Columbia River Inter-Tribal Fish Commission

729 NE Oregon St.
Suite 200
Portland, OR 97232

t?(503)238-0667
f?(503)235-4228
I?www.critfc.org

1977-2002
?
25 Years of Protecting Salmon and Tribal Treaty Rights

August 20, 2002

To: ISRP

From: Kelt Reconditioning project staff (BPA Project 20001700)

Re: Responses to ISRP Comments on Mainstem/Systemwide Project Proposal

Following are the ISRP comments on the Mainstem/Systemwide Project Proposal (BPA 200001700), and project responses to these comments. ISRP comments are presented in *italics*, project responses are provided in normal text.

ISRP Comment 1: Is there adequate scientific basis for the expansion of this project from a research-oriented activity to a production prototype? Data presented suggest an increase in rematuration efficiency of kelts over the three years of study conducted. These data probably do show increases in efficiency of rematuration due to learning during the three years of the study; however, the last value is skewed as all kelts were included during the first two years' attempts at rematuration, while only those judged capable of rematuring (based on the 1st two years observation) were entered into rematuration attempt on year 3. The initial research does show interesting promise in development but does the degree of "unanticipated success in the early years" justify the extent and cost of expansion in 2003?

Project Response to ISRP Comment 1

Expansion of proposed kelt research from 2003-2005 is not intended to be, or viewed by project personnel as a production-prototype activity. Rather, we believe that steelhead reconditioning and various transportation treatments as proposed to increase expression of iteroparity warrant expanded research at the geographic scale and level of rigor proposed. This research is designed to provide informed, decisive recommendations for future implementation options by determining the best management scenarios to increase iteroparity expression.

There appears to be a more than adequate scientific basis for expanded kelt reconditioning research as proposed, especially when one considers the potential for increased natural production of Columbia Basin steelhead. For example, during 2001, an estimated 11,458 post-spawned steelhead were counted entering the juvenile fish collection facility at Lower Granite Dam (LGR) on the Snake River. Based on adipose clip data from these fish, 6,763 were of hatchery origin and 4,695 were naturally produced or wild. Wild kelts entering the LGR bypass facility during the spring of 2001 represented approximately 21% (4,695/22,362) of the entire Snake River ESA-listed population counted crossing Lower Granite Dam fishway during the 2000-2001 migration year (Evans and Beaty 2001). Moreover, a 2000 mark-recapture study suggest that kelts encountered at the LGR juvenile bypass facility represented only 30% of the entire in-river kelt population, indicating that thousands more utilized non-bypass routes to navigate LGR (e.g., spillway and turbine units). Telemetry tracking of kelts in the Snake River conducted by Evans (2002, In Review) revealed 3.8% (8/212) in-river survival of outmigrating kelts from LGR tailrace through Bonneville Dam. Thus, the abundance of post-spawned fish, the apparent dismal outmigration success of in-river migrants, and the > 20% re-maturation rates achieved via reconditioning on the Yakima River by this project warrants expansion of kelt reconditioning research in the Columbia Basin. Similar arguments support application of this research to wild steelhead populations throughout the Columbia Basin, as proposed. However, empirical quantitative kelt outmigration data from these systems currently appear sparse, contributing to the practical importance of this study.

The ISRP is correct in pointing out that successive annual increases in survival and rematuration rate may have resulted from excluding kelts from reconditioning that were in very poor physiological and morphological condition. However, such exclusion involved 8% or less of all available Yakima River kelts, and as such does not constitute an important programmatic or population-level issue. More importantly, what it does suggests is that improvements in logistics and methods implemented during the initial 3 years of kelt reconditioning research resulted in substantial increases in the success of the

program. Thus, we feel strongly that potential benefits to natural production from this project appear to greatly outweigh fiscally driven hesitation to briefly (3 years) but robustly evaluate iteroparity enhancement measures. Failure to experimentally evaluate iteroparity enhancement measures with adequate rigor and geographic representation could prove to be a very imprudent use of funds, or in a worse case could fail to identify successful future management activities. Thus, associated costs to perform these tasks are justified as proposed.

