Comments on Chapter 2 of **Comparative survival study draft 5/30/2007**

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Conclusions and Recommendations

In Chapter 2 of the CSS Ten-year Retrospective Analysis Report the effects of environmental variables on fish passage survival were analyzed using survival (S) and instantaneous mortality (Z). The report draws conclusions based on the analysis using Z. Result using S were not presented. Mathematically the analysis based on Z is not valid. The analysis and conclusions based on Z should be deleted from the report and replaced with the analysis based on S.

The authors model the instantaneous survival (Z) and survival (S) as a function of water travel time (wt), Julian day (ju), temperature (te), turbidity (tu) and spill (sp). However, survival results are only discussed for the analysis with Z.

The equation selected is

$$Z = a + b * wt + c * wt * ju \quad (1)$$

where instantaneous mortality increases with water travel time and Julian day.

From this analysis, the report states that (lines 7-11 page 23)

> "The models for characterizing instantaneous mortality rates provide information on how and why mortality rates may vary (Figure 2.17). For wild Chinook in the LGR-MCN reach, instantaneous mortality rates are estimated to remain low throughout the season when water transit times are short (5-d). As water transit times get longer, instantaneous mortality rates rise rapidly over the season."

This result is problematic and misleading because Z is related to wt and ju whether or not survival is related to these variables. The important issue involves what affects survival not instantaneous mortality which can change by travel time without a change in survival.

The mathematical error in their analysis can be demonstrated as follows. Z contains information on fish travel time *ftt* since it is defined

$$Z = -\frac{\log S}{ftt} \quad (2)$$

However, fish travel time decreases with increasing Julian day and water travel time. This has been established in earlier studies (Zabel et al. 1997, 1998, in press). The CSS study found a similar result

$$\log ftt = a_0 - a_1(ju) + a_3(ju)^2 + a_4(wt) - a_5(wt)^2 \quad (3)$$

Therefore, *Z is a function of ju and wt independent of any effect of these variables on S*.

It follows, that effect of wt in equation (1) is strongly condition by its effects on ftt in equation (3). When using Z as the dependent variable it is not possible resolve the effect of wt on survival. In fact, Zabel et al. in press analyzed the effects of similar covariates on survival (S) and found temperature was a dominant factor in the upper reach and the only factor in the lower reach. These results stand in variance to the claims in the CSS report (lines 3-9 page 24)

> "Several patterns have emerged from the examination of instantaneous mortality rates. First, for both species, instantaneous mortality rates in the MCN-BON reach are roughly double those in the LGR-MCN reach (Table 2.3). This means that one additional day spent in the lower reach will result in twice the level of mortality that would occur with an additional day spent in the upper reach."

The claim is not supportable. In the lower reach, mortality is independent of time in reach (Zabel et al in press). Mortality depends on temperature so the results in the CSS study reflect the effect of wt and ju on fish travel time, not on survival.

Relating river conditions to Z, and not S, does not reveal the effect of temperature on survival, contrary to the claims in the CSS report. The report states (line 17-19 page 24)

> "Given that temperature was not identified as a primary factor in the upper reach where the data were more precise, the identification of temperature in the lower reach as a primary determinant of instantaneous mortality rates in steelhead may be a spurious correlation."

Zabel et al. (in press) found temperature was important in the upper reach. Furthermore, the 2001 data reveals a strong temperature effect not a flow effect (Anderson 2003). In 2001, flow increased and decreased over the migration season while survival dropped steadily (Figure 1). However, survival dropped as temperature increased showing (Figure 2). The CSS model is incapable of capturing this pattern.

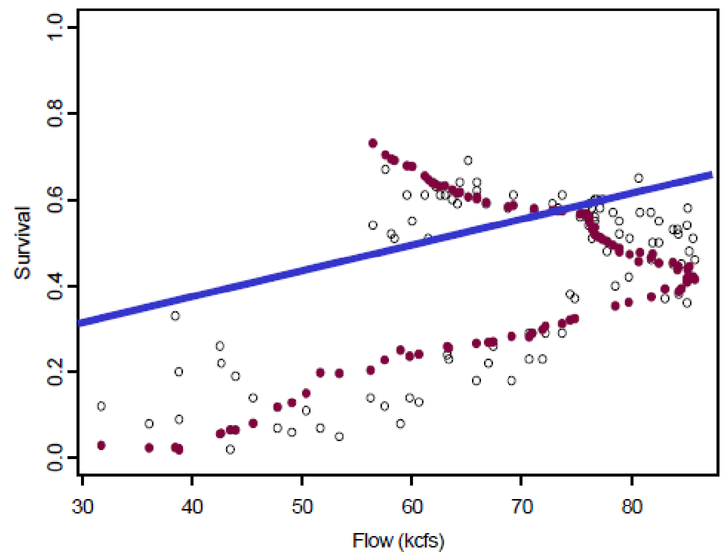

Figure 1. Spring chinook survival vs. flow between Lower Dam and McNary dam for 2001. Survival estimated with designated (○) survival estimated with the CBR model designated Line depicts the low flow segment of NOAA's hockey stick flow/survival relationship (from Anderson 2003a).

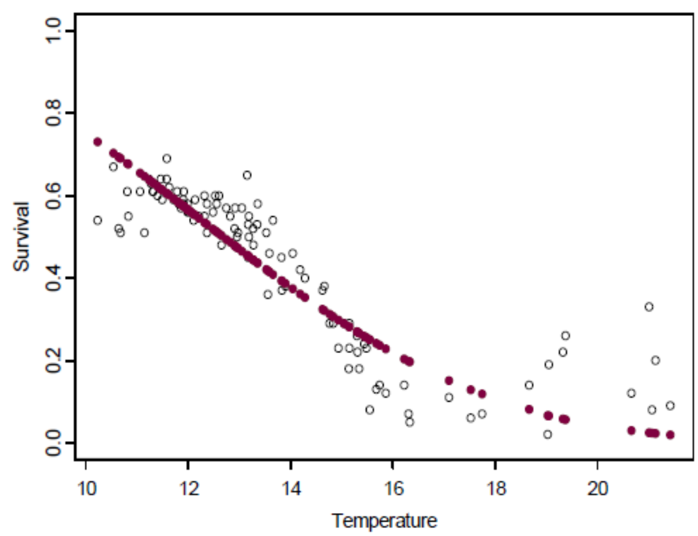

Figure 2. CBR model showing relationship between chinook survival and temperature over the reach LGR and MCN in 2001. Survival estimated with PIT tags designated (○) survival estimated with the CBR model designated (●) (from Anderson 2003a).

References

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