Priest Rapids Fish Forum

Issue of Dispute

Juvenile Sturgeon Release Number for 2014

Since October 2013, the PRFF has been discussing and debating the number of juvenile white sturgeon to release into the Priest Rapids Project Area in 2014. In an attempt to identify the number of juvenile sturgeon to release into the Project Area, the PRFF has prepared rationale papers for different release numbers, sought input from outside experts, held a juvenile white sturgeon workshop, and convened the white sturgeon subcommittee to resolve the issue. Although the PRFF has worked diligently to resolve the issue, they have been unsuccessful in identifying the total number of juvenile sturgeon to release into the Project Area in 2014. Therefore, the PRFF has requested that the Policy Committee of the PRFF convene to resolve the dispute.

The purpose of this document is to provide the PRFF Policy Committee with all the information that the PRFF has generated as part of the dispute resolution process. This document includes the following information:

1. Relevant Excerpts from PRFF Final Meeting Notes (October 2013 through April 2014).
2. Rationale Papers from the Yakama Nation and the Colville Tribes.
3. Summary Document of the Issue that was sent to the Outside Experts.
4. Responses from the Outside Sturgeon Experts.
5. Draft Notes from the Juvenile Sturgeon Release Workshop.
6. Presentation by Larry Hildebrand on Projected Future Abundances in the Project Area Based on Stocking 4,500 or 6,500 Juvenile Sturgeon assuming Two Different early Survival Rates.
7. Letters from PRFF Voting Members.
8. Letter from the PRFF Chair to Washington Department of Ecology indicating the desire of the voting members to initiate the dispute resolution.
9. Report from the PRFF White Sturgeon Subcommittee to the PRFF.
10. Report from the RRFF White Sturgeon Subcommittee on the Number of Juvenile Sturgeon to release into the Rocky Reach Project Area in 2015.

The last report was prepared by the Rocky Reach Fish Forum (RRFF) White Sturgeon Subcommittee. Members of the PRFF that are also members of the RRFF requested that the PRFF review the recommendations by the RRFF White Sturgeon Subcommittee. They believe this report may be useful to the PRFF and the PRFF Policy Committee.

Please note that this document does not contain all the information that the Policy Committee may use to support their decision. It is only intended to provide relevant information in one document that has been presented to and discussed by the PRFF.

Tracy Hillman, Ph.D.
PRFF Chair

Excerpts from PRFF Final Meeting Notes

October 2013

Stocking Options for 2014—Mike Clement recommended that the group make an early decision on stocking juvenile sturgeon in 2014. Grant PUD's position is to release 3,000 or more fish, to be determined by the PRFF, with two-thirds going into Wanapum and one-third into Priest Rapids. **Larry Hildebrand will put together a straw-man paper representing the numbers of fish to be put into the PRP in 2014, by Friday, 18 October**.

November 2013

Stocking Options for 2014— The PRFF discussed a proposal to release 4,332 juvenile sturgeon into the project area in 2014. This proposal was based on releasing 361 juveniles per cross (the maximum release of 6,500 juveniles is based on 18 crosses). Because there were 12 crosses, it was proposed that 4,332 sturgeon be released (12 crosses x 361 juveniles per cross = 4,332 juveniles). This proposal was based on the potential risk associated with a genetic bottleneck or inbreeding depression. All participants at the PRFF meeting agreed with the proposal with the exception of the Yakama Nation and the Umatilla Tribes. The two tribes recommended that all 6,500 juveniles be released in 2014, stating that the genetic risks are low. The PRFF was unable to come to a decision and will therefore revisit this item in December.

December 2013

Stocking Decision for 2014—The PRFF continued to discuss the PRFF proposal (not including the YN or the Umatilla Tribes) to release 4,332 juvenile sturgeon into the project area in 2014. The Yakama Nation and Umatilla Tribes recommended the release of 6,500 juveniles in 2014. **The Yakama Nation will prepare a white paper that describes the reasons why they believe 6,500 juveniles should be released in 2014**. The PRFF will review the white paper and hopefully make a stocking decision during the January meeting. To avoid any delays, Grant PUD will purchase up to 65 acoustic tags (1% of the 6,500 release number). Tracy Hillman stated that if there is no resolution in January, this issue will need to be elevated to the Policy Group.

Because the Columbia River is not a closed system, there is concern with sturgeon movement up and downstream. Grant PUD has survival curves that can be input into a model to estimate adult survival (survival after age 10 months is 70-80%, and after one year its 90%). 2013 monitoring results will be available in February 2014, and should be input into the model to see if earlier assumptions are indeed occurring. **Larry Hildebrand will attend the January or February meeting to discuss growth and survival modeling. Mike Clement will send the model to Debbie Williams for distribution. Tracy Hillman will distribute the Beamesderfer paper after he receives it from Jim Powell.**

January 2014

Stocking Decision for 2014—The PRFF continued to discuss alternative 2014 juvenile sturgeon stocking numbers. The majority of the PRFF agreed to stock ~ 4,300 fish, with the exception of the Yakama Nation and Umatilla Tribe, who want to stock 6,500 as outlined in the White Sturgeon Management Plan. **The Yakama Nation has prepared a white paper outlining their rationale. Tracy Hillman will distribute the paper to the PRFF.**

Tracy Hillman reminded members that this is a technical group and that he's hopeful the decision can be made in this forum without the need to elevate it to the PRFF Policy Group. Tracy Hillman and Mike Clement suggested an expert panel be formed in order to provide input on sturgeon genetics, population dynamics, and ecology, and then bring their recommendation to the PRFF. Members provided the following list of experts to contact:

Paul Anders, Cramer Fish Sciences
Ray Beamesderfer, R2 Resources
Andrea Schreier, UC Davis
James Crossman, BC Hydro
Kim Scribner, Michigan State University

Mike Clement suggested that Jim Powell and Larry Hildebrand be included on the expert panel as reviewers. **Mike Clement will ask Jim and Larry for suggestions on other experts who are members of the Sturgeon World Conservation Society. The Forum will provide names of other experts to Tracy Hillman and Debbie Williams. An objective summary of sturgeon issues will be drafted by Tracy Hillman and sent to the PRFF for review before being sent to the experts.**

In order to discuss this issue in-depth, the February PRFF and RRFF will hold a joint meeting. **A doodle poll will be sent out to find a date for the combined meeting.** If consensus cannot be met after this meeting, the issue will be elevated to the PRFF Policy Group.

February 2014

There was no official PRFF meeting in February. Some members of the PRFF met with members of the Rocky Reach Fish Forum to discuss juvenile sturgeon release numbers. This workshop was held on 19 February 2014. Draft notes from the workshop are included in this document.

March 2014

Stocking Decision for 2014 – The PRFF discussed the results from the Juvenile White Sturgeon Workshop held in February and reviewed the suggestions from the outside experts. In addition, Larry Hildebrand gave a presentation on projected future abundances in the project area based on stocking 4,500 or 6,500 juvenile sturgeon assuming two different early survival rates (28% and 50%). Assuming the lower survival rate (28%), model results showed that both stocking levels will result in about 8,000 fish or greater within the project area in a five-year period. Densities of sturgeon in the project area by

the fifth year would exceed densities reported in the downstream Hanford Reach/McNary reservoir area and other areas in the Snake River basin with naturally reproducing populations. Thus, the consistent stocking of large numbers of juveniles from limited numbers of families into the project area may quickly result in meeting or exceeding the carrying capacity of the reservoirs, but may not provide sufficient genetic diversity of the stocked population to ensure the long-term viability of the population.

The PRFF voted on the release of 4,332 or 6,500 juvenile sturgeon into the project area in 2014. Of the members present, four voted for 4,332 and three for 6,500. No members abstained. Based on this result, an impasse was declared, which initiates dispute resolution as defined in Article VI of the Final Priest Rapids Fish Forum Protocols.

April 2014

Update on Dispute Resolution and Stocking Decision for 2014 – Because the voting parties of the PRFF were unable to reach consensus on the number of juvenile sturgeon to release in the Project Area in 2014, the voting members elected to initiate the dispute resolution process as defined in Article VI of the Final Priest Rapids Fish Forum Protocols. Except for the USFWS, voting parties submitted letters to the Chair of the PRFF stating the reasons for the dispute and their respective positions on the dispute. The Chair then submitted a letter to Ecology indicating that the voting parties have elected to use the dispute resolution process. As dictated by the protocol, a subcommittee was set up to resolve the dispute. The subcommittee will meet on Friday, 11 April. They will prepare a report that describes their recommendation for resolving the dispute. The report will be sent to the PRFF Chair, who will then forward it to the PRFF. The PRFF will review the report and approve or reject the recommendation by the subcommittee.

Rationale Paper from the Yakama Nation

Yakama Nation position on 2014 stocking of

White sturgeon in Wells and Rocky Reach reservoirs

Issue: The current Management Plans for White sturgeon mitigation in the Mid-Columbia reservoirs call for stocking juveniles annually for three or four years in each reservoir to begin examining survival and carrying capacity-related density responses of the juvenile population. A wild broodstock-based stocking program was initially intended to provide the juveniles for this effort. However, recent efforts by the CCT have demonstrated the potential for also providing juveniles caught as larvae and reared in capacity over-winter. Recently, CCT has cited genetic concerns with releasing juveniles from a restricted set of families represented in the broodstock collection and suggests that juveniles collected as larvae in Lake Roosevelt represent a better cross-section of families that should be stocked instead of, or in combination with, broodstock-origin juveniles. The CCT also contends that a reduced number of individuals represented from the broodstock collected families is desired as this will reduce an unacceptable risk of moving future populations towards decreased genetic diversity and domestication.

Under the CCT recommendations, the total available release of juveniles would be substantially reduced from the initial planned releases the Parties recently agreed to in each of the three Management Plans in each of the three PUD reservoirs. Although the YN understands these arguments, we are not wholly in agreement and do not support the CCT 2014 management recommendations. Additionally, the Yakama Nation maintains that unless there is consensus within the respective forum, as agreed to in the various Management Plans, 2014 stocking levels cannot be changed from what was previously agreed.

Proposal: For 2014, Yakama Nation advocates for juvenile releases that incorporate all available larval-origin juveniles and as many broodstock-origin juveniles as needed, or is available, to achieve the White Sturgeon Management Plan goals of:

- 5,000 total juveniles released in the Wells reservoir,
- 6,500 total juveniles released in the Rocky Reach reservoir, and
- 6,500 total juveniles released in the Wanapum and Priest Rapids reservoirs.

Rationale: The rationale for this position is as follows:

1. Genetic risk is one of several considerations in deciding an appropriate stocking level. We are not convinced that identified genetic risks are fully understood, irreversible, or rise to the level that they justify compromising other aspects of the mitigation program.

2. The plan goals for juveniles/reservoir was based on the consensus of plan parties that a robust stocking level would allow follow-up M&E to actively probe the carrying capacity and production of harvestable fish in the reservoirs. Carrying capacity can only be determined when density effects are expressed in the population, and this only happens when sufficiently large numbers of juveniles are released and survive. As population abundance approaches carrying capacity, density effects should be expressed as reduced growth rates, condition factors, or as the accumulation of biomass becoming asymptotic. If release numbers are well below carrying capacity, these density effects do not occur or are small and difficult to measure. We submit that this remains an important purpose of juvenile stocking. We also

suggest that a higher stocking level is likely to produce fishery benefits sooner if harvest opportunity is determined to be an additional benefit of the mitigation program.

3. The genetic implications of different hatchery strategies are ultimately determined at the adult stage rather than the juvenile stage. The real question is how well genetics are represented in the reproductive adult survivors of stocked juveniles, and this may be related to, but not necessarily determined by, how well they are represented in the juveniles. Genetic representation is determined across a generation (20+ years), not just a single year. The two juvenile strategies might ultimately produce the same outcome from a diversity perspective. The larval strategy represents many families in every year (good for diversity at capture), but only a small number of individuals/family (bad for diversity at adulthood). The broodstock strategy represents few families in every year (bad for diversity at capture), but larger numbers of individuals from each family (good for diversity at adulthood). After one sturgeon generation we may well get to exactly the same place with either option in terms of diversity in the broodstock population. Best available science cannot yet project the genetic consequences of one-year samples of wild larvae and one-year samples of hatchery-spawned broodstock, so assertions about the superiority of one approach or the other are speculative at best. Obviously, we can get a more diverse juvenile sample from wild larvae in one year than broodstock in one year, but that is not the ultimate determinant of genetic diversity or reproductive success of the future broodstock population.

4. A hatchery strategy should optimize the capture of both a complete spectrum of the available genetic diversity and the phenotypic expression of that diversity. Current genetic analysis methods provide an index of how much diversity is captured but do not represent the full range of phenotypic, physiological, life history, or behavioral traits. The analyses provide only a very gross picture of genetic representation that may depict evolutionary lineages rather than individual variation whose expression is key to the production of fish that are successful in the current environment. Maximizing phenotypic expression of the available diversity is just as important as capturing diversity. Both are related to numbers - more fish produce more genetic combinations that have a higher probability of producing successful survivors and reproductively successful adults. It isn't enough to capture diversity if it is not expressed phenotypically. Recombination of types is important because all progeny of a family are not identical and will not be equally successful (for example, you don't look, sound, or behave exactly like your siblings). The benefit of the broodstock method is that it expresses very high genetic variation of the available material through the mixing, recombination, and expression of the genome.

5. Larval collection may offer a larger number of families but, to be effective, it requires that a sufficient number of fish per family are released for those families to be represented in the breeding population. Small numbers of fish from a large number of families does not necessarily gain more diversity in the adult population (where it matters for the next generation) if the majority of those families do not survive to reach the breeding population or don’t survive in sufficient numbers to make a difference.

6. The larval collection method is not without genetic risk. The high mortality rates associated with holding larval-origin fish in the hatchery may increase artificial selection and domestication. Mortality rates of ~60% for larval collections in the hatchery may result in the release of only families or individuals that were best suited for survival in the hatchery environment and not necessarily in the river.

7. The effective breeding populations in Wells and Rocky Reach reservoirs are likely to increase dramatically as a result of this program regardless of the origins of stocked juveniles. Broodstock-origin juveniles stocked in each year will come from completely unrelated family lines, therefore the population in the reservoirs will be an aggregate of many different family lineages. Juveniles surviving to become reproductive adults, where ancestry really matters, are likely to reflect a broad diversity of family origins from within the reservoirs, from the lower Columbia, and from Lake Roosevelt. Further, adults within a year class likely will mature at different ages and spawn in aggregate with adults of different origins and year classes to increase mixing and diversity. Ultimately, when fish stocked over the next few years reach maturity, effective size of the breeding population will not be an issue.

Rationale Paper from the Colville Tribes

Colville Confederated Tribes

Fish and Wildlife Department

M E M O R A N D U M

January 28, 2014

To: Members of the Priest Rapids and Rocky Reach Fish Forums

From: Colville Confederated Tribes

Subject: 2014 White Sturgeon Stocking in the Project Pools

Recently, Tracy Hillman requested that the Colville Confederated Tribes (CCT) develop a written rationale for the proposed approach of pro-rating release numbers of white sturgeon juveniles into the Priest Rapids and Rocky Reach project reservoirs in 2014. The impetus for this request stems from a stalemate over release numbers in both the Rocky Reach Fish Forum (RRFF) and Priest Rapids Fish Forum (PRFF). In response to this stalemate, the members of the respective forums agreed to convene an "expert panel" to discuss the science associated with the proposed release strategies. The Yakama Nation (YN) distributed a position paper to the members of both forums on January 21, 2014 outlining their alternative rationale for releasing the maximum 6,500 fish as defined in the respective White Sturgeon Management Plans (WSMP). In turn, the CCT would like to take this opportunity to provide our rationale for supporting a pro-rated stocking proposal (4,332 fish; see equations 1 and 2), summarize how that proposal originated, and discuss our concerns with the YN position paper related to the 2014 stocking proposals for the Priest Rapids and Rocky Reach project reservoirs.

The CCT rationale for supporting a pro-rated release recommendation for both projects is based on concerns over potential genetic risks that are generally recognized by conservation aquaculture programs (Hallerman and Kapuscinski 2003; KTOI 2007; Neff et al. 2011). Specifically, we are concerned with the potential for future inbreeding depression that may limit the success of the programs in establishing naturally reproducing populations in project reservoirs. As well, there is potential for substantial entrainment of released fish into downstream reservoirs that could result in reduced effective breeding populations in those areas. It is our contention that equalizing family (cross) sizes in a broodstock based stocking program will reduce these risks over the long-term. This approach is consistent with that of the Upper Columbia white sturgeon conservation aquaculture program. Please note that we have provided this same rationale in both forums and it should be captured in the meeting notes.

