

# 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<sup>1</sup> (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:

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<sup>1</sup> 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.<sup>2</sup> 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 <sup>a</sup> 1F x 2M wild cross, 2 crosses (3896 of 9117). MDH 3F x 2M captive brood cross, 6 crosses (2600 of 9117). KTH <sup>b</sup> 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.
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.

<sup>2</sup> 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
2012	7	7,979	3F x 1M wild cross and 1F x 4M wild cross. Excess stocking of 6,500 approved by RRF.
2013	12	TBD	3F x 3M wild cross and a 1F x 3M wild cross.

<sup>a</sup> Marion Drain Hatchery (MDH).

<sup>b</sup> 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

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