Project ID: 35062 ~ Impacts of Flow Regulation on Riparian Cottonwood Ecosystems in the Columbia River Basin ~ *Response to ISRP/RME Proposal Review Comments*

Given the nature and overlap of issues outlined in the comments and questions received by the Independent Scientific Review Panel (ISRP) and NMFS RME Group, we have carefully chosen to group related topics/issues in our response to these comments.

1. The ISRP cited a need to "provide better evidence of the linkages of changes in flow regimes, geomorphic processes, and cottonwood recruitment to changes in stream habitat and in the aquatic community, especially the fish community".

5. If additional studies are necessary to extend the research to other important reaches within the Yakima Basin is it likely that the results will be relevant elsewhere?

RME Group Comments: "the sponsors do not propose to measure any listed salmonid survival rates or other variables directly relevant to 183, nor would this be possible in their Flathead control area. " Measurements of salmonid survival rates, variables directly relevant to 183, and site location to meet these objectives are lacking". "The focus is on ecology of the trees with some superficial references to how that in turn affects habitat for anadromous fish".

Response:

Virtually all salmonids (as well as many species of plants, amphibians, birds and mammals) are acutely tied, for some critical part of their life history, to the ecological processes and "Shifting Habitat Mosaics found exclusively on river flood plains (Hauer et al. 2002, Synder et al. 2002). The shifting habitat mosaic is controlled by the coupled relationship between flow regimes, geomorphic processes, and cottonwood recruitment which in turn sets the template for stream habitat for the aquatic community. The most important component and the greatest hurdle faced by most rivers throughout the west is maintaining the "Shifting Habitat Mosaic" which is crucial to supporting a healthy river ecosystem (Hauer et al. 2002). Our philosophy is that if the primary drivers of hydrology and geomorphology are intact, or functioning as close to normative conditions as possible, then the river system will (or will at least have the potential to) respond in the most ecologically robust manner (Stanford et al. 1996). Cottonwoods provide a "keystone species" that reflects how intact the natural processes that drive the shifting habitat mosaic might be. Recruitment of cottonwoods is an essential component; moreover, it is a robust and easily measured indicator of normative river ecosystem processes (Braatne et al. 1996, Scott et al. 1996, Mahoney and Rood 1998, Rood et al 2002).

Thus, regardless of approach to salmonid restoration in the Columbia River Basin, without addressing ecosystem level requirements that are manifest across the river flood plains, restoration efforts will likely continue to languish, regardless of efforts and resources applied elsewhere (Stanford et al. 1996). Based on our experience in river ecology it is our thesis that most restoration efforts in river systems have proven to be remarkably unsuccessful. This is especially true whenever management has been focused on, or applied to, specific target species or family groups (e.g., salmonids, see Stanford et al. 1996, Williams et al 1999, 2000, Hauer et al. 2002).

The Nyack flood plain on the Flathead provides one of last remaining and most important un-regulated systems left in the entire Columbia Basin that can provide necessary data "to link changes in flow regimes, geomorphic processes, and cottonwood recruitment to changes in stream habitat and in the aquatic community, especially the fish community". The fact that Salmon are not found there is irrelevant. Our approach is to first focus on an analysis that allows identification and assessment of both aquatic and riparian flood plain habitats where cottonwoods provide a keystone indicator species and couple that to spatial modeling of the geomorphic/hydraulic and hydrologic system.

Our research working in Pacific NW river systems points to the necessity for application of restoration principles directed at proper function of ecosystem processes and support of biotic structure. Successful cottonwood recruitment provides a simple measure of how well the river ecosystem is responding to changes in flow regulation (Braatne et al. 1996, Mahoney and Rood 1998, Braatne and Jamieson 2001, Rood et al. 2002). This research will be directed toward the riverine flood plains of the Yakima and Flathead Rivers and provide the necessary information to make recommendations on what flow regimes best benefit cottonwood recruitment that in turn will benefit salmon recovery in the Columbia Basin.

