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MEMORANDUM

TO: Tom Lorz, CRITFC

FROM: Michele DeHart

DATE: July 7, 2006

RE: Review of Caudill, et al. (Adult Chinook salmon and steelhead dam passage behavior in response to manipulated discharge through spillways at Bonneville Dam)

In response to your request, the FPC staff have reviewed the study: "Adult Chinook salmon and steelhead dam passage behavior in response to manipulated discharge through spillways at Bonneville Dam", and provide comments below.

Summary:

This paper details a study conducted at Bonneville Dam during 2000, 2002, and 2003 to determine the influence of spill levels on the passage of adults (i.e., time to passage). The authors used paired t-tests to determine if mean passage time differed between those fish that encountered "high" versus "low" spill levels upon first reaching the tailrace. The authors also used Chi-square tests to test for differences in the frequencies of fish passing under "high" versus "low" spill conditions within each of four "switch-skip" categories. Finally, the authors utilized Cox proportional hazards regression models (i.e., survivorship analysis) to estimate the effects of origin (i.e., clipped or un-clipped), discharge (kcfs), fork length, and temperature on adult passage time. In addition to these parameters, the authors also estimated the effects of spill on whether a fish enters a fishway within a certain time interval. Spill was treated differently in two separate analyses; first as a categorical variable (high vs. low) and second as a continuous variable (kcfs). Overall, the authors concluded that "high" spill has an effect on adult passage time.

Our overall conclusion is that the use of uncorrected spill levels, combined with a sliding scale definition of "high" versus "low" spill, and the unknown cumulative affects of repeated passage of marked fish, make it difficult to determine the potential application of these study results to the management of spill at Bonneville Dam.

Issues and Concerns:

High versus Low Spill

In many of these analyses, spill was treated as a categorical variable with two possible outcomes, "high" or "low". However, the criteria for considering a spill as "high" versus "low" differed between the three years of the study. For example, "low" spill was <83.1 kcfs in 2000, <87.3 kcfs in 2002, and <81 kcfs in 2003. There was no clear biological explanation for why the authors chose to use these values as their cut-off for "high" versus "low" spill levels. Furthermore, it is unclear why they chose a "sliding scale" in their cut-off values between years. Also of concern is the fact that the magnitude of the difference between the treatments (i.e., "high" versus "low") differed between the three years (2.8 kcfs in 2000, 11.7 kcfs in 2002, and 21.5 kcfs in 2003). Again, there was no clear biological explanation for why the authors chose different magnitudes between years. Since many of the analyses treated spill as a categorical variable (i.e., "high" versus "low"), it is difficult to know whether the effects of spill are biologically relevant given that no justification for these cut-off levels are provided.

Use of Uncorrected Spill Levels:

In their materials section, the authors address the fact that the estimates for spill at Bonneville Dam had been incorrectly calibrated, and thus were overestimated (by 10-25%) in all three years of the study. However, the degree of overestimation depended on the original level of spill and, thus, is not the same for all spill levels. This is an important point because it is not enough to argue that any effects seen in the original analyses would be the same if one were to use the corrected values. Regardless, the authors chose to use the uncorrected values in their analyses. Their argument for doing so was to facilitate comparison with past studies but the use of uncorrected spill levels makes it difficult to apply any results to future management decisions.

Since the uncorrected spill levels were all overestimates of actual spill, the number of "high" spill days was inflated, especially for 2000. Using the author's criteria for "high" versus "low" spill for 2000, if one were to use corrected spill values, the number of "high" spill days would have decreased by 68%. In addition to reducing the number of "high" spill days in the analysis, this also would have affected the use of the blocked design in their study and subsequent analysis of passage frequencies within the for "switch-skip" categories.

Although the inflation in the number of "high" spill days for 2002 and 2003 is not as severe (8% and 2.7%, respectively) the analyses for these years are still of concern from a management perspective. If the analyses had used corrected spill, 60% and 94% of the spill days in 2002 and 2003, respectively, were still greater than those currently being implemented by the FCRPS. Many of these were over 20% higher than current implementation levels. Thus, it is hard to know if the effects seen in the analyses apply to current management operations.

Finally, since the analyses conducted with spill as a continuous variable were conducted with uncorrected spill, it is difficult to ascertain how informative these results are from a management perspective.

Experimental Design – Tagging and Release of Fish:

One final concern is with respect to the way the study was designed and conducted. This study indicated that fish were collected as they entered the Washington-shore fish ladder, tagged, and released ~9.5km downstream. If fish were being subjected to variable spill levels prior to

tagging, how was this "prior exposure" dealt with in the analyses? In other words, if a fish that encountered high spill prior to tagging was then tagged and released, how do we know this fish didn't have delayed passage time because of the prior exposure to high spill levels, and thus is experiencing a "double-jeopardy" when entering the tailrace for a second time?

Editorial Comments:

- Page 8, Paragraph 1. The report mentions that models using spill volume provided coefficients that express passage probabilities in terms of change in passage hazard per change in 10,000 kcfs of spill. Change to either10 kcfs or 10,000 cfs.
- Figure 3. The y-axis "count" should be better defined. It is unclear as to whether the author is referring to the number of days where spill was at each level specified in the x-axis or the frequency of each of the spill levels. Also, the authors may want to include cut-off points for "high" and "low" spill levels, just to make it a little easier to see.