Production Estimate	Factors	Carcass Survey Estimate
Total in-river escapement - 1/		2,627
In-river adult females - 2/	0.65	1,698
Prespawn mortality - 3/	0.01	1,681
Average fecundity - 4/	5308	8,922,854
Egg loss due to temperature - 5/	0.0000	
Total viable eggs estimated		8,922,854
Egg to fry survival (S1) - includes loss due to temperature -6/	0.05	502,506
Fry to smolt survival - 7/	0.59	296,479
Survival to Delta (S2) - 8/ (RBDD to Tower Bridge at Sacramento)	0.42	124,521
Total Natural Production Entering Delta		124,521
Hatchery Release - 9/		650,000
Total Hatchery Production Entering Delta - 10/	0.29	188,500
Level of Concern for wild fish (1%)		1,245
Level of Concern for hatchery fish (0.5%)		943
Incidental Take Level for Natural Production (2%)		2,490
Incidental Take level for Hatchery Production (1%)		1,885

Footnotes -

1/ Total in-river escapement from Cormack-Jolly-Seber model with 90% CI (2,741 to 3,290), includes natural and hatchery origin. Source: CDFW letter 12/23/14.

2/ The number of females is derived from carcass survey, and then the number of males is derived using sex ratio at Keswick trap. Source: CDFW letter 12/23/14.

3/ Pre-spawn mortality from 99% female spawn success in Table 1 Summary (11-9-14) carcass survey data.

4/ Average # eggs/female, from John Rueth, USFWS, e-mail status update for LSNFH 12/2/14.

5/ Using last year's method, no redds observed below Clear Creek temperature compliance point.

6/ S1 from RBDD passage estimate (JPI) of fry equvalents from Bill Poytress, USFWS 12/23/14. Includes temperature related mortality by back calculating survival to this point.

7/ fry-to-smolt survival based on fall-run Chinook salmon at Tehama-Colusa spawning channel, USFWS studies 1975-1980

8/ In-river survival (S2) estimated from 2014 winter-run acoustic tag data (S=0.42). Source: Arnold Ammann,

9/ LSNFH estimated release as of 12/03/14 (100% tagged & clipped). Tripled production due to drought year.

10/ Survival based on average of 2013 and 2014 acoustic tag studies (Ammann & Hassrick, pers. comm. 2014)