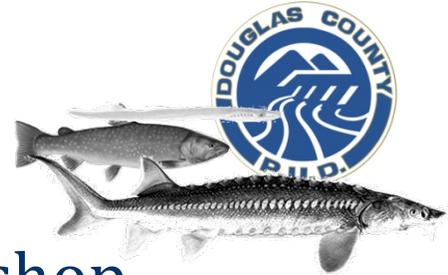


Final Mid-Columbia Regional Sturgeon Workshop Minutes



To: Aquatic SWG Parties **Date:** November 4, 2013
From: Kristi Geris (Anchor QEA, LLC)
Re: Final Minutes of the Mid-Columbia Regional Sturgeon Workshop

The Mid-Columbia Regional Sturgeon Workshop was held at Douglas PUD headquarters in East Wenatchee, Washington, on Tuesday, September 10, 2013, from 9:00 a.m. to 3:00 p.m. Attendees are listed in Attachment A of these workshop minutes.

I. Summary of Discussions

- 1. Purpose and Introductions** (Tracy Hillman and Andrew Gingerich): Tracy Hillman welcomed the attendees (attendees are listed in Attachment A) and opened the meeting. He said that the purpose of this first annual Mid-Columbia Regional Sturgeon Workshop is to review project achievements and lessons learned; and also to fulfill an Aquatic Settlement Work Group (SWG) request for a workshop to review genetic considerations in advance of implementing the Aquatic Settlement Agreement (ASA) White Sturgeon Management Plan (MP). Andrew Gingerich said that in April 2013, the Aquatic SWG signed a Statement of Agreement (SOA) stating that during the first 4 years of Douglas PUD's white sturgeon collection efforts (2013), Douglas PUD would conduct both broodstock and larval programs. He said this SOA was signed with the understanding that following collection, both programs would be revisited to discuss further actions for the first year of stocking. Gingerich said that he hoped to have discussions about current, best available information that can help inform decisions regarding Wells' first year of stocking and beyond.
- 2. Principles of Past Management Direction** (Bob Rose): Bob Rose said that this workshop is an opportunity to reflect on what has been done and to identify opportunities for the future. He said that the best indicator of success has been the professional manner in which this group has moved the white sturgeon program forward in the Mid-Columbia, despite the several logistical uncertainties at the start of the program. He said, now there are only a few pending issues that are unresolved, pertaining to broodstock collection and the issue of genetics. He added that a strategy needs to be developed

that outlines how to obtain fish throughout the entire spectrum, as well as where to obtain fish such that genetic diversity is maximized. Rose said that he feels that enough background work has been done to move the program even further forward, and more is learned each day through the ongoing monitoring programs. He said that the Yakama Nation (YN) and the Columbia River Inter-Tribal Fish Commission (CRITFC) recently broke ground on plans for renovations to the Marion Drain Facility; and he said that the renovations will largely be shaped by Mid-Columbia and Bonneville Power Administration (BPA) programs.

3. **Summary of Mid-Columbia Program Activities and Achievements** (Yakama Nation, Washington Department of Fish and Wildlife, Grant PUD, Chelan PUD, Douglas PUD):

Yakama Nation (Bob Rose): Bob Rose said that BPA, CRITFC, and the YN are currently developing a conceptual design for the new Marion Drain Facility. He said that he anticipated that the design will be complete within a year, and that this design will also accommodate implementation of monitoring strategies. The process will then move to 85 to 90 percent design, including a thorough review of fish management. Lastly, the plans will go to the Independent Scientific Review Panel (ISRP) for review. Rose said that he expects renovations at Marion Drain to be completed within 2 to 2.5 years. He said that Ringold Hatchery is also being considered for certain components of the program; and that Walla Walla Community College has also expressed interest in participating in a lamprey program. Rose said that visitors are welcome to view the facility during construction, and that he anticipates the facility to double in size. He said that certain details are still being ironed out and that contractors will be on site soon. Rose added that CAD drawings should be drafted by mid-winter to help visualize what the renovated facility will look like.

Tracy Hillman asked what the capacity of the new facility will be, and Rose replied that it is planned to be approximately 20,000 juvenile sturgeon. Rose said that the facility will have the capacity to hold broodstock year-round, but if broodstock are not held year-round, then the juvenile component might be expanded. Chad Jackson asked if construction will require an Environmental Impact Statement (EIS) and associated review. Rose said that they plan to consult BPA environmental compliance staff, and that an Environmental Assessment (EA) is definitely being considered. Mike Clement asked about stocking capacity at the new facility, and Rose replied that those details have not been discussed and will likely be reviewed by CRITFC.

Washington Department of Fish and Wildlife (Chad Jackson): Chad Jackson said that Washington Department of Fish and Wildlife (WDFW) is not directly involved with collection and stocking; rather, WDFW is more involved with: 1) permitting; 2) providing WDFW facilities as satellite facilities; and 3) fish health coordination. He said that WDFW has been filling in the gaps and helping where needed. Pat Irle asked if WDFW is

taking on a management role with white sturgeon in the Mid-Columbia, and Jackson replied that WDFW represents the State of Washington's interest to ensure that fish are handled appropriately.

Grant PUD (Mike Clement and Paul Grutter): Paul Grutter said that in 2013, Grant PUD had four key objectives: 1) release 2012 Marion Drain broodstock in May 2013; 2) collect 2013 broodstock in June 2013; 3) monitor natural production and spawning to evaluate the potential to capture eggs on a mass scale; and 4) monitor acoustic tags.

