State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Fisheries Branch
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EDMUND G. BROWN JR., Governor
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January 5, 2016

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

Dear Mr. Yip:

Two years ago, the Interagency Ecological Program (IEP)'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 new or improved information. A sub-team of the WRPWT met in February, June, September and October of 2015 to review the factors used to calculate the JPE. The JPE is used for estimating the incidental take limit of winter-run Chinook salmon in the Delta at the State Water Project (SWP) and Central Valley Project (CVP). The sub-team also discussed priority monitoring and research that would improve future JPE estimates and provide better information for managing water project operations.

JPE Recommendations:

The sub-team identified four factors in the JPE that they would advise updating for the 2015 broodyear or Water Year 2016:

1) estimated number of fry passing Red Bluff Diversion Dam (RBDD)

2) survival rate of fry to smolts

3) survival rate of smolts from RBDD to Delta entry (defined as Sacramento)

4) estimated survival rate of the winter-run hatchery fish to be released in January or February of 2016

In 2015, a preliminary estimate of 3,439[1] winter-run returned to the upper river, and of these, 3,182 were counted as in-river escapement in the JPE (Table 1). Of those, 64.8 percent were female, for a total adult female escapement estimate of 2,063 (Table 1). Pre-spawning adult mortality was estimated at 2.0 percent resulting in 2,022 adult female winter- run estimated to have spawned (Table 1). The average fecundity in 2015 was measured at 4,819 eggs per

[1] This estimate may change as the official number from CDFW has not been issued yet.

female (from Livingston-Stone National Fish Hatchery broodstock) resulting in an estimate of 9,744,018 total eggs laid in 2015 (Table 1).

Eggs and alevins experienced another year of extremely low survival potentially due to the effects of the drought and state and federal water operations. The egg loss due to water temperature is not accurately represented in the JPE methodology. No redds were observed downstream of the temperature compliance point in 2015; however water temperatures were above 56oF during periods of incubation, hatching, and rearing. Without an accurate method to estimate impacts to egg and alevin survival from high water temperatures and other stressors, the sub-team's first recommendation is to use the Juvenile Production Index (JPI) in the JPE for 2015-2016 which is based on fry equivalents at RBDD, as it was in 2014-2015 (Figure 1). The JPI seasonal estimate as of December 16, 2015 was 410,475 (B. Poytress, USFWS, personal communication; Table 1). The value through week 50 (December 16) accounts for 96.3% of annual winter Chinook passage at RBDD based on data collected from 2002 to 2014 and includes an interpolation of the remaining 3.7% (395,287 / 0.963 = 410,475). With this estimate of fry production at RBDD, the estimated mortality due to water temperatures and other stressors can be best represented.

The second recommendation of the sub-team is the continued inclusion of a factor to account for survival between the fry and smolt lifestage for the naturally produced winter-run. This is necessary because the available survival estimates between RBDD and Delta entry are based on releases of acoustically telemetered (AT) smolts, which have a higher survival rate than fry due to their larger size and faster migration rate. The AT smolt survival rate is then used to determine survival between RBDD and Delta entry (discussed in more detail below). A survival rate of 0.59, based on fall-run salmon survival from fry to smolt has been used for winter-run fry to smolt survival since 1993. This value is based on previous studies (Hallock, undated), and confirmed through a literature review in 1995 (B. Poytress, USFWS, personal communication). Without this survival factor, survival from fry to smolts is assumed to be 100%, which is unrealistic While we have reservations about the accuracy of this term (0.59; Table 1 and Figure 1), we believe it should continue to be used, until a better estimate of fry to smolt survival is available. To address this critical uncertainty we are suggesting that additional studies be conducted in the future to better estimate fry to smolt survival (see monitoring recommendations below).

The third recommendation of the sub-team is related to the smolt survival term for survival from RBDD to the Delta (*i.e.*, Sacramento; at the I-80 Bridge) for naturally produced winter-run. We recommend using results from acoustic tagging of hatchery winter-run from Livingston Stone National Fish Hatchery (LSNFH) in 2013, 2014 and 2015 for this term. There were two release groups in 2015 with survival estimated from RBDD to the Delta of 0.16 in 2013, 0.42 in 2014, and 0.45 and 0.63 in 2015 (A. Ammann, NMFS, personal communication). All hatchery releases were made at Caldwell Park. The survival estimate used for naturally produced winter run, was from RBDD to the Delta and obtained from the detections of the acoustic tag fish on acoustic receivers near RBDD and Sacramento. Although there was not complete agreement in the sub-team, the majority of members recommended that the average survival

estimate from RBDD to Sacramento of all four acoustic tag release groups (*i.e.*, average = 0.42) be used to estimate smolt survival from RBDD to the Delta for naturally produced winter-run in the JPE for 2015-2016 (Table 1 and Figure 1).

