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MEMORANDUM

TO: Rod Sando, CBFWA

FROM: Michele DeHart, FPC

DATE: June 30, 2003

RE: Review of Issue Brief No. 2, "The Variable Impact of Dams on Columbia and Snake River Salmon Populations" by Jay O'Laughlin and the supporting paper by Levin & Tolimieri.

In response to your request a group of agencies technical staff with technical expertise in these analysis reviewed these documents. As a result of that review, we conclude that O'Laughlins' Issue Paper 2 is inaccurate and misleading and has no application to present fish passage management questions. The supporting paper by Levin & Tolimieri has technical and analytical weaknesses that raise questions about the management application of their conclusions.

Comments on Issue paper:
The variable impacts of dams on Columbia and Snake River Salmon Populations
by Jay O'Laughlin, Professor and Director
College of Natural Resources Policy Analysis Group
University of Idaho

Comments by C. Petrosky, H. Schaller and S. Haeseker

- O'Laughlin claims that 'the clear logic of breaching proposition is perhaps too simple, however, as there are other factors affecting salmon populations, including not only habitat, harvest, hatcheries, and ocean conditions, but also the variable impact of dam design and operations on salmon.' The author did not acknowledge that a past study, PATH (Plan for Analyzing and Testing Hypotheses), performed comprehensive decision analyses of various management options (including breaching of the 4 lower Snake River dams), which considered all of the factors listed above and assumptions about the effectiveness of dam operation and design on salmon survival rates. The PATH analysis found that breaching the 4 lower Snake River dams, plus actions in harvest, habitat and hatchery reform was the most

likely option to recover Snake River salmon. Therefore, the logic used for justifying breaching was by no measure simple, but rather comprehensive. This work has been published in peer-reviewed journals (Deriso et al. 2001, Peters and Marmorek 2001, Peters et al. 2001, Budy et al. 2002, Petrosky et al. 2001, and Schaller et al 1999).

- In addition, recent analysis by Wilson (2003) using an analytical framework employed by Karieva et al. (2000) (and by NMFS in the 2000 Biological Opinion for the Columbia River hydrosystem) came to similar conclusions as PATH on the issue of breaching the 4 lower Snake River dams. This is a recent study, which employs sound ecological data, is based on well-constructed analyses, and was published in a well-respected international scientific journal.

- The analyses that O'Laughlin refers to (Levin and Tolimieri 2001), reanalyzes previous published data (Schaller et al. 1999, and Deriso et al. 2001) using techniques that are questionable (see comments below on Levin and Tolimieri).

- O'Laughlin claims the authors unequivocally conclude that the 4 lower Snake River dams are not preventing the recovery of salmon in Idaho. However, the authors qualify their conclusion, and the logic they present is equivocal. Levin and Tolimieri found significant declines in spawner numbers from the before to after period (pre and post lower Snake dam development) in the Snake and Upper Columbia Rivers, but not in the Middle Columbia River. The authors claim that this suggests hydropower strongly impacted both Upper Columbia and Snake River populations. Based on this finding, and their qualification that results from Ricker residuals should be interpreted cautiously, it is difficult to follow the logic how the authors concluded that dams on the lower Snake are not a potential force preventing recovery of endangered salmon.

- O'Laughlin claims that he can draw clear inferences about breaching of the four lower Snake River dams from the Levin and Tolimieri study. His hypothesis is that efforts have been taken to bypass juvenile salmon migrants around the four lower Snake River dams, and the dams are not preventing the recovery of Snake River chinook salmon populations. However, breaching was not investigated in the Levin and Tolimieri study. The results in the study were equivocal when contrasting findings from spawners, recruits/spawner, and Ricker residuals. Also, unlike the work in PATH, this study did not evaluate the operational changes in the hydrosystem versus dam breaching.