Grutter said that 2012 Marion Drain broodstock were initially tagged in two groups: a main group of 2,000, and an additional back-up group of 782. He said that because there were several groups of fish on station, another 1,000 fish were tagged for release, for a total of 3,782 fish tagged and released. He said that fish were released from both Marion Drain and Columbia Basin Hatchery into the Wanapum and Priest Rapids pools on May 14 and 15, 2013. He noted that the average release size of Columbia Basin Hatchery fish was about 270 millimeters (mm); and at Marion Drain, at the time of tagging, average fish size was already 292 mm. He reviewed the different types of tags deployed, and noted that there were some incidents of tag shedding.

Grutter said that collection of 2013 broodstock started on June 1, 2013. He said that 17 wild sturgeon were caught using a set line, and 23 were caught by angling, using two boats. He said that three fish went to the hatchery—two males and one female. Grutter also said that several large females were caught, but they were not ready to spawn.

Grutter said that only 2 weeks were budgeted to monitor natural spawning, in contrast to the typical 2-month program when the goal is to capture the entire spawning season. He said that, instead, efforts were maximized for egg capture. He said that eggs were captured and incubated in July 2013. Grutter added that they used a prototype incubator that used fibrous material to suspend panels in the incubator to avoid the need for handling the eggs. Theoretically, the eggs would hatch and embryos would drain into a collection chamber. Grutter reported low success with this method, and suggested that embryos were lost due to structural issues. He said, however, that 29 larvae were still collected from a couple of different methods.

Andrew Gingerich asked if there is a way to gauge the development of female sturgeon to predict when they will be ready to spawn. Paul Anders said that this can be gauged by looking at the eggs—he said that a “F4” will likely be ready to spawn the following year, and an “F3” would be ready to spawn in approximately 2 years. Larry Hildebrand agreed that an “F4” (i.e., having black eggs) will spawn the following year; and he said that the timing for anything beyond an “F4” is likely to be influenced by a number of factors, such as diet and diel effects. Mike Clement said that Golder Associates had

been able to collect eggs that represented six to seven different spawning events. He said that this implies that F5 females are not effectively being collected, and also suggests that there are more spawning brood present. Hildebrand said they know that more fish are located below Rock Island Dam based on tracking in previous years; however, they were unable to capture them. Jim Powell added that they are either not catching them, or they are not accurately locating where they are spawning.

Chelan PUD (Lance Keller): Lance Keller said that in 2013, Chelan PUD contracted Blue Leaf Environmental, Inc. to conduct brood collection efforts, which took place downstream of McNary Dam on May 16 through 25, 2013, and on May 30 and 31, 2013. He said that Chelan PUD borrowed Grant PUD's trailer and also received great support from Marion Drain staff as well. Keller said that, in general, there was greater success in 2013 than in 2012. He said that in the first few days of collection, four females were captured and transported to Marion Drain; three of which contributed to a three-by-three (3x3) cross. He said that nine males were also taken to the hatchery, and that a total of 23 mature adult fish were captured. He said that all females captured were taken to Marion Drain, but that several males were released because they had reached hatchery capacity. He added that they had never needed to do that before. Keller said that the success of the 3x3 cross was split between Columbia Basin Hatchery and Chelan Falls. Keller said that in order to keep more males, additional females would be needed. Jim Powell added that, genetically, there is no significant advantage from increasing the cross to a 6x6. Paul Anders said that, ideally, obtaining fish over many years would be best.

Keller said that regarding juvenile stocking, 2012 brood were stocked in the Rocky Reach Reservoir in late May 2013. He said that Corral Creek had been used for stocking in 2011 and 2012. However, past telemetry tracks indicate that those fish have moved upstream and taken up residency just below Wells Dam. Therefore, for this year, based on discussions with the Rocky Reach Fish Forum (RRFF), two new release locations have been introduced—at Daroga State Park and at the Entiat boat launch. Keller said that a total of 7,900 fish, including 65 with acoustic tags, were released at the two new release locations. Larry Hildebrand asked about the mean fish size, and Keller replied that the fish were relatively large, but did not recall the exact size. He added that the fish were released a little later than desired. Mike Clement asked about the fish holding below Wells Dam. Keller explained that the 2012 fish appeared to be holding, and so Chelan PUD conducted a recapture event in the Rocky Reach Reservoir. He said that they discovered fish holding below Wells Dam, and that only one fish had left the reservoir from the 2011 and 2012 releases. He said that passive integrated transponder (PIT) tag data indicate that only 31 fish from the 2011 release emigrated out of Rocky Reach Reservoir; and he added that one fish was detected at McNary Dam.

Keller said that Chelan PUD initiated an indexing and monitoring program that is carried out by random sampling efforts using set line gear, over five 10-day sampling periods. He said that in the first 7 days of the program, 65 fish were recaptured, including 7 adults that are now tagged and can be tracked.