The fourth recommendation from the sub-team is updating the term for estimating survival of hatchery winter-run to the Delta (Table 1 and Figure 1). Last year, this term was the average of the 2013 and 2014 estimates of winter-run survival to the Delta (0.29). This year the sub-team recommends that the average survival value of 0.37 (Table 1) be used which is the average of the four available estimates (0.15, 0.38, 0.42, 0.52) from the upper Sacramento River (Caldwell Park) to Sacramento at the I80 Bridge. The reason these survival rates are different than those used for the wild winter-run (used in the previous paragraph) is because the hatchery fish were released from Caldwell Park, whereas we are trying to get an estimate for wild winter-run that is from RBDD to I80 Bridge to apply to the JPI fry equivalents at RBDD.

Monitoring Recommendations:

One of the models we have been developing to support the JPE is associated with the holding time of winter-run acoustic tagged hatchery fish upstream of the Delta and their survival to the Delta. In using the last three years of data (four data points) from the acoustic tag releases of hatchery fish we have found that survival to the Delta appears to be related to holding time, with the lowest survival in 2013, when the holding time was the greatest at 40 days and the highest survival was for the second release in 2015 when the holding time was only 10 days. To apply this model to smaller-sized winter-run, we are recommending that hatchery winter-run be acoustically tagged and released at a smaller size (possible now due to smaller tag sizes), earlier in the season (*e.g.*, December, or early January), to inform our model for future application to smaller winter-run observed at RBDD. The peak of winter-run at RBDD is usually observed in late-September or early October. We are unable to acoustically tag winter-run fish in late-September or early October due to their small size, even with the smallest acoustic tags available.

This recommendation of acoustic tagging a small proportion of the hatchery winter-run and releasing them earlier in the season was supported by the sub-team as a way to estimate a portion of the fry to smolt survival from RBDD to the Delta for the JPE. Other high priority monitoring identified by our sub-team to improve estimates of survival of winter-run, but not explicitly tied to the JPE were;

1) expand tissue samples already collected and processed from the Sacramento Trawl between 2009 and 2011 to estimate the genetic winter-run population entering the Delta and to compare it the JPE and loss at the salvage facilities in those years

2) use parentage methods (genotypes) to link carcass and juvenile outmigrant monitoring to estimate the number of successful breeders and the factors that contribute to successful recruitment, and

3) evaluate disease impacts on winter-run juvenile Chinook salmon survival in the Upper Sacramento River.

While most members of the team thought that continuing to acoustically tag a portion of the hatchery winter-run over the next 10 years was important, there was even more support to develop a wild winter-run tagging proposal. In addition, expanding the genetic samples collected in both the Sacramento and Chipps Island trawls in 2016 for estimating the population size of genetic winter-run at those locations for comparison to the JPE was also a high priority. The improvement of the efficiency estimates at Sacramento and Chipps Island trawls was considered a high priority for all salmon runs to reduce uncertainty in abundance estimates, although one member of the team questioned whether poor and variable efficiency of these trawls could ever provide reliable expansions of total abundance.

Monitoring or research that was discussed by the sub-team, but needs more development or understanding of present work include (not in prioritized order):

1) development of a higher efficiency, continuous trapping gear for juvenile salmonids approaching the Delta (*e.g.* a motorized screw trap at Sacramento with guidance mechanism)

2) placement of additional acoustic receivers in the south Delta to understand movement of tagged winter-run in the central and south Delta

3) placement of additional real time monitoring receivers to provide accurate proportions of acoustic tagged hatchery winter-run at various locations as they move into and through the Delta

4) PIT tagging or dyeing smaller wild winter-run at RBDD to learn more about their growth and timing of entry into the Delta,

5) updating the Cramer Fish Sciences winter-run juvenile production simulation model to estimate juveniles entering the Delta

6) doing additional winter-run otolith work to learn where the survivors reared and how long they spend in different habitats as juveniles and

7) increasing effort at Sacramento and Chipps Island trawls to better estimate winter-run abundance.

We will continue to assess these potential projects and proposals for possible recommendation in 2017.