The CCT wishes to remind the members of the respective forums as to how the pro-rated proposal originated. We originally suggested pro-rating during a discussion within a PRFF meeting (November 6, 2013) as a compromise between a proposed reduced stocking number (3,245; not developed by the

CCT) and the YN proposal of the maximum possible release number (6,500). We believe this compromise is reasonable as it addresses concerns related to potential genetic risks as well as the YN desire to release greater numbers of fish. During a subsequent Rocky Reach Fish Forum (RRFF) meeting, (November 6, 2013) the facilitator suggested that the members consider consistent approaches to stocking between the projects and the CCT was asked to describe the pro-rated approach and the rationale, which we did.

The CCT would also like to remind members of the PRFF - and inform members of the RRFF - that all PRFF members, with the exception of the YN and Umatilla Tribes, supported the pro-rated stocking alternative. While we have no problem describing our rationale for supporting pro-rating, we believe all voting members should be responsible for providing rationales that support their alternative of choice. In short, we do not want this to be construed as a YN versus CCT issue and want to be clear that this is a forum specific issue related to the potential genetic risks associated with the respective aquaculture programs and how heavily these concerns are weighed against other aspects of the mitigation program – primarily monitoring and evaluation (M&E) and future harvest opportunity.

Unlike the YN, we do not believe that any potentially deleterious impacts resulting from a non-pro-rated release strategy would be easily reversible. Indeed, the YN does not specify how a reversal of poor outcomes would be achieved. Nor do we believe that other aspects of the mitigation program, such as M&E and future harvest opportunities, out-weigh the potential genetic risks. With regard to M&E, we contend that it is unrealistic to expect that carrying capacity (density dependent) related effects will become manifest over the course of a three to four year stocking program regardless of release number. The carrying capacity question can likely only be answered over the longer-term, and even then we contend that it is unlikely to be observed with any degree of statistical power. Thus, we fail to see how a pro-rated release strategy in 2014 would limit the ability to answer that question over the life of the respective FERC licenses and associated mitigation programs.

The YN position paper describes their preferred 2014 release numbers for the Priest Rapids, Rocky Reach, and Wells project reservoirs. However, the bulk of the position paper, including rationale points, is directed at contrasting the potential genetic outcomes resulting from the wild larvae and broodstock (direct gamete take) collection approaches, which is not relevant to the stocking of Priest Rapids and Rocky Reach project reservoirs in 2014. We want to be clear that the CCT has not in any way suggested that 2014 stocking of Priest Rapids and Rocky Reach project areas include fish other than those produced from wild caught broodstock spawned at Marion Drain Hatchery.

As currently organized, we believe that the YN position paper confuses the issues at hand. We recommend that the YN revise their position paper, so that it clearly separates the issues related to the 2014 stocking proposals for the Priest and Rocky Reach projects from the Wells project. Similarly, the expert panel discussion being organized by the PRFF and RRFF should confine itself to addressing potential genetic risks associated with the 2014 stocking proposals for those specific project reservoirs. While we would support convening an expert panel to discuss the relative merits and risks associated with the direct gamete take and wild larvae approaches for future consideration by the PRFF and RRFF,

this should occur separately from the 2014 stocking discussion. In addition, we believe there should be a candid discussion regarding conflict of interest when developing the list of expert invitees.

Another point of clarification is that the respective WSMP's, approved by the respective forum members, specifically state that stocking levels will be "*up to*" the levels put forth in the YN position paper. A stocking proposal that is less than the maximum target does not deviate from either of the WSMP's. Furthermore, the Priest Rapids WSMP provides an explicit broodstock spawning target of two 3x3 factorial mating that results in a total of 18 crosses. The Rocky Reach Project WSMP does not explicitly identify a goal for broodstock collection, but instead describes mating scenarios based on the number of broodstock available for spawning. In addition, the Rocky Reach Project WSMP discusses balancing the need to equalize family sizes with the need to release enough fish to meet other objectives, such as monitoring and evaluation (M&E) goals. However, it does not provide specific guidance as to how that balance should be accomplished. There is no language in any of the WSMPs (including the Wells WSMP) regarding whether or not each project should be treated independently with regard to broodstock collection goals; it is inconsistent to treat project specific release goals independently, but not the broodstock utilized.

In summary, the CCT is willing to continue working toward a consensus solution to the white sturgeon stocking levels in the Priest Rapids and Rocky Reach project reservoirs. This includes participation in a discussion with an expert panel specific to the 2014 Priest Rapids and Rocky Reach projects white sturgeon stocking alternatives. We reiterate the need to separate the wild larvae/direct gamete take approaches from this discussion. However, we are supportive of a separate expert panel discussion regarding the relative merits of the wild larvae/direct gamete take approaches.

Equation 1 – number of fish per family based on the maximum release and spawning goals

6,500 fish in maximum release goal ÷ 18 target number of crosses (two 3x3 matings) = 361 fish/cross

Equation 2 – pro-rated release number based on number of crosses achieved relative to the goal.

361 fish/cross x 12 crosses achieved in BY2013 = 4,332 fish

Literature Cited

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Summary Document Sent to the Outside Experts

JUVENILE WHITE STURGEON STOCKING NUMBERS

Fish Forums

The Priest Rapids Fish Forum (PRFF) and the Rocky Reach Fish Forum (RRFF) are decision-making bodies formed pursuant to their respective FERC Relicense Agreements and consist of representatives from the state agencies, federal agencies, tribes, PUDs, and other entities. They are responsible for meeting to share information, coordinate efforts, and make recommendations and decisions regarding implementation of their respective management plans relating to Pacific lamprey, bull trout, white sturgeon, resident fish, and water quality. The PRFF is responsible for making decisions within the Priest Rapids Project Area, which includes the Priest Rapids and Wanapum reservoirs (Figure 1). The RRFF is responsible for making decisions within the Rocky Reach Project Area, which includes the Rocky Reach reservoir (Figure 1). Decisions are by consensus.

Figure 1. Map of the Columbia River basin showing the location of the Priest Rapids Project Area (between Priest Rapids and Rock Island dams) and the Rocky Reach Project Area (between Rocky Reach and Wells dams).

Problem Statement

During the past three months, the Forums have been debating the number of juvenile sturgeon to stock within each project area in 2014. Two different release numbers have been proposed. One proposes to release the maximum 6,500 juvenile sturgeon recommended in the respective management plans to promote an increase in current sturgeon numbers. The intent here is to produce future harvest opportunities. The other proposes a pro-rated number (4,332 sturgeon) based on the number of half-siblings produced during spawning of brood stock. The latter proposal is based on releasing 361 juveniles per half-sibling, which is based on a target of 18 crosses[1] (the former was based on the maximum release of 6,500 juveniles). Because there were 12 half-siblings produced during spawning in 2013, it was proposed that 4,332 sturgeon be released (12 half-siblings x 361 juveniles per half-siblings = 4,332 juveniles) to balance maternal contributions. The intent of the second strategy is to avoid future inbreeding depression by supplementing the existing populations using a conservation genetics management strategy.

Because the Forums are unable to reach consensus on the number to release, they are seeking input from sturgeon/fisheries genetic and ecological experts. Input from experts will be used to help guide the number of sturgeon to stock within each project area. What follows is a brief description of the white sturgeon management plans for each project area and a summary of the rationale for each proposed stocking number.

Summary of the White Sturgeon Management Plans

Priest Rapids Project Area

Investigations conducted in the Priest Rapids and Wanapum reservoirs on the middle Columbia River indicate that resident white sturgeon populations are present in both reservoirs. White sturgeon spawning has been documented in the tailrace areas of Wanapum Dam (upper boundary of the Priest Rapids reservoir) and Rock Island Dam (upper boundary of Wanapum reservoir). About 22% of the white sturgeon sampled in the Wanapum Reservoir during 1999-2002 were juveniles, suggesting that some level of natural reproduction has occurred, either within the Project area or in adjacent upstream reservoirs. The sampling also indicated that the white sturgeon population in each reservoir is small (about 134 sturgeon in the Priest Rapids reservoir and about 551 in the Wanapum reservoir) and comprised of mostly larger, older fish. It is believed that the current level of natural recruitment is insufficient to maintain existing population levels.

As part of their License Agreement, Grant PUD prepared and implemented a White Sturgeon Management Plan (WSMP). The goal of the WSMP is to promote growth of the white sturgeon population in the Priest Rapids Project Area to a level that is commensurate with the available habitat. The WSMP includes the following biological objectives:

[1] The estimate of 361 juveniles per half-siblings was calculated as 6,500 juveniles (maximum release goal) divided by 18 total crosses (two 3x3 matings). Thus, 6500/18 = 361 juveniles per half-siblings. If a full 6x6 factorial mating was achieved, there would be 181 juveniles per half-siblings.

1) Increase the white sturgeon population in the reservoirs through supplementation to a level commensurate with available habitat.
2) Determine the effectiveness of the supplementation program.
3) Determine the carrying capacity of available habitat in the reservoirs.
4) Determine natural reproduction potential in the reservoirs and then adjust the supplementation program accordingly.

In addition, the following tasks, which are relevant to the problem statement, were incorporated into the WSMP:

> **Task 1.** Determine the effectiveness of the supplementation program in creating a sustainable white sturgeon population in the Project reservoirs based on natural production potential and adjust the supplementation program accordingly.
>
> **Task 2.** Determine the carrying capacity of available white sturgeon habitat in each reservoir.

The WSMP identifies the following Protection, Mitigation, and Enhancement measure, which is relevant to the problem statement, to be implemented by Grant PUD:

1) Implement a white sturgeon supplementation program by releasing up to 5,000 yearling white sturgeon into the Wanapum reservoir each year and 1,500 yearling white sturgeon into the Priest Rapids reservoir annually for Years 3 through 7 of the program, with subsequent annual release levels to be determined by the PRFF based on monitoring results.

According to the WSMP, the desired endpoint is "restoration and maintenance of the sturgeon populations through intensive hatchery intervention for the foreseeable future in order to provide a stable future population that could have the potential to support some level of a future harvest fishery."

Annual production goals for the Priest Rapids Project Area were derived from the Upper Columbia River and the Kootenai River White Sturgeon Recovery Plans. Stocking targets were based on an annual mortality rate of 10% for white sturgeon in the wild. Modeling also assumed conservatively that females matured at age 30 and a 1:1 male-to-female ratio in surviving hatchery-reared juveniles. It is believed that the annual stocking numbers of 5,000 juveniles into Wanapum reservoir and 1,500 into Priest Rapids reservoir for the first five years should be high enough to achieve adult population levels commensurate with reservoir carrying capacity. However, it was recognized that these stocking numbers are needed to "jump-start" the populations in order to rapidly replace or supplement natural recruitment and build a future population of adults as soon as possible. These programs are heavily front loaded with the understanding that if subsequent monitoring indicates density-dependent effects on growth or survival, stocking levels can be reduced and if necessary a directed harvest fishery can be implemented to reduce population levels.

The broodstock management plan of the WSMP is based on the premise that to maintain an acceptable effective breeding population to achieve these release targets, six male and six female spawning sturgeon will have to contribute to the construction of six maternal families that are derived from a full or partial factorial mating design. The goal is to collect broodstock in spawning condition from the project area during the spawning period. If the target number of broodstock cannot be collected within the project area, broodstock may be collected from McNary reservoir. Because it is unlikely that a full six female by six male (6x6) factorial breeding plan can be accomplished at one spawning event, the plan allows for two 3x3 breeding matrices. This partial factorial breeding design results in the production of six maternal families and 18 half-sibling families.

Rocky Reach Project Area

Investigations conducted in Rocky Reach reservoir in 2001 and 2002 indicate that resident white sturgeon are present in low numbers (less than 300 white sturgeon). Although juvenile sturgeon were more abundant in Rocky Reach reservoir than in the upper Columbia River or in Wanapum and Priest Rapids reservoirs, there has been no confirmed spawning in the reservoir. Thus, recruitment could be from immigration of juveniles from upstream locations. Nevertheless, it is believed that the current level of natural recruitment is insufficient to maintain existing population levels.

The goal of the WSMP is to promote growth of the white sturgeon population in Rocky Reach reservoir to a level that is commensurate with the available habitat by year 30 of the New License. This will be accomplished by meeting the following objectives:

1) Increase the white sturgeon population in the reservoir through supplementation to a level commensurate with available habitat and allowing for appropriate and reasonable harvest.
2) Determine the effectiveness of the supplementation program.
3) Determine the carrying capacity of available habitat in the reservoir.
4) Determine natural reproduction potential in the reservoir and then adjust the supplementation program accordingly.

The WSMP identifies the following Protection, Mitigation, and Enhancement measure, which is relevant to the problem statement, to be implemented by Chelan PUD:

1) Implement a white sturgeon supplementation program by releasing up to 6,500 yearling white sturgeon into the reservoir each year for three years, with subsequent annual release levels to be determined by the RRFF based on monitoring results.
2) By year seven of the New License, in consultation with the RRFF, determine a long-term source of fish to be used for continuing the supplementation program throughout the term of the New License.

Because of the low number of adult sturgeon in the project area, the Plan identifies several possible sources of broodstock, including broodstock collected from the project area,

Wanapum reservoir, Priest Rapids reservoir, and McNary reservoir; broodstock from below Bonneville Dam; excess juveniles from other compatible supplementation programs; juveniles purchased from a commercial facility; and juveniles from new or existing PUD-funded hatchery facilities retrofitted to accommodate sturgeon broodstock, egg incubation, and juvenile rearing.[2] To present, the program has used broodstock collected from Wanapum, Priest Rapids, and McNary reservoirs. The breeding plan for the Rocky Reach Project Area is consistent with the breeding plan for the Priest Rapids Project Area.

Current Situation

Based on broodstock collection in 2013, the programs were able to complete 12 of the 18 half-sibling crosses identified in the management plans. Thus, the two 3x3 matings were not achieved in 2013 for either program. Note that offspring from these same 12 crosses are proposed to be released in both project areas in 2014.

To date, a total of 13,098 juvenile sturgeon have been stocked in the Priest Rapids Project Area (Table 1). Releasing 6,500 juveniles in 2014 would increase the total number stocked to 19,598; releasing 4,332 juveniles would increase the total number stocked in the Priest Rapids Project Area to 17,430. In the Rocky Reach Project Area, a total of 14,502 have been stocked (Table 1). If 6,500 juveniles are stocked in 2014, the total number released would increase to 21,002, which is greater than the 19,500 juveniles envisioned after the three years of stocking at 6,500 juveniles per year. If 4,332 juveniles are stocked in the Rocky Reach Project Area in 2014, the total number released would be 18,834, which is under the 19,500 juveniles envisioned after the three years of stocking.

Table 1. Summary of releases of juvenile white sturgeon in the Priest Rapids and Rocky Reach Project Areas. Offspring from the same crosses (parents) are used to stock both project areas, with the exception of the Kootenay Trout Hatchery fish stocked in the Priest Rapids Project Area in brood year 2010.

Brood year	Number of crosses	Number of juveniles released	Comments
Priest Rapids Project Area			
2010	27	9,117	MDH[a] 1F x 2M wild cross, 2 crosses (3896 of 9117). MDH 3F x 2M captive brood cross, 6 crosses (2600 of 9117). KTH[b] 7F x 10M wild cross 19 crosses (2621 of 9117).
2011	1	0	1F x 1M wild cross. The PRFF recommended that no fish be released because of detection of WSIV in some juvenile sturgeon.
2012	7	3,981	3F x 1M wild cross and 1F x 4M wild cross. Representative of number of maternal groups.
2013	12	TBD	3F x 3M wild cross and a 1F x 3M wild cross.

[2] Following the development of the WSMP, genetics work indicated that brood stock collected upstream from Bonneville Dam would also be an acceptable source.

Brood year	Number of crosses	Number of juveniles released	Comments
Rocky Reach Project Area			
2010	8	6,376	1F x 2M wild cross; 3F x 2M captive brood cross.
2011	1	147	1F x 1M wild cross. WSIV and hyper-inflated swim bladder complications prevented the release of larger numbers of juveniles.
2012	7	7,979	3F x 1M wild cross and 1F x 4M wild cross. Excess stocking of 6,500 approved by RRFF.
2013	12	TBD	3F x 3M wild cross and a 1F x 3M wild cross.

[a] Marion Drain Hatchery (MDH).

[b] Kootenay Trout Hatchery (KTH).

Rationale for the Proposed Release Numbers

As noted above, the Fish Forums have debated the number of sturgeon to release into the two project areas in 2014 for several months. Below is a summary of the rationale offered by different members of the Forums for each of the two proposals.

