~~Additional Perspectives and Supporting Science Related to Use of Tributary Junctions as Potential Habitat Breaks~~

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Purpose of This Document

In August of 2018, the Forest Practices Board (FPB) passed a motion intended to clarify and document divergent perspectives among the authors of the January 2018 Science Panel Report.

> *The Board further directs the AMPA to convene the authors of the January 2018 report from the science panel to update the report to reflect all perspectives and supporting science regarding tributaries.*

In September, a sub-set of the January 2018 report authors initiated a literature review summarizing available science related to use of small tributary streams by fish. As a co-author of the Panel's report, it is my opinion that the literature review represents an incomplete response to FPB's motion and intent. My suggestions and perspectives on the Panel's January report and recent literature review were not incorporated to my satisfaction. I am offering my additional perspectives on both the Science Panel's report and literature review in this supplemental response to the FPB motion as I heard it discussed and approved at the August 2018 meeting.

Background

Regulations guiding the management of aquatic systems include protections on waters containing fish habitat intended to support meeting the goals established in the Forest and Fish Report. Riparian protections and provisions to restore fish passage intended to support meeting these goals rely on a water typing system that distinguishes between fish habitat (Type F) and non-fish habitat (Type N) waters.

Performance expectations for rules related to the water typing system are clearly articulated in the Forest and Fish Report (FFR), the Biological Opinion of the Forest Practices Habitat Conservation Plan (FPHCP), the Legislature's Forest Practices Salmon Recovery Act, and in 30 years of TFW Policy and Forest Practices Board (FPB) deliberations. Within all these documents and administrative actions, performance of the water typing rule performance is consistently described in the context of achieving the most accurate possible separation between Type F and Type N waters, with equitable allocation of remaining uncertainty or error. In other words, within the sideboards of FFR and the FPHCP, the highest possible accuracy in placement of the regulatory break is desired, avoiding errors in both over and under-classification of Type F and Type N waters.

Decisions related to water typing regulatory issues made by the FPB over the past 20 years have been consistent with these regulatory sideboards. In 2001 permanent rulemaking, electro-fishing was retained as an alternative for locating the F/N regulatory break based on data presented to the FPB demonstrating poor accuracy and bias in error allocation arising from placement of the regulatory break using proposed default physical criteria. Subsequent CMER assessments of Western and Eastern Washington fish habitat model maps characterized accuracy and error in modeled F/N breaks against

field surveyor determinations of both fish use and estimates of fish habitat. A CMER pilot study was completed intended to support a more complete understanding of the accuracy and error of statewide fish habitat model maps. In 2005, the FPB declined to adopt the resulting statewide model-based maps based on these studies and other concerns expressed about mapped F/N breaks not meeting desired accuracy and error allocation expectations. At the same meeting, the FPB unanimously endorsed a hybrid solution that would supplement model-based water typing maps with field survey information to improve their accuracy. In November of 2016, the FPB adopted consensus recommendations re-affirming the expectation for a water typing system with high accuracy and balance in the allocation of error. Quantitative information characterizing accuracy and error of water typing alternatives has been - and continues to be - an essential component of technical information necessary to support FPB decision-making.

Perspectives on the Evaluation of Potential Habitat Break Alternatives

Any alternatives intended for implementation in rule should be supported by a thorough, meaningful, technically sound analysis of available data to quantify the performance of recommendations against the established water typing performance targets.

There is no question that the quality of the available data presented challenges for the Science Panel in evaluating Potential Habitat Break (PHB) alternatives. The current rush for rule-making has forced the use of science and data never intended for the purpose currently before the FPB. However, several important data sets were excluded from the analysis summarized in the Panel's second report (e.g. landowner contributed data, CMER annual and seasonal variability study data). The data used to support the second Science Panel report's analysis and recommendations was developed from a relatively small sample of approved water typing surveys, and was used to replace, not supplement, existing data before the Panel. Those who complied the new information expressed low confidence in the reliability of the data. This new database contained a high proportion of missing values that precluded a complete and thorough analysis of PHB alternatives, including various alternatives for treatment of tributary streams. More complete data were available but not included in the analysis. Across all datasets, a lack of critical spatial information describing distances between potential PHB features in tributary streams - and all streams in general – prevented a thorough analysis of various PHB alternatives in terms of stream length correctly or incorrectly classified.

The Science Panel recommendations for PHBs in both reports were based on a review of available literature, analysis of limited field survey data, and a ranking of PHB alternatives against a "percent captured' statistic. No citation or precedent was presented supporting use of the percent captured statistic as a reliable measure of performance of PHB alternatives being considered. I am not aware of any use of the percent captured statistic as a measure of performance in the published literature. Alternative methods were proposed using existing data that included analysis of the accuracy, and the frequency and direction of errors associated with various PHB alternatives. Those methods were rejected by a sub-group of the Panel conducting the analysis. It is still my opinion that the percent captured statistic provides little reliable or useful information to support an evaluation of the accuracy or error for PHB alternatives or recommendations. Consultations with several statisticians support my conclusion. Results of my alternative analyses were presented to the Panel on multiple occasions. Arguments presented to the Science Panel were unsuccessful in changing the direction of their analysis.