Comments on Levin & Tolimieri (2001)

Our comments are primarily focused on the ill-founded construction of Levin and Tolimieri's analyses, for these following reasons:

- The authors ignored the fact that the ESUs used for evaluation are composed of a number of independent populations (with varying productivities, capacities, and hydrosystem impacts). Even though the data they relied on are segregated by independent populations, the authors aggregated the information for their analyses. This approach has the potential to dampen the

populations' response to perturbations, minimizing the individual response of the independent populations that compose the aggregate ESU. The approach of managing for these independent viable salmonid populations has been documented by NMFS in McElhany et al. (2000).

- The authors fit a parent/progeny function (Ricker function) to the entire time series of data (which includes pre and post lower Snake River dam construction). Due to major changes in the physical environment (the migration habitat impacted by four lower Snake River dams), fitting a Ricker function to all years of record would be expected to poorly describe the population dynamics for the aggregate ESU population (Walters 1987, Hilborn and Walters 1992). Analyses that have accounted for these changes in the migration habitat have been performed on these data sets (Schaller et al. 1999; Deriso et al. 2001).

- Levin and Tolimieri do not provide adequate description in the methods section to allow us to precisely duplicate their Ricker residuals presented in their figure 6 (nor do they present any results on the actual models fitted). However, it is apparent that their residual pattern grossly underestimates the actual magnitude of decline in productivity that occurred in Snake River and Upper Columbia stream-type chinook stocks coincident with hydrosystem construction and operation (Schaller et al. 1999; Deriso et al. 2001). Levin and Tolimieri residuals showed less decrease over time, particularly in the Snake River region (Fig. 1), apparently a result of their poor fitting Ricker model(s).

- Levin and Tolimieri acknowledge (p. 294) that their Ricker residuals were autocorrelated, and that "(t)herefore, significant results from analyses of Ricker residuals should be interpreted cautiously." While they caution here against type 1 error, they explicitly accept substantial type 2 error, stating (p. 294) "…absence of differences among regions that vary in dam number would be strongly suggestive that passage through the hydrosystem is not the leading determinant of population size or dynamics." If the fitted Ricker functions do not adequately describe the population dynamics, one would not expect the residuals from a poorly fit model to accurately reflect the productivity changes over time, nor would the resulting non-significant statistical results strongly suggest minimal impact from dams.

- Contrasting results between regions from other studies, the average Snake River stock productivity decreased 64%-71% compared to the Middle Columbia from the pre-dam period to the post-dam period (Schaller et al. 1999, Deriso et al. 2001). Using the Levin and Tolimieri (interpolated) residuals, ln(R/S) decreased only by 0.03, or recruits/spawner decreased by a mere 3% compared to the Middle Columbia. As discussed above, a major factor in this discrepancy appears to be due to Levin and Tolimieri's poor fitting Ricker functions.

- We analyzed the Levin and Tolimieri residuals and contrasted those to analysis of residuals from Schaller et al. (1999). Using Levin and Tolimieri's period designation (1959-65 period 1, 1980-1990 period 2) for the residuals from Schaller et al. (1999), the residuals from period 2 exhibited a significant drop from period 1 ($P<0.001$). In addition, using the period designation (1959-69 period 1, 1975-1990 period 2) from Schaller et al. (1999) for the residuals from Levin and Tolimieri (2001), the residuals from period 2 exhibited a significant

drop from period 1 ($P<0.006$). It is apparent from these analyses that Levin and Tolimieri's results are highly influenced by selection of time period, their method for fitting the Ricker function, and aggregation of independent populations. Therefore, we conclude that Levin and Tolimieri's results from the Ricker residuals are questionable and their conclusion (which primarily relies on analysis of residuals) that 'dams on the lower Snake are not a potential force preventing recovery of endangered salmon' is highly equivocal.