Maximum 6,500 Juvenile Release Proposal

This proposal advocates the release of 6,500 juvenile sturgeon into the Priest Rapids Project Area (5,000 into Wanapum and 1,500 into Priest Rapids reservoirs) and 6,500 into the Rocky Reach Project Area in 2014. The intent of this proposal is to produce future harvest opportunities. The rationale advanced by advocates for this proposal include:

- The WSMPs call for the release of up to 6,500 juvenile sturgeon into each project area. There are currently enough juveniles on station at the hatcheries to meet this goal for both project areas.
- The genetic risk of releasing the maximum number of fish within each project area is not fully understood, irreversible, and does not rise to the level that would justify compromising other aspects of the supplementation program. Potential genetic risks could be ameliorated with selective harvest in the future.
- Releasing the maximum number of juvenile sturgeon will allow the monitoring and evaluation program to estimate carrying capacity and production of harvestable fish within the reservoirs.
- Higher stocking levels will likely produce fishery benefits sooner if harvest opportunities are determined to be an additional benefit of the supplementation program.

Pro-Rated 4,332 Juvenile Release Proposal

This proposal advocates the release of 4,332 juvenile sturgeon into each of the Priest Rapids and Rocky Reach Project Areas in 2014. The intent of this proposal is to supplement the existing populations using a conservation genetics management strategy. The rationale advanced by advocates for this proposal include:

- Because there were only 12 crosses (out of the 18 total), a pro-rated, cross-equalized release of 4,332 juveniles should be conducted to avoid potential genetic risks (genetic swamping; Ryman-Laikre effect) that are generally recognized by conservation aquaculture programs (Hallerman and Kapuscinski 2003; KTOI 2007; Neff et al. 2011).
- Future inbreeding depression may limit the success of the programs in establishing self-sustaining populations in the project areas.
- There is potential for entrainment of released fish into downstream reservoirs (e.g., Hanford Reach/McNary Pool, John Day Pool, The Dalles Pool, and Bonneville Pool) that could result in reduced effective breeding populations in those areas. Entrainment has already been documented with juvenile sturgeon stocked in the project areas and with juvenile sturgeon stocked in the Rock Island reservoir. Fish from the latter release (see Kappenman and Parker 2005) have been captured in all reservoirs downstream from Rock Island Dam, as well as downstream from Bonneville Dam (Golder Associates, Ltd. 2013; ODFW, unpublished data).

Questions for the Experts

1. Based on your understanding of the problem statement, current situation, and proposed releases, what are the pros and cons of each proposal?
2. Given the status of the white sturgeon populations within the project areas and the goals and objectives of the WSMPs, which proposal do you support and why?
3. Would you recommend a different release number or an alternate stocking rate (fish/area, fish/maternal group, etc.)? If so, why?
4. A lot has been said about the potential genetic risks (future genetic bottlenecks) associated with releasing 6,500 juveniles in 2014 based on 12 of the 18 crosses. Given the releases of juveniles into the project areas to date and the potential for entrainment, can you advise the Forums on what you believe would be an acceptable level of risk?
5. If the potential risks become manifest, what is the likelihood that they can be reversed, and if so, how would that be accomplished? Are there examples where this has been achieved?
6. Given the goals and objectives of the two WSMPs, the potential for entrainment, and the low numbers of white sturgeon in the project areas, do you have recommendations for future stocking efforts (e.g., guidance on numbers to release per maternal family or half-sibling family; total numbers to release; age and size at release; use of broodstock, wild larvae, or both; etc.)?

References

Golder Associates, Ltd. 2013. 2012 white sturgeon management plan annual and biological objectives status report, Priest Rapids Hydroelectric Project (FERC No. 2114). Report to Public Utility District No.2 of Grant County, Ephrata, WA.

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KTOI (Kootenai Tribe of Idaho). 2007. Kootenai River White Sturgeon Conservation Aquaculture Program, 1990-2007 (2nd Edition). Bonners Ferry, Idaho. Report edited by R. Beamesderfer and P. Anders, Cramer Fish Sciences.

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Neff, B.D., S.R. Garner, and T.E. Pitcher. 2011. Conservation and enhancement of wild fish populations: preserving genetic quality versus genetic diversity. Canadian Journal of Fisheries and Aquatic Sciences 68: 1139-1154.

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Responses from the Outside Sturgeon Experts

Dr. Jim Powell

To assure the integrity of the process, it is proper that I not participate in the Expert Review. While qualified, my prior participation in the preparation of the document could be viewed as a conflict.

As one of many contributors to the construction of the PR WSMP, it was my understanding that the WSMP constituted a recovery plan where hatchery augmentation was meant to bolster existing populations while the issues surrounding juvenile recruitment were identified and addressed. In the ranking of Waples and Drake (2004; below) the WSRP was addressing an increase in the rate of sturgeon recovery while addressing the factors that contributed to the decline. Although the emphasis in the WSRP is on augmentation, it was not my belief that it strayed from Conservation Benefits as a motivation for recovering the population. The interpretation from brief wording in the plan regarding future harvest potential places the emphasis of the WSRP on Societal Benefits for fisheries augmentation. To support the former position, conservation genetic practices were written into the plan to embrace a motivation that is conservation based. The harvest perspective ignores the need for a broad-based breeding strategy, instead focussing on biomass production.

Conservation Benefits Items:

1. Contingency against catastrophic loss of natural population
2. Reduce immediate (short-term) risk of extinction
3. Increase rate of recovery
4. Maintain natural population while factors contributing to decline are addressed
5. Reseed vacant habitat
6. Science/experimental contributions to hatchery and/or conservation science

Societal Benefits Items:

1. Legal mandate compliance
2. Fishery augmentation
3. Ecosystem Restoration
4. Public relations/education

In my outside view, the issue is to decide the future of the 'recovery' effort. Is this a Conservation initiative aimed at sturgeon recovery or a Societal initiative based on future harvest?

This is up to the co-managers and the people of WA state to decide.

Waples, R.S. and J. Drake. 2004. Risk-benefit considerations for marine stock enhancement: a Pacific salmon perspective. In K. M. Leber, ed. Stock Enhancement and Sea Ranching: Developments, Pitfalls and Opportunities, pp. 206–306. Blackwell, Oxford.

Dr. Scott Blankenship

General Comments:

I have no conflict of interest. I am working on a white sturgeon project for the USFWS to develop a new population monitoring tool based on genetics metrics, but this is currently in an experimental state and the test population is comprised of hatchery individuals housed in California.

It does not surprise me that there has been deliberation, without resolution, over several months regarding proposed stocking numbers for juvenile White Sturgeon. The problem statement presents two conflicting objectives, with one proposal intending to produce future harvest opportunities and the second proposal intending to supplement the existing population(s) using conservation genetic principles. The project goals, perceived or realized benefits, and tolerance of risk differ depending on the overarching intent of the program(s). The forums will need to resolve the primary intent of the program(s) or the decision-making process will remain unproductive, as supporting a fishery and conserving the genetic diversity of a population segment have conflicting priorities.

The program objectives state that carrying capacity will be determined and supplementation performance will be judged relative to estimated capacity of each reservoir. Yet, there doesn't appear to be a task associated with investigating what might be limiting White Sturgeon populations that currently reside in each reservoir. As a result, the indefinite use of artificial propagation appears to be envisioned, which poses significant challenges (from a genetics perspective) given each reservoir population is isolated (disconnected). A parallel process that identifies limiting factors seems warranted.

Specific Comments:

Proposal #1: 6,500 release

Proposal #2: 4,332 release

1. Based on your understanding of the problem statement, current situation, and proposed releases, what are the pros and cons of each proposal?

Pros and cons depend on the overarching program intent, they are not absolute. The central question is whether these groups are going to be managed based on census size or effective size. If the purpose of the program(s) is to provide a fishery, then reservoirs can be managed based on census size (i.e., the number of fish present). On the other hand, if the genetic trait diversity present in these isolated reservoir groups is a priority, then the effective population size is the metric by which to gauge program performance.

2. Given the status of the white sturgeon populations within the project areas and the goals and objectives of the WSMPs, which proposal do you support and why?

If the primary intent is to establish fisheries in the reservoirs, both proposals have quite similar outcomes from a long-term population genetics perspectives, in that they will essentially replace existing populations with a lower diversity hatchery derived group. Therefore, the proposal that commands the greatest support among all interested parties could be adopted.

If the primary intent is to increase population numbers while not reducing the genetic trait diversity within the groups isolated in each reservoir, then I support neither proposal. Both proposals (as I understand them) will reduce the effective population size below what is likely present now, and subsequently reduce trait diversity maintained within the isolated reservoir groups. Further, each proposal (as I understand them) may result in populations with effective sizes in a range where inbreeding is likely to occur. While the fitness loss expected due to inbreeding is unknown for these White Sturgeon reservoir groups, wild populations in general do not tolerate inbreeding well. For example, an increase in the inbreeding coefficient (i.e., F) from zero to 0.05 is expected to reduce fitness by 26% (Frankham et al. 2014). Given the White Sturgeon groups under consideration are not ESA-listed and are disconnected from the extant larger White Sturgeon gene pool, short-term tolerance of inbreeding is not warranted in order to boost population numbers.

3. Would you recommend a different release number or an alternate stocking rate (fish/area, fish/maternal group, etc.)? If so, why?

If the intent is to create a fishery, I would not recommend an alternative stocking strategy.

If the intent is to increase population numbers while not reducing the genetic trait diversity, I would recommend an alternative stocking strategy, because both proposals (as I understand them) would reduce trait diversity from what is currently present. Alternative stocking scenarios are difficult to evaluate given imprecise biological measures and time constraints for this critique. Yet, I have roughed out some numbers given the modeling parameters already used to develop the current stocking proposals, namely a 10% annual mortality rate, a 30 y.o. age-of-maturity, and a 1:1 sex ratio.

This document states that White Sturgeon population sizes are N<300, N=551, and N=134, for Rocky Reach, Wanapum, and Priest Rapids reservoirs, respectively. If 6,500 juveniles are stocked in Rocky Reach reservoir for five consecutive years (years 1-5), then stopped, it is expected that 1,016 hatchery propagated adults would be present in the reservoir at year 35. Further, if no mortally occurs within the ~300 adults originally present, then the hatchery program will have a contribution rate of 339% (i.e., 1,016/300). If the original ~300 adults suffer mortality over the 35 years, then the hatchery contribution rate would obviously be higher. Using the same logic for the other reservoirs, a 5,000 juvenile and 1,500 juvenile stocking rate will result in 781 and 234 hatchery propagated adults present at year 35 in Wanapum and Priest Rapids reservoirs, respectively. Subsequent hatchery contribution rates would be 142% (i.e., 781/551) and 175% (i.e., 234/134), respectively.

Where this information exercise gets complicated is merging effective size information into the demographic information above. First, let's talk about the reservoir groups. While the effective sizes (N_e) are unknown, a rule-of-thumb is that N_e is ~25% of N, resulting in estimated N_e of 75, 138, and 33 for Rocky Reach, Wanapum, and Priest Rapids reservoirs, respectively. Now, let's talk about the hatchery group. Assuming the individuals in 2013 were all unrelated from each other (with inbreeding coefficients F = 0), the unequal sex ratios will create a hatchery N_e=9.6. Rounding up to 10 to make it easy, let's further assume that for each year (i.e., 5 in this scenario), that the same approximate number of unrelated (and unique) breeders are used for broodstock. This will result in a hatchery population specific N_e =50 (i.e., 10 x 5). Finally, let's talk about the Ryman-Laikre effect, which is genetics theory that relates expected total N_e given a hatchery contribution rate. Given a hatchery N_e =50 and N_e of 75,

138, and 33 for Rocky Reach, Wanapum, and Priest Rapids reservoirs, respectively, contribution rates that do not diminish total N_e can be estimated. The Ryman-Laikre model estimates that total N_e begins to diminish at contribution rates of 0.3 (i.e., 30%), 0.4, and 0.6 for Rocky Reach, Wanapum, and Priest Rapids, respectively (Figure 2). In other words, in order to not lower N_e below current levels, there can be up to 100, 220, and 80 hatchery adults present at year 35 within Rocky Reach, Wanapum, and Priest Rapids, respectively. Note, if the hatchery N_e is lower than assume, contribution rate would need to be lowered to achieve same result.

The same demographic parameters from above can be used to estimate a juvenile stocking rate that would result in the specified number of hatchery adults being present in each reservoir at year 35. Stocking 700 juveniles per year for 5 consecutive years in Rocky Reach reservoir is estimated to produce ~100 adults at year 35. Similar calculations estimate that stocking 1,500 and 500 juveniles per year will result in ~220 and ~80 adults in Wanapum and Priest Rapids reservoirs, respectively. If higher stocking rates are desired, then a hatchery population with greater diversity must be used.

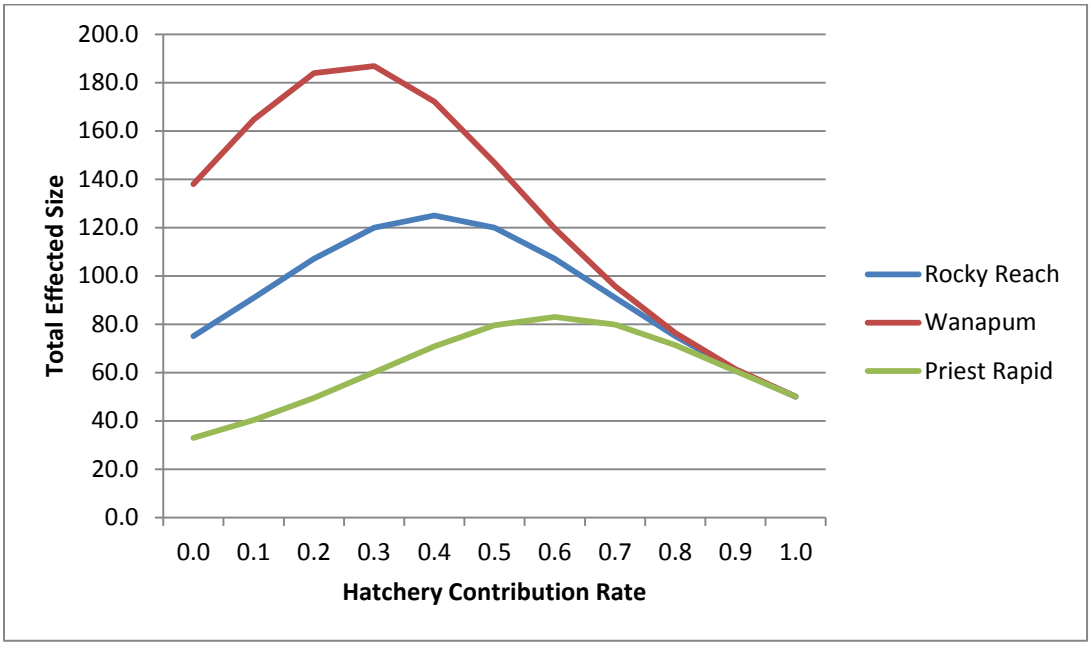

Figure 2. Ryman-laikre models for reservoirs discussed. At zero hatchery contribution, total effective size is that estimated for reservoir groups. At 100% hatchery contribution, total effective size is that estimated for hatchery (N_e = 50).

4. A lot has been said about the potential genetic risks (future genetic bottlenecks) associated with releasing 6,500 juveniles in 2014 based on 12 of the 18 crosses. Given the releases of juveniles into the project areas to date and the potential for entrainment, can you advise the Forums on what you believe would be an acceptable level of risk?

As I understand the programs, there are three genetic risk categories posed by these stocking programs: 1) Reduction of within population genetic diversity; 2) Reduced effective population size; and 3)

Domestication selection. There are many strategies for mitigating domestication selection, but this issue is best handled within HGMPs, so I will not deal with that issue here. From a conservation genetics perspective, a minimum threshold for effective size (N_e) that is tolerated in intensively managed populations is N_e=50. At this population size, a majority of trait diversity is expected to be retained over about a 100 year period, although I would expect variation around rate of genetic diversity loss to occur given the complex genetic architecture of White Sturgeon and long generation time. Yet, recent review of empirical evidence suggests that N_e=100 may be a more appropriate threshold for retention of trait diversity in the short-term (i.e., ~5 generations) (Frankham et al. 2014). I would recommend the forums adopt a criteria that reservoir populations must remain above N_e=50 and should remain above N_e=100 over the duration of supplementation evaluation in order to mitigate the risk of fitness loss due to inbreeding. Conservation genetics principles manage to effective size, not census size.