Douglas PUD (Andrew Gingerich): Andrew Gingerich said that Douglas PUD recently received a new operating license and also recently started implementing their White Sturgeon MP. He said that last winter, Douglas PUD started modifications at Wells Hatchery, including the installation of 12 round tanks—each 3 feet deep and 5 feet in diameter. He said that six of the tanks were dedicated to the direct gamete program (eggs obtained from broodstock), and the other six tanks were dedicated to the larval program. He said there were complications with the water heater in the Wells sturgeon facility; however, those issues now seemed to be resolved. He said that WDFW has been instrumental in supporting rearing at Wells; and he added that 10 families were brought back to Wells, and that about 2,500 of the 4,500 larvae survived from the larval program (i.e., about 65% survival). Gingerich said that, historically, about 30% survival has been the best achieved; and he added that with increasing rearing experience, he thinks survival will also increase. He said that Douglas PUD has just begun culling the 60,000 to 70,000 direct gamete program, and hoped to reduce these numbers down to 22,000 total. He said that the necessary permits are being obtained to move the fish if other facilities need extra family representation. Tracy Hillman asked if the fish were all from natural spawning events, and Gingerich replied that they were—that all fish are from wild original, not captive brood.

4. **PRESENTATION: *Naturally Produced Larvae: A New Approach to White Sturgeon Conservation Aquaculture*** (Jason McLellan): Jason McLellan presented *Naturally Produced Larvae: A New Approach to White Sturgeon Conservation Aquaculture* (Attachment B), which was distributed to the Aquatic SWG by Kristi Geris on September 9, 2013. He said that the CCT, in collaboration with Andrea Drauch-Schreier of the Genomic Variation Laboratory, University of California, Davis (UC Davis), conducted a genetic evaluation of broodstock versus wild caught larvae. He said that he would present Drauch-Schreier’s work on her behalf, as she was unavailable to attend the workshop due to prior obligations. (Note: “*Patterns of Population Structure Vary Across the Range of the White Sturgeon*” by A. Drauch-Schreier, B. Mahardja, and B. May [2013], was recently published in *Transactions of the American Fisheries Society* [142:5, 1273-1286].)

McLellan reviewed definitions, noting that “broodstock” was defined as adult sturgeon captured from the wild—not captive broodstock—for extraction of gametes used in aquaculture production. He explained that “repatriation” is defined as the capture of early life stage (in this case, larvae) for captive rearing and release. He also noted that “effective population size (N_e)” was defined as the number of reproducing individuals in

an ideal population that would lose genetic variation due to genetic drift or inbreeding at the same rate as the number of reproducing individuals in the real population under consideration. He reviewed key concerns with the current aquaculture program that prompted this evaluation, including concerns with genetics and broodstock handling. He said that there is concern about diversity, and that by selecting mates, natural selection is being eliminated. He also noted the stress and injury associated with broodstock handling, and also that broodstock handling requires additional infrastructure and removes fish reproductive potential.

McLellan said that researchers began studying collecting larvae because of the high degree of genetic relatedness they found in conventional broodstock collections of lake sturgeon. He said that a comparative genetic study of eggs and larvae versus broodstock conducted by Crossman et al. (2011) indicated a lower mean degree of relatedness and co-ancestry with eggs and larvae, or in other words, lower risk of inbreeding in the long term. (Note: “Gamete and larval collection methods and hatchery rearing environments affect levels of genetic diversity in early life stages of lake sturgeon [*Acipenser fulvescens*]” by Crossman et al. [2011], was published in *Aquaculture* [310:3-4, 312-324].) Pat Irle asked if the optimum number of adult broodstock was used in the study, and McLellan could not recall exactly how many were used, but believed that a representative brood program was used, which he thought was approximately 12 adult brood. He said that lake sturgeon spawn in very shallow, low-velocity rivers and streams, and that there is more difficulty collecting in large river settings. Jim Powell said that in the Crossman et al. study, one female and multiple males were used—not a matrix in this case.

McLellan said that the questions in the Upper Columbia were whether wild larvae collection was feasible, and whether the same benefits found in the lake sturgeon study result. He said that studies were conducted to determine how many larvae could be captured in Lake Roosevelt in 2010, 2011, and 2013, and also in the Wanapum Pool in 2013. McLellan noted that studies conducted in Lake Roosevelt in 2011 and 2013 were conducted at night; and Bob Rose noted the higher survival in those studies. McLellan clarified that the survival noted on page 9 of Attachment B represents survival in the collection bucket—not in-hatchery. He said that mortality was about 10 to 15%, depending on debris-loading. He noted the large collection efforts put forth in the Wanapum Pool, but said that not many larvae were obtained. He said that other areas could have higher densities, and noted that 104 larvae were captured during a couple of nights of sets in the Bonneville Pool, and additional larvae were captured using a D-ring in the McNary/Hanford Reach, Zone 6 Pools, and in the Lower Columbia River above Bonneville.

McLellan said that the increase in hatchery survival shown in studies conducted in 2010, 2011, and 2013 was largely due to increased understanding of feeding regimes,

handling, etc. Paul Anders asked if the cause of mortalities was known, and McLellan replied that a few things could be contributing factors. He said that the Sherman Creek water source is reservoir water where temperatures exceed 20 degrees Celsius. Also, the water intake lines are made of black pipes, so the water conveyed through the pipes is heated during the day and cooled at night. He said that this high fluctuation of water temperatures may be causing the fish stress. He said that there were also columnaris issues during the pilot years, which contributed to the mortalities during that time; and there were also issues with feeding regimes. He said that more is known about transitioning onto a hatchery diet, which also helps reduce mortalities.

