



## FISH PASSAGE CENTER

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### MEMORANDUM

TO: Rod Sando

FROM: Michele DeHart

DATE: June 19, 2008

RE: Examination of incidental take mortality of juvenile sockeye as presented in 2008 Biological Opinion.

In response to your request, the FPC staff have reviewed the juvenile in-river mortality estimates (LGR to BON) presented in the "Incidental Take" section of the of 2008 Biological Opinion (2008 BiOp) for sockeye.

On October 29, 2007 the FPC responded to your previous data request regarding juvenile Snake River Sockeye. In the FPC response to that request, we provided historical data on juvenile release numbers, release timing, travel time and survival. In that response we explained that survival estimation was limited to estimates of release to Lower Granite Dam and in a few years release to McNary Dam primarily due to tag numbers. Your May 29, 2008 request questioned the limited survival estimates we provided in that data request, relative to the survival estimates in the NOAA Incidental Take section of the 2008 Biological Opinion. We have reviewed the incidental take section of the Biological Opinion and the references to methods used to develop the survival estimates. The difference in survival estimates between our October 29 response to your data request and the Incidental Take section of the Biological Opinion are due to the methodology used by NOAA Fisheries. Our review conclusions are:

- The NOAA estimates were extrapolated from estimates of juvenile survival from LGR to MCN. The NOAA estimates should be considered cautiously since the methodology used by NOAA to develop these estimates of mortality has the potential to under-estimate mortality.

- We reviewed “per dam” and “per mile” survival rate expansion from the Snake River to lower Columbia River and applying either extrapolation method would likely result in an overestimate of LGR-to-BON survival rate (*i.e.*, lower estimates of overall reach mortality) than is truly occurring in the hydrosystem.
- The NOAA sockeye extrapolation of survival to the lower Columbia River described in the incidental take statement is likely to result in an optimistic characterization of juvenile sockeye survival through the hydrosystem.
- After reviewing the NOAA per dam expansion methodology and the per mile expansion methodology we do not believe it is necessary or prudent to adjust or modify the sockeye survival estimates we provided to you in our October 2007 response.

Discussion

As mentioned in the footnotes for Table 14.2 in the 2008 BiOp, the mortality estimates in the Incidental Take section were based on estimates of juvenile sockeye survival from Lower Granite to McNary Dam (2000-2003) as presented Williams et al. (2005) (Table 1).

**Table 1.** Survival estimates for sockeye salmon smolts PIT-tagged and released above Lower Granite Dam. All smolts detected and returned to the LGR tailrace in each year were pooled into one group. These data were taken from Table 32 of Williams et al. (2005).

Migration Year	Number of Smolts	LGR to LMN Survival (SE)	LGR to MCN Survival (SE)
2000	496	0.703 (0.138)	0.560 (0.142)
2001	610	0.504 (0.087)	0.239 (0.099)
2002	262	0.832 (0.144)	0.397 (0.085)
2003	679	1.044 (0.116)	0.725 (0.122)

An estimate of “per-project” survival was generated from these LGR to MCN survival estimates (Equation 1). This “per-project” survival estimate was then used to estimate juvenile survival from LGR to BON (Equation 2). Finally, an estimate of mortality from LGR to BON was generated based on the estimate of LGR to BON survival (Equation 3).