5. If the potential risks become manifest, what is the likelihood that they can be reversed, and if so, how would that be accomplished? Are there examples where this has been achieved?

Effective size functions as a harmonic mean (i.e., 1/Ne). As a result of this property, N_e can decrease quite rapidly (on the order of years). Effective size recovers as a function of the mutation rate, which is on the order of 10s to 100s of thousands of years. Further, the quantitative diversity (i.e., traits) lost within each population would be unknown. Therefore, the best action is to not reduce N_e, as is tends to ratchet lower in finite populations, leaving a smaller gene pool of available trait diversity. The only practical means to increase effective size on a "management" timeframe is to use migration to introduce diversity back into isolated populations. In other words, genetic diversity must be brought in from elsewhere to increase effective size. I am not aware of published documents specific to White Sturgeon regarding donor stock characteristics, but for other listed species (e.g., bull trout) and minimum N_e=500 is recommended in order to be considered as a donor source. I would generally agree with this recommendation.

6. Given the goals and objectives of the two WSMPs, the potential for entrainment, and the low numbers of white sturgeon in the project areas, do you have recommendations for future stocking efforts (e.g., guidance on numbers to release per maternal family or half-sibling family; total numbers to release; age and size at release; use of broodstock, wild larvae, or both; etc.)?

Answered within question #3 above.

Literature Cited:

Frankham, R., C.J.A. Bradshaw, and B.W. Brook. 2014. Genetics in conservation management: Revised recommendations for the 50/500 rules, Red List criteria and population viability analyses. Biological Conservation 170: 56–63.

Dr. Andrea Schreier

1. Based on your understanding of the problem statement, current situation, and proposed releases, what are the pros and cons of each proposal?

The first proposal would increase population size more rapidly assuming that carrying capacity has not been/will not be reached. The first proposal also may allow carrying capacity to be studied sooner. It's not clear to me how the second proposal was developed. I understand the importance of equalizing family sizes to maximize N_e by reducing variance in individual reproductive success (I support that!), but I don't understand why the number to stock from each family can't be derived from the 6,500 release goal. 6,500/12 half sib families = total number of juveniles to stock from each family. The principle of equalizing family size has more to do with increasing genetic diversity preservation and maximizing N_e rather than constraining release sizes.

It would be easier to evaluate pros and cons if survival rate was known. If survival is low, then stocking 2,168 fish may not make much difference.

2. Given the status of the white sturgeon populations within the project areas and the goals and objectives of the WSMPs, which proposal do you support and why?

I honestly don't think there is much difference between the proposals from a genetic perspective. If you equalized family sizes in both strategies, the difference in number of juveniles released per family is <200. I don't know enough about the habitat in the project areas to provide an opinion about how a larger stocking number may affect population dynamics. At this point, there doesn't seem to be enough information to evaluate that.

3. Would you recommend a different release number or an alternate stocking rate (fish/area, fish/maternal group, etc.)? If so, why?

I would recommend using as many wild broodstock as possible each year to maximize the number of maternal groups. (Better yet, use wild captured larvae!) That advice isn't exactly relevant to the two proposals but as a geneticist I recommend focusing more on representing as many parents as possible rather than worrying about differences in release sizes when the total number of fish to be released is so small (relative to many other hatchery programs).

4. A lot has been said about the potential genetic risks (future genetic bottlenecks) associated with releasing 6,500 juveniles in 2014 based on 12 of the 18 crosses. Given the releases of juveniles into the project areas to date and the potential for entrainment, can you advise the Forums on what you believe would be an acceptable level of risk?

Operating a hatchery program is going to introduce genetic risks. Releasing 4332 fish or 6500 fish will reduce the N_e of the wild population (Ryman Laikre) and potentially introduce maladaptive alleles. The choice to operate a supplementation program (vs not supplementing) is going to have a much greater effect on the wild population than the effect of stocking 6500 or 4332 juveniles. It is a good idea to equalize family sizes, a feature of both proposals. With the mating design available, this is the best way to reduce negative effects on N_e.

If you want to further minimize risk, use wild spawned larvae (excess from UCR program?) as they will represent genetic contributions of a greater number of adults and will be less likely to suffer negative effects from hatchery spawning (spontaneous autopolyploidy, hatchery selection operating at very early life stages).

5. If the potential risks become manifest, what is the likelihood that they can be reversed, and if so, how would that be accomplished? Are there examples where this has been achieved?

If genetic diversity loss and/or reduction in N_e do occur, these can be ameliorated by introducing more genetic diversity. This may be accomplished by translocating adults from adjacent reaches or increasing the number of crosses used in supplementation. I am not sure the proposal for selective harvest mentioned above will be successful. What would be the method of selection? How could an angler discern whether a fish belonged to an overrepresented family or not?

Another point is that we don't know how much inbreeding is going to cause inbreeding depression in polyploid sturgeon. Obviously we want to prioritize maximizing genetic diversity conservation in supplementation programs but we can't predict exactly how genetic diversity loss of various magnitudes will affect the wild population.

6. Given the goals and objectives of the two WSMPs, the potential for entrainment, and the low numbers of white sturgeon in the project areas, do you have recommendations for future stocking efforts (e.g., guidance on numbers to release per maternal family or half-sibling family; total numbers to release; age and size at release; use of broodstock, wild larvae, or both; etc.)?

My #1 recommendation would be to supplement with wild larvae from a geographically proximate reach exhibiting consistent recruitment. Using wild larvae preserves natural mating behavior, reduces the incidence of spontaneous autopolyploidy (which may be occurring in this program if standard artificial spawning techniques are used), and increases the number of wild parents represented. If captive spawning must be used, wild broodstock from the same or adjacent reaches are preferable. Continuing to equalize family sizes is important. I would avoid getting excess larvae from captive broodstock because programs with a small number of broodstock are more likely to be inbred (adults are close relatives) which greatly increases the chance of inbreeding depression in wild population. Wild broodstock are likely unrelated given the relative recentness of habitat fragmentation in the Columbia. I would also continue avoiding use of broodstock from below Bonneville and expand this to include adjacent reaches in the Lower Columbia (Bonneville Reservoir, The Dalles, John Day). Patterns of population structure in the Columbia suggest that white sturgeon occupying the Lower Columbia may not have interbred often with white sturgeon further up in the system.

In terms of age and size at release, reducing length of time in the hatchery is best (reducing length of time individuals exposed to unnatural selection pressures) but this also needs to be weighed with survival rate at various life stages. It is obviously not advantageous to stock juveniles at very small sizes to avoid unnatural selection pressure if survival of small juveniles in the wild is low.

Dr. Schreier offered the following addition information based on a question from the Forums:

During the workshop, participants had a question regarding Dr. Shreier's response to question #6. In her response she stated, "I would also continue avoiding use of broodstock from below Bonneville and expand this to include adjacent reaches in the Lower Columbia (Bonneville Reservoir, The Dalles, John Day)." The Forums asked if she was recommending that we should not collect broodstock (or wild larvae) from the lower Columbia (downstream from John Day Dam)? If so, why?

Dr. Schreier responded, “Population structure in the Columbia-Snake system is rather complex, so your question is a good one. There appears to be one population associated with the downstream-most end of the Columbia and one associated with the Middle Snake. Everything in between seems to be admixed, with the influence of the Middle Snake group decreasing as you sample fish downstream. This is likely a reflection of net downstream gene flow (sturgeon entrain downstream through dams but can't be back upstream, except at The Dalles). That being said, it’s probably better to get broodstock or larvae from the Middle or Upper Columbia as these are most similar to the project area. The fish in Dalles and John Day are a somewhat more similar to that Lower Columbia population than to the Mid Columbia. If there is no viable option in the Mid or Upper Columbia, Dalles and John Day would be better options than the Columbia River estuary. I wish we had better genetic markers so I could give you a more clear answer, but we are stuck with interpreting dominant microsatellite data for now.”

Mr. Ken Lepla

Given the low numbers of white sturgeon [WS] in the project areas, supplementation to rebuild WS abundance certainly appears warranted, and likely the only alternative that can meet Plan goals. That being said, it appears the primary concern (as well as most of the questions) is specific to population genetics and suspect best addressed by fish geneticists. Unfortunately I am not one and therefore my response is more along lines of some general thoughts. My suggestion to the Fish Forums is to rely on the guidance provided by genetic experts regarding what are appropriate mating schemes, release numbers, stocking rates, etc. and the acceptable levels of risk. I do not have the expertise to provide recommendations. However, because of uncertainty and potential for risk it would seem prudent to be proactive and implement strategies that maintain as much genetic diversity as possible (or managing those actions that decrease diversity) rather than later try to deal with reversing potential negative effects that could manifest.

Given WS abundance in the Project areas are small; it also seems beneficial to consider multiple sources for diversity. As you noted and a population structure analysis of white sturgeon by Schreier et al. 2013 shows, several downstream reaches in the Columbia, with much larger abundances of WS, were genetically similar to the Project areas. Perhaps brood stock or wild larvae (or both) from these reaches can be incorporated periodically in supplementation strategies, as a means to ensure high levels of diversity in the Project areas, as well as reduce downstream concerns about hatchery introgression from entrainment. The Colville Tribe has demonstrated the benefits of collecting naturally-produced larvae (see Jason McLellan). This novel approach potentially could minimize a lot of the genetic concerns within reach as well as downstream export.

Again, thanks for considering my input, but strongly feel the Fish Forums should seek the advice of fish geneticists for guidance to these questions.

The following comments from Dr. McAdam and Dr. Anders were provided after the workshop.

Dr. Steve McAdam

My apologies, but I just don't have the time to give you a proper answer.

I did briefly look over some of the material when I first got your e-mail. I do agree that the concern you are trying to address is important, but given the difference between two scenarios the consequences of choosing one scenario over the other for a single year might be small (at least for an individual year). The possibility of mitigating any 'error' by selective harvest in future is also an important consideration. Other important considerations I can think of are the extant genetic condition of the population, the low number of breeders (not unique to your situation by any means), expected survival rates, other hatchery effects (release numbers is likely only one of many considerations), future harvest levels....all of these would have affect your decision. While I didn't review your information thoroughly enough to see what information was provided on those points, they would certainly be things I would consider over the long term as release numbers continue to be evaluated.

Dr. Paul Anders

There are so many issues, conditions, and uncertainties involved here that require careful presentation and discussion, and I don't want to over-simplify and be misinterpreted. I had intended to provide additional information, but am only able to provide a short summary today re the above subject.

Re the above subject, I agree with Andrea's assessment of the 2 release number options (6,500 vs. 4,332): "I honestly don't think there is much difference between the proposals from a genetic perspective".

Thus, in the short-term (and assuming that this hatchery program will be operating annually for at least the better part of a sturgeon generation?), I could support either proposal. However, I would initially suggest the larger release strategy during initial program years specifically to reduce the time required to produce the needed empirical post-release survival estimates. This recommendation addresses a specific short-term goal, with no intention of downplaying the importance of any other demographic and genetic goals needed for the program, which the collaborating entities and outside reviewers have spoken to.

This recommendation assumes that: 1) the benefits of quickly establishing relevant post-release survival rates up front will exceed the genetic risks of these actions in the short term, or if not, risks can be compensated for over the life of the program; and 2) use of empirical survival rates from the populations of interest ASAP can reduce future risks that could occur without having those estimates. This recommendation does not suggest that the 6,500 fish release number should be maintained. Rather, survival rates should then be used to adjust future release strategies, along with efforts to maximize genetic benefit (e.g. measured as Ne, genetic contribution/diversity) and minimize genetic risks (inbreeding estimates), to be tracked annually but relevant at the generational time-scale, the time-scale at which many genetic risk/population persistence or viability models operate.

That said, the issue of equalization of family size at release is relevant here. This issue is less controversial when family sizes are not limiting or when they have relatively similar abundances. However, differences in pre-release abundance across families in the hatchery invariably occur. Then debate ensues about whether you should equalize family release numbers down to the smallest family size, which in extreme but not unusual cases can be too low to provide any benefit the population. Thus, an agreed-upon policy regarding equalization of family size at release with adequate resolution is needed if it doesn't already exist.

There are many more issues involved here. However, I am not currently able to address them with the detail they deserve, not due to of any conflicts of interest.. just due to conflicts of time..

Draft Notes from the Juvenile Sturgeon Release Workshop

RRFF/PRFF White Sturgeon Workshop

Wednesday, 19 February 2014
10:00 a.m. – 4:00 p.m.
Chelan PUD First Floor Large Conference Room
Wenatchee, WA

****These are *draft* meeting minutes and have not yet been reviewed for accuracy by meeting participants.**

Notes taken by Suzanne Hodgson

Chairperson, Tracy Hillman

Attending Participants:

Clement, Mike	Grant PUD	(509) 754-5088 x2633	mclemen@gcpud.org
Hemstrom, Steve	Chelan PUD	(509) 661-4281	steven.hemstrom@chelanpud.org
Hildebrand, Larry	Golder Assoc.		Larry_Hildebrand@golder.com
Hillman, Tracy	BioAnalysts	(208) 321-0363	tracy.hillman@bioanalysts.net
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Irle, Pat	Ecology	(509) 454-7864	Pirl461@ecy.wa.gov
Jackson, Chad	WDFW	(509) 754-4624 x250	Chad.jackson@dfw.wa.gov
Lewis, Steve	USFWS	(509) 665-3508 x14	Stephen_lewis@fws.gov
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Truscott, Keith	Chelan PUD		Keith.truscott@chelanpud.org
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Wright, Corey	Blue Leaf		cwright@blueleafenviro.com

Draft Meeting Minutes

I. Welcome and Introductions

Tracy Hillman welcomed everyone to the joint workshop of the Rocky Reach Fish Forum (RRFF) and the Priest Rapids Fish Forum (PRFF), and made known that voice recording of the meeting was initiated for note-taking purposes.

II. Purpose of the Workshop

Tracy Hillman described the purpose of the workshop as a special meeting of the PRFF and RRFF to try and come to consensus on the number of juvenile white sturgeon to release into the Rocky Reach and the Priest Rapids Project Areas. Tracy indicated that both Forums have been debating the number of juveniles to release into the project areas since November. There are currently two proposals: one proposal is to release 6,500 fish into each project area. This proposal is based on the maximum release number identified in both the Rocky Reach and Priest Rapids White Sturgeon Management Plans (WSMPs). The other proposes to release 4,332 juveniles into each project area. This was based on equalizing family sizes. That is, the 4,332 comes from releasing 361 juveniles per half-sibling, which is based on a target of 18 crosses. Because there were 12 half-siblings produced during spawning in 2013, it was proposed that 4,332 sturgeon be released (12 half-siblings x 361 juveniles per half-siblings = 4,332 juveniles) to balance maternal contributions.

Tracy indicated that he was directed by the Forums to write an unbiased summary of the issues and rationale for the two proposals. He thanked all those who provided comments on the draft summary paper. He indicated that he sent the final summary document and the questions to the outside experts as directed by the Forums. The document and questions were sent to James Crossman, Andrea Schreier, Ray Beamesderfer, Kim Scribner, Ken Lepla, Scott Blankenship, Molly Webb, Jim Powell, Larry Hildebrand, Paul Anders, and Steve McAdam. These are all noted experts in sturgeon biology and/or population genetics. Tracy noted that four of the experts provided feedback (Andrea Schreier, Ken Lepla, Scott Blankenship, and Jim Powell). He said that Dr. Anders intends to provide feedback, but is currently busy with another project. The others indicated that they did not have time to respond to the request.

Tracy outlined the structure for the workshop, stating that he would first like to review briefly the two WSMPs, then review the responses from the experts, and finally come to consensus on a juvenile release number for 2014. Tracy said that he would like to spend most of the afternoon discussing visions for the future of the supplementation programs given that the initial stocking work will be completed in 2014 or 2015. Participants agreed to the workshop structure.

Before reviewing the WSMPs, Tracy noted that several of the entities have been discussing this issue internally and among the various parties of the Forums. Therefore, Tracy asked if those discussions

resulted in consensus among the parties. Bob Rose responded that there is still disagreement among the parties as to the number of juvenile sturgeon to release into the project areas in 2014.

III. Review of the Priest Rapids and Rocky Reach White Sturgeon Management Plans

Tracy Hillman walked the participants through sections of both the Priest Rapids and Rocky Reach WSMPs. He highlighted sections that were germane to the current discussions. Below are a few of the highlights from the review. All the highlights shared with the participants are included in the WSMPs that accompany these notes.