McLellan reviewed results from a model analyzing whether repatriation captures as much genetic diversity as broodstock capture in white sturgeon conservation aquaculture. Results indicated that brood collection of adults in 2010 resulted in 121 alleles, while repatriation of larvae in 2010 resulted in 180 alleles (i.e., 90% allelic diversity). Further, results indicated that there is no benefit in combining brood collection and larval collection (i.e., brood collection of adults plus repatriation of larvae in 2010 still resulted in 180 alleles). He also noted that these same analyses indicated that collecting larvae from a less diverse population (number of alleles) can result in higher numbers of alleles in offspring used for conservation aquaculture, when compared to the offspring from a limited number of adult broodstock collected from a more diverse population. McLellan then demonstrated this same concept by reviewing a model showing how many juveniles need to be repatriated to capture target levels of genetic diversity (i.e., 180 alleles, or 90% allelic diversity). In the graph on page 13 of Attachment B, McLellan noted how the curve begins to approach its asymptote at approximately 200; this means that no more than about 200 individuals are needed to achieve 90% allelic diversity. Steve Hemstrom asked if this number would change based on the number of adults upstream, and McLellan replied that the model is representative of total spawning abundance. Powell noted that this also does not mean that the release number should only be 200 individuals; and McLellan said that the point is that a smaller number of individuals obtained from larval collection can yield high allelic diversity.

McLellan said that the number of parents represented by repatriated juveniles was investigated, and for brood year (BY) 2010, based on 89 larvae, results indicated that approximately 78 parents were represented. He said that additional analyses indicated that 17 spawning groups were present among the 78 spawners. McLellan noted that Drauch-Schreier said that this number may be an overestimate; however, analyses still suggest that white sturgeon are not one-to-one spawning in the wild—rather, they are spawning with multiple adults. Gingerich asked if the software calculating these clusters is based on known parentage, and McLellan replied that it was. He said that the program is called “Colony,” and that it had been well tested and validated. He said the

validation process used sturgeon from a commercial aquaculture facility with known parentage in California.

McLellan reviewed the benefits of larval collection, including the large numbers of larvae that can be captured, high in-hatchery survival rates, and greater genetic diversity with relatively few larvae, among others. Rose said that it seems like larval collection makes sense if the goal is to maintain diversity of a population that is isolated to one particular pool or area. He said, however, if the goal is to infuse diversity from another area, it can only be accomplished with brood collection. McLellan said that larval collection can be implemented anywhere. Rose said, however, that a lower river fish can be crossed with an upper river fish today; whereas, with larval collection, it would take 25 years for the alleles to cross. McLellan said that based on recent studies, he is unsure that there is a benefit to crossing lower with upper river fish. He said that there is a genetic benefit with high numbers of alleles, and for them to sort themselves out over time. Rose said that he is still under the impression that fish came up from the lower part of the river, so there is already that natural genetic mobility. He asked whether that natural mobility should be mimicked in the near term by crossing fish. He added that this ties into risk management. McLellan said that the question seems to be whether the genetic benefit of crossing upper and lower river fish provides a better genetic management approach than larval collection. He said that with crossing brood, a higher number of siblings is produced than in a larval approach, and so the relatedness increases while decreasing the effective population size. Anders added that fairly high resolution data are now available to support these findings.

McLellan reviewed how to transition to wild-caught larvae, including exploring additional collection locations, refining collection gear and techniques, refining hatchery techniques, and refining release strategies. He also said that if 87% survival can be achieved for 0.5-year post-release to 5.5-year post-release, then release targets can be reduced by 67%. He added that he believes this can be achieved through refined release strategies. McLellan reviewed graphs on pages 27 and 28 of Attachment B that used data from annual gill net surveys in Lake Roosevelt to analyze what fish length and weight would need to be reached to achieve 87% survival. Results indicated that fish length and weight would likely need to be in the range of 35 centimeters (cm) and 300 grams (g), respectively, to achieve 87% survival, which, McLellan said, is a target size that he believes is quite feasible to reach within 10 months. Rose said that this target size can definitely be reached within 11 months; and McLellan added that if brood was not collected, the larvae could be held longer. Gingerich asked if fish size is the biggest factor for survival, and McLellan replied that fish size is one factor, but may not be the main factor. He added that research on the Kootenai Sturgeon Aquaculture Program indicates that bigger fish have higher survival. Anders noted current efforts to reduce the number of fish in captivity, and investigations regarding how much earlier fish can be released without affecting survival. Powell added that if larger fish are released, they

may not be targeted as prey items. He also suggested monitoring what other prey items were present. Rose said that this idea has been discussed before, and suggested releasing randomly sized fish for comparison.

McLellan said that based on these results, and from a conservation perspective, the CCT believes that transition to larval collection is the appropriate approach. Larry Hildebrand also noted a paper in press that supports egg collection. He said that the paper states that during 2 years of egg recovery, analyses indicated the mean number of spawners contributing to eggs collected was 109. He said that these results were based on 12 to 18 spawning events, and that there were likely more than 12 individuals participating in each event. McLellan said that there are some places where it is difficult to collect larvae, so collecting eggs may be a good alternative; and Hildebrand suggested combining larval and egg collection.

5. **PRESENTATION: *Considerations: Egg and Larval Collection for Stocking*** (Jim Powell): Jim Powell of the Freshwater Fisheries Society of British Columbia (FFSBC) presented *Considerations: Egg and Larval Collection for Stocking* (Attachment F), which was distributed to the Aquatic SWG by Kristi Geris on September 9, 2013. Powell's presentation is based largely on research conducted by the FFSBC under the Upper Columbia White Sturgeon Recovery Initiative (UCWSRI).