ISRP Comment 2: Another concern is coordination between this study [BPA 200001700] and the large-scale reconditioning program being operated by the USACE at Lower Granite Dam....The focus of this proposed project is on natural kelts only, whereas the large reconditioning and release effort by the USACE uses both natural and hatchery origin steelhead. Reconditioning work and research objectives need to be coordinated between upper basin kelt reconditioning projects, so that larger-scale questions about recovery of upper basin steelhead stocks can be addressed in a coordinated manner.

Project Response to ISRP Comment 2: First, the Corps' funded study on the Snake River involves monitoring kelt abundance, outmigration success, and kelt bypass around the hydro system in barges; it does not involve or support any kelt reconditioning. Secondly, steelhead kelt research objectives from both projects are already well coordinated and will continue to be so, enabling this project to successfully address questions about recovery of upper basin steelhead stocks in a coordinated manner. Furthermore, the Corp funded study and this proposed project will utilize some of the same researchers, providing a stronger link and understanding among the two projects. Thirdly, the Corps' funded project can and/or does distinguish hatchery and wild fish during all phases of its operation, facilitating additional benefits of data sharing and collaborative development of management recommendations. Finally, elucidation of origin-specific differences (e.g. hatchery vs. wild) will be noted, tested where possible, and published to provide further insight into the pros and cons and applicability of tested iteroparity enhancement measures for steelhead kelts.

ISRP Comment 3: The allocation of kelts captured is uncertain in the various objectives (Section 9f). Task 1.3 refers to using the first 200 kelts for immediate transport and release, but then Task 2.3 establishes allocations of the kelts based on the number

captured (i.e. > or < 200 kelts). If less than 200 kelts are captured then all are used for long-term monitoring...why this bias in the study?

Project Response to ISRP Comment 3: Informed choices must be made during years when insufficiently low numbers of spawners return to a particular stream. This issue involves allocating enough fish to particular experiments to allow detectable treatment effects, with enough power for statistical analysis. Above that, it's about prioritizing experimental treatments. In streams where kelt collection numbers are low (e.g. < 200) within a particular year, prioritization will be given to long-term reconditioning scenarios because they will likely produce the greatest benefit in terms of repeat spawners, based on proven methods and empirical data collected during the initial project years. In systems where larger numbers of kelts can be collected (e.g. > 400 in the Yakima River) both long and short-term reconditioning can be tested simultaneously within a given year. However, since experimental replication and rigor are central to the project's expansion goals, prioritization of reconditioning scenarios are subject to change as information regarding treatment efficacy become available from the new systems. This adaptive approach will provide the flexibility needed to modify design protocols as new data becomes available.

ISRP Comment 4: Task 3.4 suggests that from 2003-2005 a minimum of 20 kelts and 20 virgin spawners would be radio tagged, released and monitored upstream of the most adjacent downstream hydroelectric facility. Why would these fish be transported downstream with the inherent risk of mortality as opposed to being released into the river of origin directly? Reviewers understand the value of tracking these reconditioned animals to the spawning grounds, but not the displacement downstream.

Project Response to ISRP Comment 4: Downstream displacement as referred to by the ISRP was incorporated to address whether reconditioning treatments had any negative effects on homing to the natal stream by mature, reconditioned fish. Arguably, releasing reconditioned kelts in the forebay of the most adjacent downstream mainstem dam may subject fish to increase mortality risks, but appears to be a reasonable trade-off between releasing reconditioned fish directly into the natal stream because a forebay release would provide study fish with navigational "options" that may ultimately strengthen data generated from this homing question. For example, in 2000 we released 20 Yakima

River reconditioned fish into the McNary forebay and monitored their subsequent movement via telemetry receivers in the Yakima River and elsewhere. In total, 12 of the 20 fish were contacted re-ascending the Yakima River, despite having limited telemetry coverage at Prosser Dam. With assistance from the University of Idaho we were able account for 5 additional fish that did not re-ascend the Yakima but were contacted at other locations (e.g. four fish were contacted in the mainstem Columbia below the mouth of the Yakima River and one fish was contacted in the Walla Walla River).