Beginning with the Priest Rapids WSMP, Tracy read the goals and objectives of the plan. For example, the goal of this plan is to promote growth of the population to a level that is commensurate with the available habitat. The four objectives associated with this goal are 1) increase populations through supplementation to a level commensurate with available habitat, 2) determine the effectiveness of that program, 3) determine carrying capacity and 4) determine natural reproduction potential. Section 3.1.2 in the Plan states that beginning in year three of the license, Grant PUD will release sufficient numbers of sturgeon annually for five years to achieve an adult population appropriate for the size of the reservoirs. Tracy pointed out that footnote 3 in table 1 states that up to 5,000 yearlings should be released in Wanapum and 1,500 yearlings in Priest Rapids each year for the first five years. Table 2 states that Grant will stock up to 6,500 yearlings. The table also identifies alternative management actions such as adjusting stocking level, alternative broodstock, and excess production. Tracy also highlighted language that indicates that harvest is a possible long-term goal in the plan. Statements in the plan also indicate the importance of "jump-starting" the system with a relatively high number of fish during the early phase of the plan. The Plan also noted that juveniles for release should come from two 3F x 3M matings, which results in 361 fish per maternal family group.

Tracy then walked through the Rocky Reach WSMP and highlighted goals and objectives. The goal of this Plan is to promote growth of the population to a level that is commensurate with the available habitat by year 30 of the license. Objectives associated with this goal are 1) increase population through supplementation to a level that is commensurate with the available habitat and allowing for appropriate and reasonable harvest, 2) determine the effectiveness of the supplementation, 3) determine carrying capacity, and 4) determine the natural reproductive potential in the reservoir. Section 4.1.2 of the Plan describes that by year three of the license, up to 6,500 yearlings will be released annually for three years. It states that during subsequent years, 0–6,500 juvenile sturgeon will be released. Following the third year, the long-term approach should be determined by the RRFF based on the monitoring and evaluation program. Table 3-1 includes a footnote that states that a total of 6,500 will be released during each of the first three years, and that in subsequent years 0-6,500 will be released. On the last page of the Plan, it states that juvenile releases for conservation purposes should maximize genetic contributions from the available adult populations. It also states that more families and smaller family

sizes should be considered in the release strategy, and that family equalization should be considered in the release strategy.

Discussion took place regarding the two proposed release numbers, their potential effects on genetics and overall numbers of fish, and the meaning behind 6,500 and "up to" 6,500. Steve Parker and Bob Rose stated that they understood the concern about risks associated with genetic bottlenecks, but noted that we cannot dismiss the risks associated with not releasing the fish (e.g., risks to the monitoring program, risks to low population abundances, risks to potential future harvest, etc.). Steve also pointed out that during licensing negotiations, the "up to 6,500" phrasing of the agreements was a concession to the fact that some parties wanted more fish, some wanted fewer, some wanted to identify harvest as a goal for stocking, others did not, and nobody had a very strong argument in any direction given the lack of data at that time. The release of 6,500 juvenile sturgeon is the only number referred to in the WSMPs, and as such it is the only recognized stocking goal. If the release of 6,500 juveniles was not the goal, then what was the goal? The purpose of the Plan is to provide some level of certainty and predictability of the mitigation actions that will be taken. That is why the Yakama Nation thinks it is imperative to consider the 6,500 release number as a default goal. To do otherwise will open the mitigation goal to renegotiation every year, or whenever someone has a different idea. Other parties noted that the 6,500 number in the WSMPs indicates an upper limit for annual releases. It does not mean that 6,500 fish should be released regardless of concerns associated with genetic or disease issues. Larry Hildebrand noted that the Plans were based on adaptive management, and said that the difference between the two proposed release numbers for this year will not be significant over time.

IV. Review of the Input from Experts

Before reviewing the feedback from the outside experts, Tracy defined some of the terms used by the experts. For example, he offered definitions for effective population size (termed N_e) and census population size. Effective population refers to the number of individuals in the population that has a value of any given population genetic quantity that is equal to the value of that quantity in the population of interest. Census population means the total number of fish in the population. Often, the effective population size is about 25% of the census population. He also defined the harmonic mean, which is a measure of central tendency often used by population geneticists.

Tracy read through the responses provided by the outside experts who responded to the request for technical information (responses accompany these notes as a separate document). Jim Powell responded by stating that his answers to the questions depended upon whether or not the goal of the programs is conservation or eventual harvest. Scott Blankenship stated that census size would be the most important factor if eventual harvest is the goal of the program, but effective population size must be considered if the goal is a conservation program. He noted that because of the effect of supplementation, both proposed release numbers could have genetic effects and push the effective population too low for a conservation program, resulting in potential genetic problems. Based on his calculations, he proposed a release of 700 sturgeon in Rocky Reach, 1,500 in Wanapum, and 500 in Priest Rapids for a conservation program. Discussion took place around the assumptions of Dr.

Blankenship's recommendations. Andrea Schreier responded that she did not think there was much difference between the two proposed release numbers from a genetic perspective. She believes that both release numbers has the potential to lower the effective population size. She recommended using as many wild brood stock (or wild larvae) as possible every year. She advocated equalizing family sizes to maximize the effective population.

After reviewing the responses from the outside experts, Tracy noted that the experts seemed to agree that the two proposed release numbers will likely create a genetic bottleneck in the long-term. Given that, Tracy asked the group if they were ready to make a decision on the release number. Participants indicated that they would like some time to think about the morning discussions. The workshop then adjourned for lunch.

V. Decision on Release Number

Following the lunch break, Tracy asked individual group members to weigh in on the issue of whether to release 6,500 or 4,332 juvenile sturgeon in 2014. Steve Lewis stated that he was leaning toward the lower number because his agency's job is to err on the side of conservation of the species. He believed that the genetic risks were more significant than other potential risks. Chad Jackson stated that he also believed the lower number was best, but would not hold up the group if the higher number was selected. Jason McClellan and Bret Nine stated that they want to see the lower number released. Blaine Parker stated that he wanted to see 6,500 released and noted that entrainment was probably not a significant issue because there are a lot of sturgeon downstream from the project areas. Thus, the release of a few closely related individuals escaping into the large populations downstream would have little effect on population genetics in the downstream populations. Bob Rose stated that he wants to see 6,500 released. Mike Clement stated that he preferred 4,332, which is based on the genetic concerns and the best available science. Steve Hemstrom stated that Chelan PUD proposes a release number of 5,000 for Rocky Reach in 2014, which would bring the total number of fish released over four years to 19,500. This is equivalent to the goal of releasing 6,500 fish each year for three years, which was the maximum envisioned after the first three years. Pat Irle stated that she could agree to 6,500 this year, but wants the group to agree to use the best available science to identify release numbers in future years.

The group discussed the Chelan PUD proposal of releasing 5,000 into the Rocky Reach Project Area in 2014. Steve Lewis stated that he would be more comfortable with 5,000 than 6,500. Bob Rose stated that he wanted to discuss this with his colleagues first. Chad Jackson stated that he was not inclined to approve the 5,000, but that he would also discuss it with his colleagues. Jason McClellan indicated that he agreed with WDFW and said that the Colville Tribes would likely not agree to releasing 5,000 fish in 2014. Pat Irle stated that it would probably be okay. Steve Parker stated that he thought that consensus was required to move away from 6,500. Steve Lewis said that some parties are thinking the number is 6,500, and others think it is up to 6,500. Participants asked that Chelan PUD prepare a rationale paper, which the RRFF will review during the March meeting.

Steve Parker stated that he wants to focus on future planning, and that risk avoidance should not be the main criteria. Discussion took place regarding the risks associated with the higher and lower release numbers. Donella Miller pointed out that two years ago, the risks associated with disease resulted in a decision to destroy infected fish, but that this year, infected fish will be released, and this was approved as an acceptable level of risk. It was noted that the diseased fish were released in the Wells Project Area, not the Rocky Reach or Priest Rapids Project Areas. Jason McClellan stated that the risks of releasing hatchery fish must be mitigated by equalizing families. Discussion took place regarding future planning. Bob Rose asked Keith Truscott to comment on what Chelan PUD will do if the RRFF comes to a stalemate. Keith replied that he is glad this discussion is taking place and added that Chelan PUD sees both sides of this issue. He noted that he would like to see the RRFF work on a planning process for future years. For example, the RRFF could develop a decision support matrix that guides how future releases with be determined. Tracy pointed out that after the third year of stocking, the Rocky Reach WSMP states that the Forum will decide on how many fish will be stocked annually in the project area. However, as noted in the Plan, the number will range from 0 to 6,500 fish annually. He added that this language is not found in the Priest Rapids WSMP. Both Mike Clement and Jason McClellan commented that the monitoring programs will inform future stocking levels. For example, if survival is high in one or more years, the number of fish released would be reduced to avoid density dependent effects.

Based on the discussion so far, Tracy identified the risks that participants had identified. Those included 1) population genetics, 2) population abundance, 3) the success of the monitoring program, and 4) disease. He asked the group if they wanted to continue to work toward a decision on the release number. Participants indicated that they would not be able to come to a consensus at this time. Therefore, Steve Parker asked the group what steps the Forums should take next. Tracy stated that an impasse in the forums required dispute resolution, which means the issue will be elevated to the policy committees. If the policy committees cannot come to consensus, the issue would be elevated to an executive committee, Ecology, or FERC. Tracy stated that he would prepare documentation of the issues to be decided by the policy committees. Tracy added that Denny Rohr is on the call because he is the Policy Committee facilitator for the PRFF. Participants talked briefly about representation on the policy committees. Keith Truscott asked if the two forums would make their decisions independently. Tracy stated that they would. Bob Rose asked what specific questions will be elevated to the policy groups. Tracy replied that it would be which proposed number of fish should be released in 2014. In addition, the policy committees could also be asked to interpret the meaning of “up to” 6,500 fish. Steve Parker asked if anyone who was involved in the writing of the initial documents remembered what was meant by “up to” 6,500. Keith Truscott replied that Steve Hays had stated that he remembered 6,500 being a starting number.

Bob Rose suggested that some select members of the group meet separately over the next few months to discuss release strategies for future years. Participants agreed with the idea of convening a small working group to help flesh out release numbers for future years. Tracy asked the group if they wanted to begin those discussions at this time. Participants stated their current levels of exhaustion and declined to discuss this topic at this time.

VI. Next Steps

Tracy noted that both Forums will meet on Wednesday, 5 March. Tracy will share the results of this workshop with the PRFF and RRFF, and will then call for an official vote on the release number. This will allow voting parties not involved with the workshop to share their thoughts. If an impasse is reached, Tracy will begin the dispute resolution process, which differs between the two Forums. Pat Irle asked if the Chelan PUD proposed number will be discussed at the RRFF meeting. Tracy said yes, and that Steve Hemstrom will provide a rationale paper for their proposal.

Presentation by Larry Hildebrand on Projected Future Abundances in the Project Area Based on Stocking 4,500 or 6,500 Juvenile Sturgeon assuming Two Different early Survival Rates

(See March Notes on pages 4-5 in this document for description of presentation)

STOCK MORE OR STOCK LESS

vs

LOWER OR HIGHER SURVIVAL

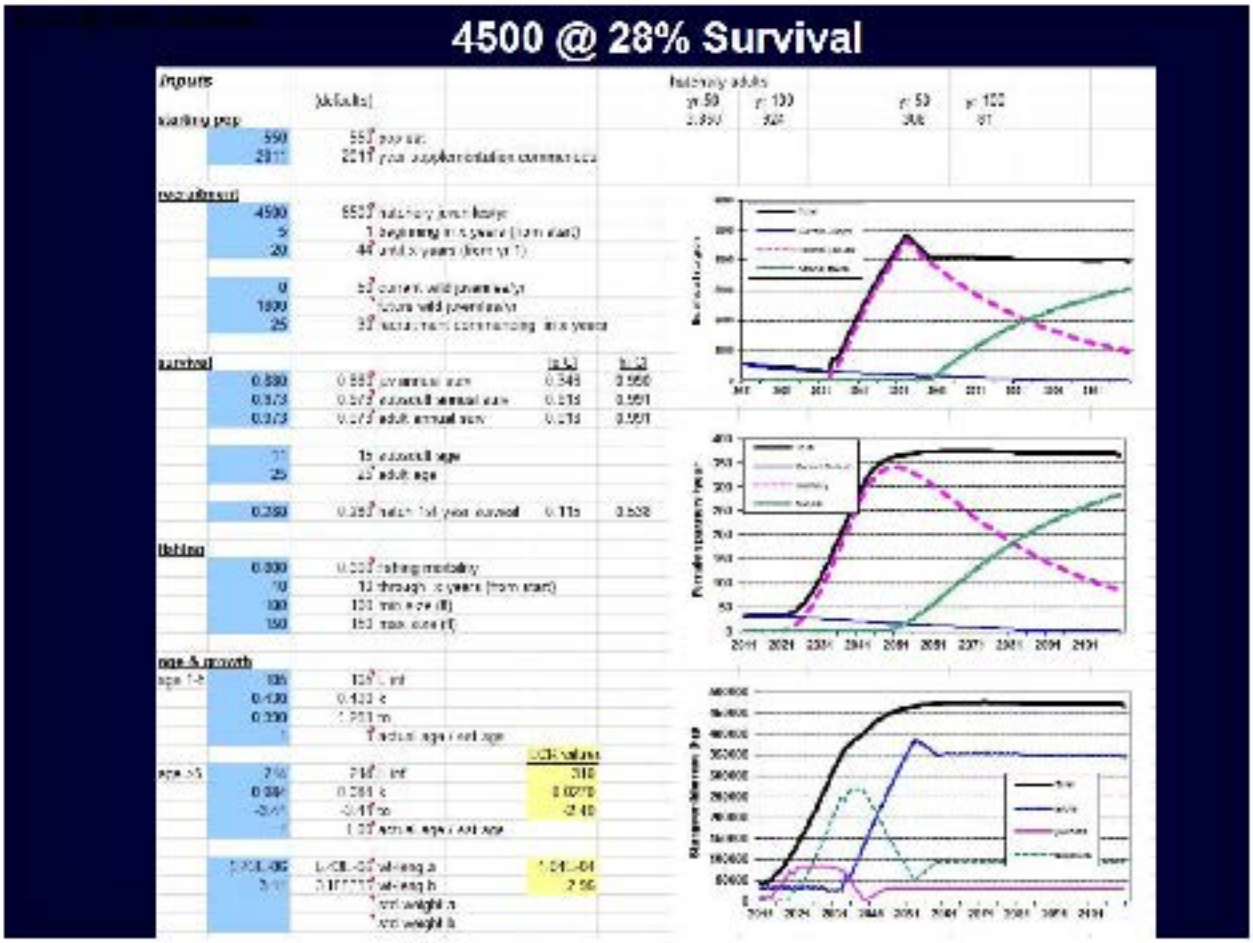
WHAT ARE THE POSSIBLE OUTCOMES?

Keys to Recovery

Main factors that affect the path to recovery of White Sturgeon:

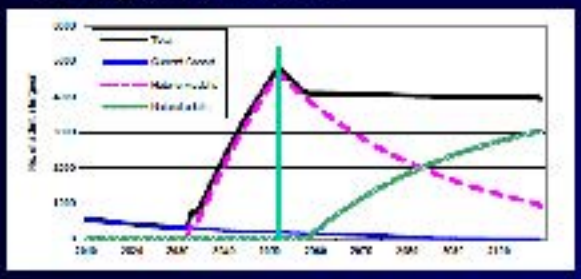
- Numbers and survival of hatchery juveniles stocked annually
  - Determines rate of recovery
- Carrying capacity of the system
  - Determines the upper limit of recovery
- Proportion of the available genetic diversity that has been captured by the breeding/release programs
  - Determines the reproductive and adaptive quality of the fish released

4500 @ 28% Survival

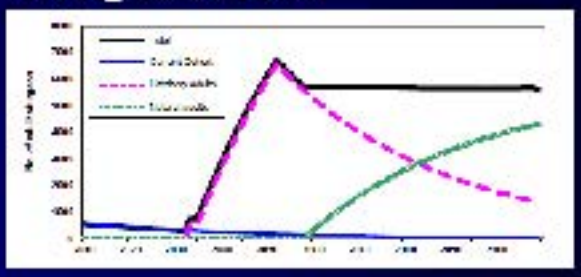


Adult Population Trajectories

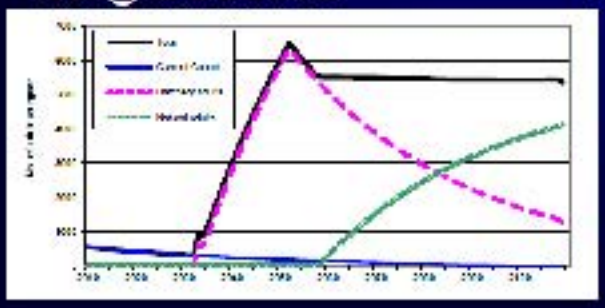
4500 @ 28% Survival



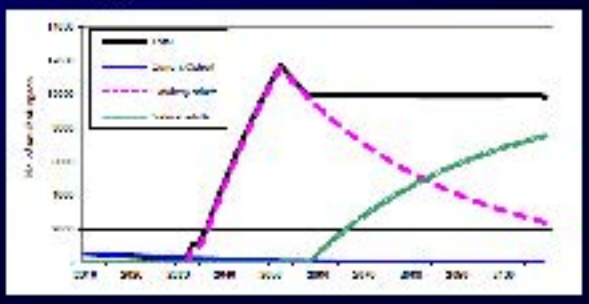
6500 @ 28% Survival



4500 @ 50% Survival



6500 @ 50% Survival



White Sturgeon Population Projections for Wanapum Reservoir Using Different Stocking Targets and Survival Rates

Projected numbers of hatchery White Sturgeon surviving in Wanapum Reservoir using selected annual release targets for 20 years and early survival rates of 28% and 50%.