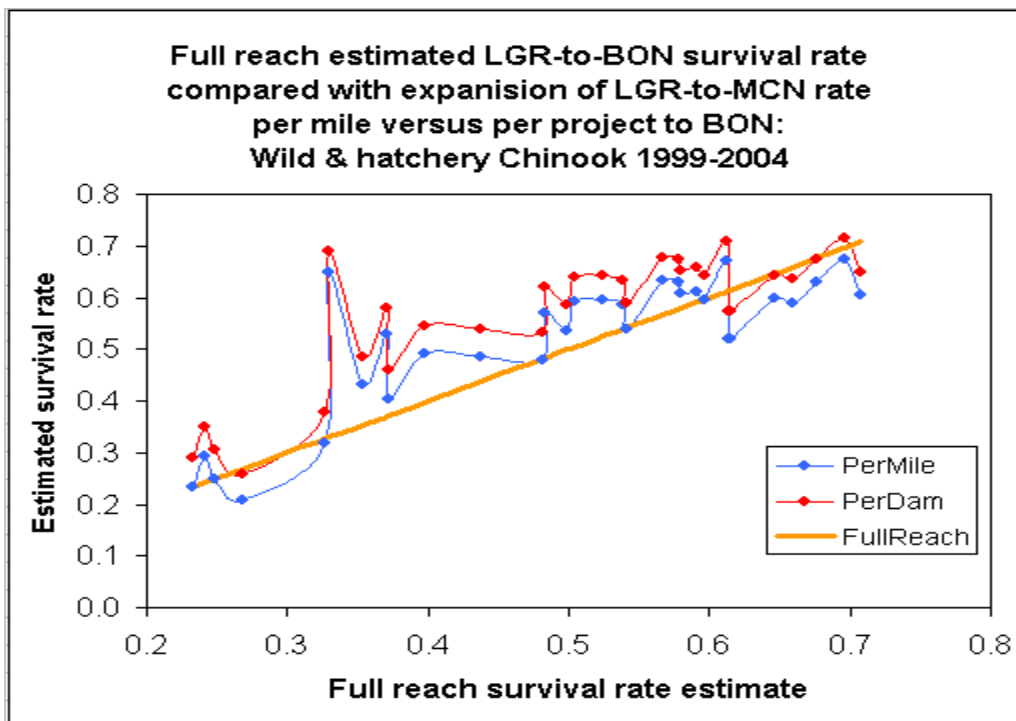
$$Surv_{per-project} = (Surv_{LGR-to-MCN})^{0.25} \tag{1}$$

$$Surv_{LGR-to-BON} = (Surv_{per-project})^7 \tag{2}$$

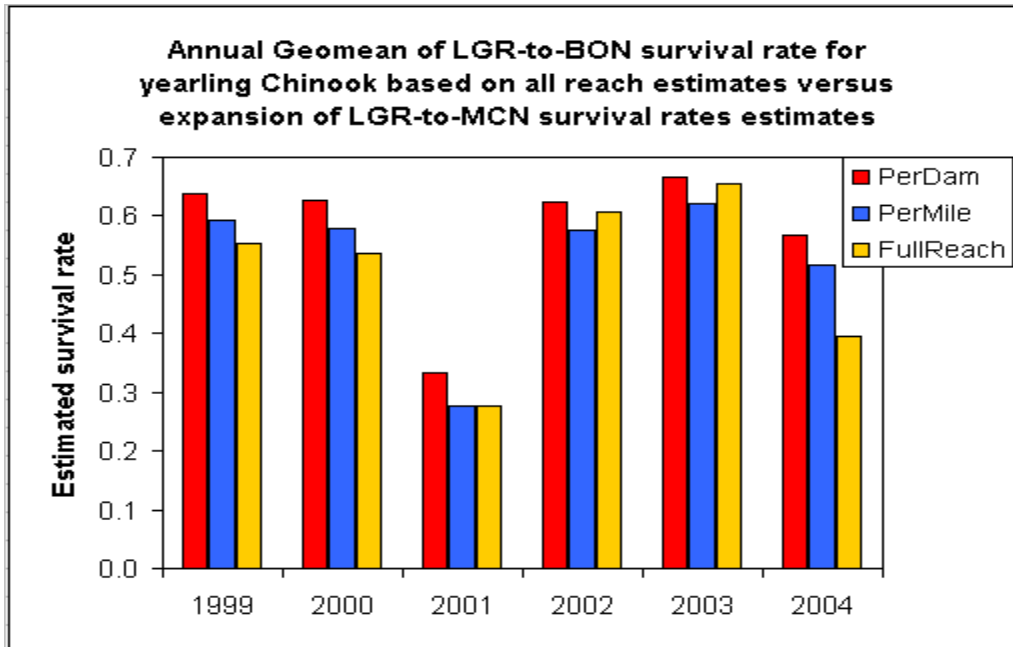
$$Mort_{LGR-to-BON} = (1 - Surv_{LGR-to-BON}) \tag{3}$$

This method of estimating overall reach mortality (LGR to BON) for sockeye juveniles is problematic. This methodology assumes that all reaches are created equal, even though the different reaches vary in their lengths. Typically, in longer reaches such as John Day pool, it takes longer for the juvenile salmon to migrate through that reach, therefore subjecting individuals to various sources of mortality for longer periods of time. Taking distance into account, one could consider the MCN-to-JDA reach to be on par with the JDA-to-BON reach, yet the former reach is only one project while the latter reach is two projects.

