Independent Scientific Review Panel
for the Northwest Power & Conservation Council
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Lake Roosevelt Kokanee Program Review

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Background

This ISRP review considers the following FY 2007-09 proposals:

- Spokane Tribal Hatchery (199104600)
- Sherman Creek Hatchery (199104700)
- Chief Joseph Kokanee Enhancement (199501100)
- Ford Hatchery (200102900) (all in the Intermountain Province, Lake Roosevelt) and
- Banks Lake Fishery Evaluation Project (20010280, Columbia Plateau Province)

In its review of the FY 2007-09 Lake Roosevelt proposals, the ISRP rated the kokanee propagation portions of the proposals "not fundable" (does not meet scientific criteria). The ISRP was concerned with the lack of success of kokanee actions given the significant limiting factors for kokanee in Lake Roosevelt, namely entrainment and predation. However, the ISRP recommended that the projects' continued redband and triploid rainbow production was "fundable" (meets scientific review criteria).[1] For the Banks Lake proposal, the ISRP had serious concerns about trying to manage for kokanee in a lake with high abundances of walleye and bass but found that the project justified continued testing of the kokanee effort.

Taking into account the ISRP's recommendation, yet considering the Intermountain Subbasin Plan's prioritization of kokanee production, the Council's funding recommendation required that the project sponsors hold a kokanee production workshop with the ISRP. The Council recommended that the funding for the kokanee production elements continue in FY 2007 but the funding recommendation for FY 2008 and 2009 would be revisited following the workshop. The project sponsors organized and held the Lake Roosevelt Kokanee Workshop on May 2 and 3, 2007 (see Appendix). Participants in the workshop included representatives from the Independent Scientific Review Panel (ISRP), Spokane Tribe, Colville Confederated Tribes, Washington Department of Fish and Wildlife, Bonneville Power Administration, Eastern Washington University, and the Council. The workshop was well organized and informative including both site visits and sponsor presentations.

Based in part on the results of the workshop, the Council intends to resolve a broader policy and programmatic issue associated with funding recommendations for the suite of Lake Roosevelt kokanee production projects. To facilitate this effort, the Council asked the ISRP to clarify some unresolved issues:

1. Will the Lake Roosevelt and the Banks Lake kokanee programs benefit fish and wildlife?

[1] www.nwcouncil.org/library/isrp/isrp2006-6.pdf; Lake Roosevelt see pages 603-610; Banks Lake see page

2. Are the different kokanee projects based on sound science principles? What alternatives could be considered?
3. Are the objectives associated with the kokanee program in Lake Roosevelt and Banks Lake clearly defined with adequate provisions for monitoring and evaluation of results? What is the timeline for expecting results?

ISRP Findings

Summary

The ISRP concludes that there is no scientific justification to continue artificial production of kokanee for stocking Lake Roosevelt or programs to develop and support naturally produced kokanee. However, the ISRP believes that if it could be conclusively demonstrated that the entrainment problem was controlled or significantly reduced, if the walleye population was significantly reduced and managed, and if drawdown levels were reduced or managed, then artificial production and/or support of natural production of kokanee could be re-initiated. As stated in our final FY 2007-09 recommendations, the kokanee production for experimental stocking in Banks Lake (where the aforementioned limiting factors are less severe) is justified.

Answers to Council's Questions

1. Will the Lake Roosevelt and the Banks Lake kokanee programs benefit fish and wildlife?

Unfortunately, there has been a significant lack of success in producing both a tribal and recreational fishery for kokanee salmon. The results reported by the kokanee program's experimental monitoring and evaluation efforts have documented that lack of success. Two major factors appear to be limiting this success: entrainment of large numbers kokanee through Grand Coulee Dam (particularly following the initiation of operations of the third powerhouse) and predation by walleye (whose population has increased significantly over the past eight years and now supports the major fishery in Lake Roosevelt). In addition, spring drawdowns have been significant in the past several years and have severely impacted kokanee spawning potential and natural production in the lower reaches of the tributaries.