Early Survival Rate	No. Released Per Year						Projected Population			
	2011	2012	2013	2014	2015	>2016	5 Years	10 Years	15 Years	20 Years
28%	6500	0	3,283	4,500	4,500	4,500	8,300	11,600	13,800	15,600
	6500	0	3,283	6,500	6,500	6,500	10,600	15,100	18,100	22,100
	6500	0	3,283	4,500	6,500	6,500	10,300	15,600	19,200	21,900
50%	6500	0	3,283	4,500	4,500	4,500	10,900	16,900	20,800	24,100
	6500	0	3,283	6,500	6,500	6,500	13,900	23,300	29,200	34,000
	6500	0	3,283	4,500	6,500	6,500	12,900	22,800	28,800	33,700

Projected Population Densities

PRFF is 96 Km long

Therefore:

8,000 White Sturgeon = ~80 fish per RKM

15,000 White Sturgeon = ~150 fish per RKM

20,000 White Sturgeon = ~200 fish per RKM

30,000 White Sturgeon = ~300 fish per RKM

Early Survival Rate	No. Released Per Year						Projected Numbers Surviving			
	2011	2012	2013	2014	2015	>2015	5 Years	10 Years	15 Years	20 Years
28%	6500	0	3,283	4,500	4,500	4,500	8,300	11,600	13,800	15,600
90%	6500	0	3,283	6,500	6,500	6,500	13,900	23,300	29,200	34,000

River System	Population Segment	Habitat Type (Length) [1]	Population Estimate (95% CI) [min FL]	No. Fish per RKM
Columbia (Lower)	Unimpounded	Riv (187 km); Est (46 km)	695,500 (678,000-1,068,900) [54 cm]	3810 (3695 – 4500)
	Bonneville	Res (76 km)	129,648 (108,300-148,200) [64 cm]	1710 (1440 – 1810)
	The Dalles	Res (36 km)	59,800 (52,400-68,200) [70-166 cm]	1633 (1340 – 1750)
	John Day	Res (122 km)	28,681 (27,070-33,102) [54 cm]	560 (200 – 566)
Columbia (Mid)	Hanford Reach and McNary	Riv (85 km) Res (80 km)	5,200 (3,800-9,100)	31 (22 – 54)
	Priest Rapids	Res (20 km)	134 (48-2,680) [46 cm]	6 (2 – 62)
	Wanapum	Res (61 km)	301 (214-1,400) [46 cm]	9 (6 – 24)
	Rocky Reach	Res (69 km)	47 (29- 237) [60 cm]	>1 (>1 – 3)
	Wells	Res (48 km)	31 (13-218) [65 cm]	>1 (>1 – 5)
	Chief Joseph	Res (82 km)		
Columbia (Upper)	Roosevelt Reach	Res (214 km) Riv (20 km)*	2,207 (1,080-3,222) [70 cm]	21 (11 – 33)
	Keenleyside Reach	Riv (56 km)	1,160 (415-1,800) [50 cm]	21 (7 – 34)
Snake	Ice Harbor	Res (91 km)	4,830 [54 cm]	53
	Lower Monumental	Res (40 km)	4,202 [54 cm]	92
	Little Goose	Res (60 km)	6,182 [54 cm]	103
	Lower Granite	Res (102 km) Riv (102 km)	4,171 (2,684-6,062) [60 cm]	18 (15 – 22)
	Brownlee	Res (99 km) Riv (190 km)	155 (70-621) [60 cm]	>1 (>1 – 2)
	Swan Falls	Res (17) km Riv (40 km)	588 (330-1,095) [80 cm]	10 (6 – 55)
	C.J. Strike	Res (36 km) Riv (68 km)	3,013 (1,955-4,762) [60 cm]	28 (18 – 46)
	Dike	Res (0 km) Riv (13 km)	93 (59 – 196) [60 cm]	4 (3 – 9)
	Lower Salmon	Res (12 km)	21 (19 – 27) [60 cm]	2 (2 – 2)
	Upper Salmon	Res (8 km) Riv (140 km)	777 (574-1,201) [>60 cm]	14 (10 – 22)

Sturgeon found mainly in upper third of reservoir; used 97 km as segment length

Letters from PRFF Members

Colville Confederated Tribes
Fish and Wildlife Department
MEMORANDUM

March 12, 2014

To: Tracy Hillman, Facilitator, Priest Rapids Fish Forum

From: Jason McLellan, Fish Biologist, Colville Confederated Tribes

Subject: BY 2013 Juvenile White Sturgeon Stocking - Priest Rapids Project 2014

Issue of Dispute: The number of broodyear (BY) 2013 hatchery origin juvenile white sturgeon to release into Priest Rapids Project reservoirs in 2014.

Colville Tribes' Proposal: The Colville Confederated Tribes (CCT) supports a pro rated release strategy where the number of juvenile fish released in any given year is commensurate with the number of male:female broodstock crosses achieved. The Priest Rapids White Sturgeon Management Plan (WSMP) identifies an annual target of 18 broodstock crosses from two 3x3 factorial matings and calls for the release of up to 6,500 white sturgeon juveniles. Under the scenario where the target number of crosses is achieved, then each cross would contribute 361 juveniles to the resulting release (6,500 ÷ 18 = 361). Assuming that family (cross) size equalization is desirable across years, then based on the observation that twelve crosses were achieved for BY 2013, a pro rated approach would dictate a total release of 4,332 juveniles in 2014 (12 x 361 = 4,332).

Rationale: The CCT rationale for supporting a pro-rated release strategy is based on concerns over potential genetic risks that are generally recognized by conservation aquaculture programs (Hallerman and Kapuscinski 2003; KTOI 2007; Neff et al. 2011). It is our contention that equalizing family (cross) sizes in a broodstock based stocking program will reduce genetic risks over the long-term.

Specifically, we are concerned with the potential for future inbreeding depression that may limit the success of establishing naturally reproducing populations in project reservoirs. Of equal, or perhaps greater, concern is the potential for impacting downstream sturgeon (sub)populations. This potential is illustrated by the results of a setline stock assessment of McNary Pool in 2011, where thirty one percent (n=113) of the total sturgeon catch, and the majority of the catch in the size range of approximately 80 – 120 cm fork length, comprised

hatchery origin white sturgeon originally released in Rock Island pool (three reservoirs upstream) in 2003 (release n≈20,000) (Figure 1) (ODFW, unpublished data). Hatchery sturgeon from this release have been captured in every Columbia River reservoir downstream from Rock Island Pool as well as in the lower Columbia River as far downstream as the estuary (Golder Associates, Ltd. 2013; ODFW, unpublished data). Clearly then, combined annual releases of up to 18,000 juveniles (i.e., from the Grant, Chelan, and Douglas PUD supplementation programs) in the mid-Columbia pools have the potential to profoundly affect the character of the entire Columbia River sturgeon population both within and downstream of the project reservoirs.

Unlike some of those in support of the 6,500 release number for 2014, we do not believe that any potentially deleterious impacts resulting from a non-pro-rated release strategy would be easily reversible. Indeed, the proponents of the 6,500 release have not specified how a reversal of poor outcomes would be achieved. Nor have the proponents provided any empirical evidence to suggest that the pro-rated approach would jeopardize other aspects of the mitigation program, such as M&E and future harvest opportunities. The CCT also does not believe that the M&E and harvest opportunities, which remain largely undefined, out-weigh the potential genetic risks to the entire Columbia River sturgeon population within and downstream of the project reservoirs.

With regard to M&E, we also assert that it is unrealistic to expect that carrying capacity (density dependent) related effects will become manifest over the course of a three to four year stocking program regardless of release number. The carrying capacity question can likely only be answered over the longer-term, and even then we contend that it is unlikely to be observed with any degree of statistical power. Thus, we fail to see how a pro-rated release strategy in 2014 would limit the ability to answer that question over the life of the respective FERC licenses and associated mitigation programs.

The CCT had originally suggested the pro-rated release approach as a compromise between a proposed stocking number of 3,245 (not developed by the CCT) and the Yakama Nation proposal of the maximum possible release number (6,500) during a PRFF meeting on November 5, 2013. We believe this compromise is reasonable as it addresses concerns related to potential genetic risks as well as the desire of other parties to maximize release numbers.

The family equalization approach is consistent with that of the Upper Columbia white sturgeon conservation aquaculture program. In fact, the experts asked to review the two PRFF stocking proposals generally advocated family size equalization over the long-term. In fairness, the experts saw little difference in the outcomes, genetic or otherwise, between the two proposals

in the context of a single year of releases. However, while CCT agrees with their single year assessment, we ask if we are not going to address potential genetic risks now, then when?

Opportunity for Compromise: A similar impasse with regard to 2014 white sturgeon supplementation numbers occurred within the Rocky Reach Fish Forum (RRFF). However, consensus was eventually reached which identified a release number of 5,000 BY 2013 juvenile white sturgeon in to Rocky Reach Pool. During the RRFF meeting on Wednesday March 5, 2014, some of the members of both the PRFF and RRFF briefly discussed the potential for a similar outcome for the Priest Rapids Project. In the spirit of compromise, the CCT would support a release of 5,000 BY 2013 juvenile white sturgeon in to the Priest Rapids Project reservoirs in 2014 if consensus can be reached. We support this compromise with the expectation that the Priest Rapids Fish Forum shall work toward the development of a Statement of Agreement (SOA) regarding the long-term aquaculture strategy for the Wanapum and Priest Rapids reservoirs. We expect that the SOA shall include, at a minimum, specific abundance and harvest objectives, assessments of potential risk (genetic, disease, ecosystem, etc...), and implementation strategies to achieve the objectives and mitigate for the risks. In the event that the PRFF cannot reach consensus on the 5,000 release number, then we would revert to our original proposal of 4,332.

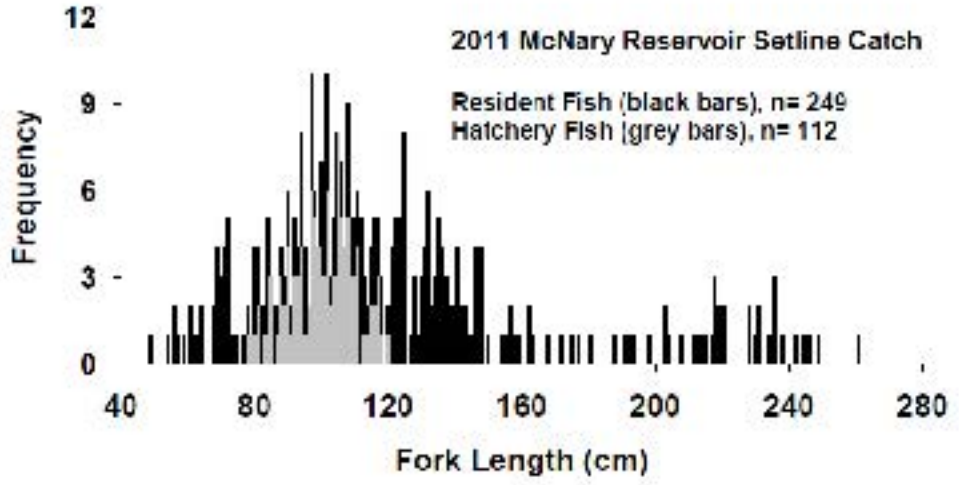


Figure 1. Length Frequency distribution of resident and hatchery white sturgeon captured using setlines in McNary Reservoir, 2011 (provided by Colin Chapman, ODFW).

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COLUMBIA RIVER INTER-TRIBAL FISH COMMISSION
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www.critfc.org

March 20, 2014

Dr. Tracy Hillman
BioAnalysts, Inc.
4725 N. Cloverdale Rd., Suite 102
Boise, ID 83713

RE: Justification to Maintain Juvenile White Sturgeon Stocking Rates in 2014

Dear Dr. Hillman:

The Columbia River Inter-Tribal Fish Commission (CRITFC), designated as a representative for the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) in the Priest Rapids Fish Forum, appreciates the opportunity to contribute our expertise to the Forum. Attached you will find our comments regarding the Forum's recent consideration to reduce juvenile White Sturgeon stocking rates. To be clear, the tribes object to a reduction in the juvenile stocking levels to anything less than that directed in the White Sturgeon Management Plan.

If you have any questions regarding these comments, please contact me or Tom Skiles, CRITFC, at 503-238-0667.

Sincerely,

Robert Paul Lumley
Executive Director

Attachment

Cc: N. Kathryn Brigham, CTUIR
Brent Hall, CTUIR
Pat McGuire, WDOE

Justification to Maintain Juvenile White Sturgeon Stocking Rates in 2014

Tom Skiles, CRITFC Fish Passage Specialist
Representing the Confederated Tribes of the Umatilla Indian Reservation
March 20, 2014

1. Issue of Dispute

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Yakama Nation (YN) maintain that the Grant County PUD White Sturgeon Management Plan (WSMP) and the Washington Clean Water Act section 401 water quality certification (401 Certification) are clear in direction and intent that a total of 1,500 and 5,000 juvenile White sturgeon shall be stocked in the Priest Rapids and Wanapum reservoirs, respectively, during the first five years of implementing this WSMP.

Some parties of the Priest Rapids Fish Forum (Forum) argue there is compelling information to change stocking rates now. The CTUIR and YN disagree. At this time, Year 4 of 5 (per Table 1, pg. 23, WSMP), there is no compelling information from either the index monitoring or any other source that suggests current stocking rates are causing irrevocable or unacceptable harm to White sturgeon populations within or in proximity of the Priest Rapids Project reservoirs. Suggestions that stocking rates should now be changed from those agreed upon are based on speculation, not the best available science. There is no consensus in the Forum that stocking rates should be changed at this time. Since there is no consensus there cannot be a change in the 2014 juvenile stocking rate, as indicated in Table 1 of the WSMP.

2. Proposed Solution to the Issue

The CTUIR advocates stocking 1,500 White sturgeon juveniles in Priest Rapids and 5,000 juveniles in the Wanapum pools in 2014, in accordance with the Priest Rapids WSMP and the 401 Certification.

3. Rationale Supporting the Solution

<u>The language of the Agreement calls for 6,500 juvenile sturgeon.</u>

The intent and purpose of stocking more sturgeon early in the program is to, "rapidly rebuild the population" and to:

> [P]rovide sufficient time to collect information via the indexing program on spawning success, growth of wild and stocked fish, and survival rates. The number of yearlings released in subsequent years (after the initial five-year stocking period) will be determined from the results of the indexing program and/or the evaluation of spawning potential and will be adjusted based on this data and in consultation with the PRFF.

(WSMP, p. 20). Similarly, the understanding and intention of front loading 6,500 sturgeon is clearly stated in the Production Goals section of the plan. "The WSMP calls for the release of 1,500 and 5,000 juvenile sturgeon per year for five years into the Priest Rapids and Wanapum reservoirs, respectively." In addition, the intent to stock more sturgeon in the initial years of the program is equally clear in the 401 Certification (p. 66):

> 3) Juvenile White Sturgeon Stocking
>
> a) Stock 6,500 yearlings annually in Wanapum Reservoir in Years 3, 4 and 5 to increase the reservoir white sturgeon population.
> b) Stock 3,500 yearlings annually in Priest Rapids Reservoir in Years 3, 4 and 5 to increase the reservoir white sturgeon population

Indeed, the stocking requirement in the 401 Certification is even higher than what is enumerated in the WSMP, indicating the importance of, and need for, increasing the population in the first five years of implementation of the WSMP. *Clearly, The WSMP and the 401 Certification call for stocking 6,500 fish or more - in the two pools during the early years of the program.*

The value in stocking 6,500.