(**Note:** The need for this integrative research perspective is strongly emphasized in recent papers entitled: 1) “Landscapes to Riverscapes: bridging the gap between research and conservation of stream fishes”, K.T. Fausch, D.C. Torgersen, C.V. Baxter & H.W. Li. 2002. Bioscience 52(6): 483-498, and 2) “Landscapes and ecological variability of rivers in North America: factors affecting fisheries restoration strategies”, Hauer, F. R., C. N. Dahm, G. A. Lamberti and J. A. Stanford. 2002. IN: Wissmar, R. C. and P. A. Bisson (eds.), Strategies for Restoring River Ecosystems: Sources of Variability and Uncertainty in Natural and Managed Systems. Special Publication of Am. Fish. Soc. In press. . A major section of our original proposal, “The role of cottonwoods in sustaining the biodiversity of floodplain habitats” ~ pgs 5-7, and Appendix A: Using Life History Information to Restore Riparian Forests ~ directly addresses many of the issues raised in ISRP Questions #1 & #5

2. How do differences in surface elevations (A and B in Figure 2 and Objective 2, Task a) relate to cottonwood recruitment?What relative values of A and B are desirable/what ones are not?

Response:

Cottonwood recruitment is dependant on the dispersal and deposition of seeds on geomorphic surfaces (e.g. gravel bars) coupled with the rate of water recession (Braatne et al. 1996, Mahoney and Rood 1998, Scott et al. 1996, Braatne et al. 2002). If for example the difference in A is small that would mean that the potential surface is at an elevation very close to that of the Top Bank (Fig. 2). This would mean that only floodwaters that reached this level could deposit seeds and recession rates for peak stages are relatively fast further limiting recruitment success. On the other hand if A is large that would mean the potential surface would have a much high probability of being scoured the following year removing the previous years successful recruitment. Similar arguments can be made for values of B.

There is no ideal value for A and B, moreover that concept is dangerous (Decamps 1996, Ward 1997). Managing a flow for some “optimum” value would set the template for cottonwood recruitment at a single stage relationship, and hence, greatly lower the diversity of potential aquatic habitat important to fish and other organisms (Hughes and Rood 2002, Ward et al. 1999). What is desirable is a broad range of relationships between recruitment elevations and the elevation of the top bank and water surface at base flow. This would present the best opportunity for successful recruitment of cottonwoods and produce the highest level of aquatic habitat diversity for fish (Braatne et al. 2002).

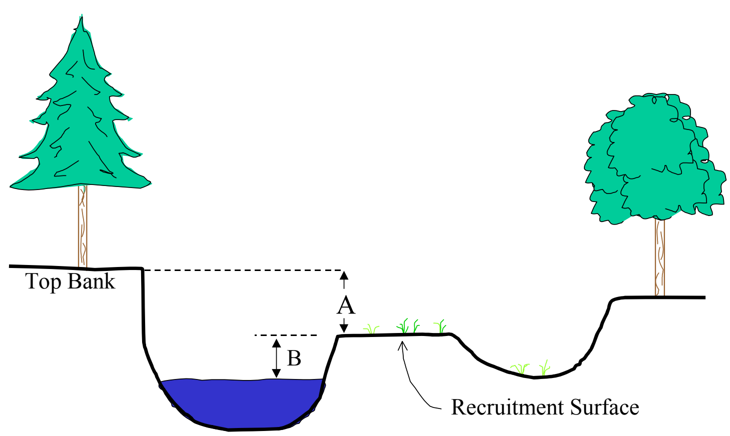

Figure 2. A schematic showing the difference in elevation between a newly formed recruitment surface and top of the floodplain bank (A) and the difference in elevation between base flow water surface and the recruitment surface (B).

3. In discussing the results of the innovative project, some empirical evidence needs to be presented supporting the contention that the current flow regime disrupts recruitment processes (pg 26). A more thorough and concise discussion of the kinds of flow management options that could improve recruitment would be beneficial.

Response:

The proposal already presents significant empirical evidence on the disruption of recruitment processes by current flow regimes in the Yakima River Basin. These include figures 7, 10, 11 (note: due to file size limitations, please refer to the proposal for Figures 10, 11) and the discussion from the pgs. 23-26, with critical excerpt below:

"During the 2000 growing season, field studies of riparian cottonwood forests were conducted along the Cle Elum, Union Gap and upper Wapato reaches of the Yakima River. These reaches were selected on the basis of their distinctive patterns of flow regulation (locally referred to as "flip-flop"). High flow regimes along the Cle Elum reach are maintained near bankfull elevations throughout the summer months (May – August, Figure 10). In early September, these regulated flows are diminished to improve spawning conditions for fall chinook. In the Union Gap reach, high flow regimes are consistently maintained throughout the irrigation season (May – September). In contrast, flow regimes on the Wapato reach are very low throughout the summer and early fall (May – October, Figure 11). These regulated flow regimes contrast sharply with historic patterns of seasonal flow, thus prior to the construction of dams and the widespread diversion of water to irrigate crops and pastures within the Yakima Basin (Figures 10-11).

