PRCC Hatchery Subcommittee Meeting

Wednesday, May 17, 2017
GPUD Wenatchee Office
Meeting Summary

PRCC HSC Members
Matt Cooper, USFWS
Brett Farman, NOAA (via phone)
Bill Gale, USFWS
Peter Graf, GPUD (alt)
Keely Murdoch, Yakama Nation
Todd Pearsons, GPUD
Mike Tonseth, WDFW
Kirk Truscott, CCT

Other Participants
Deanne Pavlik-Kunkel, GPUD (via phone)
Elizabeth McManus, Facilitator (via phone)
Andy Chinn, Facilitator (via phone)

Decisions

There were no decisions made during the May meeting.

Actions

1. For Coho NNI, GPUD will look at adult loss between Priest Rapids and Rock Island and how that can be accounted for in project returns and also the loss of hatchery juveniles prior to arriving at the Priest Rapids Project.
2. GPUD will circulate the Excel file, PowerPoint file, and draft SOA on Coho NNI for HSC members to review prior to the June meeting.

I. Updates and Meeting Summary Review

A. PRCC – The PRCC recently discussed the right fishway at Wanapum Dam, which is currently not operational and is under inspection. There is currently no timeline for repair. The left fishway remains operational.

B. March Meeting Summary – HSC members deferred approval of the March meeting summary until the June meeting.

C. HCP – *Note: See Appendix A for summary of joint HSC-HCP discussion during May HCP meeting.*

II. Coho NNI

A. Context for NNI Calculation and Survival Estimate – GPUD provided a presentation that covered the overview of hatchery mitigation calculations, methods of recalculation (including required variables), applying recalculation methods to Coho, mitigation schedule, and committee roles and responsibilities (link to presentation). At the end of the presentation, the HSC discussed next steps including data needs, NNI methodology, fish distribution, and schedule for contracting.

- WDFW noted the importance of documenting the data and decision making process,

for future reference.

- YN commented on the importance of consistency in the calculations across all species.
- WDFDW noted that the Rock Island count is used as a surrogate because of the apparent bias at Priest Rapids, and if the fish counts at Priest Rapids are getting closer to Rock Island counts, the Priest Rapids data set may be usable by 2023.
- USFWS inquired about accounting for the loss of adults between Priest Rapids Dam and Rock Island Dam and expressed the desire to have these refinements included in the estimate.
- Grant PUD noted that if refinements to the methodology are to be made, then they should also include accounting for the mortality of hatchery smolts prior to arriving at the Priest Rapids Project. The USFWS was interested in seeing both sets of refinements.

B. Next Steps

3. GPUD will look at loss between Priest Rapids and Rock Island and how that can be accounted for in project returns and also the loss of hatchery juveniles prior to arriving at the Priest Rapids Project.
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    - GPUD will circulate the Excel file, PowerPoint file, and draft SOA on Coho NNI for HSC members to review prior to the June meeting.

III. Wrap Up and Next Steps

A. Next Meeting: Wednesday, June 21, 2017

B. Potential Agenda Items:

- Coho NNI

Meeting Materials

The following documents were provided to HSC members in advance of this meeting:

- May meeting agenda
- Draft March meeting summary
- March White River rotary trap summary
- March Nason Creek rotary trap summary
- March PUD Hatchery progress report

Appendix A: Joint Agenda Item from January HCP-HC Meeting

III. HCP-HC/PRCC HSC Discussion

A. Epigenetics Presentation (Mackenzie Gavery)

Tracy Hillman welcomed Mackenzie Gavery to the Hatchery Committees meeting. Gavery said she is working on postdoctoral research with Penny Swanson (NOAA) and Krista Nichols (NOAA) and coordinating with Winthrop National Fish Hatchery (NFH) staff to study the influences of hatcheries on DNA methylation in Methow River steelhead. Gavery said her presentation, "Epigenetics: what is it and why is it relevant to hatchery practices?" (Attachment B), will include an overview of epigenetics, discussion of a specific genetic mark called DNA methylation, and its functions and relation to the environment, and then she will present results for the Methow River steelhead DNA methylation study. A summary and questions and comments are included in the following sections.

