FINAL

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ANCHOR QEA

Memorandum

To: Wells, Rocky Reach, and Rock Island HCP Hatchery Committees, and Priest Rapids Coordinating Committee Hatchery Subcommittee

Date: March 17, 2021

From: Tracy Hillman, HCP Hatchery Committees Chairman and PRCC Hatchery Subcommittee Facilitator

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Final Minutes of the February 17, 2021, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, February 17, 2021, from 9:00 a.m. to 3:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

- Brett Farman will discuss with the National Oceanic and Atmospheric Administration (NOAA) staff and Mike Tonseth the potential use of a multipopulation model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A). *(Note: this item is ongoing.)*
- Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A). (*Note this item is ongoing.*)
- Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Salmon Outplanting plan based on historical run size data (Item I-A). (*Note this item is ongoing.*)
- All parties will provide updates on changes to monitoring and evaluation plans due to the impacts of coronavirus disease 2019 (COVID-19) on operations as updates become available (Item I-A). (*Note this item is ongoing.*)
- Kirk Truscott will determine the number of scales that should be collected from spring Chinook salmon at Wells Dam for elemental signature analysis to discern Okanogan River spring

Chinook salmon from Methow River spring Chinook salmon (Item I-A). (*Note this item is ongoing.*)

- Kirk Truscott will work with Colville Confederated Tribes (CCT) staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook Salmon at Wells Dam (Item I-A). (*Note this item is ongoing.*)
- Mike Tonseth and Greg Mackey will solicit input from hatchery managers on effective methods to count surplus fish (Item I-A). (*Note this item is ongoing.*)
- Representatives will review the NOAA research summary and Hatchery and Genetic Management Plans (HGMPs) presentation distributed by Tracy Hillman and consider whether to request the authors attend a future committee meeting to discuss their research (Item I-A). (*Note this item is ongoing.*)
- Catherine Willard will distribute a draft Statement of Agreement (SOA) seeking concurrence on the success of the Okanagan Sockeye Re-Introduction Program for approval in the March 17, 2021, meeting (Item II-A).
- Keely Murdoch and Mike Tonseth will obtain estimates of pre-spawn mortality from Andrew Murdoch to update the retrospective analysis for Wenatchee spring Chinook salmon (Item II-B). (*Note this item is ongoing.*)
- HCP-HCs and PRCC HSC members will prepare the final *2021 Broodstock Collection Protocols* according to the following schedule (Item II-C):
  - Mike Tonseth will prepare and Larissa Rohrbach will distribute to HCP-HCs and PRCC HSC members a revised draft by Friday, February 26, 2021.
  - HCP-HCs and PRCC HSC members will provide edits and comments to Rohrbach by Friday, March 5, 2021.
  - Permit holders (Chelan PUD, Douglas PUD, Grant PUD, and Washington Department of Fish and Wildlife [WDFW]) will provide and Rohrbach will distribute a final draft by Friday, March 12, 2021.
  - Final revisions will be addressed for approval in the Wednesday, March 17, 2021, meeting.
  - Rohrbach will distribute the final version to the HCP-CC by Thursday March 18, 2021.

Rock Island/Rocky Reach HCP-HCs

- Catherine Willard will prepare, and Larissa Rohrbach will distribute a plan for the release of Wenatchee steelhead in 2021, for approval in the March 17, 2021, meeting (Item IV-B).

Wells HCP-HC

- Matt Cooper will prepare, and Larissa Rohrbach will distribute a document describing sampling of Methow Conservation Program summer steelhead for early maturity, for approval in the March 17, 2021, meeting (Item V-B).

PRCC HSC

- None.

Decision Summary

- The Rock Island/Rocky Reach HCP-HC unanimously approved the *2021 Rocky Reach and Rock Island HCP Action Plan* without further revisions in today's meeting (Item IV-A).
- The Wells HCP-HC unanimously approved the *2021 Wells HCP Action Plan* without further revisions in today's meeting (Item V-A).
- The Wells HCP-HC unanimously approved that an additional 73,000 juvenile coho salmon may be acclimated at the Twisp Pond (operated by Douglas PUD) for the Yakama Nation (YN) coho salmon reintroduction program. Approval was provided by Douglas PUD, National Marine Fisheries Service (NMFS), WDFW, U.S. Fish and Wildlife Service (USFWS), and the YN during today's meeting, and by the CCT via email following the meeting (Item V-D).

Agreements

- The HCP-HCs and PRCC HSC agreed to the addition of Brandon Kilmer (Douglas PUD) to the email distribution list for final documents in the January 20, 2021, meeting (Item I-A).
- The HCP-HCs and PRCC HSC agreed to the addition of Andrew Gingerich (Douglas PUD) to the email distribution list for final documents in today's meeting (Item V-C).

Review Items

- The list of NMFS points-of-contact for programs and permits was distributed by Sarah Montgomery (Anchor QEA) for HCP-HCs and PRCC HSC review on December 18, 2020.
- The draft *2021 Broodstock Collection Protocols* will be distributed by Larissa Rohrbach for HCP-HCs and PRCC HSC review by Friday, February 26, with comments and edits due to Rohrbach by Friday, March 5, 2021.
- The draft 2021-2022 Priest Rapids Hatchery M&E Implementation Plan was distributed by Rohrbach on Wednesday, February 24, 2021 for 30-day review with comments and edits due to Todd Pearsons by Friday, March 26, 2021.

- The USFWS's Wells Fish Hatchery summer steelhead sampling request was distributed by Rohrbach on February 25, 2021, for review and approval by the Wells HCP-HC in the March 17, 2021, meeting.
- An Okanagan Sockeye Re-Introduction Program SOA will be available for HCP-HC and PRCC HSC review and approval in the March 17, 2021, meeting.
- A Wenatchee steelhead release plan will be available for HCP-HC and PRCC HSC review and approval in the March 17, 2021, meeting (details presented in today's meeting).

Finalized Documents

- The *2021 Rocky Reach and Rock Island HCP Action Plan*, distributed by Larissa Rohrbach on Wednesday, January 20, 2021, was approved as final.
- The *2021 Wells HCP Action Plan*, distributed by Larissa Rohrbach on Thursday, January 21, 2021, was approved as final.
- The *Priest Rapids Hatchery M&E Annual Report*, distributed by Larissa Rohrbach on Thursday, January 14, 2021 was finalized without further revision.

I. Welcome

A. Review Agenda, Announcements, Approve Past Meeting Minutes, Review Last Meeting Action Items

Tracy Hillman welcomed the HCP-HCs and PRCC HSC to the meeting and read the list of attendees signed into the meeting. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the COVID-19 pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda.

Keely Murdoch added a decision item seeking approval from the Wells HCP-HC for 73,000 juvenile coho salmon to be acclimated at the Twisp Pond (operated by Douglas PUD) for the YN, in addition to the other HCP program fish acclimated there in 2021.

No other additions were made to the agenda, and all HCP-HCs and PRCC HSC representatives approved the agenda. Revised minutes from the January 20, 2020, meeting were reviewed and approved by all members of the HCP-HCs and PRCC HSC.

Action items from the HCP-HCs and PRCC HSC meeting on January 20, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Brett Farman will discuss with NOAA staff and Mike Tonseth the potential use of a multipopulation model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said he and Tonseth will prepare a presentation for next month's meeting.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said this item is ongoing.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said this item is ongoing.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historical run size data (Item I-A).*
  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to monitoring and evaluation plans due to the impacts of COVID-19 on operations as updates become available (Item II-D).*
  This item will be discussed in today's meeting.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook salmon at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook salmon from Methow River spring Chinook salmon (Item I-A).*
  Truscott said this item is ongoing.
- *Andrew Murdoch (WDFW) will present pre-spawn mortality data during the February 2021 HCP-HC and PRCC HSC meeting (Item II-B).*
  This item will be presented in today's meeting. This item is complete.
- *Kirk Truscott will work with CCT staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook salmon at Wells Dam (Item I-A).*
  Truscott said this item is ongoing. CCT staff are currently summarizing the 2020 spring Chinook salmon return data to the Okanogan Basin and spawning ground survey information.
- *Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item II-B).*
  Tonseth said this item is ongoing and dependent on results presented in today's meeting.
- *Mike Tonseth will check on the WDFW policy for releasing unmarked surplus fish (Item II-C).*
  Tonseth said there are no requirements for marking fish in excess of 110% of hatchery production targets, as described in the permits. This item will be discussed with revisions to the draft *2021 Broodstock Collection Protocols* in today's meeting. This item is complete.

- *Mike Tonseth and Greg Mackey will solicit input from hatchery managers on effective methods to count surplus fish (Item II-C).*
  Tonseth said this item is ongoing but he plans to complete it with Mackey in the next week. This item will be discussed with revisions to the draft *2021 Broodstock Collection Protocols* in today's meeting.
- *HCP-HC and PRCC HSC members will review the list of NMFS points-of-contact for programs and permits provided by Brett Farman in an email distributed on December 18, 2020 (Item I-A).*
  Farman said this item is ongoing until next month's meeting.
- *Representatives will review the NOAA research summary and HGMPs presentation distributed by Tracy Hillman and consider whether to request the authors attend a future committee meeting to discuss their research (Item I-A).*
  Hillman said this item is ongoing.
- *Tracy Hillman will coordinate a workshop to discuss desired outputs and management scenarios to support Mark Sorel's Wenatchee spring Chinook salmon integrated population model.*
  Hillman said Sorel will reach out to Hillman and Rohrbach when appropriate to hold a workshop. This item is complete.
- *Kirk Truscott will provide, and Larissa Rohrbach will distribute information about a virtual meeting on the Chief Joseph Hatchery program to occur in March.*
  This information was distributed by Rohrbach on Thursday, February 18, 2021. This item is complete.

Rock Island/Rocky Reach HCP-HCs

- *Catherine Willard and Mike Tonseth will coordinate with USFWS regarding potential modifications to the Chiwawa Weir to allow Bull Trout passage during 2021 spring Chinook salmon broodstock collection.*
  Willard said she and Tonseth met with USFWS and will report on the outcome during the discussion of the draft *2021 Broodstock Collection Protocols* today. This item is complete.

II. Joint HCP-HCs and PRCC HSC

A. Okanagan Sockeye Comprehensive Evaluation Summary

Tracy Hillman welcomed Ryan Benson (Okanagan Nation Alliance [ONA]) and Howie Wright (ONA) to the meeting. Catherine Willard reminded the HCP-HCs and PRCC HSC members of the Statement of Agreement (SOA) approved by the Rocky Reach and Rock Island HCP-HCs on August 26, 2010, regarding Skaha Lake and Okanagan Lake Sockeye reintroduction in British Columbia (B.C.). She noted that the 2010 SOA states that the Hatchery Committees will conduct a comprehensive program assessment in 2021, and a determination would be made on whether or not the program

was a success. All documents regarding the program were provided in emails sent on November 25, 2020, and December 8, 2020, and a summary of the program progress was presented by Benson in January 2021. Willard said several of the current HCP-HC members were not present at the inception of the program, including herself, so Benson and Wright were invited to give a historical overview of the program. Wright and Benson gave the presentation titled *Okanagan Sockeye Re-Introduction Program Update* (Attachment B).

Slide 1 – *Okanagan Sockeye Re-introduction Program Update*. Wright presented the history of the program dating back to 2006 to 2007.

Slide 2 – Wright said fish passage has been corrected over several barriers in B.C. with the ultimate goal to reintroduce sockeye salmon into Okanagan Lake.

Slide 3 – Additional areas of salmon reintroduction work in Syilx Traditional Territory in the Fraser River Basin and Upper Columbia Basin.

Slide 4 – Traditional knowledge tells of how coyote brought salmon back to the people in the Columbia River and its tributaries. Wright said stories like this are a record of the Okanagan history and natural laws. Wright said there is a similar story about crayfish and the relationship with Chinook salmon.

Slide 5 – Project Rationale: Wright said the cultural and social significance makes sockeye salmon reintroduction a management obligation for the Okanagan Nation. Wright said conditions in Osoyoos Lake where sockeye salmon were previously limited are degrading; high water temperatures in the upper water column and low dissolved oxygen in lower water column causes crowding of juveniles and adults into a smaller vertical area of the lake.

Slide 6 – Project Background: Wright said the effort started with assessing the feasibility of sockeye reintroduction to Skaha Lake, leading to Bonneville Power Administration funding in 1998 and 1999 for a risk assessment. A technical working group was developed with the Department of Fisheries and Oceans Canada, B.C. agencies, and ONA to review technical issues in the Okanagan River Basin.

Slide 7 – Risk Assessment: Wright listed the main risks associated with the reintroduction (disease transmission among species, translocation of exotic species, and limits to the habitat capacity/potential for Skaha Lake). A Life Cycle Model was used to support reintroduction plan development. The result was the program presented low risk, and a 12-year pilot program was initiated to monitor success and impacts of the reintroduction.

Slides 8 and 9: Photographs from the first release events and monitoring work.

