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DEPARTMENT OF FISH AND WILDLIFE
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December 22, 2014

Mr. Garwin Yip
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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,

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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

Literature Cited:

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