In past reports, the CSS has addressed this problem by estimating a “per mile” survival for those reaches where a survival estimate was possible and applying it to the down-stream reaches where a survival estimate was not possible due to low sample sizes (Berggren et al. 2005, Bouwes et al. 2002). While this methodology is not the most preferable, it at least recognizes that the length of the reach has an effect on juvenile survival and, therefore, does not treat longer reaches the same as shorter reaches. Although the “per mile” expansion provides a mechanism to fill in a survival rate in reaches for which no estimate exists, it has a similar (though less severe) drawback as the “per dam” expansion. Based on yearling Chinook data from migration years (1999 to 2004) when survival components in the lower Columbia River are directly computable (Figures 1 and 2), both approaches had the tendency to overestimate the overall LGR-to-BON reach survival rates using a LGR-to-MCN reach survival rate expansion whenever the directly computed overall reach survival rate estimates were below 60%. Above the 60% level, the “per dam” expansion produced closer estimates, but it appears unlikely Sockeye will achieve that high a survival rate in the hydrosystem. Therefore, applying either “per dam” or “per mile” survival rate expansion from the Snake River to lower Columbia River would likely result in an overestimate of LGR-to-BON survival rate (*i.e.*, lower estimates of overall reach mortality) than is truly occurring in the hydrosystem).



**Figure 1.** Comparison of “per mile” and “per dam” expansions of LGR-to-MCN survival rates to estimate an overall LGR-to-BON survival rate for yearling Chinook, 1999 to 2004.



**Figure 2.** Annual geometric means of yearling Chinook data shown in Figure 1 for “per mile” and “per dam” expansions of LGR-to-MCN survival rates to estimate an overall LGR-to-BON survival rate, 1999 to 2004.

For comparison with the NOAA approach, the CSS “per-mile” expansion was applied to the LGR to MCN survivals from Williams et al. (2005) (Table 2) in order to estimate sockeye reach survival (and ultimately mortality) from LGR to BON. To the nearest mile, the reach from LGR to MCN is 140 miles, with approximately 51% of the overall reach still remaining below MCN. The MCN to BON reach is approximately 147 miles. The estimates of LGR to BON mortality from this “per-mile” expansion methodology can be found in Table 2.

**Table 2.** Estimates of average sockeye juvenile in-river morality (range) from Lower Granite Dam to Bonneville Dam using NOAA’s “per-project” Expansion versus the CSS “per-mile” Expansion. These estimates were generated by using estimates of survival from LGR to MCN.

Reach used for expansion	Average Flow Condition	NOAA “per-project” Expansion	CSS “per-mile” Expansion
LGR to MCN	< 65 Kcfs @ LGR	91.8%	94.7%
	> 65 Kcfs @ LGR	63.6% (43.0-80.1%)	69.5% (48.3-85.0%)

From these results, it is clear that the NOAA “per-project” expansion used for the 2008 BiOp resulted in lower estimates of LGR to BON mortality than would using the CSS “per-mile” Expansion. However, in the range of overall LGR-to-BON reach survival estimates for Sockeye, which is very likely to be less than 60%, even the “per-mile” expansion is expected to result in an underestimation of sockeye mortality in the hydrosystem. These results indicate that the reliance on one particular methodology to estimate incidental take mortality could be

problematic. This is of particular concern since the methodology employed by NOAA for the 2008 BiOp is potentially under-estimating the incidental take mortality for sockeye.

**Literature Cited:**

- Berggren, T., H. Franzoni, L. Basham, P. Wilson, H. Schaller, C. Petrosky, K. Ryding, E., Weber, and R. Boyce. 2005. Comparative Survival Study (CSS) of PIT-tagged Spring/Summer Chinook. 2003/04 Annual Report, Migration Years 1997-2002 Mark/Recapture Activities and Bootstrap Analysis. BPA Contract # 19960200.
- Bouwes, N., C. Petrosky, H. Schaller, P. Wilson, E. Weber, S. Scott, and R. Boyce. 2002. Comparative Survival Study (CSS) of PIT Tagged Spring/Summer Chinook, Status Report for Migration Years 1997 – 2000. Mark/Recapture Activities. BPA Contract #8712702.
- Williams, J.G., S.G. Smith, R.W. Zabel, W.D. Muir, M.D. Scheuerell, B.D. Sandford, D.M. Marsh, R.A. McNatt, and S. Achord. 2005. Effects of the Federal Columbia River Power System on salmonid populations. NOAA Technical Memorandum NMFSNWFSC- 63, 150 p.