Slide 10 – Benson presented program milestones:

- 2003: First year of broodstock collection; approximately 300,000 eggs collected and fertilized.
- 2004: Initial year of the 12-year reintroduction experiment.
- 2007: First adult returns to the hatchery in Oliver, B.C. ONA initiated experimental radio-tagging of 30 adults transported to Skaha Lake to observe movements; some fish dropped back below the dam, but the majority of those remained in the channel.
- 2009: ONA initiated an effort to retrofit gates at McIntyre Dam, the migration barrier between Skaha and Osoyoos Lakes. Gates were modified from undershot gates to overshot gates and the retrofit was monitored for effectiveness.
- 2011: Dam operators assumed passage was not possible upstream of Skaha Lake. In 2011, high flows with elevated freeboard levels persisted into late spring and allowed hatchery sockeye salmon to enter Penticton Channel.
- 2014: Another experimental reintroduction into Okanagan Lake was carried out with 160 adults from Skaha Lake. Just over 30 were acoustic-tagged, others were spaghetti-tagged with a secondary operculum punch. About one-third dropped back to Skaha Lake, but a large component migrated to Mission Creek and spawned. This demonstrated the program's ability to transport adult sockeye salmon upstream and showed adult fish migration patterns.
- Since 2016: Fry have been outplanted to Okanagan Lake. Obtaining approval for fry releases from federal and provincial regulatory agencies has been a long process. The program started with ceremonial releases limited to 10,000 fry, split between three sections of Okanagan Lake.
- 2019: The Okanagan fishway was reactivated. At the time of dam construction, a fishway was constructed, but because there was not passage at McIntyre Dam (downstream), it was never activated. Since 2011, adult sockeye salmon have moved upstream in July and August, and a handful were arriving at the Okanagan Dam fishway. In 2019, it was a major milestone to remove the final barrier to Okanagan Lake. Fish were trapped and tagged to be able to track their movement in the lake. In 2019, the timing of trapping was slightly later than the peak of the run. In 2020, 41 adults were tagged and tracked with telemetry. High flows out of Okanagan Dam occurred, which were similar to 2011 and allowed a large number of sockeye salmon and some Chinook salmon to swim under the dam gates and into Okanagan Lake. A number of fish were detected at Mission Creek. Data analysis of movement patterns is ongoing. A record natural escapement occurred into Skaha Lake, with 38,000 fish into Penticton Channel and Shingle Creek. Shingle Creek runs past the hatchery, captures hatchery effluent, and is the location for fry volitional releases.

Slide 11 – Skaha Lake natural production by year: Benson said natural production depends on river flows that affect the height of natural falls and dam gates. Adult fish pass under gates during high flows and at lower flows they will navigate the fishway with variable success depending on the flow.

Benson said an overall average survival was applied to fry survival to estimate natural smolt production from the previous year's escapement.

Slide 12 – Okanagan Lake Program: Benson said that in 2018/2019, conditional approval was obtained for outplanting fry to Okanagan Lake, contingent on development of a monitoring and evaluation (M&E) plan agreed to by the Canadian Okanagan Basin Technical Working Group (COBTWG). A final version of the M&E plan was approved in spring 2020. In the interim, work went forward as long as monitoring of five metrics occurred: hybridization with kokanee, competition with kokanee, disease, smolting, and residualization. Benson showed hatchery stocking numbers by year from 2016 through 2020. Larger numbers were available in 2017 and 2019; decisions on the number to outplant depended on overall status of the population. Only 10,000 offspring of BY 2020 were outplanted. Smolt year 2020 (offspring of BY 2019) was a larger release and adults from that release should return this year.

Slide 13 – In 2019, the fishway was reactivated at Penticton Dam (the outlet of Okanagan Lake). Benson said the fishway was already in place; it was just a matter of removing boards in the fishway to allow 1-foot jump heights. Hydraulics, attraction, and passage efficiency were tested. Results from fall 2020 showed Bull Trout and kokanee were able to pass. Benson said the logic is that if a smaller, 20-centimeter Bull Trout can pass, adult sockeye salmon should be able to pass easily. Fish appeared to be moving up and down the fishway with ease.

Slide 14 – Benson said of the 41 acoustic-tagged adult fish transported to Okanagan Lake in 2020, preliminary results showed about one-third fell back and two-thirds migrated upstream, most to Mission Creek, a tributary to the upper lake, near Vernon, B.C. In 2019, 600,000 fry were split into three groups for release into Okanagan Lake at Mission, Equisis, and Trout creeks, and return numbers suggest a similar proportion returned to these three sites. All fry were marked with the same thermal mark. In recent years, the different release groups were marked differently and can be tracked based on release location in the future. Benson said Chinook salmon were also observed in Okanagan Lake and Chinook salmon reintroduction was part of the original intent of the ONA initiative in the 1990s.

At the conclusion of their presentation, Benson and Wright asked if there were any questions.

Keely Murdoch asked Benson to explain the driving factor behind variability in the number of fry released each year. Benson said it depended on the environmental conditions and escapement (of the parents). Fry production from BY 2015 was poor due to a near population collapse resulting from low flows and high water temperatures. The first adults from the poor 2015 spawning year returned in 2019. When escapement was very low, a decision was made to rebuild the Skaha Lake cohort first. Decisions are made on a year-by-year basis. For 2021, there was a high egg take (just over

4 million eggs), and it was suggested to split the resulting fry equally between Skaha and Okanagan Lakes. Benson said this will allow the program to repeat the hatchery experiment in Skaha Lake this year to determine differences in survival based on fry release timing (early, mid, late, and very late in September) in line with the idea that larger fry released later may be able to survive predation better.

K. Murdoch asked if there is a goal or target release size (number of fry) moving forward. Benson said the goal of establishing fish in Okanagan Lake has driven the program all along and the program has been approved for releasing up to 3.5 million hatchery fry each year. Benson said based on recent natural escapement to Skaha Lake, an argument could be made that it is a naturally reproducing population, though it may require supplementation with hatchery fry in some years. Benson said there is flexibility year-to-year on whether the focus should be rebuilding the Skaha Lake population or to distribute fish elsewhere, with a minimum of 10,000 ceremonial fry to be released into Okanagan Lake. Benson said the adult run resulting from the BY 2015 cohort will require rebuilding over several years. He said there are probably a dozen suitable tributaries in Okanagan Lake, though they have only monitored five kokanee-producing tributaries. He said although Okanagan Lake has lower productivity compared to Osoyoos and Skaha Lakes, it can likely outproduce the other lakes combined due to the scale of its headwater tributaries and potential for shore spawning (there is a large shore spawning kokanee population) but it remains to be seen if sockeye salmon will use the shore for spawning.

Wright said the original biological criterion was to release 1-gram fry depending on number of fry reared in the hatchery. He said there are a number of factors being monitored with regard to survival in the hatchery. An average of 60% survival with a range of 35% to 75% survival was observed in other sockeye salmon programs and was used as the basis for the Okanagan program. He said egg availability was limited in some years, which also depends on escapement to Skaha Lake. Wright said there are approximately 25,000 fish coming from the Skaha Lake population.

Benson said that based on intensive in-lake monitoring and bioenergetics modeling, there is an upper limit to the carrying capacity and survival in Skaha Lake; a winter growth check was observed with low zooplankton survival (there may have been a decrease in survival or a plateau). Benson said in-lake survival depends on natural escapement, kokanee escapement, and flows that can flush zooplankton downstream and every year is unique. Benson said reaching the carrying capacity of Skaha Lake may provide good justification for moving fish into Okanagan Lake in a given year.

David Duvall commented that historically the goal was to achieve fish returning to Skaha Lake by 2010 and 2011; however, while working under the current SOA and building the hatchery, the momentum increased to move fish beyond Skaha Lake. Duvall said ONA was critical in moving fish into Okanagan Lake much sooner than expected; it should be remembered that this program is 5 to

10 years ahead of what was initially envisioned. Duvall said this may be the source of some persistent uncertainty with the goals and adaptive management actions. Duvall posed the question, if the program has exceeded expectations, what is left to do?

Wright agreed that natural production in Skaha Lake happened a lot faster than expected—in less than 12 years—but Okanagan Lake was always the long-term objective. Wright said it was suggested back in 2008 that a capacity goal for Skaha Lake be identified for a combination of natural spawners and hatchery fry and the remainder of hatchery production can go into Okanagan Lake. Wright said the remaining question is what is the long-term natural spawner limit in Okanagan Lake? He said that in the 2000s, analyses suggested it is approximately 320,000 spawners to Okanagan Lake, at which point the future utility of the hatchery program could be discussed. In addition, Benson is developing a monitoring plan for in-lake hybridization and basic risk of sockeye salmon-kokanee interactions.

Todd Pearsons asked Wright to elaborate on uncertainties at the start of the project, what work was necessary to resolve the uncertainties, and what role did work in the Skaha Lake (e.g., limnology and risk assessment, etc.) play in getting fish into Okanagan Lake. Wright said the Skaha Lake work was about understanding interactions with kokanee, mysids, and bioenergetics; outcomes showed that the impacts to kokanee life history and the population were smaller than other things that occur in the environment (e.g., recruitment of *Mysis relicta*). Benson said the bioenergetics work showed that juvenile sockeye salmon ate 1% to 2% of available food and age-2 and age-3 kokanee are grazing far more extensively, even if sockeye salmon fry numbers were increased by a factor of 10. In addition, Benson said, after the sockeye salmon reintroductions (2003 to 2004), kokanee experienced a large increase. He said Okanagan Lake is a different system altogether. It is a much deeper lake, and the Skaha Lake bioenergetics model cannot be applied there, but it is promising that the kokanee population did so well in Skaha Lake. Benson said they have conclusively shown that the reintroduction of sockeye salmon did not cause a crash in kokanee.

Mike Tonseth asked whether a lower escapement limit exists at which point the hatchery program would not be implemented. Benson said when the pilot year kicked off and the 12-year experimental plan started, it was agreed that if the natural escapement to the Canadian portion of the Okanagan River was less than 10,000 fish, there would be no egg take so as not to reduce the natural production of the Osoyoos Lake population that is driving the whole system. He said the escapement trend is highly variable but has not been as low as in the late 1990s (about 3,000 natural spawners), which kicked off the process by the B.C. Provincial government and ONA to intervene before the population crashed to zero. Tonseth said climate predictions show there could be similar conditions in the Lower Columbia this year to those that caused a large die-off of sockeye salmon in 2015, coinciding with a low escapement predicted to Skaha Lake. Wright said yes, the numbers showed low

escapement to Skaha Lake, but there would still be additional escapement to Osoyoos Lake. Tonseth asked whether there is a plan for low-escapement years to take advantage of higher in-hatchery survival. Benson said that was part of the motivation for holding fry longer in the hatchery. There is only one year of data so far, but these outcomes will be tracked over several years. Benson said BY 2019 was a very low return for the basin, though egg take was twice as many as for BY 2015, leading to the rationale to plant all fry into Skaha Lake. He said in years of high hatchery egg production, there are more options available, such as splitting half of the fry into Okanagan Lake as they will do this year. Benson said there are no hard rules at this time—decisions will change year-to-year in consultation with ONA; the Grant, Chelan, and Douglas PUDs; COBTWG and climate predictions. He said climate predictions for the Okanagan Basin have not been very accurate with unexpected flow events. Wright said part of the restoration goal is to increase outplanting so as to have three populations in the Okanagan system among the three lakes. Wright said even in years with low returns to Osoyoos Lake, perhaps there could be a requirement to continue a stepwise outplanting to each of the three lakes to retain the population variation those options provide in low-escapement years. He said they are talking with different groups down-river about trap and transport to the lakes if in-river survival and/or thermal regimes are predicted to be hazardous. He concluded that one approach is to "place all eggs in one basket" in Osoyoos Lake, the second to continue splitting groups of fry releases, and another option would be to take drastic measures to trap and transport sockeye salmon in large groups to the lakes.

Kirk Truscott said risk is now more spread out with more production of adults and juveniles above Osoyoos Lake. He encouraged thinking out of the box to avoid collecting from fish that are contributing to the Osoyoos Lake population (to minimize risk to that population). He said managers may decide to take a larger risk to save fish returning to the reintroduced Skaha and Okanagan Lake populations by taking them into the hatchery for broodstock.

Hearing no other questions, Hillman asked the ONA representatives and each HCP-HC and PRCC-HSC member whether they believe the reintroduction program has been successful from their perspective and if not, why not.

Benson responded yes, they would definitely say it has been highly successful based on the original goals and uncertainties at the start of the 12-year experiment. He said some of those concerns and risks have been addressed, and at that time there was never any discussion of target numbers of adult returns because the idea that there would be natural returns to Skaha Lake was so far-off. He said there were record numbers of spawners that returned to Shingle Creek this past year, so many fish that the creek was red from bank to bank. Benson said there were other minor details, for instance, unknowns about a kokanee population crash or whether the same levels would be maintained. He said the program has demonstrated that there is no risk; there have been no

outbreaks of disease nor exotic fish migrations. He said the reintroduction has been a success based on population biology and based on feedback from community members. He said there was concern that the population was going to blink out in the Okanagan Basin, and there has definitely been positive response from the community based on press releases and feedback from the Okanagan Nation and its elders. Benson concluded that the program has been a success.

Wright added that initial feedback at the inception of the program was that there had not been much success in similar reintroduction efforts. That is, there were not many public documents on sockeye salmon programs that were proven to be successful at establishing natural production (e.g., Hanging Lake in Alaska and Upper Adams Creek in B.C.). Wright said this program has been successful, ultimately producing returns in the context of simultaneous restoration actions and changing ocean conditions.