If the ISRP feels strongly, it is possible to modify this portion of the study to release long-term reconditioned kelts directly into their natal river systems, and forgo telemetry outside the natal river system, based on risk-aversion, balancing mortality risks vs. repeat spawning success of reconditioned kelts.

ISRP Comment 5: Task 4 is a little difficult to understand. The ISRP's understanding is that 40 virgin females will be collected and transported to the CRITFC/UI Collaborative Center for Applied Fish Science. This research will be performed as part of an MS degree research program under the supervision of salmon reproductive biologist Dr. Joseph Cloud at the University of Idaho. The females would be fertilized with cryopreserved sperm but the source of the sperm is not stated and why would cryopreserved sperm be required? If the intention is to avoid transporting males then sperm could be collected from males at a local hatchery or from natural spawners. Further, in the spawning of the reconditioned female kelts, will the same males be used with each female?

Project Response to ISRP Comment 5:

NOTE TO ISRP: Research under this task was designed in conjunction with Dr. Joseph Cloud, who was unavailable for comment prior to the submission date of these responses to the ISRP. Thus, in his absence, kelt project personnel will address ISRP Comment 5. However, we hope that the ISRP will allow subsequent input from Joe Cloud if necessary in defense of this portion of the proposal.

The source of sperm for these experiments to assess effects of reconditioning and rematuration on gamete viability and reproductive physiology will be from males and females of the same spawning aggregate. For example, males from the same run during the same year will fertilize eggs from fish from the same river. In addition, the same male and female pairs will be used to eliminate bias due to potential among-male gamete variability. The ideal design in a perfect world would involve collecting and spawning

wild pairs, collecting reproductive physiology and gamete condition data as proposed, reconditioning them, releasing both parents, recapturing them as repeat spawners and performing the same analysis again. However, in the real world, males appear very unlikely to exhibit iteroparity, and we cannot design a study based on the relatively low probability of ensuring recaptures of specific reconditioned female fish from the wild. Therefore, the design we've chosen minimizes bias associated with among-male variability and maximizes the probability of project success by controlling experimental subjects and conditions. Thus, cryopreservation allows the use of the same male and female gametes for reproduction with specific pairs before and after reconditioning. For the purposes of experimentation (to ensure use of the same fish) paired parents will be initially spawned, reconditioned, and respawned in captivity. This design should ensure collection of adequate data to address research questions and MS degree research requirements.

ISRP Comment 6: The proponents might also reconsider the issue of genetically effective population size with repeat spawners. These animals will increase the census population and could change the generation length (if they were a significant portion of the population), but they are likely to decrease the Ne value due to the increased contribution from a small sample of original parent stock. This issue may come down to a trade-off between demographic risk versus genetic, but he actual effect/value of kelt reconditioning should at least recognize this potential.

Project Response to ISRP Comment 6: Kelt Reconditioning Project personnel appreciate this comment by the ISRP regarding potential effects of kelt reconditioning and repeat spawning on genetically effective population size. In addition to the following response, kelt project personnel have addressed additional genetic hazards and risk in writing, in the project's Scoping Document provided to the NPPC during the end of June 2002 for the ISRP's review (See Part II, Section 2, b, pages 13-18).

In a recent review (Roger Doyle reviewer, www.genecomp.com) of a paper entitled: Effective size of fluctuating salmon populations, Waples (2002) explores problems of calculating long-term effective population numbers (*Ne*) for salmon species (chinook and coho), and addresses among-year variation in spawner numbers and overlapping generations. In this paper Waples addresses issues of *Ne* calculation analytically and by

simulation, and finds that variation in the number of breeders among years within a cohort enters the calculation as the harmonic mean, as does variation among generations in the standard non-overlapping generation model. The result, as mentioned in ISRP Comment 6, suggests that resulting *Ne* values can be smaller than the harmonic mean estimate, and much smaller than the average census population estimate.