Powell reviewed reasons for considering egg and larval collection for stocking, including costs, genetics, and time and labor required to collect broodstock. He said that with egg and larval collection, there are more opportunities to save funds than with collecting broodstock, and costs can be reallocated. From a genetic perspective, the number of alleles and rare alleles increases. He also noted that sturgeon are getting older in the Transboundary Reach (TBR), and that on average, one sturgeon dies with each year of old age. Powell said that stocking efforts and survival in the TBR have been so successful that the growing abundance of really young fish is resulting in an increase in the amount of time needed to find broodstock. Also, because a spawner cannot be used twice, it is getting harder to capture "new" fish each year. Powell also noted the difficulty in handling adult sturgeon, which can be more than 10 feet long and weigh more than 300 pounds, creating potential safety and hatchery capacity issues.

Powell said that through more than 10 years of spawning monitoring conducted by Golder Associates and two internal feasibility evaluations, it has been determined that egg and larval collection for stocking is economically, biologically, and logistically feasible. He said that other work completed by sturgeon experts such as Katy Jay, Andrea Drauch-Schreier, and Paul Anders also supports the feasibility of egg and larval collection for stocking. Research indicates that larval collection results in greater diversity, and is superior to trap and transport. Powell said that in the TBR, as a safeguard, indexing continues, a reserve population is being reared in the Revelstoke

Reach, and research and hands-on monitoring of stock continues. Bob Rose asked if a low larval year can be predicted so that appropriate preemptive actions can be taken; and Powell replied that this is not possible yet. Jason McLellan added that there is no consistent natural recruitment anyway; so if there is an occasional year with no larval collection, it should not pose a significant impact. Pat Irle asked whether the event of no larvae being collected is an indication that there is no breeding taking place. Powell replied that sometimes larvae may just be missed when sampling. Larry Hildebrand added that it may also be due to larval drift. Powell said that the ability to detect spawning events is not totally accurate, and in this instance, Revelstoke Reach is the safeguard. Hildebrand added that there are also mechanisms in place to avoid predation by raising Revelstoke Reach fish to a larger size. Powell also said that in the 5 years that he has been involved in this program, the management tools available have doubled and are only growing.

Powell reviewed the risks and problems with egg and larval collection for stocking, such as a “bad” spawning year; he noted, for example, the impacts of the high flows experienced in 2012. He also noted the possible lack of site fidelity, or sites that change with high flows. Powell also said that the mechanical aspect of collecting eggs can be tedious and difficult. Powell said that the FFSBC is moving more towards egg and larval collection. He said that there are two full incubation early-life rearing units, plumbed out and electrical at the KSH facility (as shown on page 17 of Attachment C). He also said that the FFSBC is still collecting reduced numbers of brood, but they have reduced stocking numbers and increased wild capture. McLellan noted that Powell was referring specifically to the British Columbia (BC) component of the UCWSRI, and that the Washington component has gone completely to egg and larval collection for stocking. Hildebrand said that based on the success of the incubators, he expects that egg and larval collection will move forward next year. Powell said that a poll was distributed to gauge what thoughts are regarding what needs to be accomplished to move egg and larval collection forward. The poll included questions about whether a pilot study was needed, what is important to the Mid-Columbia, what research will be involved, what data gaps need to be filled, what monitoring is needed, and whether there is a reason to continue brood collection. Powell said that the poll will be discussed at the next UCWSRI Technical Working Group (TWG) conference call. Hildebrand noted that certain components of the program that the FFSBC developed are not required for the U.S., and he added that the FFSBC does not have nearly as many opportunities to capture larvae as there are in the U.S. He said this is one of the reasons that the FFSBC is looking into eggs as well as larval collection, and he added that it is also easier to capture eggs.

Powell said that, in conclusion, “conventional” methods are changing, and now egg and larval collection are being considered. He said that the reasoning is clear and supported by research, and that egg and larval collection are genetically superior and cost effective. Paul Anders asked if the Mid-Columbia should consider collecting larvae in

the BC regions of the Columbia River, and Powell cautioned that moving gametes across the border is difficult.

BREAK: Lunch

6. **Open Forum Discussion** (All): Tracy Hillman provided a recap of the morning discussions, and opened the floor for discussion.