Tonseth said on the grand scale, yes, the reintroduction has been largely successful, and a lot of the initial concerns have been resolved in a positive way. Tonseth said, from his perspective, because the SOA is in response to Grant PUD's and Chelan PUD's ability to meet obligations for mitigation, it will be important to have more consistency in the production target.

Truscott said he concurs that the program has been successful. He said the success was in large part due to efforts by ONA, in coordination with provincial resource managers. He said with the addition of Okanagan Lake, the future potential for success is even greater and he is encouraged.

K. Murdoch said she was a member of the HCP-HC during the inception of the program. She agreed that a lot of the early questions in 2010 have been resolved. She is encouraged by the expansion into Okanagan Lake, which opens large potential for sockeye salmon production. She said that in the context of the 2010 SOA, this has been a success. K. Murdoch said she likes the approach of adjusting the program based on run size year-to-year, but within the HCP-HCs, there will be a need to determine if mitigation by Chelan PUD and Grant PUD is being met.

Brett Farman said he is encouraged by the observations and he echoed what other members have said. Farman agreed that the sockeye salmon reintroduction program has been successful.

Matt Cooper echoed the comments by others and agreed that risks have been addressed, such as disease concerns and ecological impacts of introductions. Cooper said the program looks like it has been largely successful. Gale agreed and added that the Committees should communicate this success story to a wider audience.

Willard said she echoes others' comments on the success of the program. She congratulated ONA on achieving success at the political level as well. Willard said, regarding success relative to the 2010

SOA, she agreed that they were successful with credit for hatchery and natural production being achieved. Willard agreed there is a broader discussion to be had for defining future goals.

Pearsons said he agrees this program has been successful. He said that, thinking back on their position on the obstacles and the large amount of uncertainty and significant ecological, social, and political risks, it is hard to think about another project of this nature that has exceeded the success of this program in such a short time. Pearsons said, in context of the 2010 SOA, but also in a broad context of all projects to improve productivity in the Columbia Basin, the conclusion is yes, this is a success in terms of obstacles overcome and numbers achieved.

Greg Mackey said yes, the combination of the fish water management tool (Douglas PUD's mitigation obligation), hatchery production, and barrier correction/habitat restoration has been successful. There are few examples of successful population restoration at this scale. The only similar example may be striped bass restoration on the East coast.

Tom Kahler said he wants to commend the ONA as a success such as this is unprecedented. He said this has been incredibly successful. He said ONA has been an outstanding partner and this is the result of decades of collaboration. Kahler said it is especially important that the future of the sockeye salmon hinges on production in Okanagan Lake in context of climate predictions, as the population in Osoyoos Lake is on the precipice due to production capacity, eutrophication, and mid-summer water temperatures. Kahler said it is imperative that the population diversity be expanded into Okanagan Lake and that the run timing of the adults be diversified for the future of Columbia River sockeye salmon to survive climate change. He commends the Canadian partners on this success.

Hillman thanked everyone for their input and asked Willard about the timeline for SOA finalization. Willard said she will distribute a draft SOA demonstrating agreement among members on the success of the program for approval in the March 17, 2021, meeting. She said another SOA will follow on the future of the program, but it has not yet been drafted.

B. Pre-Spawn Mortality

Hillman introduced Andrew Murdoch and explained the need to understand pre-spawn mortality (PSM) rates to support an analytical tool for recalculating population size for Wenatchee spring Chinook salmon. A. Murdoch gave a presentation entitled *Chiwawa Spring Chinook Pre-Spawn Mortality* (Attachment C).

Slide 1 – A. Murdoch said he would present results for Chiwawa River spring Chinook salmon and that Mike Hughes (WDFW) is currently finishing the Nason Creek spring Chinook salmon results.

Slides 2 and 3 – A. Murdoch said the focus has been on female PSM, using recaptures at Tumwater and Wells Dams to estimate population level PSM with a long time series of data. He said in years of very low abundance, PSM is low, typically about 50%. He said monitoring was not done at the tributary scale. He said PSM numbers could be much higher if using observations made in the tributaries.

A. Murdoch noted a paper recently published by Tracy Bowerman and others (University of Idaho) using WDFW data. The paper is a result of her post-doctoral research at the University of Idaho on spring and summer Chinook salmon. Bowerman examined several populations from all over the Columbia Basin and found that for Wenatchee, Entiat, and Methow spring Chinook salmon, carcass-based PSM is very low, but her analysis only included the spawning period, so mortality during the holding period was not included. She considered these estimates as trends in PSM, not absolute values. A. Murdoch said this was a nice approach to modeling and included different factors such as temperature and carcass size. He said she included the holding periods for three streams and found a large increase in PSM if the holding period was included, more similar to what has been observed in the Methow and Wenatchee populations (a similar analysis was done in the Upper Yakima River at Rosa Dam and higher survival was observed, likely due to the artificial hydrograph). A. Murdoch said there are few surveys done during the holding period in general. He said carcass recovery probability of pre-spawn and post-spawn mortalities may not be equal and could be a source of bias in this type of work.

Slide 4 – A. Murdoch described their methods for estimating stream-based PSM using a combination of previously developed population models for the Wenatchee Basin. One previous model estimated numbers of fish entering tributaries of the Wenatchee River. There were high tag rates due to the Relative Reproductive Success study, providing unbiased estimates based on origin, sex, and age. Another previous model, the redd observer efficiency model, estimated escapements using data back to 2011 when passive integrated transponder (PIT-)-tag arrays were installed. A third carcass-based estimate of spawner numbers modeled the fish per redd (FPR) ratio. The final need was a stream-specific rate of PSM (the focus of today's talk). To address this, FPR was divided by the escapement for each tributary as an unbiased estimate of PSM. A model was then used to break down results by origin, sex, and age, and was adjusted by carcass observer bias.

Slide 5 – Carcass recovery model 2.0 used a FPR ratio at the population level; a newer approach can use PIT tags at the tributary level. One criticism was the need to separate PSM from carcass recovery probability. The dataset from the Relative Reproductive Success study from 2004 to 2013 provided fish observed on redds and subsequently recovered as carcasses. In the past, a model based on fish observed at Tumwater Dam was used, but it was unknown whether fish even survived to spawn. In this new case, spawning was observed, and it was determined that post-spawn behavior is the

primary driver of carcass recovery (e.g., leading to differences in recovery location between males and females driven by fish behavior). If post-spawn behavior is important to carcass recovery probability, PSM based on carcass recovery is unknown. Other covariates influence carcass recovery such as body size, channel type, and discharge variation.

Slide 6 – Hatchery and natural-origin fish had the same post-spawn behaviors and carcass recovery probabilities in the Lower Wenatchee River where the two groups spawn in close proximity. This removes origin as a contributing factor in the model.

Slide 7 – Channel type was a significant factor affecting carcass recovery. Some fish spawn in pool-riffle channels and some spawn in plane-bed channels (e.g., Lower Chiwawa River and Nason Creek). Raw recovery values generally indicate higher recovery probabilities in plane-bed channels, with a bigger difference among females. Males have a very low recover probability in both channel types, although slightly higher in pool-riffle channels. Plane-bed types have simpler channel complexity and carcasses are more likely to be flushed out of the reach.

Slide 8 – Other significant covariate effects include: thalweg coefficient of variation (CV) is a surrogate for channel complexity (within plane--bed or pool-riffle channels). In plane-bed channels, as thalweg CV increases, recovery probability increases. A different relationship is observed in pool--riffle channels. Discharge had a negative effect on recovery probability and discharge variability (a freshet metric) was a significant covariate, but post-spawning behavior caused differences in observability between sexes. A reduction in discharge allowed for more effective surveys for females, while; and increases in discharge allowed for males to be redistributed out of marginal edge habitat and become observed. Fish size was a significant covariate. Larger fish were recovered more often than smaller fish in pool-riffle channels. In plane-bed channels, size was not very important. Other covariates were tested but not found to be significant.

Greg Mackey asked about the meaning of the thalweg CV metric. A. Murdoch said it is a measure of thalweg depth every 3 meters along the length of the stream channel. He said sampling is not random; the stream channel is sampled where fish are known to spawn. He said thalweg CV is used as a constant representing channel complexity for each reach based on 12 to 15 measurements taken along a reach. He said reaches are not remeasured every year. Pool-riffle channels may change at small spatial scales but essentially at the reach scale they are more-or-less constant.

Slide 9 – A mostly unbiased model of PSM was developed, although there is a slight negative bias for jacks that tend to become lost in the system.

Slide 10 – A. Murdoch described the basic math that was done to estimate spawner demographics. Carcass samples were run through the model with a new male to female ratio. A FPR ratio was

produced and total number of spawners was estimated from the number of redds multiplied by FPR ratio to estimate the number of females and then deduce the number of males.

Slides 11 and 12 – A patch occupancy model was used to estimate FPR values. The Chiwawa River PIT-array was installed in 2008. The data showed variability was influenced by large jack years and FPR fluctuating up and down prior to 2012. Data represent fish entering the Chiwawa River (run escapement), not spawners observed, and are based on observations of fish tagged at Tumwater. The same analysis was done to model FPR-based on carcasses observed on spawning grounds. This effort showed strikingly similar results with only slight difference in male/female survival.

Slides 13 through 16 – Mean survival (by sex) in the Chiwawa River shows some slight differences over the years. Murdoch said these stream-specific data will be provided to Jeff Jorgensen (NOAA Fisheries) for use in his Wenatchee spring Chinook salmon life cycle model. This is the first estimate of male PSM, which appears to be fairly similar to female PSM, with slightly higher PSM among females. On average, wild females survive slightly better than hatchery females. This is the first estimate for wild and hatchery fish by sex.

Slide 17 – A next step is to start working on the Nason Creek dataset. Murdoch said they are struggling with what do to with sparse data (either due to low numbers of observations or low numbers of spawners). Hopefully, this new analysis will offer some conclusions. Assumptions will be made, for instance, if there is no prior information on escapement. He said the Little Wenatchee and White rivers are prime examples, with 20 to 40 redds and a handful of carcasses. The goal is not to make a Wenatchee or Chiwawa-specific model, but rather to leverage this model in a way that can be used by others and offer options depending on data availability. A. Murdoch emphasized that large carcass datasets are key to the accuracy of modeled predictions (e.g., reconstruction of the spawning population).

A. Murdoch will be comparing WDFW's stream-based estimates to Bowerman's stream-based estimates. He wishes to expand the estimates of PSM with tributary-specific estimates for the Entiat and Methow rivers based on PIT tagging at the off-ladder adult fish trap (OLAFT) and detections in the tributaries. He plans to roll this into a larger PSM model and life cycle model to identify mechanistic reasons for low PSM. Improving pre-spawn survival would give the Wenatchee spring Chinook salmon a huge demographic boost. Earlier modeling suggested density may be a significant factor, and temperature and flow are definitely factors, but where the mortality is occurring is unknown at this time.

Hillman thanked A. Murdoch and asked if there were any questions.

Mackey asked if the newer model could be applied to older data and whether the spawner estimates were biased over the longer dataset. A. Murdoch said this is part of the evaluation plan. Using the

earlier data, it was hard to determine whether the model was biased or if the data were poor quality. He said this work helped determine that the model worked well given enough data (as in the Chiwawa River during this time period). He said that, on the few occasions where the model over-predicted spawner abundance, few male carcasses were recovered. He said hopefully they can make recommendations for sampling after looking at the number of spawners, escapement, and PSM. The current approach calls for sampling (20% of tagged carcasses, but for small populations, perhaps it should be 50% of the carcasses). He said the amount of data needed also depends on how many bins are used for the data (e.g., sex, hatchery/wild, and age). He said they would like to work with the current data more to determine whether the Wenatchee PSM model can be applied to the Entiat and Methow before doing any hindcasting. The Wenatchee has a longer dataset that could be applied.

Keely Murdoch said she now appreciates how complex the data and modeling are. She said one question has been how many fish need to be allowed to escape from Tumwater to Nason Creek to optimize the conservation program size. She said, ideally, this model could be used at the tributary level, as the model showed, there are slight differences between males and females and hatchery and wild-origin fish, but those differences were not significant. A. Murdoch said an average number can be used, although hopefully there will be a way to predict PSM based on a couple of factors. A. Murdoch said that they will have to make some assumptions about anticipated temperature, flow, and density, and that they also need to revisit the forecasting model for Tumwater. K. Murdoch said for the retrospective analysis, a single value would be adequate. A. Murdoch said they can probably give specific values for a retrospective analysis, and perhaps even for different bins, (e.g., females versus males). He said there are better data now and they should be able to do a much better job. For example, they could include migration conditions in the model that affect how many fish arrive at Tumwater and develop a pre-season forecast model early in the year and an in-season model to modify the number expected as the season progresses.

Bill Gale asked how compounding levels of variance are handled in the models, because three models are aggregated into a compounded estimate of PSM. A. Murdoch said in the redd model, uncertainty has been incorporated in the FPR values, redd per female, and sex ratios (redd observer efficiency model), which are very precise estimates with the current tagging rates. He said in this new model, they are incorporating the same approach to estimating uncertainty about sex ratios. He said that final PSM estimates will include uncertainty associated with run escapement estimates and spawner escapement estimates. Gale said he will be interested to see that. In years with low returns, a much higher proportion of spring Chinook salmon will have to be tagged at Priest Rapids Dam; it is important to do this (modeling) work up front to ensure PSM estimates are useful while weighing the impacts of handling fish. A. Murdoch said that in some cases such as the Little Wenatchee, there will be imprecise estimates because of low numbers of spawners. For major spawning areas, the uncertainty should be small enough to provide useful estimates.

