To: Federal hydro work group

From: Charlie Paulsen

Subj.: Estimated upstream survival and associated standard errors, 2002-2008

Date: 2010-01-23

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At out last meeting on Jan. 20, I agreed to provide estimates of precision for the existing upstream survival estimates used in the 2008 BiOp and updated by Blane Bellerud, NOAA Portland, through calendar 2008.

The methods are adapted from Burnham et al (1987: 115). In this adaptation, I assume that the detection efficiency at LWG and MCN is 1.00. If detection efficiency is indeed 1, the “q” terms in Burnham et al become zero and may be ignored.

The formula for survival with detections at BON and LWG is simply:



Where:

 = Estimated survival, BON to LWG;

 = Number of fish detected at both LWG and BON, and

 = Number of fish detected at BON.

The variance in estimated survival is:

,

with terms as defined above. The standard error is just the square root of the variance. Methods for BON to MCN and MCN to LGR are identical, after substituting appropriate counts at MCN, etc.

The resulting standard errors (Table 1) range from just over 10% (transported Snake fall chinook, 2006) at the high end to about 0.5% (Upper Columbia steelhead, 2006) as the most precise estimates to date. While including harvest and straying could in principle increase precision, currently available empirical estimates of these factors have unknown statistical properties, and so were not included in this analysis.

# Reference

Burnham, K. P., and four coauthors, 1987. *Design and Analysis Methods for Fish Survival Experiments Based on Release-Recapture*. American Fisheries Society, Bethesda, MD.

Table 1. Estimated upstream survival rates (not adjusted for harvest and straying), and standard errors, 2002-2008.







Table 1 (concluded)