Background (Slides 1-10)

Epigenetics refers to heritable changes in trait or phenotype caused by a mechanism other than mutation to the DNA sequence. The epigenome of an organism provides the instruction for which genes should be expressed; it regulates the functional aspects of the genome.

An organism's phenotype is influenced by its genes (DNA), its environment, and its epigenome. Unlike DNA, the epigenome can be changed by signals from the environment. In certain cases, epigenetic changes can persist in an organism or be passed to subsequent generations even after the environmental signal is removed.

Of the multiple epigenetic pathways, DNA methylation is the most studied and the focus of Gavery's research.

DNA Methylation (Slides 11-42)

Gavery reviewed the function of DNA methylation, how environmental factors (e.g. toxins, temperature, behavior) have been shown to affect DNA methylation and how DNA methylation state can be inherited. Gavery emphasized environmentally induced epigenetic changes are more likely to be persistent/heritable when exposure occurs during early development.

Todd Pearsons asked what controls which parts of a gene are methylated. Gavery said during mitotic cell division, methylation is on each strand of a Cytosine-Guanine (C-G) base pair, so when the double-helix separates, an enzyme replaces the methyl group on each side of the strand. She said the process for controlling methylation during meiotic cell division is less clear. She said it could be a combination of noncoding RNAs attending certain portions of the genome, but factors determining methylation during meiosis are still being researched. She said there is a clear association between

genetics and epigenetics and multiple epigenetic markers work in concert to control gene expression.

Tracy Hillman asked if methylated C-G base pairs anywhere in the codon influence the reading of DNA strands. Gavery said yes, promoter gene sequences play an important regulatory role and methylation in a gene can influence splicing.

Gavery summarized that DNA methylation can be adaptive if the embryonic environment and adult environment match, but can also be maladaptive if they do not match.

Epigenetics: Relevance to Hatchery Programs (Slides 43-68)

Salmon and steelhead reared in a hatchery are phenotypically different than wild fish. Some of the phenotypes, including reduced reproductive success of hatchery fish, are associated with a loss of fitness. Hatchery-induced selection (domestication) or environmentally induced, heritable, epigenetic change could be mechanisms for these fitness losses. Some differences in the environment of wild and hatchery fish that could influence the epigenome include light, temperature, water chemistry, olfactory clues, and available nutrients. Gavery is studying whether there are discernable epigenetic differences between hatchery- and natural-origin steelhead at Winthrop NFH. The project collected returning hatchery- and natural-origin adult steelhead in 2014 and took blood and sperm samples. This research found that hatchery- and natural-origin fish in this system are differentiated by epigenetics. Previous research found that hatchery- and natural-origin fish in this system are not genetically distinct. Larissa Rohrbach (Anchor QEA, guest) asked how other populations of steelhead would compare on the PCA. Gavery said she expects different populations would be distinguishable on the PCA. This project's DNA methylation analysis was performed on red blood cells and sperm cells in order to look at both somatic and germ-line cells (which are passed on to the next generation). Results show steelhead have a heavily methylated genome compared to other species. Comparisons of differentially methylated regions (DMRs) between red blood cells and sperm cells show sperm carry important epigenetic information regarding which genes are going to be turned on in the early embryo. Results also show there are differences in DNA methylation between hatchery- and natural-origin steelhead in both somatic and germline-derived cell types. This research is an important first step in understanding the role of epigenetics in the observed fitness loss of steelhead after a single generation of rearing.

Gavery emphasized that epigenetics can help organisms retain and pass on information about their environment and epigenetics is an emerging field that will help understand how the environment affects phenotype in hatchery fish. Genetic and epigenetic variation can be assessed when considering fitness loss in populations.

Gavery said a second study is underway at the NMFS Manchester facility wherein offspring from natural-origin Methow steelhead families are divided into two groups and reared in a hatchery tank

and an artificial stream. Because the fish are siblings and will have similar genomes, differences in epigenetics between the rearing environments will be assessed.

Questions and Comments

Tom Kahler asked if specific genes were identified that were differentially methylated for hatchery- and natural-origin steelhead. Gavery said the research focused on the function of the genes and there are multiple functional classes associated with methylated areas.