Hillman thanked A. Murdoch for his presentation and noted that Tonseth and K. Murdoch would follow up for PSM estimates for the retrospective analysis. A. Murdoch said he can provide an update after this information has been incorporated into the life cycle modeling. He hopes to find what habitat issues are linked to PSM in the Wenatchee River.

C. Draft 2021 Broodstock Collection Protocols

Hillman asked the authors to note specific sections of the *2021 Broodstock Collection Protocols* (BCPs) in which they wish the Committee members to focus their review.

1. Catherine Willard summarized the approach for collecting spring Chinook salmon broodstock at the Chiwawa Weir while minimizing Bull Trout encounters. She said the weir operation hours will be the same as what was done in 2019 and 2020, with 105 Bull Trout encounters allowable this year according to the USFWS Biological Opinion[1]. She said Chelan PUD will simultaneously pilot the addition of a Bull Trout bypass located in the trap box that would allow Bull Trout to move upstream above the weir. Willard will share final drawings and operation timing and describe in detail how the Bull Trout bypass will work in the next meeting. Willard reported that Chelan PUD and WDFW have come to an agreement with USFWS on a preliminary design for the Bull Trout bypass to be monitored with a video camera, and possibly using PIT tags, to assess Bull Trout passage delays. Willard said they have discussed PIT array installation with Biomark, and the timeline would not allow installation of antennas before the increase in flows this year, but cameras will be installed.
2. Willard noted that in Appendix B, the table states "TBD" in the column for marks/tags for Chiwawa River and Nason Creek spring Chinook salmon. Willard shared a table from the April 17, 2019, meeting notes to remind the Committees and Subcommittee members of the tagging scheme that was used to identify Chiwawa Conservation Program fish. Body tags were used in 2019 and 2020 to discern hatchery-origin spring Chinook salmon used to backfill the program. The tagging scheme for the Nason wild-by-wild offspring was shifted from a caudal to a dorsal blank wire tag (BWT) because of the tendency for the caudal tag implanting to cause spinal deformities. Willard asked the Committees if the tagging scheme used in the previous two years should be repeated again this year. Mike Tonseth added that the BWT is used when there is no coded wire tag (CWT) in the snout. Willard said, hearing no suggested changes, she will update the table in Appendix B to reflect the same tagging approach for 2021.
3. Willard noted that Chelan PUD and WDFW are still working on a steelhead release plan for 2021 through 2023. She said the plan would affect the 2020 through 2022 brood. Therefore, it will be

[1] USFWS (U.S. Fish and Wildlife Service), 2017. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion Consultation for the Wenatchee River Spring Chinook Salmon, Summer Chinook Salmon, and Steelhead Hatchery Programs. November 27, 2017.

an amendment to the 2020 BCPs and attached to the 2021 and 2022 BCPs. The plan was discussed later in the meeting (Item IV-B).

4. Tonseth said he now has all the data to complete the pre-season return forecast for Upper Columbia Spring Chinook salmon and will update adult return information by the end of next week. Tonseth said these updates will affect some program tables in the body of the text as well as in Appendix C (Return Year Adult Management Plans). Tonseth said there is uncertainty around the forecasts this year but does not expect major differences in predicted returns compared to 2020.
5. Tonseth said 2020 ended a 3-year evaluation of bacterial kidney disease inoculation. He said he is preparing those data and will meet with WDFW, Chelan PUD, and Grant PUD, and invite Betsy Bamberger (veterinarian for Douglas PUD), to discuss the disease management plan for 2021 and future years. Tonseth said the final approach could be an amendment after the BCPs have been approved and submitted to NMFS. Todd Pearsons asked if a statement could be added to the BCPs to state that discussions are ongoing regarding future plans for these programs. Tonseth agreed to add this language in Appendix I.
6. Tonseth said he has updated text in Appendix G, Hatchery Production Management Plan, regarding a process for notifying the HCP-HCs of a production surplus. Tonseth said the language states that notification should occur at least two weeks prior to transfer or as soon as surplus is identified; in some cases there may be less than two weeks advance notice. Pearsons noted that hatchery managers shared concerns about revising the language to allow situations where they need to act very quickly and were encouraged to reach out to Tonseth directly. Tonseth said he identified additional language to note that Committees should be notified that a surplus exists but to allow for some flexibility if the destination of the surplus may not be known. Tonseth said this is meant to be a general approach for most cases in which there is plenty of time to respond. Pearsons asked how Tonseth wanted the Committees to comment on these guidelines for surplus notification. Tonseth noted he and Greg Mackey are still talking to hatchery managers regarding methods for making reasonable estimates of inventory, at the eyed-egg stage and at marking, and for determining what methods should be used to derive that estimate. They will refine this bullet during the coming week.
7. Pearsons asked about concerns with marking fish when a surplus exists (over 110% of the production target). Tonseth said agreeing to this language in the BCPs does not mean that the surplus has to be externally marked. Tonseth said the plan is to mark up to 110% of the release target and any fish above this number do not need to be marked. Tonseth said a program may choose not to release 110% of the release target, which is a separate issue.

   Pearsons said that the Grant, Chelan, and Douglas PUDs have felt constrained on this point in the past because of differences in perspective on the releases to be consistent with permit

language. Tonseth said marking up to 110% would be consistent with the permit conditions and would be consistent with WDFW's position on marking. Tonseth said if a program had more than 110% of the release target, WDFW's previous position would be that all fish should be marked. WDFW's current position is that the surplus over 110% would not need to be marked unless fish were being transferred to another program for release into anadromous waters, in which case it would be the obligation of the receiving program to determine the marking. Pearsons asked whether Farman supports the statement as written. Farman said this statement was okay, although NMFS does not support programs using 110% as an ongoing target. Tonseth said 110% was never meant to be used as an annual target. The 10% leeway was built into the permit conditions to account for annual variability in factors outside of fish culturists control like fecundity, egg-to-fry survival, etc. Tonseth said it is not their intent to advocate for production of 110%, but if through culture processes a program is left with 110%, that number of fish may be released. Farman agreed this is fine as written.

Hillman recalled that Kirk Truscott wanted to ensure that no fish being released from a program into anadromous waters would be unmarked and the language should reflect that intent (Truscott had left the meeting before this discussion). Tonseth said his interpretation of Truscott's position was that all fish from a given program should be marked, even if being transferred to non-anadromous water. Bill Gale said that all fish from a given program should be marked. He added that in some years, programs would fall below that target and in some years they would be above. Tonseth agreed that up to 110% of fish would be marked because not all fish would be released in excess of the 110%. Mackey said he was less concerned about surplus production in the programs that use hatchery fish for broodstock, but more concerned about the conservation programs where you do not want to reduce the number of natural-origin fish escaping (to spawn naturally). However, creating surplus fish should be avoided for all programs. Mackey said he has no problems with the statements in the BCPs as written. However, there may be cases where even though 110% of a program has been produced, managers should choose not to release all of the fish. Mackey said there could be a situation, for example, where 110% of the release target are released over four years, and perhaps in the fifth year the program chooses to release only 100% of the release target to stay within the bounds of the permit for the program. Mackey said programs can refocus on the allocation of surplus at the eyed-egg stage rather than later with fry or smolts. Tonseth agreed and added that although they have been communicating this to hatchery managers, there should be some more latitude in conservation programs regarding the conservation of natural-origin fish. Tonseth said that especially in small conservation programs, collection of just one extra female can create well over the target number of eyed-eggs. Tonseth said by following the protocols, programs will invariably arrive at more than the targeted number of fish. In looking through

annual reports, he said programs can do better to track surplus in each year. Mackey said even if identifying surplus at the eyed-egg stage, hatchery managers would retain a suitable buffer to account for losses during culture. Mackey agreed he has no problem tagging all fish retained past the eyed-egg stage since production over 100% is to be expected fairly often (program managers try to not fall under 100% which tends to drive the production over 100%, and even over 110%, which is part of the challenge). Tonseth said ±10% is allowed, but the programs tend to lean toward the +10% intentionally to buffer the uncertainty in broodstock collections. Tonseth said this should be addressed in the future. Examples include uncertainty in the ability to collect steelhead in the spring only or fall Chinook salmon in the angler broodstock collection Angler Broodstock Collection program that required retention of additional fish just to secure the production. These actions invariably leading to a surplus. Tonseth advocated reviewing programs to ensure surpluses are infrequent and minimal.

Brett Farman said he is reluctant to suggest that anything over 100% should be surplused in any year, and for these conservation programs, the addition of 1% to 3% in the context of ecological processes is pretty minimal. Farman said his input is to try to manage for the target. He understands there is a tendency to buffer so programs are never under their target, but there should be some effort to recalibrate if a program is consistently in the upper end of that +10% range. Farman said although this would be within the range of what was consulted on, NMFS is uncomfortable with treating 110% as a target. Hillman asked Pearsons if the proposed edits would be adequate. Pearsons said yes if the language about estimating abundance of surplus is softened. Mackey said an important point in the surplus production appendix language is to act upon the earliest life stage to identify surpluses. Tonseth said that language has existed for a long time to prevent sacrificing later life stages and agreed that management should be done based on eyed-egg counts. Mackey agreed and said he plans to work with their hatchery programs to improve upon that, especially to take the appropriate number of wild fish for broodstock.

Keely Murdoch said she agrees with managing excess as early as possible, especially when dealing with hatchery-by-hatchery offspring, but considerations should be made for wild-by-wild fish to buffer for losses later (during fish culture). K. Murdoch said she does not agree with culling progeny from wild fish at that point at time. Tonseth said he agrees but programs should be able to manage within the range of ±10%. K. Murdoch said she would not want to see a population overmanaged at an early stage. Tonseth said it puts the State (WDFW) in an awkward position if there is an overage that they cannot easily cull. K. Murdoch said there are years with 1% to 2% excess and there should be some kind of rolling average that allows the

progeny of wild fish to be released regardless of percentage over the target, and that progeny of natural-origin endangered species should not be destroyed.

Gale said he agrees to a degree, but the danger of depending on a rolling average is that there may need to be years of under production to meet an average that should not be an intentional action. Gale said if there are programs that are continually producing over 110% of targets, the numbers should be revisited. K. Murdoch agreed if programs are continually over the target. Tonseth said he understands K. Murdoch's line of thinking but recalled a firm directive from Craig Busack (former NMFS representative to the HCP-HCs and PRCC-HSC) that 110% should be the limit. Tonseth said he is not in favor of destroying progeny from natural-origin fish in programs that have a companion safety net program. Those, programs could reduce the release size of the safety net program to accommodate the surplus wild-by-wild fish.

K. Murdoch said one inconsistency is that PNI is treated as a rolling average, and 110% is somewhat of an arbitrary limit. Thus, her personal opinion is that there should be more flexibility to release progeny of natural-origin fish in a given year. Farman said he shares a similar perspective and does not favor destroying progeny of natural-origin fish but agrees with Gale's point that programs should recalibrate to avoid collecting too many natural--origin adults for broodstock. Farman said if there is an overage, the process to release the overage may or may not require a formal meeting, but NMFS also needs to think about the aggregate effect on the entire basin if all programs are consistently producing up to 110%. Farman said a release of an overage would be assessed on a case-by-case basis but would be treated by NMFS in context of production at the basin scale.

8. Mackey identified suggested deletions in the notable changes bullets, and an addition of new information relative to adjustments made for the 2020 Wells Dam Survival Study results.

9. Mackey said in the steelhead section, the meaning of the content was not changed, but it was reorganized for readability. He added that content was streamlined, and some tables were combined to make them easier to refer to. Mackey said he retained the details of the Winthrop National Fish Hatchery (WNFH) steelhead program to ensure there is a record as it is a collaborative program with the DPUD steelhead program and is quite complicated. Tonseth said there is a lot of interrelatedness between Methow HCP and WNFH that requires the explanation given in this document.

10. Mackey said under Wells Summer/Fall Chinook salmon, the orca production fish were added even though these fish come from program surplus broodstock. Mackey noted the brood are not allocated for the program in this document, so questioned whether it is appropriate to include in tables in this document, but it should be noted somewhere as it is such a large program. Tonseth had suggested that it not be incorporated into last year's BCPs because the source was identified as coming from surplus, and while it is a large program, if there is no surplus fish to support it, they would not be raised. Tonseth suggested a conversation with Mackey, K. Murdoch, Truscott, and Gale or Cooper [JFP]) on documenting programs that acquire broodstock from the HCP programs. Mackey agreed and [reluctantly!] suggested that another appendix could be created to capture production that uses HCP program fish but are not HCP programs; although WNFH programs in the Methow River might fit a similar description and are included in the tables throughout the BCPs. Tonseth suggested outlining the direction of adult surplus returns to Wells Hatchery in Appendix C, but to avoid showing any prioritization or preference for a non-HCP program. Kahler said if orca production is stricken from Table 8, the line for 484,000 Wells 0+ production would need to be reinstated. Mackey said he would ensure that Table 8 is correct.