Consequently, the ISRP concludes that there is no scientific justification to continue artificial production of kokanee for Lake Roosevelt or programs to develop and support naturally produced kokanee. However, kokanee production for experimental stocking in Banks Lake (where the aforementioned limiting factors are less severe) is justified. Based on the empirical evidence from Lake Roosevelt - a reduction in kokanee abundance from that observed in the 1960s and poor survival from at least fifteen years of hatchery stocking - the ISRP believes it would be erroneous to conclude that achieving success with this effort is just around the corner. What is being achieved now is what is likely to

continue until major changes occur in reservoir operations and predator population management.

2. Are the different kokanee projects based on sound science principles? What alternatives could be considered?

The original assumptions for selecting kokanee for mitigation were sound. These assumptions included the belief that the reservoir had sufficient biomass of forage (large zooplankton and fish) to support several million kokanee; that survival from hatchery release to maturation would be sufficient to provide harvest and returning adults to maintain the hatchery production; and that the capacity and productivity of the reservoir and tributary streams would be sufficient to either establish, or reestablish, natural kokanee production.

In recent years there has been a significant lack of success in managing for both a tribal and recreational fishery for kokanee salmon, because of the major limiting factors associated with entrainment, walleye predation, and drawdown.

The ISRP believes that if it could be conclusively demonstrated that the entrainment problem was controlled or significantly reduced, if the walleye population was significantly reduced and managed, and if drawdown levels were reduced or managed, then artificial production and/or support of natural production of kokanee could be re-initiated.

3. Are the objectives associated with the kokanee program in Lake Roosevelt and Banks Lake clearly defined with adequate provisions for monitoring and evaluation of results? What is the timeline for expecting results?

The kokanee component of the Lake Roosevelt projects has yet to establish explicit post-release biological objectives. Further, the projects have yet to establish a timeline and decision path to determine when to continue or discontinue the efforts to produce a kokanee fishery using artificial production.

The states of Idaho, Oregon, Washington, California, Wyoming, and Colorado have kokanee production programs where kokanee adults in lakes or reservoirs provide eggs for hatchery production that supports angling in reservoirs. Many of these states have established monitoring programs to evaluate the suitability of individual reservoirs for fishery production using stocked hatchery kokanee. If future environmental and ecological conditions become suitable for re-introduction of kokanee, the Lake Roosevelt co-managers should consider the methods used in these other regions to establish an effective monitoring program for evaluating kokanee in Lake Roosevelt, and to establish reasonable yield to harvest from the production and stocking of hatchery kokanee. This routine monitoring should produce metrics similar to the Fall Walleye Index Netting, which can serve as a baseline to evaluate kokanee production and yield.

In addition, the proposal and project, do not appear consistent with and fully address the Policy guidelines for artificial production developed in the Artificial Production Review (NWPCC 99-15). Specifically:

- Policy 1. The manner of use and the value of artificial production must be considered in the context of the environment in which it will be used;
- Policy 3. Hatcheries must be operated in a manner that recognizes that they exist within ecological systems whose behavior is constrained by larger-scale basin, regional and global factors; and
- Policy 5. Naturally selected populations should provide the model for successful artificially reared populations, in regard to population structure, mating protocol, behavior, growth, nutrient cycling, and other biological characteristics.

The ISAB has provided additional information on the implications and application of these policies when implementing artificial production strategies. In particular, the ISAB has recommended that artificial production goals and objectives must include standards for survival, harvest, and escapement, not just numbers or pounds of fish produced and released from a hatchery.

Appendix

Lake Roosevelt Kokanee Workshop

Eastern Washington University - May 3, 2007

Participants: Participants in the workshop included representatives from the Independent Scientific Review Panel (ISRP), Spokane Tribe, Colville Confederated Tribes, Washington Department of Fish and Wildlife, Bonneville Power Administration, Eastern Washington University, and NPCC staff.

Objectives: The workshop was held to discuss ISRP concerns raised in the FY 2007-09 project review regarding justification for continuing artificial production of kokanee in Lake Roosevelt considering the lack of success to date.