As already stated, the proposal to stock 6,500 fish in the first five years is a purpose-driven plan based on an acknowledged value to stakeholders, researchers and resource managers. The importance of releasing larger numbers of sturgeon in the early years is to rapidly rebuild the population (401 Certification, p. 20; WSMP, p. 20). The releases will have the additional benefit of reducing the "time required to produce the needed empirical post-release survival estimates" and create a more robust data set (P. Anders, expert testimony, February 27, 2014). Additionally, the Monitoring and Evaluation (M&E) objectives in WSMP require estimates of survival, growth rate, distribution, habitat use and *carrying capacity*, beginning in the third year of the program. In turn, the estimates will inform future stocking activities.

Proponents of changing the stocking level erroneously base their contention on conservation genetics, assuming that decreasing the stocking level would reduce the risk of inbreeding depression. For example, the Colville Confederated Tribes (CCT) propose stocking 4,332, not the 6,500 in the WSMP and 401 Certification. However, reducing the numbers of fish stocked would make little, if any, measurable difference. Indeed, Dr. Andrea Schreier stated, "I honestly don't think there is much difference between the proposals from a genetic perspective." This statement was explicitly supported by Dr. Paul Anders and implicitly supported by Dr. Scott Blankenship, who arrived at a parallel conclusion (S. Blankenship, expert testimony, February 27, 2014). With regards to the risks associated with genetic depression, there is no compelling information that warrants a change in strategy.

Monitoring and evaluation will inform future management.

As mentioned above, there is no current information that compels a change from the 6,500 stocking level. If later M&E results indicate that the environment is close to its carrying capacity, or that the population needs to be reduced for other reasons, the WSMP provides a

management tool. Harvest, *which is also a specific biological objective of the WSMP*, can be used to effectively reduce ultimate population size when needed. (WSMP, Part B, Sect. 2.2.1.).

Conclusion

According to the experts, there is very little difference between the two stocking proposals at the center of this debate, given the intent and purposes spelled out in the WSMP and the 401 Certification, and the potential for harvest to contribute to management. The CTUIR supports the default proposal to stock a total 6,500 sturgeon in Wanapum and Priest Rapids pools in 2014.

References

Grant County Public Utility District. White Sturgeon Management Plan (WSMP). Priest Rapids Project FERC P-2114. License Article 401(a)(11) (April 2009).

Responses From Sturgeon Experts, Document received from Tracy Hillman February 27, 2014.

State of Washington Department of Ecology. ORDER NO 4219. Relicensing of the Priest Rapids Hydroelectric Project (FERC No 2114). 401 Certification (2006).

Grant County
PUBLIC UTILITY DISTRICT

March 18, 2014

Tracy Hillman,
BioAnalysts, Inc.
4725 N. Cloverdale Rd, Suite 102
Boise, ID 83713 USA
Priest Rapids Fish Forum Facilitator

RE: Public Utility District No. 2 of Grant County, Washington (Grant PUD) Position of Juvenile White Sturgeon Stocking in 2014.

Dear Tracy,

The Priest Rapids Fish Forum (PRFF) has been debating the number of juvenile sturgeon to release into the Priest Rapids Project Area (PRPA) in 2014, but has been unable to reach a consensus on whether to release 4,332 juveniles (based on equalized family sizes to address potential future genetic concerns), or 6,500 juveniles [the maximum annual release number, based on a 6X6 cross, or (2) 3X3 crosses, as identified in Public Utility District No. 2 of Grant County, Washington's (Grant PUD) White Sturgeon Management Plan (WSMP)]. This memo provides the rationale for Grant PUD's preference to release 4,332 juveniles and describes how this option is consistent with the science and breeding plan as outlined in the WSMP and incorporates appropriate adaptive management responses.

A key point of disagreement between the two release strategy positions is related to the potential future genetic risks of stocking larger numbers of related individuals. Grant PUD's WSMP clearly indicates the importance of genetics in planning the supplementation program. Section 3 (Genetics Considerations; page 43) of the WSMP states, "*The genetic integrity of wild sturgeon populations is an important consideration in any recovery program involving hatchery supplementation.*" In addition, the breeding program prescribed by the WSMP and agreed to by all members of the PRFF requires a full factorial 6X6 (or two partial factorial 3X3) breeding matrix to increase genetic diversity within the stocked juveniles. Grant PUD's is concerned that potential future inbreeding and genetic swamping of downstream wild populations in Wanapum, Priest Rapids, and downstream reservoirs of the Columbia River, although difficult to quantify at this point in the restoration program, is a known genetic risk which can potentially be avoided by choosing the lessor and justifiable 4,332 stocking target. As such, when the breeding matrix cannot be met, measures that are reasonable and easily implemented such as the equalization of family sizes and reducing the numbers of related individuals stocked, should be employed to reduce any potential risk to the degree possible. The requirement for this type of adaptive management approach was foreseen and is specifically identified in Grant PUD's WSMP which specifically states "… *white sturgeon aquaculture in the Columbia Basin is relatively new and as a result, policies regarding genetic issues and collection of broodstock are still being developed.*"

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Further, Grant PUD believes there is increased risk if broodstock collected from stocking area (Priest Rapids and Wanapum reservoirs) are to be used in the breeding matrix; the future inbreeding potential is

elevated by increasing the amount of full and half-sib juveniles released into the reservoirs. Although the number of sturgeon surviving to maturity is unknown, it is clear that in principle, increasing the number of related fish in a cohort released into the area likewise increases the risk of future inbreeding. Reducing the number of related fish released continues to maintain the captured genetic component and proportionally reduces the potential for inbreeding. This is notwithstanding survival, and inter-year class crosses 25-40 years from now.

During the course of this debate, Grant PUD has continued to express its concern that reduction in the stocking levels from the annual maximum of 5,500 fish which will impact the ability of the M&E programs to address questions such as carrying capacity and production of harvestable fish in the PRPA, and that the PRFF should take into consideration a conservative stocking number as identified in Grant PUD's WSMP which includes a range of 0-6,500 which is informed by the M&E program and in the best interest of the resource and other resources in-directly affected. For a variety of reasons (mainly related to uncertainties regarding early growth, survival, and emigration currently being evaluated), the WSMP sets no time requirements for when these M&E objectives need to be met. In Grant PUD's view, these considerations should be secondary to the establishment of a genetically diverse White Sturgeon population both within the PRPA and downstream reservoirs where based on the movements of juveniles stocked by Columbia River Inter-Tribal Fish Commission (CRITFC) in Rock Island reservoir, some portion of the fish stocked in this program will undoubtedly effect wild populations. In addition, recent analysis presented at the March PRFF meeting indicated that even under a variety of early juvenile survival rate scenarios, the differences in stocking 4,332 versus 6,500 juveniles in 2014 would not affect the numbers of fish surviving after five years of stocking at a level that would have any likely effects on the outcomes of the M&E programs, even after only 5 years of stocking. The objective of Grant PUD's WSMP conservation and restoration program is not to achieve carrying capacity within a few years, but to replace missing year classes with genetically sound and diverse hatchery juveniles until such time as self-sustaining natural reproduction can be achieved. Supplementation of the population to a point where carrying capacity is achieved and harvest can be considered is a long-term objective of the program that will not be affected by reducing the stocking rate in 2014 from 6,500 to 4,332 juvenile White Sturgeon.

In summary, Grant PUD's preference moving forward is to follow the goals and objectives of Grant PUD's WSMP Conservation and Restoration Program included in the 401 Certification/FERC License which was agreed to and advocated for by the PRFF and interested stakeholders utilizing the best available science to inform the decision-making body. While Grant PUD is hopeful that during the next phase of discussions held by a sub-group, the group can come to a mutually agreeable and consensus-based outcome in the near term (similar to what was achieved in the recent RRFF meeting on March 5, 2014 and agreed upon amount of 5, 000 fish), we would consider compromising our release target from 4,332 to 5,000 for 2014 only until the PRFF is able to convene a working group in the future to develop a Statement of Agreement decision framework to inform these decision in future years and evaluate the very specific language in Grant PUD's WSMP and aquaculture strategies that discerns the very nature of the conservation program (goals, objectives, stocking) and the need to modify it.

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PRFF members with any questions should contact Tom Dresser at 509-754-5088, ext. 2312, or at tdresse@gcpud.org.

Sincerely,

Tom Dresser,
Fish, Wildlife, Water Quality Manager,
tdresse@gcpud.org

CC: Mike Clement, Grant PUD
Pat McGuire – WDOE
Priest Rapids Fish Forum

March 19, 2014

Tracy Hillman
BioAnalysts, Inc.
4725 N. Cloverdale Rd., Suite 102
Boise, ID 83713

Re: White Sturgeon Release

Dear Tracy,

This letter is submitted in accordance with the PRFF Dispute Resolution Protocol. There has not been success to reach consensus on the issue of releasing 4332 or 6500 juvenile white sturgeon in the Priest Rapids Project reservoirs. Wanapum voted for releasing 4332 rather than the 6500 juveniles.

Wanapum have a strong appreciation for the natural biosphere, untouched and undisturbed by mankind. The dam structures along the Columbia River have altered much of the natural environment including the upriver migration of white sturgeon. We see stocking the reservoirs with hatchery juveniles as a means to supplement the natural wild population.

During relicensing of the PRP, a management plan was developed in which stocking and breeding were discussed and included in the plan. The management plan outlines the science behind breeding to ensure the genetic diversity desired to support the natural population. And Wanapum have not been convinced that the larger release would not adversely affect the genetic integrity of the white sturgeon population. It is our position to follow the measures identified in the management plan to best support genetic diversity and support the natural population.

Wanapum appreciate this opportunity to be a part of the solution and look forward to continued coordination amongst all members of the PRFF. If you have any comments or questions, please contact me Rex Buck, Jr. at 509-754-0500, ext. 3113 or at rbuck@gcpud.org.

Sincerely,

Alicia Buck for Rex Buck Jr.

Rex Buck, Jr.
Wanapum Leader

STATE OF WASHINGTON
DEPARTMENT OF FISH AND WILDLIFE
1550 Alder St. N.W. Ephrata, Washington 98823 (509) 754-4624 FAX (509) 754-5257

March 19th, 2013

Tracy Hillman, Ph.D.
Senior Ecologist and PRFF Chair
BioAnalyst, Inc.
4725 N. Cloverdale Rd. Suite 102
Boise, ID 83713

SUBJECT: Priest Rapids Project Area white sturgeon stocking issue

Dear Dr. Hillman,

Since October 2013, the Priest Rapids Fish Forum (PRFF) has debated on the number of juvenile white sturgeon to release into the Priest Rapids Project Area (PRPA) in 2014. The two proposals identified by the PRFF call for the release of either 4,332 or 6,500 juvenile white sturgeon. The rationale for each proposal is well documented and understood by all involved parties so therefore I will not explain them in detail here. To date, the PRFF has not reached consensus on a release number and has elected to elevate this issue to the policy level for resolution.

Throughout these technical debates, the Washington Department of Fish and Wildlife (WDFW) has remained flexible in agreeing to a release number for the PRPA. The WDFW believes there is no significant difference between the two proposals and the genetic risk to the wild population from this single release is negligible. Written testimony from the independent expert panel supports our stance. More importantly, Grant PUD is nearing completion of the "front-loading" phase (years 3 through 7) of White Sturgeon supplementation, and future stocking is open to discussion. The WDFW believes this is the best time to address long-term supplementation, population growth, and conservation genetic objectives.

Based on our interpretation of the White Sturgeon Management Plan goals, and the lack of sufficient information to invoke adaptive management in altering these goals, the WDFW maintains its March 5, 2014 vote for a release of 6,500 juvenile white sturgeon into the PRPA. It should also be noted that the proposed release actually has the most genetic diversity of any release to date. In addition, the abundance of acoustically tagged white sturgeon were tied to the stocking goals for the initial years of the program (1% of release tagged). Should less than 6,500 sturgeon be stocked, the success of M&E activities may be diminished unless there is agreement that all 65 acoustic tags would be employed even if the stocked number is reduced.

The WDFW hopes to reach resolution on this matter quickly through subcommittee consensus in order that we might focus our collective energies and expertise on the next phase of white sturgeon supplementation in the PRPA. Should the subcommittee not reach consensus, the WDFW optimistically looks forward to policy level discussion on this matter. Finally, the WDFW recommends that policy members also discuss and provide guidance to the PRFF as they develop the next phase of white sturgeon supplementation, in particular as the PRFF considers adaptive management when new science becomes available. Such guidance may prevent future dispute resolution events.

Sincerely,

Patrick Verhey
WDFW PRFF voting member

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

In Reply Refer To:
FF01EWFW00-2014-CPA-0010

APR 22 2014

Tracy W. Hillman, Ph.D.
Senior Biologist
BioAnalysts, Inc.
4725 N. Cloverdale Rd., Suite 102
Boise, Idaho 83713

Re: Priest Rapids and Wanapum Reservoirs 2014 White Sturgeon Releases

The U.S. Fish and Wildlife Service (Service) received your March 7, 2014, email regarding dispute resolution on the release of juvenile white sturgeon into the Priest Rapids and Wanapum reservoirs in compliance with Public Utility District No. 1 of Grant County's (Grant PUD) *White Sturgeon Management Plan* (WSMP) for the relicensing of the Priest Rapids Hydroelectric Project (Project) (FERC No. 2114). In this email you requested that the Service, as well as the other voting members of the Priest Rapids Fish Forum (PRFF), describe the issue of dispute, our solution to the issue, data and scientific rationale supporting our solution, and benefits compared to the alternative proposal. At issue is whether to stock these reservoirs with 4,332 or 6,500 juvenile white sturgeon in 2014. The PRFF, the decision-making body for issues related to white sturgeon and other aquatic species associated with the Project, has not reached consensus regarding these release numbers, thereby initiating the "dispute resolution" process. In accordance with this process, this letter outlines why the Service voted for the 4,332, rather than the 6,500, juvenile white sturgeon release proposal.

The Service has been an active participant in the resolution of aquatic issues through the PRFF. We have expressed our rationale for supporting the lower release proposal during numerous meetings of the PRFF and these opinions have been documented on the record for the implementation phase of the Priest Rapids Hydroelectric Project relicensing. The intent of releasing juvenile sturgeon, in this scenario 4,332, is to supplement existing populations, while following a conservation genetics management strategy. The rationale for our position includes the following:

- Because there were only 12 crosses (out of the 18 lots), a pro-rated, cross-equalized release of 4,332 juveniles should be conducted to avoid potential genetic risks (e.g. genetic swamping; Ryman-Laikre effect) that are generally recognized by conservation aquaculture programs (Miller and Kapuscinski, 2003; Kootenai Tribe of Idaho, 2007; Neff *et al.*, 2011)

- Stocking 4,332 juvenile sturgeon rather than 6,500 is necessary to have equal representation of sturgeon families and lessen the risk of this stocking program driving the evolutionary trajectory of the population in the Project area. Future inbreeding depression may limit the success of the program in establishing self-sustaining populations in the project area.

- There is potential for entrainment of released fish into downstream reservoirs (e.g., Hanford Reach/McNary Pool, John Day Pool, The Dalles Pool, and Bonneville Pool) that could reduce effective breeding populations in those areas. Entrainment has already been documented with juvenile sturgeon stocked in the project areas and with juvenile sturgeon stocked in Rock Island Reservoir. Fish from the latter release (see Kappenman and Parker 2005) have been captured in all reservoirs downstream from Rock Island Dam, as well as downstream from Bonneville Dam (Golcer Associates, Ltd. 2013). In essence, entrainment would limit future harvest opportunities and influence whether or not Grant PUD's biological objectives are achieved in the WSMP.

While we see the utility in advocating for the 4,332 proposal in 2014, we believe the requirements outlined in the WSMP perhaps are unclear and may require further clarification regarding the release of juvenile white sturgeon in subsequent years. Although we believe the 4,332 proposal is in keeping with our biological concerns, the Service is willing to come to agreement on releasing more fish in 2014 provided that a formal "Statement of Agreement" (SOA) is developed for application in future years and our biological concerns are addressed in the SOA. The use of an SOA will provide clarity between the biological objectives and harvest aspects of the WSMP while providing assurance that the plan will be implemented in a timely manner.

The Service appreciates the opportunity to provide its rationale for supporting the 4,332 juvenile white sturgeon release proposal. Questions or comments regarding white sturgeon issues as they pertain to the Priest Rapids Hydroelectric Project may be directed to Steve Lewis of my staff at (509) 665-3508 ext. 2002 or Stephen_Lewis@fws.gov.