11. Pearsons said tables have been updated for GPUD programs. He added they have always included the Army Corps of Engineers production that is provided at Priest Rapids Hatchery (e.g. in Appendix A, Table 1) as it helps the fish culturists to have information on various programs in one place. This should be noted as it is relevant to the previous discussion on whether to include non-HCP/PRCC programs in these tables. Pearsons said the Okanogan steelhead program has not been updated and he assumes Truscott will update the relevant numbers.
12. Pearsons said the Priest Rapids Fall Chinook salmon paragraph about surplus is not very representative of what is ongoing and the text states "those details to be inserted at a later date." Tonseth said this text was based on a significant expected shortfall in 2019 and 2020, with an expectation that there would be a request from YN for surplus fish for transport to the Klickitat, Umatilla, and Yakima basins. Pearsons said the language needs to be clearer to support conversations within WDFW's Region 3 (South Central Washington). Tonseth said yes, there are other conversations ongoing within the Production Advisory Committee, and he does not believe there has been a new effort to use fish from Priest Rapids Hatchery due to a desire to shift to a different source of upriver bright production. Gale agreed there was a desire to shift mitigation for John Day and The Dalles dams for broodstock that is more representative of in-kind and in-place mitigation rather than by production at Bonneville Hatchery. Tonseth said the only production for the programs mentioned is Ringold Hatchery and Priest Rapids Hatchery. Gale said Little White Hatchery is another site of production. Pearsons said he wants to clarify expectations whether this is a placeholder stating that the JFP is interested in having access to

surplus or whether there is going to be a larger discussion in the PRCC HSC. Tonseth said the summary statement reflects the JFP's interest in access to surplus adults returning to Priest Rapids Hatchery is accurate. Gale said the other piece for context (not for recording in the BCPs) is a continuing discussion on how these hatchery programs will stand on their own in the future and more directly mitigate for John Day and The Dalles dams. Pearsons asked if the process used over the past couple of years worked well or if changes need to be made. Tonseth said he can reach out to other managers to get a sense for whether changes should be made to better serve getting access to those fish. Pearsons asked if Deanne Pavlik-Kunkel had any thoughts about this text. Pavlik-Kunkel said there is some need to align language with the intent of the passage. Tonseth suggested replacing the language with the statement regarding the intent to allow access to the JFP to surplus fish. Pavlik-Kunkel said this language seems to indicate that the PUDs would provide this service to other organizations. Tonseth suggested striking all language suggesting an obligation to backfill shortfalls, because there has not been any specific request or plan in place, and that would have to happen to provide access to upriver brights from Priest Rapids and Ringold hatcheries. Pavlik-Kunkel agreed with Tonseth's revisions to the passage. Pearsons agreed with those changes and had no other changes to highlight.

Hillman reviewed the schedule for making final revisions. Tonseth will provide a revised version of the protocols by Friday, February 26. All Committee members will provide comments and edits by Friday, March 5. The authors will provide a final draft by close of business on Friday, March 12. HCP-HCs and PRCC HSC members will review the final draft on March 15 and 16 and be prepared to discuss and approve the BCPs on March 17. The final approved draft will be delivered to the HCP-CC no later than March 18. Larissa will compile edits and distribute each version.

D. Effect of COVID-19 Pandemic on Monitoring and Evaluation Activities

Tracy Hillman asked each Committee member to provide an update on impacts of the COVID-19 pandemic on M&E activities.

- Todd Pearsons said Grant PUD is communicating with contractors who use the OLAFT (Off-Ladder Adult Fish Trap) about COVID-19 risk. For comparison, at Wanapum Dam, anyone in the gated area that could interact with Grant PUD staff must be tested twice per week, and this existing measure could have implications for workers at the OLAFT. Pearsons said, as of today, anyone that needs to go to the OLAFT would need to be tested for COVID-19. Mike Tonseth asked whether the twice per week testing is a requirement for individuals who have received the vaccine. Deanne Pavlik-Kunkel said her understanding is that people that have received a vaccine will still be required to be tested. She said the only exemption from testing is for a period of time after having COVID-19. Pearsons said to contact Rod O'Connor (Grant PUD) with questions.

- Mike Tonseth reported no changes from WDFW. Katy Shelby said field work has started and they are operating under the same protocols as last fall.
- Keely Murdoch reported no changes from the YN.
- Kirk Truscott said he has no changes from CCT.
- Matt Cooper reported no updates from USFWS. Bill Gale said with the new administration, masks are no longer just suggested, they are required for all employees, contractors, and guests. Cooper said masks are required when indoors, and social distancing is required when outside.
- Catherine Willard reported no changes from Chelan PUD.
- Brett Farman reported no changes from NMFS. He said that NOAA has required masks during the entire pandemic.
- Greg Mackey reported no changes from Douglas PUD.

III. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the January 20, 2020, meeting minutes.

B. Update: Priest Rapids Hatchery M&E Annual Report

Hillman asked Pearsons to describe any updates on the *Priest Rapids Hatchery M&E Annual Report* resulting from the 30-day review period. Pearsons said no comments were received. Pearsons said he will finalize the report for distribution by Larissa Rohrbach to the PRCC HSC and for posting to the Web.

IV. Rock Island/Rocky Reach HCP-HCs

A. DECISION: 2021 Rock Island and Rocky Reach Action Plan

Willard said she received no comments on the draft 2021 Rock Island and Rocky Reach Action Plan. All Rock Island and Rocky Reach HCP-HC members approved the hatchery section of the 2021 action plan.

B. 2021 Steelhead Release Plan

Catherine Willard gave a brief presentation with an overview of the proposed juvenile steelhead release plan (Attachment D). She said the release plan would be an amendment to the 2020 BCPs, as it affects BY 2020 offspring and would be appended to this year's (2021) and next year's (2022) BCPs as well.

Slide 1 – Willard said in the past there was no ability to do a traditional volitional release from the Chiwawa Hatchery. Instead, a "screened release" from Pond 1 could allow fish to move from Pond 2 to Pond 1 in an effort to mimic a volitional release and identify fish that were moving as a sign of readiness to outmigrate. Similarly, fish could move between circular vessels. A group of fish in the raceway and in the circular vessels would be PIT-tagged to track their movement between vessels. The "non-movers" would be taken to and released in the Lower Wenatchee River to avoid allowing them to residualize in the upper basin. The "movers" would be released into Nason Creek, Upper Wenatchee River, and the Chiwawa River.

Slides 2 and 3 – PIT tag-based outmigration survival estimates for the various groups and release methodologies for release years 2012 to 2017 were shown from the annual report; however, the small sample sizes confounded the interpretation of results. Out-migration survival through the mainstem Columbia River was higher for "movers" than for "non-movers;" however, there were several covariates such as vessel type, release date, and release location that also confound the results.

Slide 4 – In 2017, the permit directed the program to minimize residualism. Haush and Melnychuck (2012) suggest size and condition factor were most influential for steelhead in determining which fish were most likely to residualize.

Slide 5 – From 2018 to 2020, Chelan PUD focused on optimizing size and condition factor, and eliminated the covariates of different release date and location, allowing comparisons in survival between fish of different sizes and origin. Rates of early maturation were also assessed by measuring gonadosomatic index.

Slide 6 – Going forward, Chelan PUD is proposing to better evaluate the screening method for fish reared in the raceway. They are prepared to PIT-tag 10,000 "movers" and 10,000 "non-movers." All fish will be released into the Upper Wenatchee River on the same day.

Willard concluded that she would distribute a written plan for Rock Island/Rocky Reach HCP-HC approval in the March meeting.

V. Wells HCP-HC

A. DECISION: 2021 Wells Action Plan

Hillman asked if there were any questions from Committee members on the hatchery section of the *2021 Wells HCP Action Plan* and whether all members approve the hatchery section of the plan. All Wells HCP-HC members approved the hatchery section of the 2021 Wells Action Plan.

B. Winthrop National Fish Hatchery Summer Steelhead Sampling

Tracy Hillman asked Matt Cooper to give a brief summary on what USFWS is proposing to do. An overview of the proposed study was provided in an email from Cooper and distributed by Larissa Rohrbach at the start of the meeting.

Cooper said there is currently integration of the Methow Conservation Program with Winthrop WNFH programs. He said siblings to WNFH production are raised at Wells Fish Hatchery for release at age 1 (S1), versus those at WNFH that are released at age 2 (S2). USFWS is requesting to sacrifice 300 fish reared at Wells Fish Hatchery in release year 2021 and 2022 to compare precocity rates to siblings raised at WNFH, which are already sampled as part of an ongoing study. Greg Mackey noted that the lethal sampling for precocity is a research study, and Douglas PUD supports the objective that the USFWS is investigating, but it is not a requirement under either of the program permits. Gale said the permits may not suggest the lethal sampling for gonadosomatic index but they do not preclude it. Mackey agreed with Gale. Mike Tonseth asked whether they wish to compare precocity levels of juveniles from the same release year or the same brood year. Cooper said there would be a comparison between the same brood year, including the S1 group split raised at WNFH and Wells Fish Hatchery and S2s that would be released the following year. Gale said they would continue to sample the S2s to be released in 2023 for comparison as well.

Cooper asked whether there is a need to formally inform the Wells HCP-HC. Mackey suggested moving the text provided in the email into a formal 1-page description of the study describing how Douglas PUD's fish are being used. Mackey said the Wells HCP-HC needs to approve the action because it is taking a portion of fish from their release. Cooper agreed to distribute a formal description of the sampling effort for approval in the March 17, 2021, meeting.

C. Addition to Document Distribution List

Douglas PUD has requested that Andrew Gingerich (Douglas PUD Natural Resources Supervisor) be added to the HCP-HC email distribution list for receiving finalized materials. Shane Bickford (Douglas PUD) has moved to the Assistant Manager position, although he is still overseeing the hatcheries. Greg Mackey said Douglas PUD has posted an opening for a biologist job to backfill the position vacated by Andrew.

D. DECISION: Yakama Nation Program Coho Salmon Acclimation in Twisp Pond

Keely Murdoch said, per the original SOA for coho salmon mitigation for the Twisp Pond, the YN must seek Wells HCP-HC approval annually to acclimate more fish than is approved for the Douglas PUD program, which acclimates 37,000 coho salmon and 30,000 spring Chinook salmon in the pond. K. Murdoch said coho salmon have been acclimated in the pond in previous years. She said the YN is requesting approval to have Douglas PUD acclimate an additional 73,000 coho salmon in the pond.

Greg Mackey said the total number would be 130,000 fish, which is still well within the capacity of the pond with a density index that would remain quite low.

All members present approved, which included Douglas PUD, NMFS, WDFW, and YN. Tracy Hillman obtained CCT's approval via email following the meeting.

VI. Administrative Items

E. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday, March 17, 2021; Wednesday, April 21, 2021; and Wednesday, May 19, 2021; held by conference call and web-share until further notice.

VII. List of Attachments

Attachment A List of Attendees
Attachment B Okanagan Sockeye Re-Introduction Program Update, Howie Wright and Ryan Benson, ONA
Attachment C Chiwawa Spring Chinook Prespawn Mortality, Andrew Murdoch, WDFW
Attachment D Chelan PUD's 2021 Steelhead Release Plan

Attachment A
List of Attendees

Name	Organization
Larissa Rohrbach	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Scott Hopkins*	Chelan PUD
Catherine Willard*	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
David Duvall	Douglas PUD
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Ryan Benson	Okanagan Nation Alliance
Howie Wright	Okanagan Nation Alliance
Matt Cooper*‡	U.S. Fish and Wildlife Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Michael Humling	U.S. Fish and Wildlife Service
Ryan Fortier	Washington Department of Fish and Wildlife
Alf Haukenes	Washington Department of Fish and Wildlife
Andrew Murdoch	Washington Department of Fish and Wildlife
Katy Shelby	Washington Department of Fish and Wildlife
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate

Okanagan Sockeye Re-Introduction Program Update

syilx Okanagan Nation Alliance

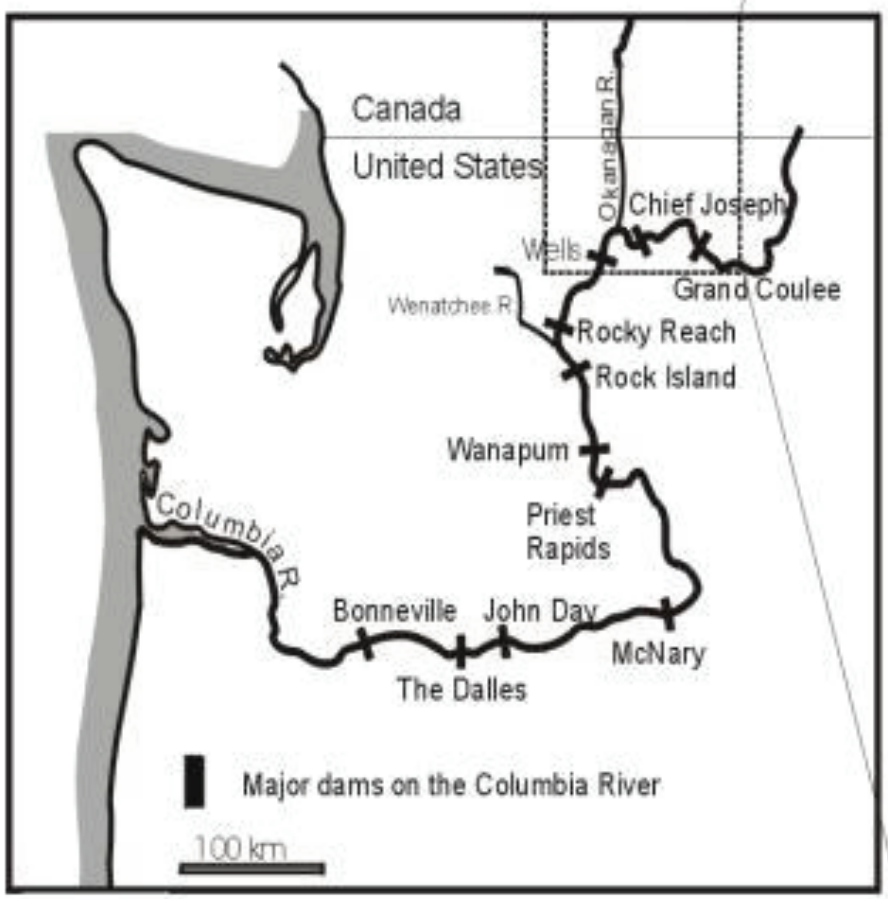
February 17, 2021

Presented to HCP Hatchery Committee and

PRCC Hatchery Sub-Committee

OKANAGAN NATION AQUATIC ENTERPRISES LTD.