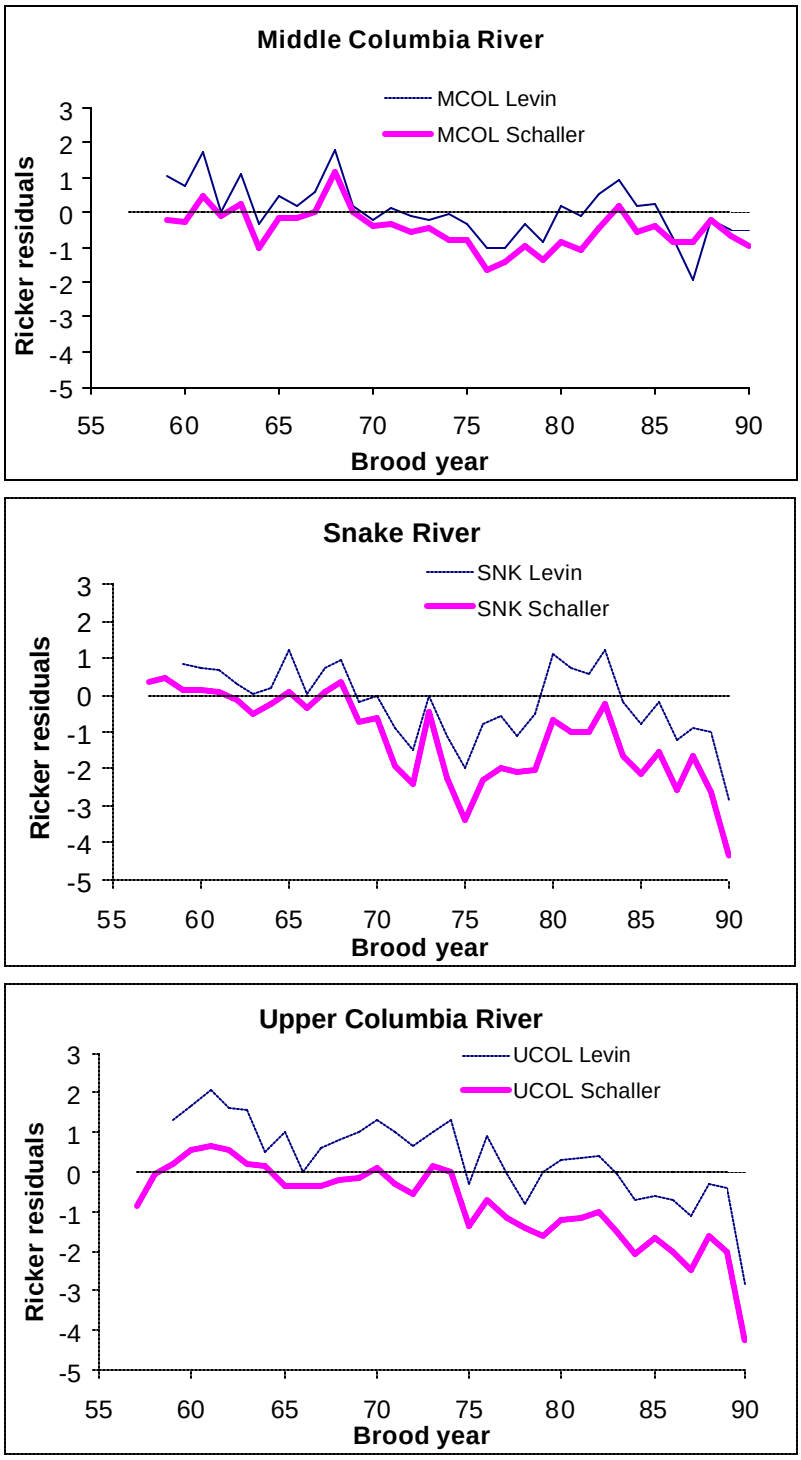

Figure 1. Residuals from Ricker functions for three interior Columbia regions, from Levin and Tolimieri (2001) and Schaller et al. (1999), 1957-1990.

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