Sturgeon vs. Lamprey

Paul Anders recommended that consideration should be given to how sturgeon contribute to the marine ecosystem; for example, how sturgeon supplementation may affect lamprey supplementation efforts. He added that, initially, there seems to be a focus on genetics and representation, and it is not until later that the focus moves to real-time demographic issues and concerns about how those fish are contributing to the entire community. He said that, sometimes, it is difficult to address those management questions until they are at the forefront. Jim Powell added that another good example of long-term supplementation affecting other populations is when bull trout supplementation efforts ceased in order to supplement the kokanee population. Larry Hildebrand said that Golder Associates is in their eleventh year of an indexing program that indexes key representative species in a population, and monitors growth and other metrics. He said that this program has been ongoing in parallel with sturgeon data collection, so those data are available to be compared up to 10 years ago. Tracy Hillman said that this issue of how managers will supplement sturgeon as well as lamprey also came up in the RRF. Steve Hemstrom said that Chelan PUD's White Sturgeon MP, for example, has a goal to create a "harvestable" population; however, it is unclear what abundance is needed to achieve that goal. Pat Irle asked if WDFW already has those numbers defined. Brad James replied that in a number of areas, the management approach is to assess the population abundance, and then to develop a sustainable exploitation rate, and he noted that this rate is often already being exceeded. He said that the goal is to increase abundance until it can be expected that a population will slowly increase. He said that the annual production and abundance continually fluctuates, which translates into an ever-changing exploitation rate, resulting in fluctuating harvestable numbers. Hemstrom asked if this means that there is no minimum harvestable number, and Hildebrand said that it has been the case that most healthy populations can withstand 3 to 5% harvest. James said that based on work conducted in the late 1980s, the exploitation rate was initially 15%. He said that WDFW measured fish by toe length and then narrowed size, looking for ways to slow harvest down, and he added that now there are variable size slots. He said that due to the sea lion predation below Bonneville Dam, WDFW recognized that the previous exploitation rate needs to be lower. So the previous rate of 15% translated into 22% for the current size slot, and about 12% below Bonneville Dam due to the higher mortality rate. James said that developing accurate exploitation rates comes down to a lot of monitoring,

namely of mortalities and angling. Anders said that the 3 to 5% harvest is based on lake populations, and he added that lake sturgeon managers are adamant about this number. He said that 3 to 5% is not the absolute answer, but lake populations have been increasing in recent years. Hemstrom said that it also needs to be determined if there is higher risk associated to stocking too many or not enough numbers, in terms of the conflicting commitments to sturgeon and lamprey.

Bob Rose acknowledged the challenge of how to capture these questions and develop action items for a path forward. He asked, for example, what “habitat capacity” means, and how it is measured. Is habitat capacity calculated by stocking a reservoir and monitoring the fish, or does the habitat capacity need to be maxed out throughout an entire life stage? How does habitat capacity incorporate into the discussion of “how many is enough?” Anders said that he addressed a similar issue with the ISRP on the Kootenai River; and added that it was no easy task. He said that, in that case, based on more than 20 years of sampling, a target population size was defined and then release numbers were generated by working backwards. He said that based on the high variability and difficulties with modeling, ultimately several scenarios were presented, including proposed management decisions based on a formal adaptive process. Anders said it seems that the solution needs to be an approach that balances risk and what is tangible.

Collecting Broodstock vs. Collecting Eggs and Larvae

Tracy Hillman said that, currently, Mid-Columbia programs are largely collecting broodstock, but research is now indicating that collecting eggs and larvae may have greater benefits. He asked whether it was wise to completely abandon collecting brood based on these new findings. Pat Irle said that she would like to ask the experts that question, as well as how much value there is with collecting adults versus larvae, and also questions about timing and location. Jim Powell said that, ultimately, it is the co-managers’ decision. He also asked if it is the number of fish or biomass that should be considered. Larry Hildebrand said that there is no simple answer, and added that the number of fish needed can very easily change because of factors such as fluctuating mortalities. Jason McLellan said that based on his experiences, he feels it is a fair assumption that the best survival is going to be driven by fish size. Andrew Gingerich noted that based on fish source, survival calculations may be complicated by variable emigration and immigration rates. Hildebrand said that downstream migration does happen, and it counts as a mortality to the population. He added that many of these problems are due to release location; but if the habitat is present, they will stay. McLellan suggested that timing of release may also be a contributing factor, and he added that, for example, if fish are released during a freshet (i.e., in high flows), they may leave. Powell said that many of these questions can be answered with monitoring, and he suggested that monitoring be ramped up. Hillman noted that, historically,

reservoirs were considered more of a sink than a source for sturgeon; he asked if that was not the case anymore. Hildebrand replied that it seems so.

Hillman said that based on recent research, a lot of effort was put into collecting larvae from downstream with little success; and he asked if there were any thoughts on how this can be improved. McLellan suggested that other locations with larger spawning areas need to be considered. He added, however, that it took at least 5 years of early-life history research in the Upper Columbia to find these locations that resulted in good success; and so he indicated that it cannot be expected to just go to a random, unevaluated area to drop frames and immediately have success collecting adequate numbers of larvae. He suggested that areas that have already been fished will have greater success. He said, for example, that based on the pilot year and Hildebrand's crews success with egg collection, collecting larvae below Rock Island Dam in the Wanapum Pool may be a more viable option.

Powell asked if any habitat improvements have been completed to improve larval collection, and Paul Anders replied that some work is being done. He added that within populations, behavior patterns are duplicative; and in different rivers there are different patterns. He recommended obtaining this type of information on the larvae that are collected, and recreating this habitat in the Upper Mid-Columbia. He also suggested not stopping with early life stages, and said that it would be beneficial to see what types of habitat they prefer throughout all life stages.

Hillman asked if there was consensus to move to larval collection, and whether there is a need to continue collecting brood. Bob Rose said that it makes no sense to stop one and start another; rather, he suggested evaluating both for a few years. He added that instead of a change in management, he sees an augmentation in management. Gingerich said that Douglas PUD's thoughts are consistent with Rose's. He added that the Aquatic SWG came to a unanimous decision to conduct both brood and larval programs for 4 years, and that further decisions will need to be vetted within the forum. Gingerich said that Douglas PUD has about 2,500 larvae on station, and a total target of 5,000 sturgeon; this target could not be met with larvae alone. He added that, luckily, both brood and larval programs were successful for Year 1, and that, collectively, Douglas PUD has good options for stocking this year. He said that after 4 years, the Aquatic SWG will re-evaluate the programs, but in the meantime, monitoring and evaluation will continue as the programs move forward.