Sincerely,

for Ken S. Berg, Manager
Washington Fish and Wildlife Office

cc:
Mid-Columbia Fisheries Resource Office, Leavenworth, WA (J. Craig)

LITERATURE CITED:

Golder Associates, Ltd. 2013. 2012 white sturgeon management plan annual and biological objectives status report, Priest Rapids Hydroelectric Project (FERC No. 2114). Report to Public Utility District No.2 of Grant County, Ephrata, WA.

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Miller, L.M., and A.R. Kapuscinski. 2003. Genetic guidelines for hatchery supplementation programs. Pages 329-355 *in* E.M. Hallerman, editor. Population genetics: principles and applications for fisheries scientists. American Fisheries Society, Bethesda, Maryland.

Neff, B.D., S.R. Garner, and T.E. Pitcher. 2011. Conservation and enhancement of wild fish populations: preserving genetic quality versus genetic diversity. Canadian Journal of Fisheries and Aquatic Sciences 68: 1139-1154.

Position Statement of the Yakama Nation on
White Sturgeon Stocking Levels in the Priest Rapids Project

Issue in Dispute

The Yakama Nation maintains that the Grant County PUD White Sturgeon Management Plan (WSMP) and the State of Washington Section 401 Certification (401) are clear in direction and intent that a total of 1,500 and 5,000 juvenile White sturgeon shall be stocked in the Priest Rapids and Wanapum reservoirs, respectively, during the first five years of implementing this WSMP. The plan also provides that the parties may modify this stocking level if the results of "index monitoring" or other compelling information creates a consensus of the Priest Rapids Fish Forum.

Some Parties of the PRFF suggest there is compelling evidence that stocking rates should be reduced now. The Yakama Nation disagrees. At this time, which is Year 4 of 5 (per Table 1, pg. 23, WSMP), there is no compelling evidence from either the index monitoring or technical experts that indicates current stocking rates are producing irrevocable or unacceptable harm, to White sturgeon populations within or in proximity of the Priest Rapids Project reservoirs. Accordingly, suggestions that stocking rates should now be changed from those in the Agreement are based on speculation and not Best Available Science. The tribes cannot allow unsupported speculation to drive the Agreement when terms such as "unacceptable risks" are undefined and have no formal analysis to support them.

1. **Proposed Solution to the Issue**

The Yakama Nation strongly asserts that there is no basis for modifying the terms of the WSMP that call for stocking 1,500 White sturgeon juveniles in Priest Rapids and 5,000 juveniles in the Wanapum pools in 2014, in accordance with the Priest Rapids WSMP and the 401.

2. **Data and Scientific Rationale Supporting the Solution**

<u>The language of the Agreement calls for 6,500 juvenile sturgeon.</u>

The intent and purpose of stocking more sturgeon early in the program is to *"...rapidly rebuild the population.."* and to *"..provide sufficient time to collect information via the indexing program on spawning success, growth of wild and stocked fish, and survival rates. The number of yearlings released in subsequent years (after the initial five-year stocking period) will be determined from the results of the indexing program and/or the evaluation of spawning potential and will be adjusted based on this data and in consultation with the PRFF."* (WSMP, p. 20). Similarly, the understanding and intention of front loading 6,500 sturgeon is clearly stated in the Production Goals section of the plan, *"The WSMP calls for the release of 1,500 and 5,000 juvenile sturgeon per year for five years into the Priest Rapids and Wanapum reservoirs,*

respectively (p. 37)." In addition, the intent to stock more sturgeon in the initial years of the program is equally clear in the required 401 Certification (p. 66):

> ***3) Juvenile White Sturgeon Stocking***
>
> *a) Stock 6,500 yearlings annually in Wanapum Reservoir in Years 3, 4 and 5 to increase the reservoir white sturgeon population.*
>
> *b) Stock 3,500 yearlings annually in Priest Rapids Reservoir in Years 3, 4 and 5 to increase the reservoir white sturgeon population.*

Indeed, the stocking requirement in the 401 certification is even higher than what is enumerated in the WSMP, indicating the importance of, and need for, increasing the population in the first five years of implementation of the WSMP. Clearly, The WSMP and 401 cal for stocking 6,500 fish – or more - in the two pools during the early years of the program.

Genetic concerns are not warranted

As previously stated, the provision to stock 6,500 fish in the first five years is a purpose-driven plan based on acknowledged values to stakeholders, researchers and resource managers. The importance of releasing larger numbers of sturgeon in the early years is to rapidly rebuild the population (401, p. 20; WSMP, p. 20). The releases will have the additional benefit of, "*reduce[ing] the time required to produce the needed empirical post-release survival estimates*" and create a more robust data set (P. Anders, expert testimony, February 27, 2014). Additionally, the Monitoring and Evaluation (M&E) objectives in WSMP require estimates of survival, growth rate, distribution, habitat use and carrying capacity, beginning in the third year of the program. In turn, the estimates will inform future stocking activities.

The value in stocking 6,500

Proponents of reducing the stocking level base their proposal on an indeterminate risk to conservation genetics and the possible risk of inbreeding depression in the broodstock population some 20 years in the future. To address this goal Co ville Confederated Tribes proposes stocking 4,332, not the 6,500 in the WSMP and 401. But with respect to conservation genetics and inbreeding depression, this reduction in stocking makes little if any measureable difference. Indeed, Dr. Andrea Schreier stated, "*I honestly don't think there is much difference between the proposals from a genetic perspective.*" This statement was explicitly supported by Dr. Paul Anders and implicitly supported by Dr. Steve Blankenship, who arrived at a concurrent conclusion (S. Blankenship, expert testimony, February 27, 2014). With regards to the risks associated with genetic depression, there is no compelling information that warrants a change in strategy.

3. Conclusion

The Yakama Nation suggests that this dispute is no longer about the science, as the genetic concerns brought forth as the basis for reducing the stocking level in the WSMP have been examined and dismissed by technical experts. Absent the technical issue, this dispute as it now stands can only be about the decision process itself and the enforceability of terms and conditions in the agreements made by Parties to the PRFF. The Parties must consider whether an agreement that can be changed without compelling reason or consensus of the Parties has much value at all. The terms of the Agreement allow the Parties to modify its provisions, but the requirement for consensus was carefully and deliberately crafted to prevent one or a few Parties from forcing their management priorities on the other Parties. To allow otherwise undermines the integrity of this Agreement and, indeed, any agreement made by the Parties now or in the future.

According to the experts, there is very little difference between the two stocking proposals at the center of this debate, given the intent and purposes spelled out in the WSMP and the 401. The Yakama Nation sees no compelling reason to abandon the stocking levels agreed to by the Parties and concludes that the terms and conditions of the WSMP bind the Parties to the default condition of stocking 6,500 sturgeon in Wanapum and Priest Rapids pools in 2014.

REFERENCES

Grant County Public Utility District. White Sturgeon Management Plan (WSMP). Priest Rapids Project FERC P-2114. License Article 401(a)(11) (April 2009).

Responses From Sturgeon Experts, Document received from Tracy Hillman February 27, 2014.

State of Washington Department of Ecology. ORDER NO 4219. Relicensing of the Priest Rapids Hydroelectric Project (FERC No. 2114). 401 Certification (2006).

Letter from PRFF Chair to Washington Department of Ecology

BioAnalysts, Inc.®

March 24, 2014

Mr. Patrick McGuire
Washington Department of Ecology
Eastern Regional Office
4601 N. Monroe
Spokane, WA 99205

Dear Mr. McGuire:

The purpose of this letter is to inform you that the voting members of the Priest Rapids Fish Forum (PRFF) have exercised their right to use the Dispute Resolution Process as described in Article VI of the Final PRFF Protocols. Below I briefly summarize the dispute.

Since October 2013, the PRFF has been debating the issue of how many juvenile sturgeon should be stocked in to the Priest Rapids Project Area in 2014. Two different release numbers have been proposed. One proposes to release the maximum 6,500 juvenile sturgeon recommended in the White Sturgeon Management Plan to promote an increase in current sturgeon numbers. The other proposes a pro-rated number (1,332 sturgeon) based on the number of half-siblings produced during spawning of brood stock. The intent of the second strategy is to avoid future inbreeding depression by supplementing the existing populations using a conservation genetics management strategy.

In an effort to resolve this dispute, rationale papers were prepared that supported the two different release numbers. In addition, the PRFF consulted outside experts, who provided their input on the number of sturgeon to release into the Project Area. Finally, the PRFF held a joint workshop with the Rocky Reach Fish Forum to discuss the pros and cons of each proposed release number. After discussing this issue extensively during the March PRFF meeting, I called for an official vote on the number of juvenile sturgeon to release into the Project Area in 2014. Four members voted for 1,332 and three voted for 6,500. No members abstained. Because the PRFF could not reach consensus, I declared an impasse and reviewed the dispute resolution process with the PRFF.

As part of the dispute resolution process, I asked each voting party (save the Bureau of Indian Affairs, because they did not participate in any of the discussions or meetings associated with this issue) to prepare a letter addressed to me that describes the issue of dispute, a proposed solution to the issue, data and scientific rationale supporting the solution, and benefits compared to the alternative proposal. As an aid to the voting parties, I prepared a document that contained final PRFF meeting notes, rationale papers, the document sent to the outside experts, responses from the outside experts, and the draft notes from the Juvenile Sturgeon Workshop held in February (document I accompanies this letter). Six of the seven voting parties submitted their letters to me by March 24, 2014. Those letters accompany this letter. A letter from the USFWS is forthcoming.

The next step in the process is to refer this issue to a subcommittee of the voting members. The subcommittee will have 30 days to reach resolution on the dispute using the best available information. Following the 30-day period, the subcommittee will provide me with a written report describing the outcome of its efforts to reach resolution. I will distribute the report to you and the PRFF. If the

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subcommittee is able to come to consensus on a proposed resolution, the PRFT will have up to 30 days to approve or reject the proposed resolution. If the subcommittee cannot reach consensus, the subcommittee will still submit a report to me that describes the remaining issues in dispute, the efforts needed to resolve them, and any additional information that may be suitable to assist in resolving the issue. The PRFT will have 30 days to achieve agreement on the disputed matter. If the PRFF cannot resolve the issue, within five business days I will notify you and the Policy Representatives of the existence of the continuing dispute and request that the Policy Representatives convene to resolve the dispute. The PRFT Policy Committee will have 60 days to resolve the dispute.

Please let me know if you have questions or need additional information.

Yours truly,

Tracy W. Hillman, Ph.D.
PRFT Chair

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cc: PRFF

Report from the PRFF White Sturgeon Subcommittee to the PRFF

REPORT OF PRFF WHITE STURGEON SUBCOMMITTEE MEETING

To: Tracy Hillman, Chair
Priest Rapids Fish Forum (PRFF)

From: PRFF White Sturgeon Subcommittee

Date: April 25, 2014

Subject: Discussion of Appropriate Number of Juvenile Sturgeon to Release into the Priest Rapids Project Area in 2014

The White Sturgeon Subcommittee of the PRFF met on April 11, 2014 to discuss the issue of **"the appropriate number of juvenile sturgeon to release into the Priest Rapids Project Area in 2014."** Previous discussions have taken place in recent PRFF meetings, and there has been a lack of consensus regarding the appropriate number to release. Therefore, the PRFF elected to move the issue into the dispute resolution process in an attempt to resolve the issue. Included in the dispute resolution process is a requirement of the PRFF to appoint a subcommittee from its membership to address the disputed issue and arrive at a recommendation for the PRFF to consider. Accordingly, this report is a summary of the subcommittee meeting that was held, and the agreed upon recommendation to be delivered to the PRFF.

Subcommittee members and other meeting attendees discussed the issue before them. Release numbers discussed included 4,332, 5,000[3], and 6,500 juvenile sturgeon. Representatives presented their rationale supporting their positions. Members noted that there is no "new" science or data, beyond what is currently available, to inform the discussion. After extended discussion on the issue, subcommittee members stated their final positions. Representatives of the Yakama Nation and Umatilla Tribes concluded that the number should be 6,500 because the technical evidence does not indicate a need to move off the 6,500 identified in the White Sturgeon Management Plan. Accordingly, they found no basis for concluding that a number other than 6,500 is appropriate. In contrast, representatives of the Colville Tribes, Grant PUD, and the USFWS believe the number should be 4,332, but would reluctantly support 5,000 to avoid further dispute. The representative of the Wanapum Band believes the number should be 4,332, but would discuss the release of 5,000 with her superiors. These parties concluded that a conservative approach that balances maternal contributions should be used to avoid future inbreeding depression. They believe this approach is consistent with the White Sturgeon Management Plan, which states that genetic integrity of the wild sturgeon population should be an important component of the supplementation program and that "up to" 6,500 fish should be planted

[3] The 5,000 release number was approved by the Rocky Reach Fish Forum as the number of juvenile sturgeon to release into the Rocky Reach Project Area in 2014. During the Rocky Reach Fish Forum meeting, it was suggested by voting members of both the RRFF and the PRFF that the 5,000 number should be considered by the Priest Rapids Fish Forum.

annually. Consequently, there was a lack of consensus among subcommittee members regarding the appropriate number of juvenile sturgeon to release in 2014.

The subcommittee concluded their meeting with a recommendation that the issue be raised to the PRFF Policy Committee. In addition, the subcommittee requests that the PRFF Policy Committee should provide guidance or a Statement of Agreement (SOA) that outlines the protocols to be used in determining the appropriate release numbers post-2014.

White Sturgeon Subcommittee Meeting Participants	
Subcommittee Members:	**Other Participants:**
Bob Rose, YN	Donella Miller, YN
Chad Jackson, WDFW	Steve Parker, YN
Doris Squeochs, Wanapum	Patrick McGuire, DOE
Jason McClellan, CCT	Tracy Hillman, PRFF Chair
Mike Clement, GCPUD	Denny Rohr, PRFF Policy Committee Chair
Steve Lewis, USFWS	
Tom Skiles, CTUIR	

Report from the RRFF White Sturgeon Subcommittee on the Number of Juvenile Sturgeon to release into the Rocky Reach Project Area in 2015

On April 28th, 2014 select members from the RRFF met at CPUD to discuss the next phase of white sturgeon supplementation into the Rocky Reach Project Area (RRPA). Also in attendance was Mike Clement from GPUD and Andrew Gingerich from DPUD. I believe the meeting was very productive and the group identified a clear next step towards plan development. The group did generally agree that it's likely to take the remainder of 2014 to finalize a new RRPA white sturgeon supplementation plan that would begin in 2016. As such, the group did discuss a more pressing matter which is how many fish stock in 2015. With brood stocking activities starting next week (May 15th), affected hatcheries and funders (PUDs) need some level of certainty and/or direction as to how many fish need to be raised and where. Deciding stocking rates now will hopefully avoid any disputes in late-2014 and/or early-2015.

Provided below is a summary of the proposed white sturgeon stocking strategy for the RRPA for release year 2015 that the group discussed. The strategy is based mostly off the existing CPUD white sturgeon management plan with some additional guidance added. This strategy was also suggested for stocking into the Priest Rapids Project Area (PRPA) in 2015, so please share this information with the members of the PRFF. Please note that the below is based off my notes from the group discussion. Members from both fish forums should discuss the strategy and change/modify the guidance provided as necessary. However, I believe both programs should be standardized to the greatest extent possible.

<u>2015 White Sturgeon Stocking Strategy</u>:

- Between 0-6,500 age-1 juvenile white sturgeon may be released into the RRPA (and PRPA).
- A minimum of 18 half-sibling families must be produced in order for 6,500 fish to be released.
- If >18 half-siblings are produced the stocking rate will not exceed 6,500.
- If <18 half-siblings are produced, a reduced and pro-rated release strategy will be employed.
    - (e.g., 6,500 fish/18 half-sib = 361 fish/half-sib; thus if 10 half-sibs are produced the 2015 stocking rate would be 10 X 361 or 3,610 fish).
- Regardless of how many half-siblings are produced, family equalization will be reflected in the release to the greatest extent possible.
- If multiple spawning events occur and result in significantly >18 half-siblings, all reasonable attempts will be made to not stock the same half-siblings into the RRPA (and PRPA) in 2015.
- The ultimate stocking rate identified for 2015 does not necessarily have any baring or relation to future stocking rates developed for 2016 and beyond.
- All entities involved in brood stock collection agreed to fish the entire contracted length of time and collect as many spawners as possible as opposed to fishing until a 6 female and 6 male collection goal was achieved.