While we acknowledge that there will still be uncertainty in the JPE estimate even if these recommendations are incorporated, we believe it to be the best information available from which to derive a JPE. To reduce the uncertainty in the JPE in future years, we have suggested additional monitoring or analyses in 2016.

To better manage exports for improving juvenile winter-run survival in the Delta, a suggestion was made, during sub-team discussions, to estimate patterns of entrainment loss using genetic and coded-wire tag information for exporting water at the SWP and CVP in ways that entrainment losses could be targeted to be below required limits. Such an analytical method would provide statistical confidence intervals associated with proposed operations. For example, a proposed export level for a specific river inflow regime could be estimated (with available data) not to exceed a 1% level of incidental take with 95% confidence. Entrainment losses could continue to be monitored to provide a backstop to identify atypical events and to adjust operations accordingly. Further discussion of this topic by the team will be done during 2016.

In summary, we hope these additional analyses and technical advice from the sub-team of the Interagency Ecological Program's WRPWT will help improve the JPE and the incidental take limits for 2015-2016. Continued drought conditions have likely resulted in significant mortality to the winter-run population in the last two years and improvements to the JPE would increase the accuracy of the take limits for the SWP and CVP in water year 2016, for managing the incidental take of winter run at the CVP/SWP water projects.

Sincerely,

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Winter-Run PWT (email list)

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

	Factors	2015-2016 Result using suggested methodology
Total in-river escapement [1]		3,182
Adult female estimate [2]		2,063
Pre-spawn mortality [3]		2.0% (2,022)
Average Fecundity [4]		4,819
Egg loss due to temperature [5] (below compliance point)		No redds below CCR
Total Viable Eggs		9,742,765
In redd loss and fry loss upstream of RBDD due to temperature and other factors [6]	0.958	
Estimated survival: egg to fry (at RBDD) [7]	0.042	
Estimate of fry production at RBDD [8]		410,475
fry survival from October (peak at RBDD in most years) to smolt at RBDD [9]	0.59	242,180
Estimated smolt survival – RBDD to Delta [10]	0.42	101,716
Total natural production entering the Delta		101,716
hatchery release [11]		400,000
Total hatchery production entering the Delta [12]	0.37	148,000
Level of concern for naturally produced fish (1%)		1,017
Level of concern for hatchery fish (0.5%)		740
Incidental Take limit for Natural Production (2%)		2,034
Incidental Take limit for hatchery production (1%)		1,480

Footnotes:

1/ Total in-river escapement from Cormack-Jolly Seber (CJS) model includes natural and hatchery origin, but not hatchery fish retained for brood stock at Livingston Stone National Fish Hatchery.

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 2015 returns to Livingston Stone National Fish Hatchery.

5/ No redds observed downstream of Airport Rd, temperature compliance point, but temperatures were not in compliance during periods of the season in 2015

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 minus the estimated loss on previous line

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

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

10/ Average survival of acoustically tagged winter run in 2013, 2014 and 2015 (2 values in 2015) between RBDD and I80 Tower Bridge in Sacramento – A. Ammann, NMFS, personal communication. Survival is estimated from the Salt Creek receiver site, located 3 miles downstream of RBDD, to estimate survival from RBDD for acoustic tag studies.

11/ LSNFH estimated release as of 12/10/15 (100% tagged and adipose clipped). Production was increased due to the drought.

12/ Average of acoustically tagged winter run survival in 2013, 2014 and 2015 (2 values in 2015) between Caldwell Park and I80 Tower Bridge in Sacramento, (A. Ammann, NMFS, personal comm).