Steelhead kelt reconditioning (and by extension iteroparity) exists as a slightly different reproductive model than those described by Waples (2002) and others (Wright 1931,1938. Crow and Dennison 1988; Van den Berghe and Gross 1989; Waples and Teel 1989; Waples 1989,1990a, 1990b, 2002; Gross 1991; Fleming and Gross. 1994; Unwin et al. 1999) regarding issues of resulting *Ne* values. These distinctions are very important. First, empirical sex ratio data from all steelhead kelt collections from the Yakima and Snake rivers from this and the Corps-funded kelt projects to date indicate that a large majority (~$\geq$ 90%) of all successfully outmigrating kelts are female. If steelhead naturally exhibited functionally female iteroparity, repeat spawning by female reconditioned kelts should occur with males from different cohorts, and less frequently with temporal variant spawners from the same year class. Thus, relative to mixing genes within a population of semelparous spawners, female iteroparity in wild steelhead populations may have provided a mechanism for increased within-population gene flow and reduced inbreeding.

Furthermore, reduction of *Ne* should only result from: 1) reduction in overall N; 2) increased inbreeding coefficient or relatedness (observed as low or reduced among-individual variation), or 3) some combination of the two. Outcomes of the kelt reconditioning program do not appear to contribute to either of these two mechanisms of *Ne* reduction; alternatively, they may counteract negative effects of both above mechanisms. Thus, although expression of female iteroparity (naturally or by reconditioning and/or bypass) may reduce the N/*Ne* ratio, and may reduce inter-annual variation among spawners, it in and of itself should not reduce the resulting *Ne* value of populations experimentally subjected to kelt reconditioning.

Allowing expression of female iteroparity, which has been suppressed by the hydrosystem due to direct turbine mortality of outmigrating kelts, should also reduce inbreeding, which may be a more prominent threat in small populations exhibiting semelparity and non-overlapping generations than with wild iteroparous steelhead populations. It is illogical to refer to wild steelhead populations as healthy if they are characterized by depressed expression of iteroparity.

It is very important to understand this distinction: this project is not artificially creating iteroparity from naturally semelparous fish, which could directly reduce *Ne* values. Conversely, this project facilitates natural expression of an evolutionarily beneficial life history strategy (female iteroparity) that has been artificially depressed due to hydro development in the Columbia Basin. Thus, possible reductions in among-year variability in spawners due to expressed female iteroparity must have provided more demographic and possibly genetic benefit than genetic risk at the population level for iteroparity to have been retained as an evolutionarily stable strategy, prior to hydro development in the basin.

References

Crow, J. F. and C. Dennison. 1988. Inbreeding and variance effective population numbers. Evolution 42:482-495.

Evans, A. F. 2002. In-review. Steelhead (Oncorhynchus mykiss) kelt outmigration from Lower Granite Dam to Bonneville Dam: Abundance, downstream conversion rates, routes of passage, and travel times. Ann. Report to US Army Corps of Engineers. Contract No. DACW68-01-0016.

Fleming, I. A. and M. R. Gross. 1994. Breeding competition in a pacific salmon (Coho:*Oncorhynchus kisutch*): Measures of natural and sexual selection. Evolution 48:637-657.

Gross, M. R. 1991. Salmon breeding behavior and life history evolution in changing environments. Ecology 72:1180-1186.

Unwin, M. J. M. T. Kinnison, and T. P. Quinn. 1999. Exceptions to semelparity: postmaturation survival, morphology and energetics of male chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences 56:1172-1181.

Van den Berghe, E. P, and M. R. Gross. 1989. Natural selection resulting from female breeding competition in a Pacific salmon (Coho: *Oncorhynchus kisutch*). Evolution 43:125-140.

Waples, R. S. 1989. A generalized approach for estimating effective popuation size from temporal changes in allele frequency. Genetics 121:379-391.

Waples, R. S., and D. J. Teel. 1989. Conservation genetics of Pacific salmon I: Temporal changes in allele frequency. Conservation Biology 4:144-156.

Waples, R. S. 1990a. Conservation genetics of Pacific salmon II: Effective population size and the rate of loss of genetic variability. Journal of Heredity 81:267-276.