Kahler said other research has found differences in wound healing, immunity, and metabolism between groups of study fish. He asked if that persists to a second or further generation. Gavery said her research focuses on a specific cell type, which does not functionally overlap with genes regulating wound healing so it is unclear whether that change would persist.

Greg Mackey asked about the timing and intensity of exposure needed to elicit epigenetic change. Gavery said the timing of exposure appears to be more important than the intensity or length of exposure and early gestational periods are very sensitive to environmental conditions. Rohrbach asked if the most sensitive timeframe is known for fish. Gavery said epigenomes are especially sensitive to change when germlines develop. Rohrbach said when thinking about hatchery rearing affecting phenotypes, this sensitive period could be as short as one day during incubation. Gavery agreed and said epigenetics could be used as a tool, in aquaculture for instance, to effect positive phenotypic changes in a short period without expending as much energy throughout the entire rearing process. Kahler asked if Gavery is familiar with anyone using epigenetics for those kinds of applications. Gavery said she expects epigenetics research is being applied in sole aquaculture and provided an example of an application in plants where high-producing phenotypes are selected for cloning (oil palms).

Bill Gale asked if research so far has shown that reductions in relative reproductive success in hatchery fish carry through more than one generation, and if so, what is the timeline for reversing those epigenetic effects. Gavery said that is currently unknown, but in plants phenotypic changes can persist for 20 generations before reversing; but since the next generation of hatchery fish is being reared in the wild, the impact may or may not erase after just one generation. Kahler said some studies in humans and mouse-models show three to four generations are common, but others have found the persistence of epigenetically induced phenotype persisting for 84 generations. Gavery added teleosts have a high rate of methylation and some fish populations seem to have more environmentally sensitive genotypes than other groups of fish or species. Gale said persistence to a second or further generation in hatchery-origin fish could be a combination of domestication and epigenetic effects, and domestication effects could be longer lived than epigenetic effects. Gale said it would be interesting to see the evolutionary difference in epigenetic effects between different groups of fishes, such as sharks, which are commonly used for biomedical research. Gavery said

invertebrates, for example, have much less methylation than teleosts. She said methylation is a tool and different organisms adopt it for different purposes in different evolutionary lines. Kahler added that some species use acetylation and other molecules instead of methylation as tools for epigenetic change.

Catherine Willard asked if methylation in fish species can be reversed by diet, such as high-soy diets. Gavery said in trout, high-methyl diets have been shown to help reverse methylation. She said humans, in contrast to fish, reset methylation regularly although certain regions do not change (imprinted genes are probably more sensitive to transgenerational signals) and diet does appear to affect methylation reversal. She said fish do not reset their methylation in the same way, so they are perhaps more susceptible to transgenerational effects. Gavery emphasized that epigenetic research in fish, especially non-model species, is a really new field and while so much is still unknown, researchers need to be careful when extrapolating results for species in different evolutionary lines.

Hatchery Committees representatives present thanked Gavery for her presentation.

USFWS Bull Trout Consultation Update (Matt Cooper)

Matt Cooper said Karl Halupka (U.S. Fish and Wildlife Service [USFWS]) sent him an update on USFWS consultations, which he summarized as follows:

- Halupka said he is still revising the draft Biological Opinion (BiOp) for the batch of Wenatchee subbasin programs and expects it will be finalized in mid-June 2017.
- Halupka has no other progress to report on consultations in the upper Columbia River.

NMFS Consultation Update (Brett Farman)

Brett Farman said Emi Kondo (NMFS) has been working on consultation for the unlisted programs in the upper Columbia River. He said the proposed actions will likely be finished in June and any questions regarding that consultation should be directed to Kondo.

Farman said Charlene Hurst is working on the Methow steelhead consultation and coordinating with various people on data requests. He said there is a consultation update meeting schedule for June 1, 2017, and if any additional parties would like to attend, please alert Hurst. He said the Twisp steelhead discussion should be finalized soon, which will also inform this consultation.

Wells Hatchery Power/Water Outage (Mike Tonseth/Tom Kahler)

Mike Tonseth said Wells Fish Hatchery experienced a power and water outage on May 2, 2017. He said the power disruption shut down the main well field for the hatchery and even though staff turned on the pumps to the main raceways, there were issues getting enough water to the main incubation building, perhaps due to an airlock that occurred when the well field back up was restarted, preventing the well water from reaching the incubation area.