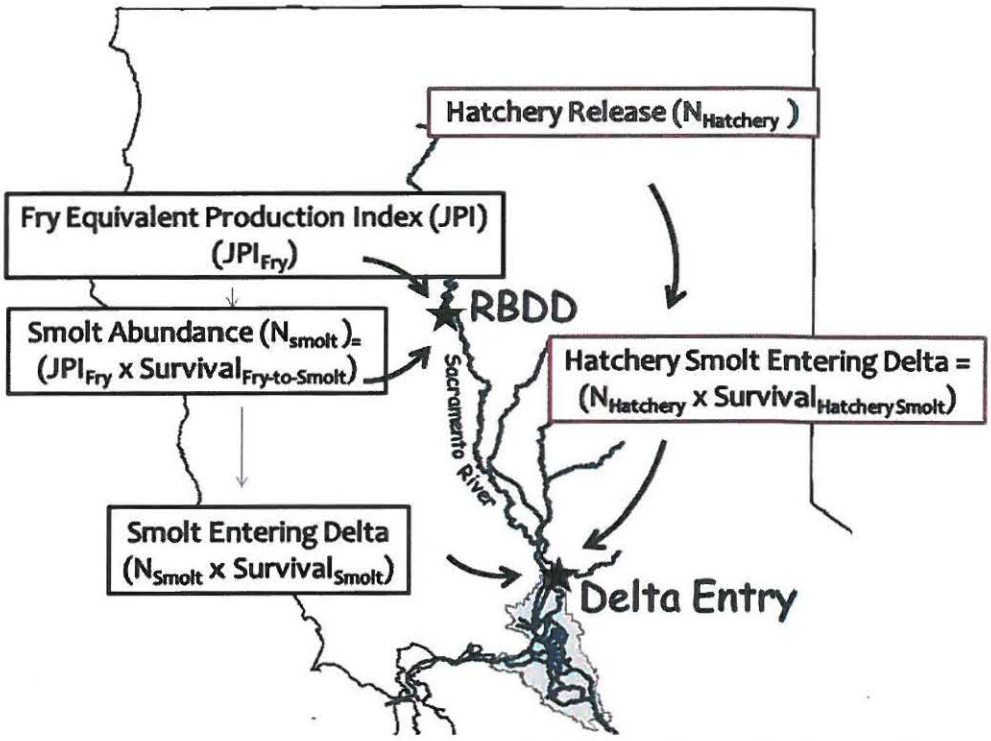

Figure 1: Location and formula's recommended for use in the JPE for the wild (black boxes) and hatchery (red boxes) components of the winter run population estimated in 2015-2016.

NMFS - Southwest Region

Enclosure 3

WINTER RUN JPE ESTIMATOR PROGRAM

Version 3

1/25/2016

DATA ENTRY HERE

Year Pair	*Broodyear*
2015/2016	2012

Carcasses observed: 1,193

Females unspawned: 2.00% 3/

CDFG Carcass Survey: 1,193 1/

Female Percent: 64.83% 2/

LSNFH

Hatchery Release: 420,000

Release Date: 02/05/16

WINTER RUN CHINOOK SALMON Juvenile Production Estimate	Factors	Carcass Survey Estimate
Total in-river escapement - 1/		3,182
In-river adult females - 2/	0.65	2,063
Prespawn mortality - 3/	0.02	2,022
Average fecundity - 4/	4,819	9,744,018
Egg loss due to temperature (old method)- 5/	n/a	
Total viable eggs		9,744,018
Egg to fry survival from JPI estimate at RBDD (S1) -6/	0.042126	410,475
Fry to pre-smolt survival (Oct-Mar) - 7/	0.59	242,180
Survival to Delta (S2) - 8/ (RBDD to Tower Bridge at Sacramento)	0.42	101,716
Total Natural Production Entering Delta		101,716
Hatchery Release - 9/		420,000
Hatchery Production Entering Delta - 10/	0.37	155,400
Level of Concern for wild fish (0.5%)		509
Level of Concern for hatchery fish (0.5%)		777
Incidental Take Level for wild fish (1%)		1,017
Incidental Take level for Hatchery Production (1%)		1,554

Footnotes -

1/ Total in-river escapement, CDFW letter 12/15/15. Not including 257 kept for broodstock at Keswick Trap.
2/ In-river females derrived from carcass survey. Males derived using sex ratio at Keswick trap.
3/ Pre-spawn mortality from 2015 carcass survey data (CDFW Table 1 Summary).
4/ Average # eggs/female from LSNFH (n = 104), John Rueth, USFWS, pers. comm. 10/30/15.
5/ No redds observed below the temperature compliance point at Clear Creek.
6/ RBDD passage estimate in fry equivalents as of 12/16/15, Bill Poytress, USFWS, pers. comm. 12/23/15.
7/ Pre-smolt survival from fall-run Chinook studies at Tehama-Colusa spawning channel (USFWS 1975-1980)
8/ Average of 4 acoustic tag releases (2013-2015) RBDD to Sacramento. A. Ammann, NMFS, pers. comm.
9/ LSNFH estimate, John Rueth, USFWS, as of 1/13/16, increased due to drought (100% tagged & clipped).
10/ Hatchery survival from average of acoustic tag studies (2013-2015) Redding to Sacramento.