Mike Clement asked Rose, with being located the furthest downstream, what resources the YN and WDFW have to perform juvenile collection below Priest Rapids Dam. Rose said that these discussions have come up between the YN and WDFW, and also with BPA and CRITFC; however, no final determinations have been made. He said that he anticipates collecting next spring. Clement asked if collection would be more focused

on larval and egg collection, and Rose replied that larval collection is being considered, but he was unsure about egg collection. Lance Keller said that Chelan PUD conducted a trial effort with egg collection, but due to complications with the hydrograph and other unforeseen hurdles, the experience was not as valuable as they had hoped. Tucker Jones of the Oregon Department of Fish and Wildlife (ODFW) said that it was his understanding that Oregon is quite interested in egg collection. Clement asked Jones if ODFW has data on spawning locations, and Jones replied that he thinks that the U.S. Geological Survey (USGS) has those data, especially near the Bonneville Dam tailrace and throughout the Willamette River. Powell asked Jones if their egg mat worked well, and Jones said that it did. Keller also suggested using a D-ring. He said that Chelan PUD has stocked two years of sturgeon using a D-ring, which so far has shown no problems. Clement asked Keller if he has seen an index report for 2012, and Keller replied that, so far, the 2012 report only has 7 days of data.

Chad Jackson said that WDFW supports larval collection, and recommended that others follow suit. He said that soon contracts will expire and Requests for Proposals (RFPs) will be issued for collection next year, and he added that some hatcheries will need infrastructure upgrades in order to raise larvae. Hillman said that the decision is up to the individual forums, but having these discussions about risks and benefits is helpful.

Stocking Levels

Paul Anders said that it seems that front-loading releases may help inform stocking level decisions. He said that by doing so, useful data can be obtained on initial early survival; and combined with adult survival data, a range of scenarios could be developed that could help inform decisions. Jason McLellan asked how future stocking can be planned with any certainty when those plans are based on survival estimates with confidence intervals of (+/-) 20%. Steve Hemstrom said that research studies are designed to produce reliable results and added that survival estimates will always have variability. He said that his concern is that the stocking issue is being addressed in terms of short-term management, instead of long-term. He asked, for example, what would happen if entrainment prevented fish from passing the ladders and spawning upstream. Anders noted that entrainment rates presumably differ by project. Lance Keller said that he is encouraged by the natural recruitment in the Mid-Columbia, and he added that stocking levels can always be adaptively managed as more data are collected.

Andrew Gingerich said that Douglas PUD's White Sturgeon MP is separated into two phases: Phase 1 and Phase 2. He said that Phase 1 was developed with the concept in mind to simply get fish in the reservoir—stocking 5,000 fish in the first 4 years. He said that Phase 2 says that subsequent stocking decisions will be based on monitoring and evaluation (M&E) data. Tracy Hillman asked how Douglas PUD plans to use those M&E data to help inform future stocking rates, and Gingerich replied that those data will help inform survival and retention within the reservoir. He added that he is optimistic about

retention in the Wells Reservoir because, in terms of available habitat, there is a lot to choose from between the Methow and Okanogan rivers in addition to the mainstem stretch of the Wells Project. Hillman asked if stocking numbers would be increased in the event of poor retention (i.e., how would those data be interpreted?). Gingerich said that those decisions would need to be vetted in the Aquatic SWG. Hillman asked how those data inform other programs. Anders said that over time, the benefits of fish become out of sync with certain geographical boundaries, but will always accrue in one place or another. He said that based on this notion, new boundaries may eventually need to be reconsidered, or there will need to be acceptance of the idea that everyone is contributing to a resource that will continually shift.

Mike Clement said that Grant PUD is required to annually stock 0 to 6,500 sturgeon collectively between Priest Rapids and Wanapum, and it is up to the RRF to determine how many are actually stocked. He said that in the past few years, stocking levels were based on the quality of fish and their ability to serve M&E and supplementation needs. He said that in Year 1, three different origins were used, and monitoring data indicated that emigration rates were fairly high among the first release group. He said there have been years where no fish were released; and he added that last year, roughly 3,000 were released based on achieving a 6x6 factorial cross.

Anders asked if anyone has looked at empirical data for indications of a “breaking point” where fish with low fitness may become the majority (i.e., is there risk associated with producing too many endangered fish?). He clarified that he is asking what the severity of risk would be in, say, 10 to 15 years, and he suggested possibly minimizing the number of stocking events per year. McLellan noted a concern that a very high proportion of catch were from CRITFC releases, and so he suggested proportional numbering. Lance Keller said that there was a similar situation with Grant PUD’s first year with wild-by-wild versus captive brood, and he added that there were different survival rates among two different stocks of fish. He said that in the first year, they stocked just greater than 6,300 fish, and in 2012, there was a fish health issue, but some juveniles at Chelan Falls did survive. He said that, to date, about 6,500 sturgeon have been stocked in the reservoir. He said that for BY2014, Chelan PUD’s White Sturgeon MP will once again be under discussion. He said that discussions can be based off of preliminary indexing and monitoring data, and also pikeminnow bycatch numbers (Keller clarified that recapture data are obtained from bycatch caught on pikeminnow set lines). Hillman said that PUD monitoring data provide information on movement, residency, and survival; and he asked if these data also indicate habitat. Keller replied that the data do indicate habitat and also provide information on growth rates. Clement added that Larry Hildebrand’s group has also collected data on deep water habitat. Keller said that Chelan PUD also has pressure tags out that are obtaining diel depth data, and that shore releases are also being conducted; and so, there should be ample data to inform 2014 releases. Pat Irle asked if there are juvenile passage data