Tonseth said approximately 20,000-25,000 steelhead fry (of unknown origin) were lost, and a few hundred Chinook fry, but he does not expect this to impact the overall production obligation. Greg Mackey clarified that the fry were sucked into pipe headers and then came out of headers into other tanks (e.g., the sturgeon tank) where hatchery staff attempted to retrieve them but were not entirely successful.

Mackey said the source of the outage was a blown fuse in the dam after power was reestablished after a planned shutdown. The blown fuse knocked out the three-phase power (which the hatchery pumps run on), so dam operators, electricians, and hatchery staff worked to turn on the backup generators, then switch to surface water. Mackey said the surface water was shut off quickly after it was turned on because the water had become stagnant and foul while in the pipe. Mackey said it is not clear whether the well water was prevented from reaching the incubation area by an airlock or not, but there are multiple high points in the pipes of this system where Douglas PUD will be placing air-relief valves. He said this facility will be used for sturgeon, trout, and other species in the future, rather than steelhead or Chinook.

Kirk Truscott asked if the backup plan of switching to surface water worked. Tonseth said it did work; however, the water was determined not to be suitable for fish, so staff switched back to groundwater. Truscott asked which stocks were affected by the fish loss and said the Okanogan program is relatively limited on natural-origin fish. Mackey said he does not think that natural-origin fish were part of the loss, because they would have been in trays instead of start tanks. Tonseth said most of the fish loss was from start tanks and one tray was lost. Kahler said the earliest spawned fish (Wells stock) were more likely killed than other stocks. Tonseth summarized that the fish loss will likely not be detrimental to production obligations; however, it is a fish kill and Douglas PUD has implemented facility improvements to address this.

Wells West-ladder Trapping Contingencies (Greg Mackey)

Greg Mackey said the West-ladder Trap at Wells Dam traps fish, which are then transported through an underground pipe to a new adult holding pond. He said Douglas PUD has found that the extension from the old pipe to the new pipe is not designed in a satisfactory way and is being updated. He said a lot of water flows through this 30-inch diameter pipe and there is no dewatering screen before the water enters the pond. He said decreasing the water flow in the pipe could result in fish being trapped and using the desired amount of flow results in too much water in the pond. He said Douglas PUD is working with fabricators to increase the pipe diameter (from 18" to 30" for almost the enire length) and install a dewatering screen. Currently, WDFW is trapping spring Chinook salmon manually at the West-ladder and trapping as usual at the East-ladder. Manual trapping at the West-ladder includes catching fish with a net in a method approved by the Wells HCP Coordinating Committee in 2016. Tom Kahler said so far 12 spring Chinook salmon have passed Wells Dam and the run is later than usual this year. Mackey said that when the West ladder is trapping, the West-

ladder is blocked by grating, so fish continue left into a Denil fishway, then into a holding box. He said the operator can use a diverter to pass fish to the holding pond or through the system. He said the improvements to the pipe should be complete very soon.

Review Hatchery M&E Plan Objectives (All)

Tracy Hillman said the Hatchery Committees are beginning to review the objectives in the Hatchery M&E Plan[1] in order to update the Plan. He suggested the review of objectives start with Table 1, which includes program objectives, indicators, and goals for conservation hatchery programs including productivity and monitoring indicators.

Hillman said the first objective is to "determine if the program has increased the number of naturally spawning adults" and its indicators are abundance of natural spawners and adult productivity (i.e. natural return rates [NRRs]. There were no issues raised with this objective or its indicators.