Waples, R., S. 1990b. Conservation genetics of Pacific salmon III: Estimating effective size. Journal of Heredity 81:277-289.

Wright, S. 1931. Evolution in Mendelian populations. Genetics 16:97-159. Reprinted in Bulletin of Mathematical Biology 1990 52:241-295.

Wright, S. 1938. The size of populations and breeding structure in relation to evolution. Science 87:430.

Waples. R. S. 2002. Pacific salmon require special Ne calculation: Effective size of fluctuating salmon populations. Genetics 161:783-791.

Columbia River Inter-Tribal Fish Commission

729 NE Oregon St.
Suite 200
Portland, OR 97232

t?(503)238-0667
f?(503)235-4228
I?www.critfc.org

1977-2002
?
25 Years of Protecting Salmon and Tribal Treaty Rights

To: ISRP August 21, 2002

From: Steelhead Kelt reconditioning Project personnel (BPA 20001700)

Re: Responses to brief reviews of proposals that have implications to BO RME Hydro-related matters.

Project: BPA 200001700 – Kelt reconditioning –
Sponsor: CRITFC

Short project description: Continue to test and evaluate methods to recondition steelhead kelts and/or transport them around hydro system, generate science-based management recommendations, and assist in their implementation to rebuild wild steelhead populations throughout the Basin.

Note: RM&E comments are presented in *italics*, project responses are in plain text:

RM&E Comment 1: Elements of this proposal involve assessing the effectiveness of certain treatments relative to hydro passage experience by kelts. For example, some kelts will be transported to below Bonneville Dam in order to evaluate potential benefits of this passage option. This type of study would be classified as action effectiveness research in the RME-vernacular of the BO. It would be instructive if the authors provided additional detail regarding projected sample sizes and the ability to detect meaningful differences in adult returns, between hydro passage options (transport vs. not).

Program Response to RM&E Comment 1: The issue of sample size for each treatment (transportation/hydro bypass, in-river survival) has been addressed in a preliminary fashion for the Snake River kelt survival research program using a priori power analysis. The true parameter of interest in such a study is not how many fish you release from each treatment but how many fish return from each treatment, and more importantly the magnitude of difference between them. The problem arises from anticipating the trade-off between a type I error (alpha) relative to a type II error (Beta). Based on a priori power analysis, a sample size of 1,000 kelts per treatment would be adequate for statistical comparison, assuming

differences between return rates were no less than 1.3% with a minimum return rate of at least 0.5%. Such a calculation provides a statistical power of at least 80% (Beta). Because a 0.8 Beta value is high, and other assumed parameter values may be conservative for multivariate field systems such as kelt this involving outmigration, survival, rematuration and repeat spawning we can provide estimates of required sample sizes from a given range of Beta values. Such analysis would be beneficial.

However, more beneficial is the chosen approach to performing power analysis based on empirical values to be collected during implementation of kelt reconditioning and bypass research. After collecting quantitative return data from repeat-spawning treatment fish this fall we can calculate a minimum return rate for the various treatments (in-river and transported from the Snake and short-term from the Yakima) and given that more fish (a currently unknown % but likely less than 1/2) will return next fall we can calculate sample sizes and associated power (Beta) estimates. Large differences in return rates of different treatment groups will contribute to increased statistical power behind our observations and subsequent inferences.

RM&E Comment 2: Address critical element of RPA? It has no application to RPA 182, since hatchery/wild reproductive success is not evaluated as a part of the proposal.

Project Response to RM&E Comment 2: Currently, pilot study steelhead kelt reconditioning research on the Yakima River (at Prosser Hatchery), and the proposed, expanded research under BPA Project 2000-1700 Mainstem/Systemwide opportunity involve exclusively wild populations. However, future applications derived from this study's experimental results may certainly apply to RPA 182. This proposal may apply to RPA 182 because it will generate valuable new empirical reproductive success data from wild populations undergoing proposed experimental treatments, for comparison to corresponding estimates from virgin spawners from hatchery origin populations.