- Why? Okanagan Perspective
- History of project
- Where we are at now



Syilx Traditional Territory

Today

Okanagan Nation (Can.)

Colville Confederated Tribes (U.S.)

How Senk'lip Brought Salmon to the People

- Knowledge passed down through *captik^{w}l*
- Stories are a record of Okanagan history
- Coyote's travels are a record of natural laws
- Brought salmon to the Columbia and tributaries

Project Rationale

- Cultural and social significance to the Okanagan Nation
- Stabilize and rebuild Okanagan Sockeye population
- Reintroduce sockeye into former historic range in Okanagan Basin
- Rearing conditions in Osoyoos Lake degrading
- Improve over summer survival

Project Background

- Concept outlined in 1997 to reintroduce sockeye into Okanagan Lake
- ONA and Canadian regulatory agencies agreed to investigate feasibility of experimental reintroduction into Skaha Lake
- 2000 - 2003 – ***Evaluation of an Experimental Reintroduction of Sockeye Salmon into Skaha Lake (BPA funded project)***
- Annual review by the Canadian Okanagan Basin Technical Working Group

Risk Assessment

RESULTS: Controlled reintroduction of sockeye will likely pose little risk to either the existing Sockeye pop'n (Osoyoos L) or the kokanee pop'n in Skaha Lake

Develop a 12-year Reintroduction Program, designed to be reversible if long-term monitoring demonstrates significant negative impacts to either the existing Osoyoos L Sockeye or Skaha L kokanee

Program Milestones

- 2003 – Pilot broodstock collection and egg take
- 2004 – Initiate 12-year Skaha Lake re-introduction experiment
- 2007 – First hatchery adult returns; 30 telemetry tagged in Skaha L.
- 2009 – McIntyre Dam (migration barrier) gates retrofitted to provide fish passage
- 2011 – First adult Sockeye spawners confirmed in Penticton Channel (primary Skaha L spawning grounds)
- 2014 – Trap and transport 160 adult Sockeye into Okanagan L
- 2016- present – Sockeye hatchery fry outplants into Okanagan L
- 2019 – Okanagan Dam fishway activated
- 2020 – 41 telemetry-tagged Sockeye transferred to Okanagan L; high spring flows and dam operations allow Sockeye and Chinook to enter the lake; record natural escapement in Skaha L (38,000)

Skaha Lake Natural Production

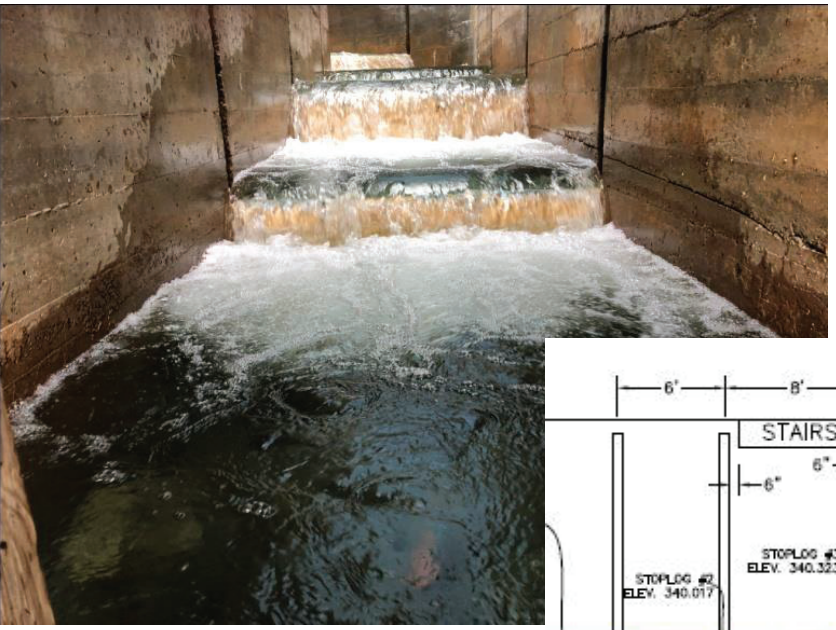
Brood Year	Escapement	Egg deposition (million)	Natural Smolts (est)
2011	9,426	10.3	309,000
2012	8,273	9.1	270,000
2013	6,840	7.5	225,000
2014	20,916	23	690,000
2015	1,632	1.8	54,000
2016	4,016	4.4	132,000
2017	5,600	6.2	185,000
2018	23,500	25.9	940,000
2019	2,600	2.6	60,000
2020	25,600	28.1	845,000

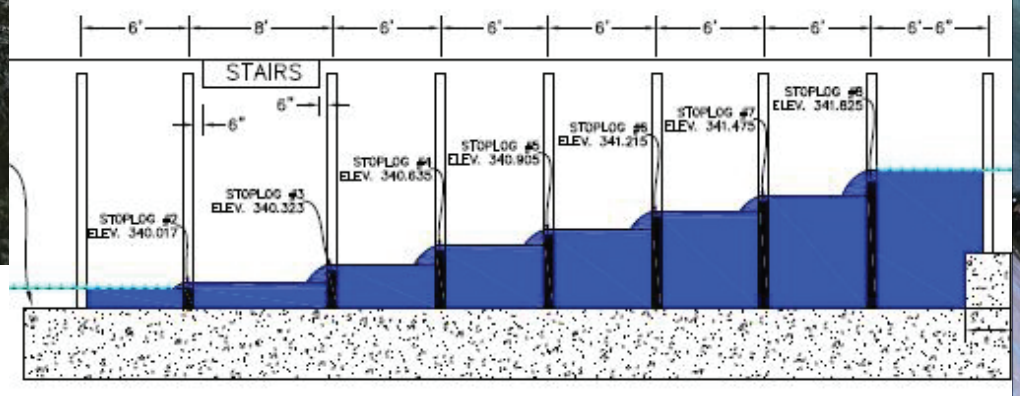
Okanagan Lake Program

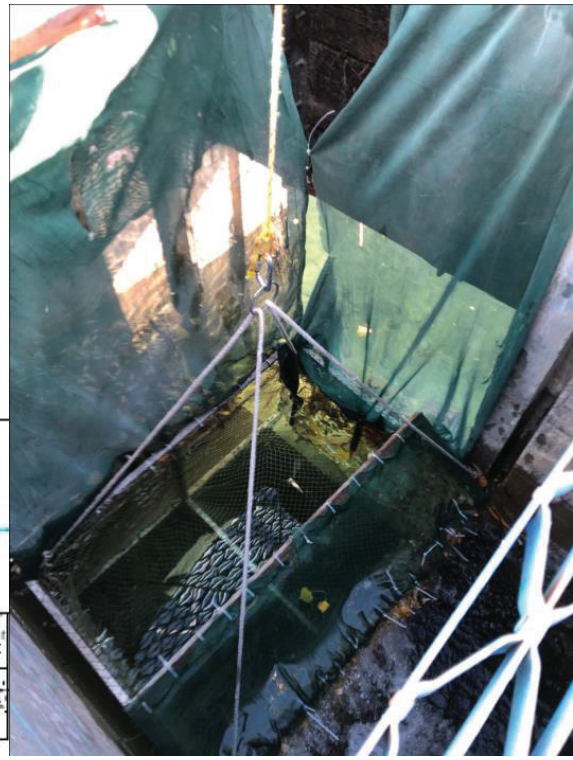
- DFO has approved long-term hatchery Sockeye outplants, conditional on M&E results
  - Okanagan Basin Salmon Recovery Sub-Committee (COBTWG)
  - M&E Plan is finalized; Working on implementation
  - Working towards Salmon passage at Penticton Dam

- Hatchery stocking:
  - 2016 – 9,994
  - 2017 – 683,656
  - 2018 – 10,110
  - 2019 – 4,200,000
  - 2020 – 9,538

Penticton Dam (Okanagan Lake Outlet) Passage







- First passage since 1953
- Similar to Skaha Lake Dam configuration
- Testing hydraulics, jump and passage efficiency, attraction flow
- Identify improvements for future funding (e.g. automated gates, capture platform, PIT antenna)

Final Known Fate of Tagged Sockeye (n = 41)

Tributary	Number detected	Percent of total Tagged
Equisis	7	17.1%
Mission	14	34.1%
Powers	1	2.4%
Trepanier	1	2.4%
Trout	4	9.8%
Penticton Channel	8	31.7%
Shingle	5	
unknown	1	2.4%

limləmt

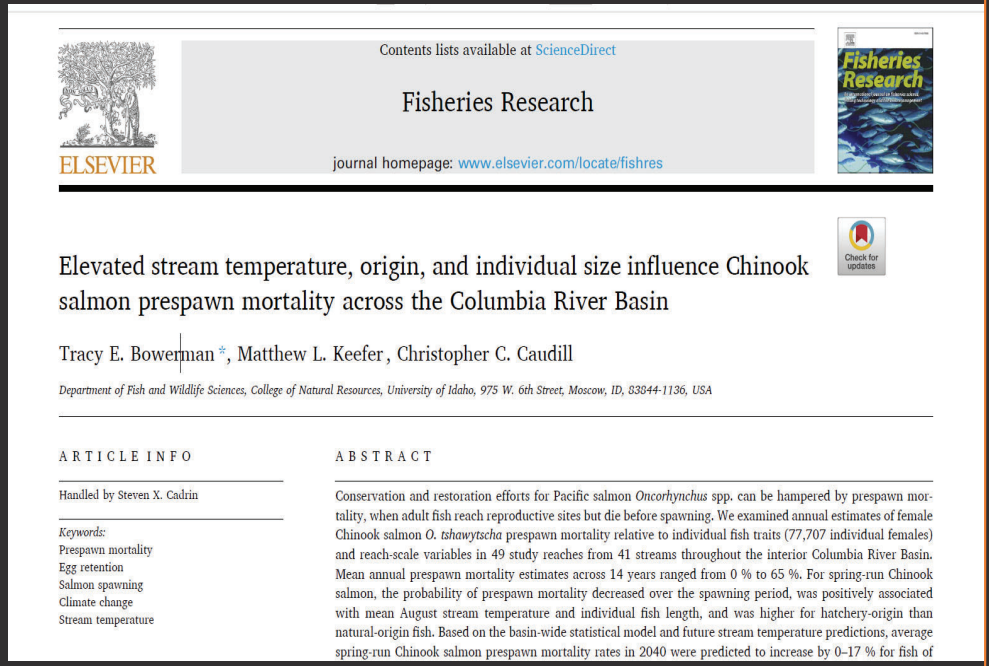
Chiwawa Spring Chinook Prespawn Mortality

Mike Hughes, Kevin See, and Andrew Murdoch

Estimating Prespawn Mortality

- Population level monitoring
  - Number of redds/Number of females
  - Wenatchee (TUM) and Methow (Wells)
    - Over 50% in some years
  - Not at the tributary scale and include some migration related mortality
  - Male PSM unknown

- Bowerman et al. (2020)
  - Carcass-based female estimates
    - Wenatchee = 0.08 (0.0 – 0.19)
    - Entiat = 0.02 (0.0 – 0.08)
    - Methow = 0.03 (0.0 – 0.20)
  - Spawning period only
  - Trends not absolute values



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Elevated stream temperature, origin, and individual size influence Chinook salmon prespawn mortality across the Columbia River Basin

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ARTICLE INFO

Handled by Steven X. Cadrin

Keywords:
Prespawn mortality
Egg retention
Salmon spawning
Climate change
Stream temperature

ABSTRACT

Conservation and restoration efforts for Pacific salmon *Oncorhynchus* spp. can be hampered by prespawn mortality, when adult fish reach reproductive sites but die before spawning. We examined annual estimates of female Chinook salmon *O. tshawytscha* prespawn mortality relative to individual fish traits (77,707 individual females) and reach-scale variables in 49 study reaches from 41 streams throughout the interior Columbia River Basin. Mean annual prespawn mortality estimates across 14 years ranged from 0 % to 65 %. For spring-run Chinook salmon, the probability of prespawn mortality decreased over the spawning period, was positively associated with mean August stream temperature and individual fish length, and was higher for hatchery-origin than natural-origin fish. Based on the basin-wide statistical model and future stream temperature predictions, average spring-run Chinook salmon prespawn mortality rates in 2040 were predicted to increase by 0–17 % for fish of

PSM estimates including the holding period

(Bowerman et al. 2020)

- Inclusion of holding period increased PSM (2x – 9x)
- Carcass-based estimates of PSM assumes the recovery probability of pre-spawn to post-spawn carcasses are equal and may not be true (i.e., potential bias).
- More on the that later in presentation.