Hillman said the second objective is to "determine if the proportion of hatchery fish affects freshwater productivity" and its indicators are residuals vs. proportion of hatchery-origin spawners (pHOS) and juveniles per redd vs. pHOS. Greg Mackey said there are two issues with this objective. He said getting a good estimate of freshwater production is hard, especially in the Methow basin. He said there are also limiting life stages or factors that could influence hatchery operation, which is not considered in this objective and is not captured by using rotary screw smolt traps. He said, for example, if there was no limiting factor in freshwater, programs could confidently boost the hatchery production of smolts. Alternatively, he said if habitat was a limiting factor in freshwater, programs would not want to boost production of smolts because that would result in no increase or possibly decreased natural origin production—the habitat would have to be fixed first. Hillman said for Chiwawa spring Chinook salmon, freshwater production can be estimated. He said there are estimates of total number of migrants, summer parr, and smolts produced within the Chiwawa River basin. No density dependence has been observed with total migrants; however, there is evidence of strong density dependence in parr and smolt production. Comparing the residuals from the stock-recruitment relationships with pHOS indicated no relationship, suggesting that the proportion of hatchery orirgin spawners has not negatively affected productivity of Chiwawa spring Chinook salmon. He said the Nason Creek program could be analyzed in the same way, because total migrants and smolt production within Nason Creek is known. Hillman asked if this objective should be reevaluated, considering the Methow basin data are questionable. Mackey said the key step is to develop a better estimate of freshwater productivity and while the methodology for doing this is being improved in the Methow basin, this objective is okay as it is written. He cautioned that precise estimates do not equate to accurate estimates (using an example where increasing the number of

[1] Hillman, T., T. Kahler, G. Mackey, J. Murauskas, A. Murdoch, K. Murdoch, T. Pearsons, and M. Tonseth, 2013. Monitoring and Evaluation Plan for PUD Hatchery Programs: 2013 Update. Report to the HCP and PRCC Hatchery Committees, Wenatchee, Washington.

sites reduced confidence intervals, but caused the true number not to be captured within the confidence interval) and emphasized that the methodology for estimating freshwater productivity can be improved. No changes were requested to this objective because improvements to methodologies are underway.

Hillman said the third objective is to "determine if run timing and distribution meets objectives" and has the indicators of migration timing, spawn timing, and redd distribution. Hillman said in general wild and hatchery fish should have the same migration timing, spawn timing, and redd distribution; however, there are exceptions, e.g., Wenatchee summer Chinook salmon, which the Committees indicated should be segregated. Hillman said the exceptions are outlined in the Appendix to the Plan. Todd Pearsons suggested adding a footnote to this objective and citing the appropriate appendix to review for deviations from the indicator targets. Bill Gale asked how migration timing is quantified. Hillman said it depends on the stock, but usually includes counts at mainstem dams and other locations (such as Bonneville Dam, Priest Rapids Dam, Rock Island Dam, Dryden Dam, Tumwater Dam, and wiers, or for Methow and Okanogan programs, Wells Dam). Tom Kahler said the metric for comparing migration timing is mean Julian date. Hillman said wild and hatchery stocks are compared using cumulative frequency plots and differences in 10%, 50%, 90%, and mean timing.

Regarding all objectives, Pearsons asked if there is a time at which sufficient data could be collected that the committees could say an objective is addressed, and although data could continue to be collected, a difference in result would not be expected (unless the program is changed). In such a case, pehaps the variable no longer merits annual assessment. He suggested considering variables where there is a high degree of correlation year to year, such as spawning distribution. Mackey said he thinks it would not be removed from the list of objectives, but monitoring frequency could be changed. Gale said most of the monitoring pieces are used to make management decisions for hatchery programs anyway, so he does not see how frequency would be changed. Pearsons said some of the variables like spawn timing or spawn distribution answer multiple objectives anyway and emphasized that the M&E Plan is supposed to assess the performance of the hatchery and its effect on natural populations.

Pearsons said the target for spawn timing is "no difference;" however, there should be a difference in spawn timing depending on elevation. He said if hatchery fish are spawning lower in a river, they may spawn later than upper river fish. Kirk Truscott said this indicator could be assessed for fish in the same location at the same time. Gale said the differences in distribution may be subtle enough to not appear in this analysis, because the surveys are weekly. Mike Tonseth said steelhead have protracted spawn timing, which appears to be more related to temperature gradients than elevation. Hillman said his opinion is that differences in spawn timing should focus on biological significance rather than statistical significance. He said he will also add a footnote to this objective for spawn timing.

Hillman said the fourth objective addresses genetic diversity and population structure and suggested the Hatchery Committees review McLain Johnson's genetic monitoring update at the June 21, 2017, Hatchery Committees meeting before discussing this objective. Members present agreed.