Projects/Proposals Discussed:

- Kokanee production -- Spokane Tribal Hatchery (199104600)
- Sherman Creek Hatchery (199104700)
- Chief Joseph Kokanee Enhancement (199501100)
- Ford Hatchery (200102900) (all in the Intermountain Province) and
- Banks Lake Fishery Evaluation Project (20010280, Columbia Plateau Province)

Workshop Summary Results and ISRP Comments

The initial presentation by Dr. Allan Sholz provided the background justification for developing a management plan for Lake Roosevelt. Surveys by the U.S. Fish and Wildlife Service and its predecessor agencies conducted purse seine sampling in Lake Roosevelt in the 1960's. Estimates of kokanee in Lake Roosevelt from that sampling were nearly 15 million fish. The ISRP has not reviewed these original sampling reports but accepts their conclusion. At some time during its recent history, Lake Roosevelt has supported a significant population of kokanee. In these same reports, and other subsequent reports, there was speculation that kokanee in Lake Roosevelt originated within the reservoir from beach (shoreline) spawning. These reports were apparently anecdotal, and the ISRP has not seen evidence to assume that shoreline spawning was ever a major source of kokanee within Lake Roosevelt, nor that there is evidence that reservoir management actions could induce kokanee to exhibit this reproductive behavior.

The management plans developed for Lake Roosevelt in the mid 1980s and incorporated into the Northwest Power and Conservation Council's Fish and Wildlife Program were predicated on assumptions concerning the life-stage survival of kokanee in Lake Roosevelt. These assumptions included the belief that the reservoir had sufficient biomass of food resources (large zooplankton and forage fish) to support several million

kokanee, that survival from hatchery release to maturation would be sufficient to provide harvest and adults to maintain the hatchery production; and that the capacity and productivity of the reservoir and tributary streams were sufficient to either establish, or reestablish, natural kokanee production which would provide ecological linkages for natural food webs.

The assumptions were reasonable, but they have not been supported by the results of this project. Re-examining these assumptions and reconsidering the likely success of the naturally-spawning kokanee is warranted, based on the lack of evidence of success to this point.

The sponsors' various strategies and actions to improve the kokanee project elements have, for the most part, had a logical basis. Some actions, however, appear to not be well thought out. For example, the plan to catch adults at Hawk Creek without sufficient adult holding infrastructure and security is puzzling.

There seem to be two strategies that the kokanee portions of the projects are pursuing. One is providing hatchery kokanee for both a recreational and tribal fishery. The second is the production of natural kokanee to mitigate the ecological and cultural values provided by anadromous salmon prior to constructing Grand Coulee Dam.

The first question that needs to be considered is whether it is likely that kokanee will actually populate and thrive in a moderately high velocity reservoir like Lake Roosevelt. Lake Roosevelt is somewhat similar physically to the run-of-the-river reservoirs on the lower Columbia and Snake Rivers, rather than the large terminal storage reservoirs and natural lakes where kokanee have thrived.

The second question is what is the origin of the naturally-spawned kokanee in Lake Roosevelt? Is it from production in Lake Roosevelt tributaries, or are they immigrants from the Arrow Lakes region in Canada? The ISRP was told that the Canadians have found kokanee to spawn in significant numbers below Kennlyside Dam. Sponsors have observed some spawning kokanee in several tributaries of Lake Roosevelt. On the basis of these spawning adults there is interest in establishing self-sustaining kokanee runs in tributaries to provide eggs for hatchery production. The ISRP was also told that at a fish trap on the San Poil River only natural fish were passed upstream for spawning. When hatchery kokanee are trapped they are not passed upstream. The discovery that hatchery kokanee are straying into the San Poil River raises the question of whether all the adult kokanee that are observed in Lake Roosevelt tributaries are hatchery strays or immigrants from upstream lakes or reservoirs.

During the presentations by sponsors, the ISRP asked whether the lack of evidence of kokanee recruitment to the fishery was a consequence of insufficient design in the creel census used to evaluate the project, rather than an actual failure of fish to survive long enough to eventually be harvested. In the recent past the ISRP has recommended revising the creel census protocol. This census revision has been completed and implemented, but the data have not yet been summarized in a report. There was a verbal

report at the workshop of a harvest of 4,000 kokanee based on expansion of the creel census counts from one recent year. The ISRP believes this yield to the fishery is not particularly high in comparison to yields observed in other kokanee enhancement programs. The fishery harvest relative to the level of hatchery release needs to be verified by the sponsors.