Stream	Holding Period	Spawning Period
Imnaha River	0.16 (0.03 – 0.51)	0.13 (0.03 – 0.34)
Newsome Creek	0.35 (0.15 – 0.50)	0.04 (0.00 – 0.10)
Upper SF Salmon	0.28 (0.00 – 0.76)	0.14 (0.00 – 0.10)

Stream-based Estimates of PSM

1. Unbiased estimates of run escapement (pre-spawners) using patch occupancy model (Waterhouse et al. 2020)
   - Origin, sex and age
2. Unbiased estimates of redds (Murdoch et al. 2019)
3. Estimate of spawners using an unbiased carcass-based FPR value (Hughes et al. *in prep*)
   - Carcass recovery probability model
     - Origin, sex and age
4. Estimate stream-specific rates of PSM

$$\text{PSM} = \frac{Unbiased\ Number\ of\ spawners}{Unbiased\ Number\ entering\ stream}$$

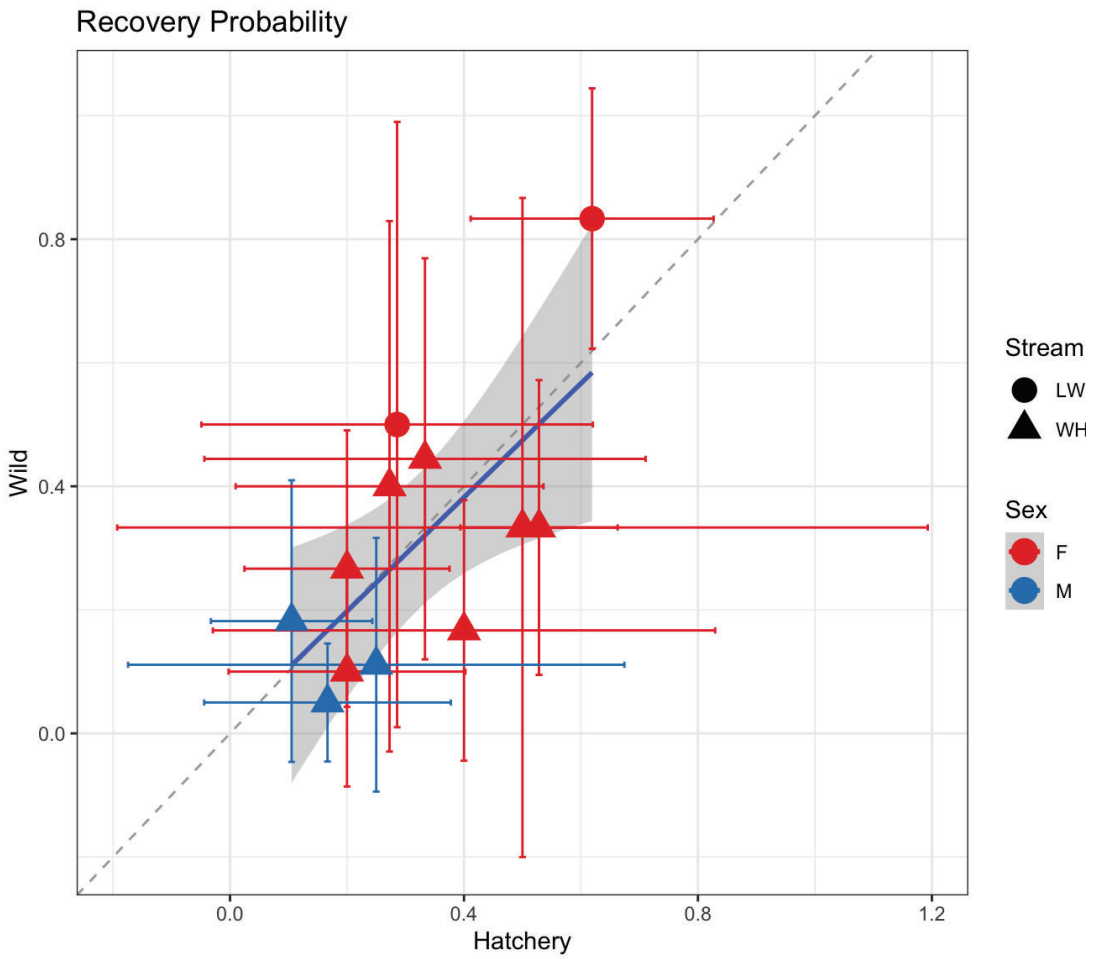
Carcass Recovery Model 2.0

- Carcass Recovery Model 1.0 (Murdoch et al. 2010)
  - Sex, length
  - Study included the prespawn holding period
    - Fish tagged at Tumwater Dam
    - Recovered as carcasses
  - Used population not stream FPR values to estimate spawner abundance

- New model dataset
  - Spawning fish detected between 2004 and 2013 and recovered as carcasses
  - Underlying hypothesis is post-spawn behavior is the primary driver in recovery probability
  - Covariates included sex, length, channel type and discharge variation