Hillman said the fifth objective is to "determine if hatchery survival meets expectations," and its indicators include hatchery return rates (HRRs) being greater than NRRs and greater than goals set for each program. Hillman said the updated appendix includes HRR targets and he will make sure the Plan is consistent with the appendix. No other issues were raised with this objective.

Hillman said the sixth objective is to "determine if stray rates of hatchery fish are acceptable," and its indicators include out-of-basin and in-basin stray rates. Gale suggested editing this to say, "recipient stray rates," and Hillman made that change. Hillman pointed out that the table does not include brood year stray rates. He said this discussion can continue at the June 21, 2017, Hatchery Committees meeting. The seventh and eighth objectives can also be discussed at that time.

Methow Steelhead Gene Flow Plan (Greg Mackey)

Greg Mackey shared a spreadsheet titled "Methow Steelhead Gene Flow Analysis," which Sarah Montgomery distributed to the Hatchery Committees on May 16, 2017 (Attachment C). Mackey said Michael Humling (USFWS) and Charlene Hurst also contributed todevelopment of the gene flow management sliding scale.Hurst said she will use whichever plan the Hatchery Committees agree to while writing the Methow steelhead BiOp. Hurst said this plan includes achieving a pHOS of 0.3 for most run sizes. Mackey said that the original plan was to adapt the spring chinook Methow sliding scale to steelhead, but found that this approach did not work very well because of the compressed zone between low run size (300) and recovery target (1,000). He said instead of a sliding scale, this plan is a two-part scale. The plan operates by achieving 500 total spawners at all time at runs below 300 wild fish, regardless of pHOS. Once wild fish number 300 or more, the plan targets pHOS of 0.30. Mackey said he estimates based on the assumption of program performance that a proportion of natural-origin broodstock (pNOB) of 0.9 and a proportionate natural influence (PNI) of 0.75 could be reached.

Keely Murdoch said she is uncomfortable with this gene flow plan. She said in 2013, the Hatchery Committees came to an agreement about pHOS, PNI, and gene flow for the purposes of permitting, which Craig Busack described in a document. (Note: Busack distributed the document, Methow Basin Management Frameworks for Spring Chinook and Steelhead, via email to Hatchery Committees representatives on June 10, 2013, and Montgomery sent it again to the Hatchery Committees distribution list on May 17, 2017, following the meeting). Murdoch said the 0.3 pHOS in the current gene flow plan proposal stems from the Hatchery Scientific Review Group (HSRG) guidelines, which are recommendations, not laws. Hurst said NMFS intends to permit the most scientifically defensible gene flow plan possible, and the one presented today is a proposal for discussion. Hillman asked Murdoch to describe Busack's 2013 gene flow document. Murdoch said the document included a

phased approach to reaching a pHOS of 0.5 over the entire basin from October 2013 to October 2020 (phase 1), and to a maximum pHOS of 0.25 in spawning habitat upstream of hatcheries and unrestricted pHOS below hatcheries from October 2020 to October 2023 (phase 2). She said the document also includes a maximum for total steelhead releases, specific information for the Twisp River, and a phased approach to reaching different levels of pHOS in different areas. Hurst asked how that plan would be implemented, because there is no weir in the upper Methow basin. Murdoch guessed that it would be implemented through fisheries and specific release locations for fish with upper basin releases limited. Mike Tonseth recalled that there was uncertainty at the time as to how effective the hatchery can be in attracting hatchery adults back to the facilities. He said there are limited data available now to inform this, and it is still in development. Bill Gale said the other intent of the 2013 plan was to provide a transition period from the old production scheme and levels to the newer production scheme with lower levels, and it would allow for more liberal allowances for pHOS knowing that programs are working through a shift.