Perhaps the strongest evidence that the program is not meeting its biological objectives in a timely manner is the failure to achieve sufficient returns of adult kokanee to eliminate the need for importing eggs from outside the subbasin. The major source of eggs is currently from Lake Whatcom (Puget Sound) and this source is soon to be lost due to the restoration of a naturally-spawning sockeye run there. With this action disease risks will be elevated and eggs will not be able to be shipped outside this drainage. As Meadow Creek is not a reliable source for kokanee eggs, Banks Lake may be the only potential alternative. In summary, the ISRP remains concerned that the existing artificial production program for kokanee in Lake Roosevelt is not likely to be self-sufficient in the foreseeable future.

Triploid Rainbow Trout Net Pen Operations

In the 2007-09 proposal review the ISRP provided a general recommendation to all projects that planned on using triploid rainbow trout:

The ISRP recommends that only female triploids be stocked, because male triploids (in mixed sex production lots) will engage in courtship behavior with native trout, possibly leading to gamete waste (from the native trout). The ISRP notes that standardized Quality Assurance/Quality Control protocols are not yet established for using sterile female triploids to provide recreational angling in waters inhabited by native trout. Large-scale production of triploid female rainbow trout is not 100% effective. Sponsors should have the production lots they stock evaluated for the percentage of triploids, and report this as part of the project monitoring. The efficacy of avoiding hybridization between stocked and native trout is unknown when less than 100% of the stocked fish are triploids. Ongoing evaluation of hybridization in contemporaneous native trout populations will be needed in the future. Stocking triploid females to provide recreational angling in regions with highly sensitive native populations is not yet justified. See Kozfkay, J. R., J. C. Dillon, and D. J. Schill. 2006. Routine use of sterile fish in salmonid sport fisheries: are we there yet? Fisheries 31(8):392 - 401.

The essence of this recommendation was to use only female triploid rainbow trout instead of mixed-sex triploids, have triploid production lots evaluated for the proportion of triploid individuals, and do not use triploid hatchery fish to provide a recreational fishery in watersheds believed to be inhabited with native, genetically pure populations of redband trout. The rationale for these recommendations was summarized in the 2007-09 review, and is repeated here because the conditions still exist.

Female triploid rainbow trout were suggested because male triploid trout undergo a modest level of testis development and engage in courtship behavior. This could lead to attempted spawning between triploid males stocked for angling and natural self-reproducing diploid rainbow trout. The objective of having the production lots of triploid individuals screened to determine the proportion of triploids is to document the level of triploidy achieved in the heat or pressure treatments used to induce triploidy. This will further the evaluation of the post-stocking consequences of using triploid fish. Stocking triploid fish has not been an ongoing management tool long enough to know the full extent of the environmental results of using these fish. The recommendation to not use triploid fish to support recreational fishing in waters inhabited by native species of concern is because there is no certainty that interbreeding between stocked trout and native trout will not occur, and the level of competition between stocked triploid and native trout is unknown. These risks suggest using caution in planting triploid rainbow trout in waters with potentially sensitive native trout until the above concerns are more completely addressed. Opportunities for fishing may be found in other waters. Washington Department of Fish and Wildlife biologists indicated they had a risk assessment tool to evaluate the likelihood of escape to natural spawning grounds by diploid individuals present in triploid lots. The ISRP encourages the evaluation of triploid production using these risk assessment tools, and peer review of the risk assessment tools.

The ISRP did not anticipate that these recommendations would be controversial. Co-managers from Lake Roosevelt indicated that they wanted to use mixed-sex populations of triploid rainbow trout in net pen production. They were concerned that the ISRP recommendation would become a requirement. During the presentation the ISRP indicated that mixed-sex triploids were acceptable, but that it would be useful to provide a justification for not using all female triploids. The co-managers provided information on the proportion of triploid individuals in the production lots. The ISRP continues its recommendation that this should be reported for stocking programs employing triploid trout and that using triploid trout to provide a recreational fishery in waters inhabited by sensitive native trout populations is premature at this time and does not meet Artificial Production Review policies established in the Council Artificial Production Review (NWPPC 99-15) and incorporated into the 2000 Fish and Wildlife Program.