My recommendation is to conduct a more thorough analysis incorporating all available data and employing more meaningful statistical procedures in a manner that supports the FPB's accuracy and error allocation information needs. Given the limitations of the available data and concerns about the analysis conducted, there is a high degree of uncertainty regarding the performance of any of the Panel's recommendations. Caution should therefore be applied in the interpretation of the Science Panel's reported results and recommendations.

Perspectives on Tributary Streams

Tributary stream junctions are often associated with abrupt changes in upstream/downstream channel characteristics that can support accurate placement of the break between fish habitat and non-fish habitat waters.

Recommendations of the Science Panel report included a single sentence stating that evaluations of tributary stream junctions should only consider information measured upstream of tributary junctions being evaluated. I believe it is premature to conclude that information gathered below tributary junctions has no value in supporting the accurate placement of the regulatory break.

Implementation of the Panel's tributary recommendation could have the effect of eliminating the use of many tributary junctions as PHB's where a biologically meaningful change in stream size or gradient potentially occurs. No supporting analysis was conducted by the Panel to evaluate accuracy or error allocation implications with or without incorporating their tributary recommendation. The tributary recommendation conflicts with the Panel's data analysis and PHB criteria recommendations, which included alternatives for both gradient and size-based PHB criteria identifying inflection points where a change in tributary stream characteristics measured in both a downstream and upstream direction occur. Any recommendations that preclude full implementation of recommended PHB alternatives deserve a thorough analysis and presentation of supporting data.

Changes in stream size and gradient associated with tributary junctions have long been identified by surveyors as important features associated with the determination of the upper extent of fish habitat. In a call for field survey data to support the Western Washington Fish Model development, 3,120 "Last Fish Habitat" surveys were contributed by 16 organizations representing state agency, tribal, and landowner stakeholder groups (Conrad et al 2003). Of those "Last Fish Habitat" points contributed, 2248 (73%) were associated with tributary stream junctions. Lateral category tributary stream junctions were associated with 1410 (45%) of those contributed "Last Fish Habitat" points. More recently, in a sample of concurred-with survey data contributed by landowners to the Science Panel, 875 of 1561 (56%) fish habitat survey points were associated with lateral tributary stream junctions identified as the end of habitat likely to be used by fish. Recommendations for treatment of tributary streams that are inconsistent with long-standing field survey practices should be more thoroughly analyzed and supported by data.

Results of CMER and other fish habitat modeling research suggest it may be premature to dismiss the value of information collected below tributary junctions. Incorporating information characterizing stream characteristics above and below tributary junctions into PHB criteria may improve accuracy in placement of the regulatory break. Downstream gradient is included in several best performing models predicting the upper extent of fish habitat (Conrad et al 2003, Fransen et al 2006). PHBs based on changes in stream size associated with tributary junctions, rather than simple threshold values of upstream stream size, may also support more accurate placement of the F/N break. Further analysis in

warranted. Stream size (as indicated by upstream basin area) was highly a significant variable (<.001) in CMER models predicting the upper extent of fish habitat. Basin area was selected by the stepwise variable selection procedure employed as the first physical attribute selected in 50 out of 50 models estimated. Consistent with the field survey data, resulting end of fish habitat points predicted by fish habitat models frequently coincided with abrupt changes in stream size and channel gradient associated with lateral tributary junctions. An evaluation of the accuracy of the CMER fish habitat model reported that 68% of model predictions occurring at lateral stream junctions aligned exactly with a field survey-identified end of fish habitat break. Less than 5% of other F/N boundary types aligned exactly with field survey-identified end of fish habitat breaks.

Multiple CMER field studies also support lateral tributary junctions as reliable indicators of a meaningful change in the likelihood of upstream fish use. Resurveys of lateral tributary streams initially determined not to support fish use by electrofishing survey demonstrated a very low likelihood of upstream movement seasonally or annually by fish (Cole et al 2006, Cole and Lemke 2005). Locations where upstream movement was observed tended to occur along continuous channel reaches where low gradient, large stream size, and few potential barrier features occurred. In a CMER pilot field study designed to evaluate the W WA fish habitat model (Cupp 2005), 92% of end of fish habitat predictions associated with lateral tributary junctions correctly identified the end of fish use as determined by field survey verification.

The Panel's tributary recommendation has the potential effect of unnecessarily restricting use of tributary junctions as PHBs. Recommendations potentially affecting a high proportion of regulatory breaks identified at tributary junctions may have significant implications on the performance of the resulting stream classification system. Conflicting Science Panel recommendations for PHB alternatives and the treatment of lateral stream junctions need to be resolved. Additional analysis of available data characterizing potential implications on performance for alternatives affecting tributary junction PHBs should be conducted and carefully considered prior to adopting the Panel's recommendation.