Kirk Truscott said the HSRG included qualifications with their pHOS recommendations as well. He said the pHOS level, according to the HSRG, should be based on listing status and populations with low abundance may not be applicable. Mackey said in the Methow, the recommendation at the time was to have a 100,000-steelhead release program. He said Douglas PUD thought at the time that they could achieve a pHOS of 0.25 with some assumptions about adult fish removal at hatchery outfalls. Mackey said the level of scrutiny of the programs has increased and there is the real possibility of a lawsuit concerning the consultation; therefore, Douglas PUD wants to make sure their steelhead program is designed in the most scientifically sound way. He said looking to the future, Douglas PUD is responsible for 8,000 no net impact fish and the 140,000 inundation fish (with 40,000 fish in the Twisp River) that are currently released in the basin, and the steelhead program is further complicated because Winthrop NFH is the driver for the conservation program. Mackey said he did not include the safety-net program in this spreadsheet, but it would need to be included if that program stays in the basin. Mackey emphasized that this spreadsheet is just a first look at the basic shape of the curve for pHOS, pNOB, and PNI and how individual programs contribute to the numbers in this spreadsheet is still to be determined.

Hillman asked Hurst how NMFS would approach an initial pHOS target of 0.5. Hurst said NMFS currently prefers a pHOS target of 0.3, but she understands that it takes time to reach 0.3. Humling said another consideration is that it would take about 85% to 90% removal rates to get to a pHOS of 0.3, which would mean that a PNI of 0.67 would be reached at approximately the same time as a pHOS of 0.3, if not earlier. Tonseth said a phased approach similar to the 2013 approach could be considered. He said since recalculation, steelhead releases in the Methow basin have been capped at 350,000 fish and upper basin releases according to the 2013 approach would be capped at 250,000 fish. He said he likes the idea of a floating pHOS in the lower basin and more stringent pHOS in the upper basin. He said adult removal can also be increased in multiple ways and adult management

activities are also being evaluated. Tonseth said capping releases in the upper basin and moving in the direction of trying to reach a pHOS of 0.3 would be a good direction for steelhead in the basin. Hurst agreed that a phased approach might be appropriate to allow for program goals to be realized, but of course it depends on what the phases are and when they start. Hurst asked how many fish the Winthrop program was releasing at the time Busack wrote the 2013 document. Murdoch said Busack's framework document addresses that; it says the Winthrop NFH program will grow during the permit period from 100,000 fish to as high as 200,000 fish as feasible and consistent with a pNOB of 0.5. Gale explained that Winthrop NFH shifted to a 2-year rearing cycle and an increased program and reduced the spring Chinook salmon production on station to save space. He said the Winthrop program maximizes pNOB within the production range of 100,000 to 200,000 fish. Tonseth advocated for combining the 2013 phased approach with the current proposal. Gale said PNI and PNI goals should be calculated using a multi-population model. Murdoch agreed. Hurst said the bulk of the analyses will be completed with the 3- or 4-population model, but the Twisp program will inform these analyses so they are not finished yet.

Mackey said Douglas PUD wishes to release only the fish required to achieve desired purposes in the Methow basin and that might involve changing the proportions of fish in different programs. Tonseth said the ideal program would be appropriately sized so that fewer fish need to be removed as adults. Truscott said the size of the conservation program would ideally maximize recovery efforts, which could be different from the required mitigation level. Hillman summarized that there is more work to be done on the Methow steelhead gene flow plan and the Joint Fishery Parties are also meeting to discuss this. Hurst emphasized that the final gene flow plan should be communicated to her by the end of June so she can write the BiOp.

Truscott asked why the proposed gene flow plan includes meeting a pHOS of 0.3 at 500 fish instead of 750 fish. Mackey said the goal of the plan is to reach 0.3 at the lowest run size possible once 500 total spawners are achieved (and 500 is used because it is a standard, widely-used minimum population size for conservation purposes).

Hurst asked if the future of Twisp broodstock has been decided yet. Gale said 2017 broodstock collection was decided, but parties are still discussing 2018 and future years. Gale said he approves of mixing the smolt age of releases in the conservation program and releasing S2s in the Twisp and S1s in other areas (which would only work if the Twisp and Winthrop programs are composited). He said these elements would maximize diversity of brood years returning and increase the number of age classes and family sizes on spawning grounds. Tonseth said he also advocates using a mainstem collection approach and using the Twisp weir as a back-up collection location. Mackey summarized that the future of the Twisp program will be decided soon and that the gene flow model can be finished by the end of June.