Detailed field transects along the Cle Elum, Union Gap and Wapato reaches show that the current patterns of flow regulation in the Yakima Basin have had a significant negative effect on the recruitment of cottonwood seedlings. These findings are consistent with the observed flow regimes for these study reaches (Figures 10-11). High flows during the periods of seed dispersal (May – July) along the Cle Elum and Union Gap reaches completely inundate potential recruitment sites. During the same time period, low flows along the Wapato reach result in the germination of seedlings at low riverbank elevations. After the irrigation season is over, higher flows released into the Wapato reach readily scour away these young seedlings. As a result, older age class stands now dominate all of these study reaches. The extent of younger stands is extremely limited and largely an artifact of maturing clonal root sprouts. In fact, there doesn't appear to have been a significant recruitment event on any of these reaches since the initiation of the flip-flop regimes in the early 1980's (Figure 7)."

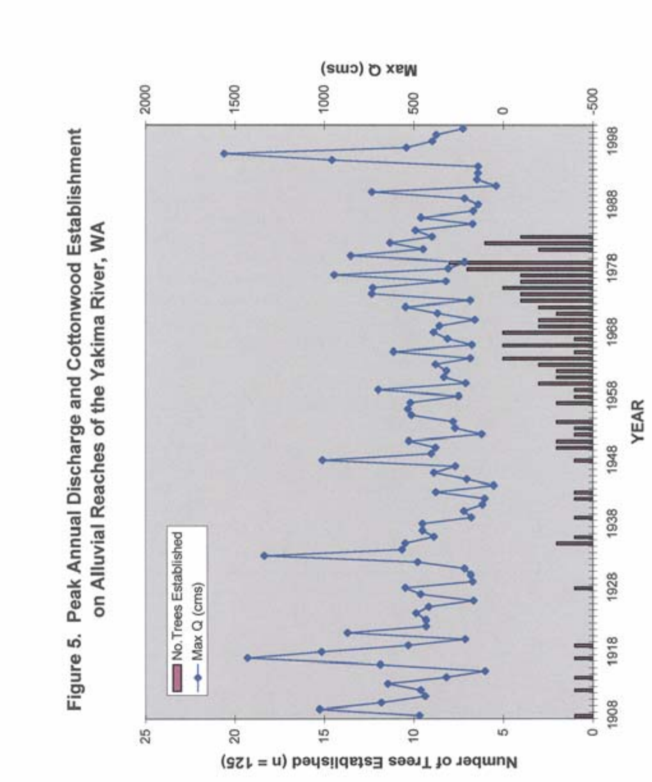

Figure 7. Peak annual discharge and cottonwood establishment on alluvial reaches of the Yakima River, Washington.

In addition, our final report (Braatne and Jamieson 2001) and current manuscript (Braatne et al. 2002) specifically match the discontinuities of seasonal river stages along the Yakima with the life history requirements of riparian cottonwoods; resulting in long-term recruitment failures, reach by reach; a critical excerpt for the Wapato reach being:

"The highly regulated flows along the Yakima River lead to a severely altered river stage in the Wapato reach (Figure 20), limiting the recruitment of native willows and cottonwoods to such low elevations (Figure 22, note elevation relative to baseflow for 2000 seedlings) that all recently germinated seedlings are readily scoured as discharge levels rise during the winter months. The lack of spring peakflows to recharge shallow groundwater acquifers combined with low summertime flows further induce significant levels of water stress in mature cottonwoods (Braatne, Hinckley and Stetter 1992, Braatne et al. 1996). This regulated flow regime thus has very serious consequences for the long-term health and vitality of riparian cottonwood forests along the Wapato reach."

