SCHOOL OF AQUATIC & FISHERY SCIENCES
COLUMBIA BASIN RESEARCH

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Dear John,

RE: Statistical Review of Steve Haeseker's (March 2008) Presentation, "Comparative Survival Study, Chapter 2"

The presentation referenced above is based on Chapter 2 of the Ten-Year Retrospective Summary Report by the Comparative Survival Study (CSS) Oversight Committee and Fish Passage Center. We previously reviewed the ten-year retrospective summary report in July 2007. Consequently, our earlier comments remain pertinent. Some of our biggest concerns regarding the analyses and presentation are as follows.

1. An *ad hoc* approach to estimating the instantaneous mortality rate (Z) is used. Properly, the value of Z is based on the average lifetime $(\hat{T})$ of the fish within the reach (both alive and dead), where

$$\hat{Z} = \frac{1}{\bar{T}}$$

The CSS study uses average fish travel time $(\widehat{\mathrm{FTT}})$ and reach survivals $(\hat{S})$ to approximate this value, i.e.,

$$Z = \frac{-\ln(\hat{\mathrm{S}})}{\widehat{\mathrm{FTT}}}. \qquad (1)$$

Th estimate of fish travel time is based on only fish that survive the reach. Hence, the Z value is biased high because the slowest fish are more likely to succumb in a reach.

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2. From the ROSTER results (http://www.cbr.washington.edu/trends/roster.php), there is not a simple inverse relationship between survival and fish travel time as seen below for the yearling Chinook salmon in the McNary-to-Bonneville reach.

McNary – Bonneville Reach

	Hatchery Steelhead		Hatchery Yearling Chinook	
Year	$\hat{S}$	TT (days)	$\hat{S}$	TT (days)
2000	0.56	6.11	0.92	5.65
2002	0.61	5.28	0.95	4.99
2003	0.64	4.85	0.76	4.17
Average	0.613	5.413	0.877	4.93

In addition, the reported "daily percent mortality" in the presentation are not consistent with estimated reach survivals from PTAGIS. For example, the CSS reports a daily percent mortality of 6.4% for hatchery Chinook salmon. Using that value and average travel time, reach survival is estimated to be

$$(1-0.064)^{4.93} = 0.722,$$

which is lower than any year or average (0.877). Similarly, for steelhead, they report a daily percent mortality of 10.6%, which corresponds to a reach survival of

$$(1-0.106)^{5.413} = 0.545,$$

again lower than any year or average (0.613).

3. Because the CSS estimates of *Z* are based on reach survivals (S) and fish travel times (FTT), separate analyses of *Z*, S, and FTT are not independent. In particular, survivals within a season are relatively stable while fish travel times show marked seasonal trends. Using a ratio of this information in the form of the *Z* value [Eq. (1)] induces seasonal patterns in *Z*. In part, the trends in *Z* are nothing more than the inverse trends in fish travel times which are misinterpreted as trends in survival.

4. Julian day (seasonality) was included in most or all of the fitted survival and travel time models. Julian date is a surrogate for numerous factors that may have a within-season trend, including smoltification, flows, temperature, turbidity, etc. In some instances, Julian day alone does a good job of modeling the data. Using that variable in the regression models obscures the influence of the other model factors and their relevance in describing flow or spill − survival relationships. Its inclusion in the regression models also makes the predictions seem better than they really are. The degree of this problem can be measured by how correlated Julian day is with the other model variables (e.g., flow, spill, etc.).

In summary, the presentation is a restatement of last year's CSS ten-year retrospective summary report. Many of the review comments at that time were not taken into account in this new presentation. While models predicting smolt survival as a function of environmental and operational covariates would be very helpful, the CSS analysis is statistically inadequate for this purpose at this time. Shifting the focus from survival (S) to instantaneous mortality rates (Z), as presented, results only in confusion and should be avoided.

Please let me know if we can be of any further assistance.

Sincerely,

John R. Skalski
Professor of Biological Statistics