The Lake Roosevelt co-managers raised three concerns about using all female triploid rainbow trout in the net-pen program. First, they objected to eating fish that had been fed hormones; second they objected to consuming fish that were genetically modified (GMO concerns); and third, they were concerned about hazards posed to hatchery technicians feeding fry with food to which methyl-testosterone has been added.

With regard to the first concern – eating fish that have been fed hormones – all female production fish, whether diploid or triploid, have not been fed hormones. To the ISRP's knowledge, there are no hormone additives that are FDA-approved for fish food. All-female production fish are produced by mating normal females (that produce eggs that all carry an X chromosome) with females that are sex inverted so they produce sperm rather than eggs, and all the sperm carry an X chromosome. Mating between an XX female and

XX male produces all XX progeny and they are all females. The XX individuals that are sex inverted (they would be female under normal circumstances, but they are transformed into males) are done so by feeding trout fry mash that has alpha-methyl testosterone as an additive. This mash is usually fed for a month or two when the fry are very small. During this period the fry are susceptible to inducing the undifferentiated gonad to developing into testis in both XX (normal females) XY (normal males) individuals. XX males develop sperm cells, but do not have normal sperm ducts and cannot be manually spawned. This facilitates differentiating XX and XY males. To produce an all-XX line of trout, the XX males are used to fertilize eggs from XX females. A portion of the individuals produced by this process are set aside, and then fed mash with alpha-methyl-testosterone to invert them to males. These males are used in subsequent production matings, and the pedigree is advanced each generation. No fish that are fed hormones are released for angling or processed for human consumption.

Regarding the second concern, that all-female triploids are Genetically Modified Organisms (GMOs), the term GMO – genetically modified organism – usually is restricted to a plant or animal that has a gene inserted and whose regulation is under special regulation. These organisms are also referred to as transgenic individuals. The inserted gene can be from the same species, or it can be from a different species. For example, many cereal crops have genes from other species inserted. Some of these add production value to the final product; others add value by making the crop easier to grow. An example of this latter situation would be inserting genes that would make a plant resistant to herbicides. Then farmers could apply herbicides to the fields without injury to the primary species under cultivation and kill competing weeds. There are coho and Atlantic salmon that have had a growth hormone gene inserted that results in four to six fold increase in growth rate and 20% improvement in feed conversion. The ISRP is under the belief that no transgenic coho or Atlantic salmon are being produced on a commercial scale in the United States. Using this narrow definition, triploid individuals are not Genetically Modified Organisms.

Using a broader definition, all hatchery trout are genetically modified organisms. Typical production hatchery fish will undergo domestication selection that will lead to changes in allele frequencies in the population compared to allele frequencies in the natural population. Triploid individuals, whether from an all-female pedigree, or from a mixed-sex pedigree, are genetically modified compared to the diploids from which they are derived. The triploids have three sets of genomes, the normal diploid has only two. Ploidy manipulation is a routine tool in plant agriculture. It is uncommon in animal agriculture. Obviously, it has gained acceptance in trout production. The extent of genetic modification is no greater in all-female trout, in comparison to mixed sex production.

Finally, regarding health hazards to hatchery employees feeding mash with alpha-methyl testosterone as an additive, the ISRP has not been able to verify the status of safety concerns at this time. An internet search of paradoxical feminization failed to turn up any reports in humans from feeding this testosterone-supplemented mash. Contacts with state biologists involved in triploid production revealed that they were unaware of the health

hazard status, and that they were currently producing mix sex lots of triploid rainbow trout. All-female eggs (both diploid and triploid) are available commercially (from Trout Lodge, Inc, Sumner, Washington). The biologist in charge of this aspect of production was unavailable for comment until early July. This would be a likely source to establish the current status of environmental hazards for hatchery technicians. Without question, the ISRP endorses employing safe production methods.