Small Tributary Literature Review

The Science Panel's literature review of fish use in small tributary streams is an incomplete response to the FPB's motion.

A sub-set of the Science Panel report's authors elected to develop a literature review narrowly focused on fish use in small streams as their response to the FPB motion. I expressed concerns about the scope of the response and whether it was consistent with the FPB motion. A majority of authors apparently disagreed with my specific concerns and recommendations to broaden the review. Lacking incorporation of my perspectives in subsequent drafts, I elected not to be included as a co-author on the final document.

My comments and edits focused on the need to include information describing small tributary streams that are not likely to be used by fish as well as those that are likely to be used by fish. In the context of current rule-making process, it is just as important to understand where fish are not likely to occur as it is to understand where fish are likely to occur. The primary purpose of PHBs is to support locating the break between Type F and Type N waters in an accurate and reproducible manner. Important information from studies capable of informing the discussion about the likely use of tributary streams were not included in the literature review (e.g. Conrad et al 2003, Cole and Lemke 2006). The omission of the Cole and Lemke seasonal variability study is particularly troublesome, as it provides the most

complete and targeted evaluation available describing seasonal use of streams by fish and the physical characteristics that may influence a likelihood of seasonal fish use.

Supporting information included in the literature review representing extremes of piscatorial performance or exceptions to generally observed tends in fish use (e.g. those representing the highest gradients where individual fish have ever been found, or atypical individual examples of fish occurrence selected from broader research studies) do not support a balanced understanding of the ranges of stream characteristics necessary to develop accurate PHB criteria to separate Type F and Type N waters at a landscape scale. My suggestions to broaden the discussion and include a more complete presentation of data describing the frequency, magnitude, and range of stream characteristics associated with tributaries used by fish and not used by fish, and the physical characteristics that may help separate those waters, were not adequately incorporated.

It is also important to recognize that PHB's are proposed as potential regulatory breaks only after the completion of a protocol electro-fishing survey demonstrating no upstream fish use occurs at the time of survey. Site-specific situations where fish occur in unusually steep or small streams are therefore identified and incorporated into the classification of Type F waters whenever possible - no regulatory F/N breaks are ever proposed below the surveyed extent of fish use. PHBs therefore provide a means by which the relatively small proportion of fish habitat stream length found not to support fish at the time of a protocol survey can be identified as likely to be used by fish at some other time, and correctly classified as Type F water.

Finally, the FPB motion seems perfectly clear. Contrary to the direction provided by the FPB, the authors of the Science Panel's report were not convened in any meaningful way, the Panel's report was not updated, and the perspectives of all authors were not reflected within the materials produced. In my opinion, the literature review simply does not meet the FPB motion intent.

Conclusions

There is no dispute that small tributaries often provide important habitats for fish. However, the technical work necessary for the development and evaluation of reliable small tributary PHB alternatives and methodologies remains incomplete. The Science Panel and various stakeholder groups have discussed many options to refine PHB criteria associated with tributary streams, but they have never completed the task. Rather than continue to debate PHB implementation methods on tributaries in the absence of supporting analysis, a recommendation to conduct additional work to develop and evaluate PHB criteria that better differentiate between tributary streams likely or unlikely to be used by fish (following an initial protocol survey determination of fish absence) would seem more appropriate.

In support of achieving that goal, clarity at a policy level regarding performance expectations for the water typing system needs to be provided to the technical participants in this process. Differing interpretations of the definition of fish habitat and the role of accuracy and error allocation in the water typing system continue to prevent meaningful progress on a consensus technical solution. Any alternatives considered for adoption into rule or guidance could then be evaluated against clearly defined and measurable performance objectives using the best available data and statistically sound analytical procedures. Technical recommendations that meet policy objectives could then be developed to provide a science-based regulatory solution consistent with FFR, FPHCP, and Salmon Recovery Act expectations.

References

Cole. Michael B., and Lemke, Jena L. 2006. *Annual and Seasonal Variability in the upper Limit of Fish Distribution in Eastern Washington Streams.* Final Report: DNR Contract Number PSC 05-145.

Conrad, R. H., Brian Fransen, Steven Duke, Martin Liermann, Scott Needham. 2003. *The Development and Assessment of the Preliminary Model for Identifying Fish Habitat in Western Washington.* CMER Report.

Cupp C.E. 2005. *Water Typing Model Field Performance Assessment Pilot Study.* CMER Final Report. PSC 03-286

Cole, M. B., D.M. Price, B.R. Fransen, T.B. Jackson. 2006. *Interannual variability in the upper extent of fish distribution in eastern Washington streams, 2001–2002.* Transactions of the American Fisheries Society. 135: 634-642.

Fransen, B.R, S. Duke, L.G. McWethy, J.K. Walter, and R.E. Bilby. 2006. *A Landscape scale model for predicting the upper extent of fish distribution in streams.* North American Journal of Fisheries Management 26: 960-975