RM&E Comment 3a: With respect to RPA 184, it has very limited application, since its goal is to simply use hatchery facilities as a means to "improve" the usefulness wild steelhead often found in juvenile collection facilities associated with hydro operations. This proposal fails to specifically address how conservation hatcheries can contribute to recovery. Proposal doesn't develop an argument as to kelt reconditioning constitutes a hatchery reform.

RM&E Comment 3b: Opposing view. This could be a reform, if, for instance, a hatchery program live spawned fish and released them below Bonneville Dam or reconditioned them. Proposal may have relevance to RPA184, if it is characterized as a conservation hatchery strategy to replace current strategies.

Project Response to RM&E Comments 3a and 3b:

Supporting ISRP language: "This is a strong proposal that merits funding support due to its solid design and to the information it may provide on enhancing steelhead population" (ISRP 2002-13, pgs 35-36).

Expansion of proposed kelt research from 2003-2005 is not intended to be, or viewed by project personnel as a conservation hatchery strategy, or as hatchery reform – it is strictly a research project. This research is designed to provide informed, decisive recommendations for future implementation options by determining the best management scenarios to increase iteroparity expression. For example, during 2001, an estimated 11,458 post-spawned steelhead were counted entering the juvenile fish collection facility at Lower Granite Dam (LGR) on the Snake River. Based on adipose clip data from these fish, 6,763 were of hatchery origin and 4,695 were naturally produced or wild. Wild kelts entering the LGR bypass facility during the spring of 2001 represented approximately 21% (4,695/22,362) of the entire Snake River ESA-listed population counted crossing Lower Granite Dam fishway during the 2000-2001 migration year (Evans and Beaty 2001). Moreover, a 2000 mark-recapture study suggest that kelts encountered at the LGR juvenile bypass facility represented only 30% of the entire in-river kelt population, indicating that thousands more utilized non-bypass routes to navigate LGR (e.g., spillway and turbine units). Telemetry tracking of kelts in the Snake River conducted by Evans (2002, In Review) revealed 3.8% (8/212) in-river survival of outmigrating kelts from LGR tailrace through Bonneville Dam. Thus, the abundance of

post-spawned fish, the apparent dismal outmigration success of in-river migrants, and the > 20% re-maturation rates achieved via reconditioning on the Yakima River by this project warrants expansion of kelt reconditioning research in the Columbia Basin. Similar arguments support application of this research to wild steelhead populations throughout the Columbia Basin, as proposed.

RM&E Comment 4: Scope? [ESU's covered, Transferability, Species covered] Proposal targets steelhead, and may have application to steelhead throughout Columbia River system.

Project Response to RM&E Comment 4: This proposal targets only wild steelhead, and may have valuable, large-scale future application to steelhead populations throughout the Columbia River Basin.

RM&E Comment 5: Study design adequate, as is, or as may be modified? Uncertain at this time.

Project Response to RM&E Comment 5: As supported by the positive ISRP comments below, we feel that in terms of addressing stated goals and objectives, and their collective value to T&E listed steelhead populations in the Basin, as strictly a short-term research project, this proposal provides a very strong study design.

Supporting ISRP language (ISRP 2002-13 Mainstem/Systemwide Preliminary review, pages 35-36): "The proposal is well written and presents a logical and justified approach to examining uncertainties associated with kelt reconditioning. The proposal builds on work in this area over the last 2-3 years by the Yakama Nation and the US Army Corps [and CRITFC]. The proposal also addresses concerns expressed by the ISRP in its FY 00 review of this ongoing project.

Strengths of the proposal include a systematic investigation of various reconditioning and transportation strategies, collaboration with other projects to expand the PIT tag and radio tag information that an be collected, and a series of replicated treatments. *This is a strong proposal that merits funding support due to its solid design and to the information it may*

provide on enhancing steelhead population (emphasis added). Another advantage of this study, as compared to the supplementation projects, is the 1-3 year timeframe for data collection, rather than the 5-6 years required in supplementation studies due to generation time. There is good cost sharing associated with this proposal, so apparently there is strong user support for the work".

Finally, the very supportive ISRP language above would not have been issued had the adequacy of this project's study design been uncertain!