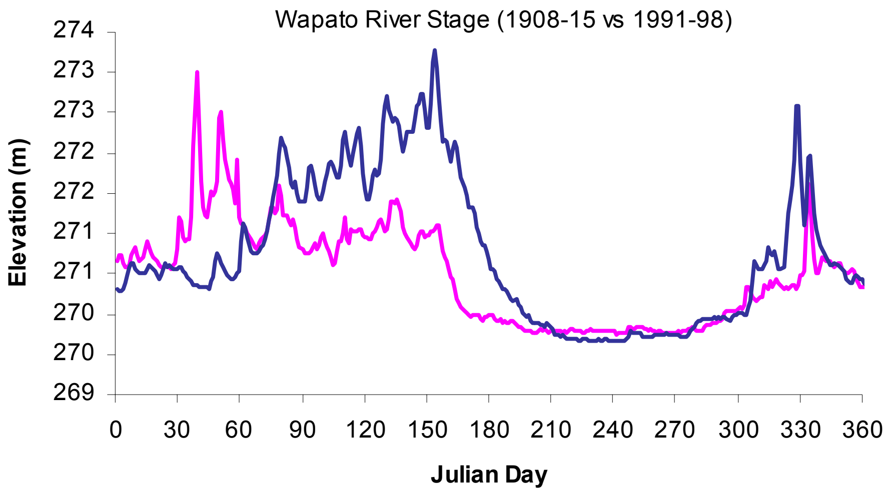

Figure 20. Seasonal patterns of river stage for the upper Wapato Reach of the Yakima River. Blue line = 1908 to 1915, Pink line = 1991-1998.

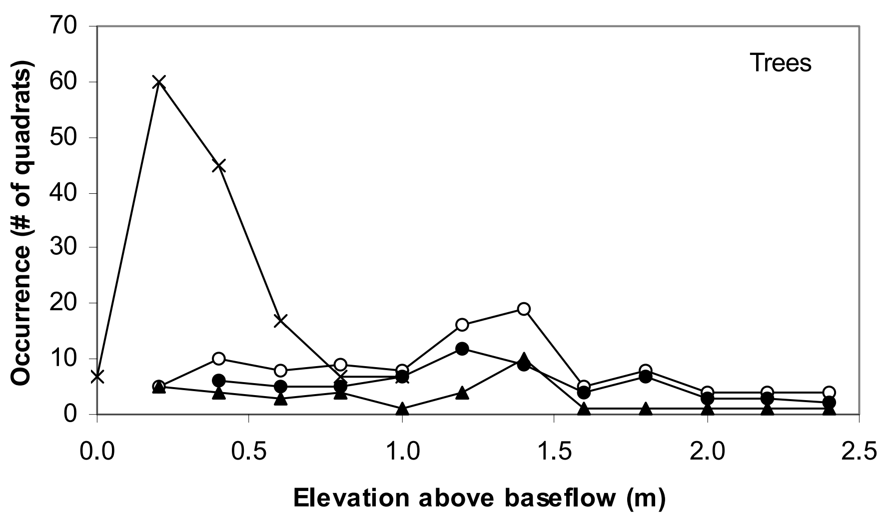

Figure 22. The distribution of trees relative to seasonal baseflow conditions in the upper Wapato study reach (open circles = all trees, closed circles = mature cottonwoods, closed triangles = other deciduous species (exotic species), x = 2000 cottonwood seedlings).

4. Objective 4 related to model development needs to be expanded. What kinds of models are being considered? What are the critical parameters in the models? Exactly how will the data collected in the previous three objectives be used in model development?

Response:

Modeling efforts can take on many forms. Our intent, as discussed in the proposal, was to develop and expand existing conceptual models (not a computer modeling exercise) based upon the relationships between seasonal flow regimes and cottonwood recruitment (Mahoney and Rood 1998). A large part of this effort is directed towards quantifying the degree of deflection & loss of geomorphic power by regulated flows in relation to a more normative flow regime (Figure 1, see proposal). As an example of the type of conceptual model envisioned, ISRP reviewers were specifically directed to Appendix A: Using Life History Information to Restore Riparian Forests (Molles 2002), where Figure 12.24 (see below) combines critical elements of seasonal flow patterns with the life history attributes of riparian cottonwoods as a means of extrapolating flows to promote the recovery of riparian cottonwoods and other native riparian and aquatic species (Molles 2002).