below Rocky Reach Dam, and Keller replied that sometimes those data can be obtained from PIT tags. He said, however, that most data are from recaptures, which do not indicate passage. Anders asked if Andrea Drauch-Schreier's genetics research found that fish from different projects in the Mid-Columbia were contributing to groups downstream. Hildebrand replied that Drauch-Schreier's research was based on wild fish captured in the Mid-Columbia. He said, however, that those data did not include progeny in the pool; so, captive progeny and wild data. Bob Rose asked if genetic samples were obtained from every adult, and Clement replied that samples were obtained from all wild adults. Keller said that Chelan PUD inherited archived larval juvenile data from efforts conducted below the Dalles Dam, but that those data have not yet been reviewed.

Hildebrand said that crossing downstream fish with upstream fish presupposes that downstream fish have greater genetic diversity, which needs to be proven first. Anders said that in order to test whether there is a difference between upper and lower fish, there need to be representative populations from both locations. McLellan said that the only advantage to crossing upper and lower fish is to demonstrate survival, as the benefits in progeny would not be apparent until 25 years later. Rose questioned whether a large enough sample size could be obtained for a valid study. Further, he asked how far downstream is "downstream," and whether there is a difference between fish from Bonneville and fish from below Bonneville. He added that recent research indicates that that these fish are all the same. Hildebrand disagreed that recent research indicates that all fish are "the same." He added that there are major behavioral differences that cannot be fully quantified; however, they should still be considered.

McLellan asked what the ultimate goal is for stocking; and Hillman asked what needs to happen for an effective M&E program, and in Chelan PUD's case, to put out harvestable numbers. McLellan asked if fish should be grown larger and stock fewer, if stocking strategies should be adjusted, or whether what is currently written in the plan should just be continued. Hemstrom said that growth rates will determine whether there is density dependence; and added that ecological concerns also need to be considered. He said that with all of the unknowns it is difficult to determine where to go, and how fast or slow is the best way to get there. McLellan said that if the goal is growth then fewer fish would be needed. He added that density dependence can then be evaluated through recapture, and if the process moves too slowly, the effects of growth will be harder to monitor. Irle suggested that Chelan PUD ask Steve Hays what he intended by inserting the "harvestable numbers" language into the MP. Hemstrom said he thinks that survival in the Rocky Reach Reservoir will be high. McLellan asked, then, if the goal is conservation and maximizing genetic diversity. Hildebrand said that the carrying capacity of sturgeon is unknown, and he added that arbitrary numbers are known, but the genetic considerations are not applicable to sturgeon. McLellan said that larval

collection can represent allelic diversity, and if high survival can be achieved, a large number of fish do not need to be stocked, from a conservation perspective. Rose said that sufficient levels of monitoring need to be determined. He asked, regarding ecological impacts, if there are enough resources in place to make a meaningful interpretation; and he added that he does not believe so. He also said that he does not believe that adequate resources are in place to make determinations about carrying capacity. Anders said that it would be advantageous to obtain agreement on diagnostic metrics for different ecological conditions. He said without that, there is no plan to obtain those data. Hildebrand said that it is serendipitous—that these fish will start preying on other fish once they grow large enough, and at that point, impacts to other species will be apparent.

7. **Concluding Remarks and Next Steps** (Tracy Hillman): Tracy Hillman thanked Douglas PUD for hosting this first annual Mid-Columbia Regional Sturgeon Workshop. He also thanked Kristi Geris of Anchor QEA for developing and distributing the Workshop minutes. He said that this Workshop will likely be held annually, and thanked everyone for their participation.

List of Attachments

Attachment A – List of Attendees

Attachment B – Naturally Produced Larvae: A New Approach to White Sturgeon Conservation
Aquaculture

Attachment C – Considerations: Egg and Larval Collection for Stocking

Attachment A List of Attendees

Name	Organization
Tracy Hillman	BioAnalysts
Kristi Geris	Anchor QEA, LLC
Bob Donnor	Douglas PUD
Andrew Gingerich*	Douglas PUD
Chas Kyger*	Douglas PUD
Steve Hemstrom	Chelan PUD
Lance Keller	Chelan PUD
Mike Clement	Grant PUD
Jim Powell	Freshwater Fisheries Society of British Columbia
Paul Anders	Cramer Fish Sciences/University of Idaho
Larry Hildebrand	Golder Associates
Paul Grutter†	Golder Associates
Pat Irle*	Washington Department of Ecology
Chad Jackson*	Washington Department of Fish and Wildlife
Brad James	Washington Department of Fish and Wildlife
Tucker Jones†	Oregon Department of Fish and Wildlife
Christine Mallette†	Oregon Department of Fish and Wildlife
Bob Rose*	Yakama Nation
Jason McLellan*	Colville Confederated Tribes
Matt Howell	Colville Confederated Tribes
Bret Nine	Colville Confederated Tribes

Notes:

- * Denotes Aquatic SWG member or alternate
- † Joined by phone