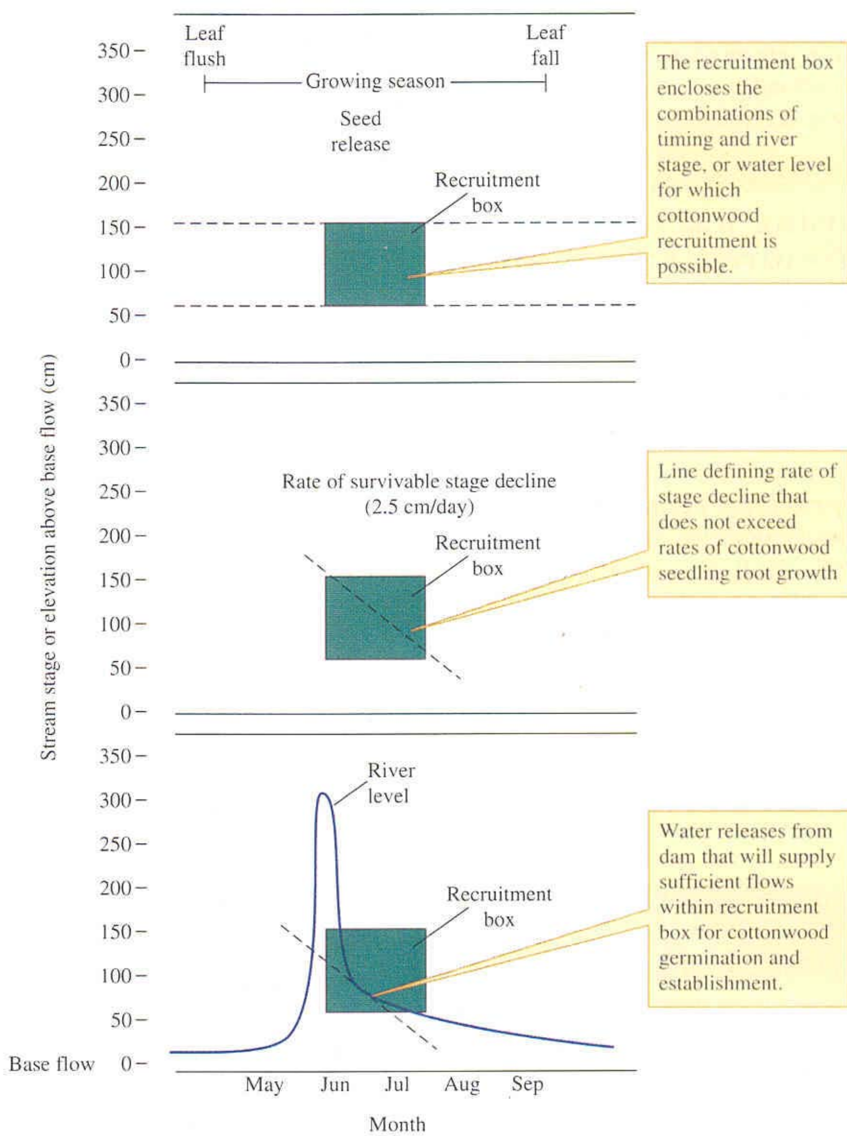

FIGURE 12.24 *River management to sustain cottonwood riparian forests (after Mahoney and Rood 1998).*

6. The project needs an M & E plan.

Response:

Our project has a defined endpoint, which is identification and prioritization of conceptual flow models and instream flow regimes to promote the recovery of riparian cottonwood ecosystems. In that sense, we do not require a monitoring and evaluation plan. If we were proposing to implement specific flow prescriptions to restore riparian cottonwoods, then a monitoring plan would be needed. Yet, we agree external oversight evaluation is warranted. Thus, we have assembled a review team (in similar fashion to our innovative project) composed of river scientists to examine our research goals, protocols & conclusions. This team will be headed by Dr. Jack A. Stanford (Floodplain Ecologist), Director of the University of Montana Flathead Lake Biological Station and former member of the ISRP. Additional committee members include: Dr. F. Ric Hauer (River Ecologist), UMT ~ Flathead Lake Biological Station; Dr. Mike L. Scott (Fluvial and Riparian Ecologist), USGS -Stream and Riparian Ecology Section, Fort Collins, CO, and Dr. Patricia McDowell (Fluvial Geomorphologist), Department of Geology (Chair), University of Oregon, Eugene, OR. The committee will meet twice. Once early in the process to prevent a glitch in our research protocols and at the end of the study to conduct a peer review. This will add about $15 to 20K per year to our budget for travel and consultation fees.

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