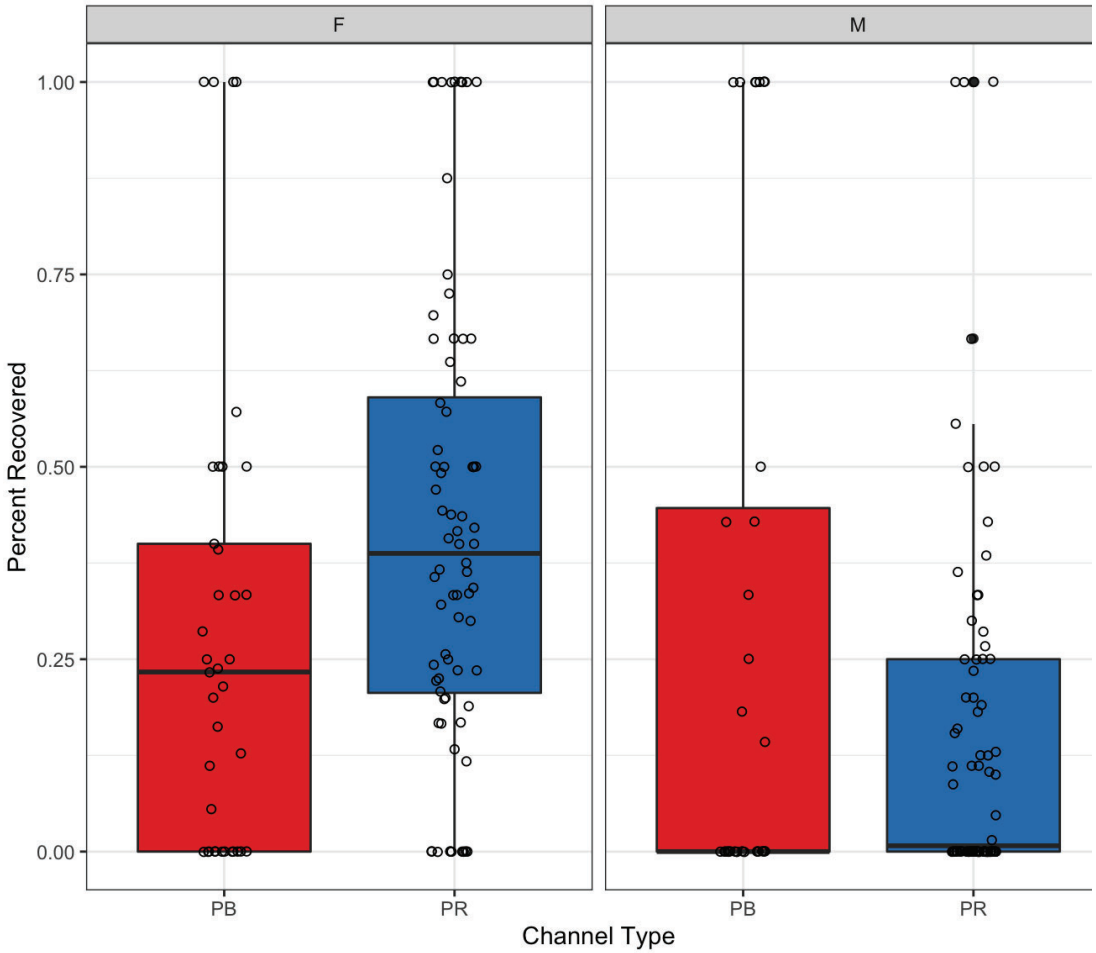
Origin Effect

- Similar spawning distribution
- Not Significant



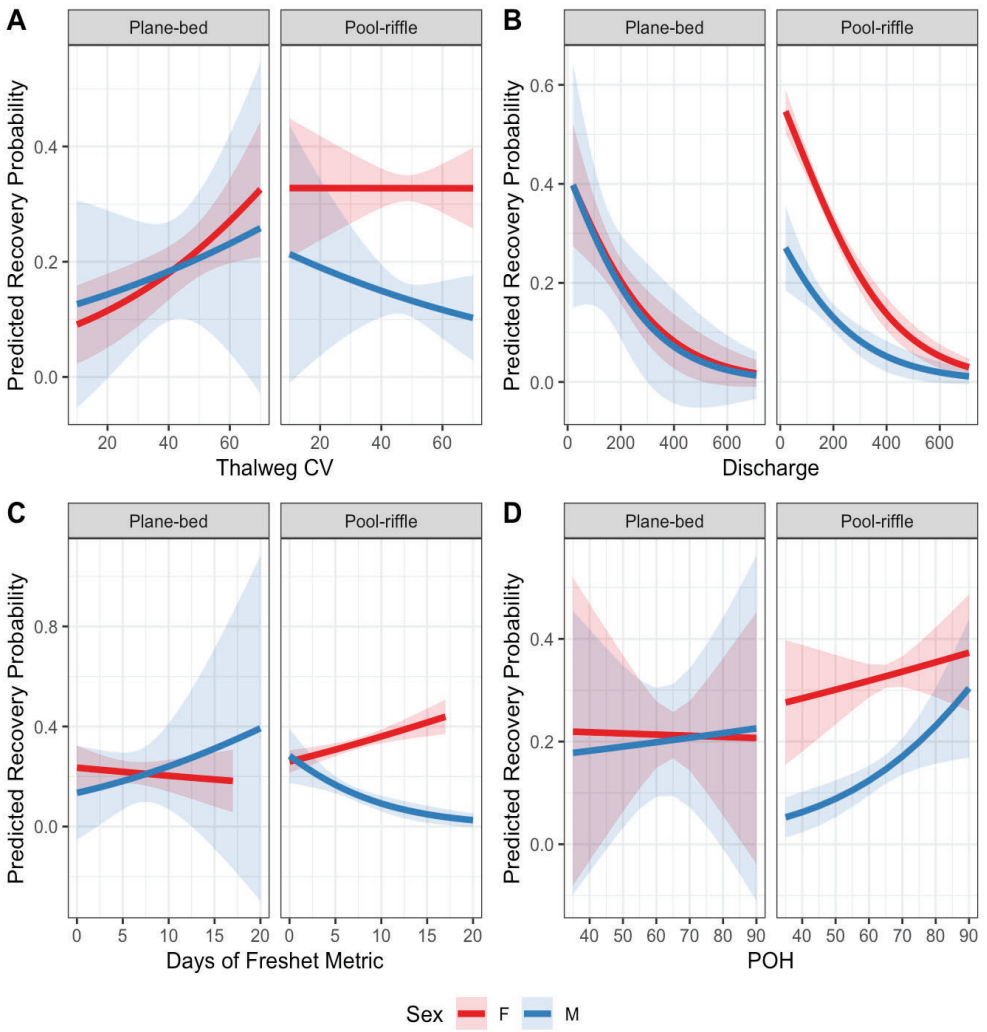
Channel Type Effect

- Differences in channel complexity
- Significant



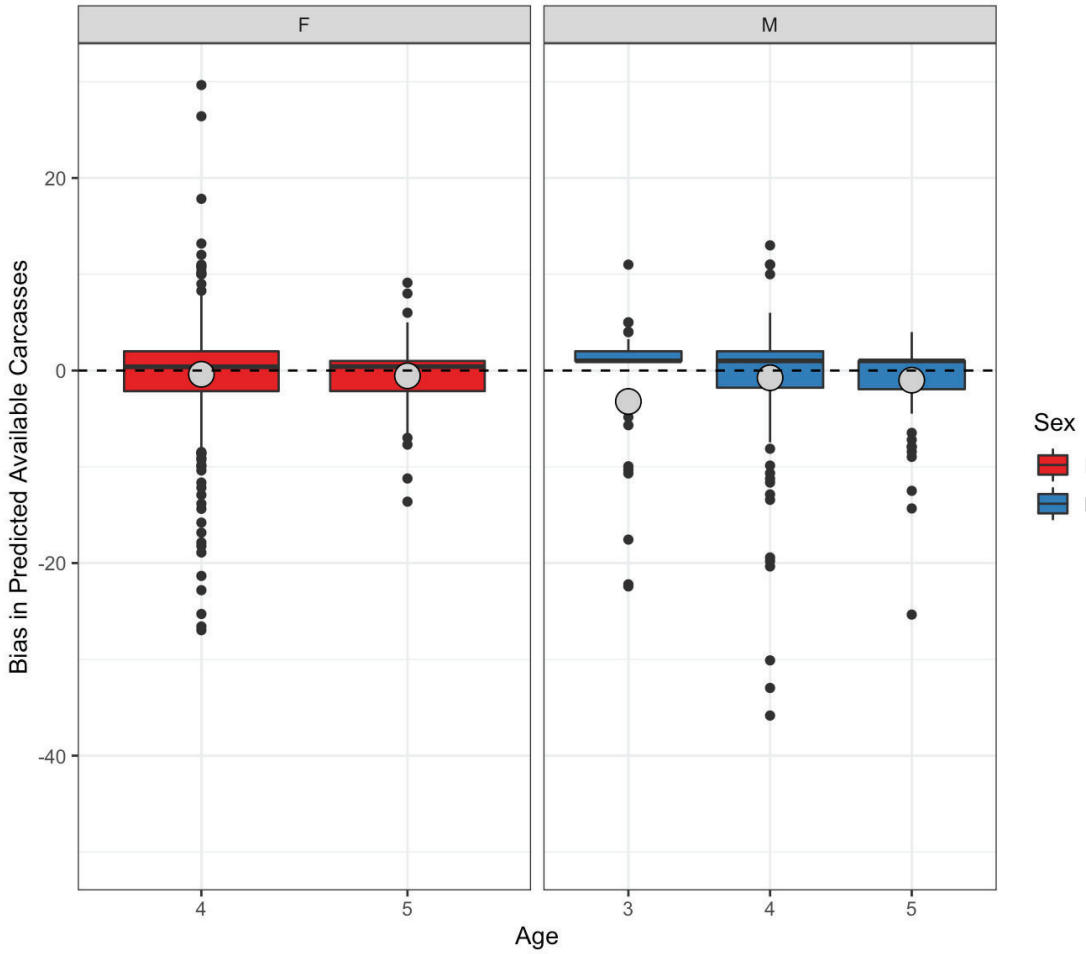
Covariate Effects

Covariate	Female	Male
Channel Complex.	Mixed	Mixed
Discharge	Neg.	Neg.
Discharge Var.	Mixed	Mixed
Length	Mixed	Pos.



Bias

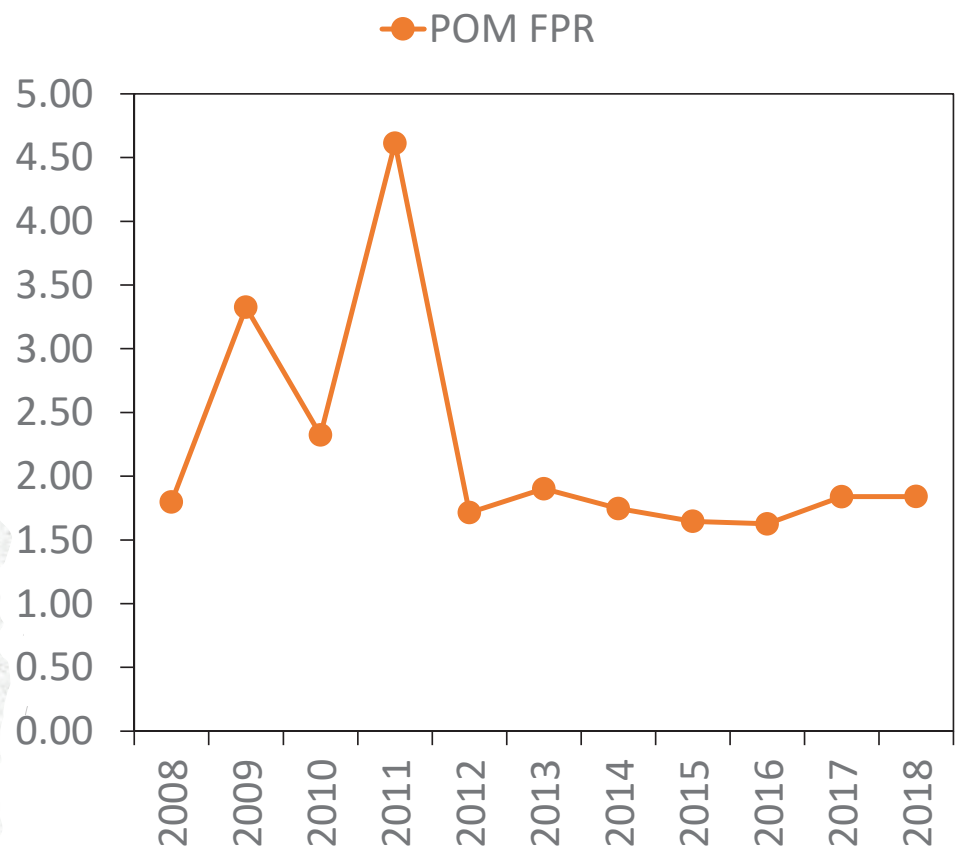
- Mostly unbiased
- Slight underestimate of jacks



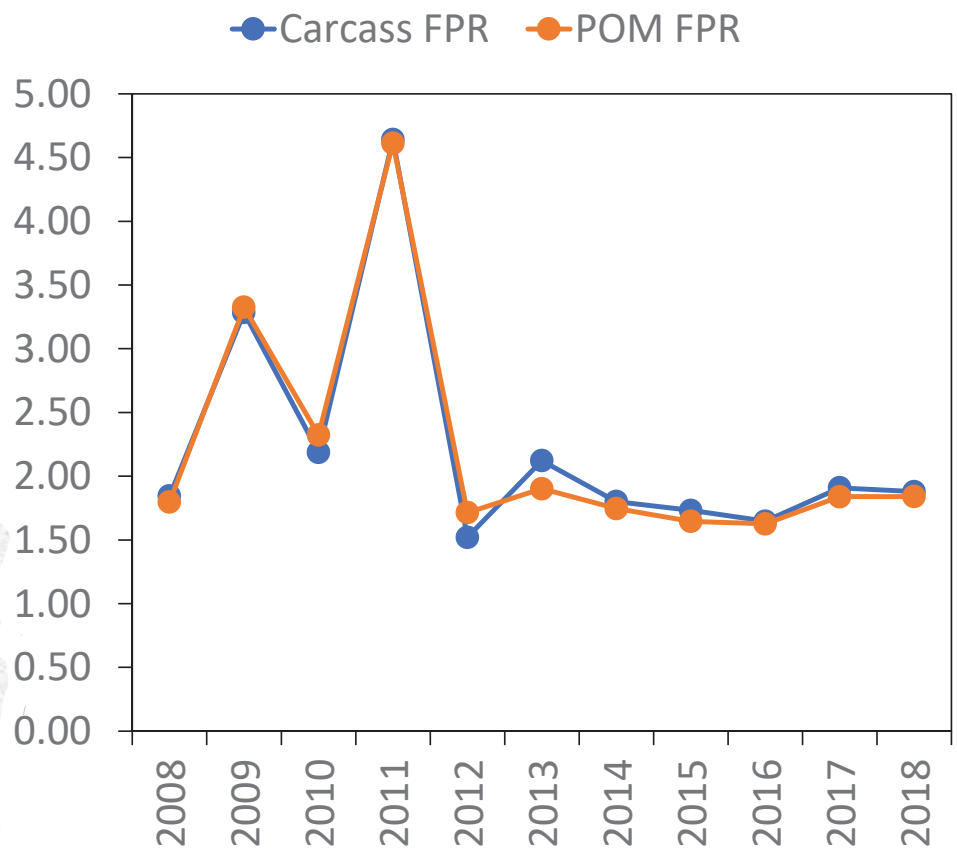
Estimating Spawner Demographics

1. Use predicted carcasses to calculate FPR of spawners
2. Estimated # of redds x FPR = Total Spawners
3. Estimated # of redds = Females
   - Assigned origin and age based on % carcasses
4. Total Spawners – Females = Males
   - Assigned origin and age based on % carcasses

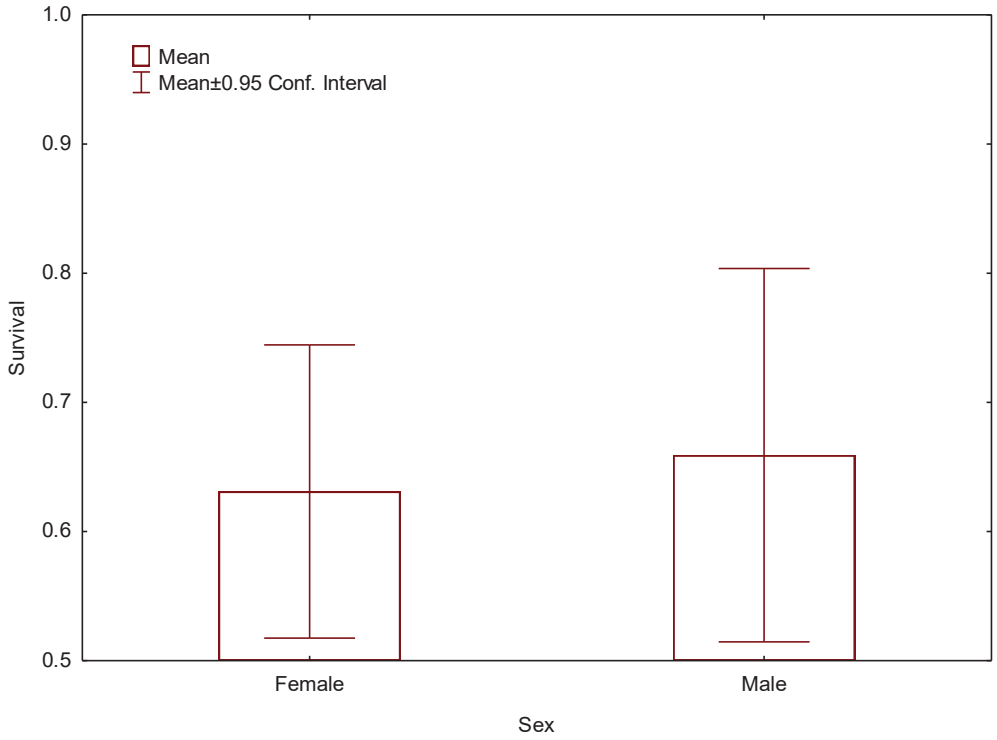
Pre- and Post-Spawn FPR Values

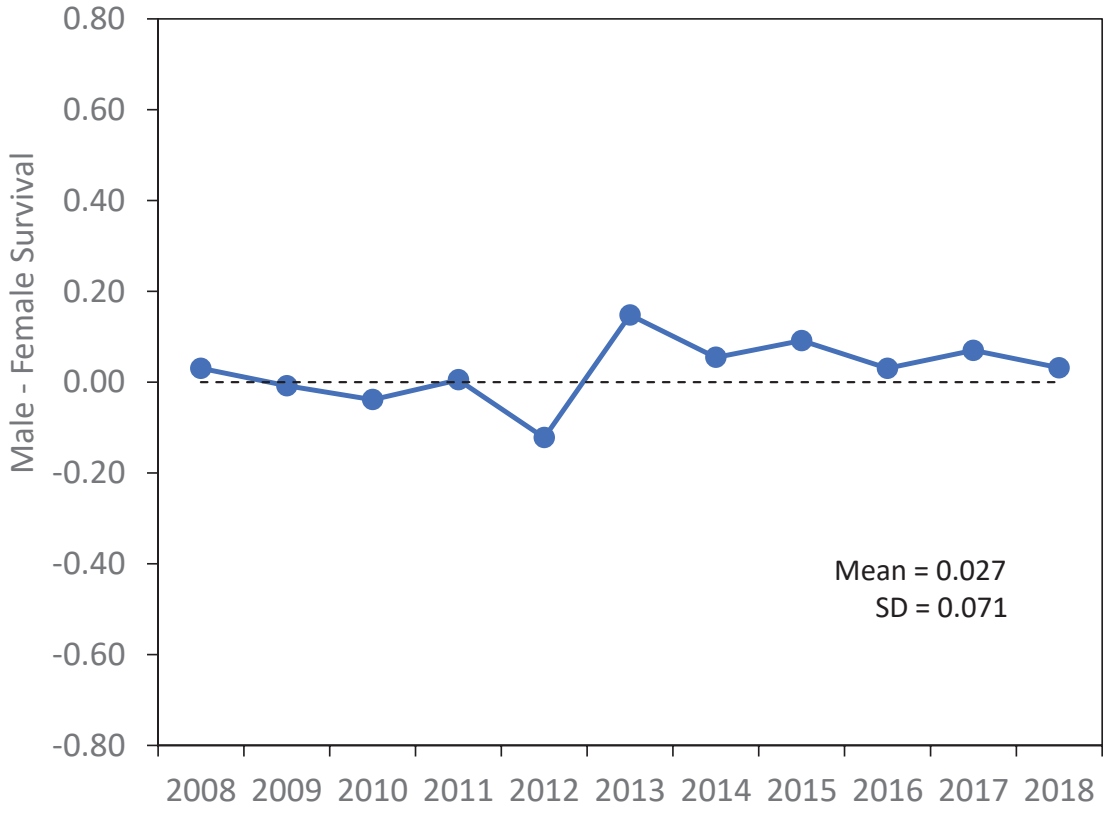


Pre- and Post-Spawn FPR Values



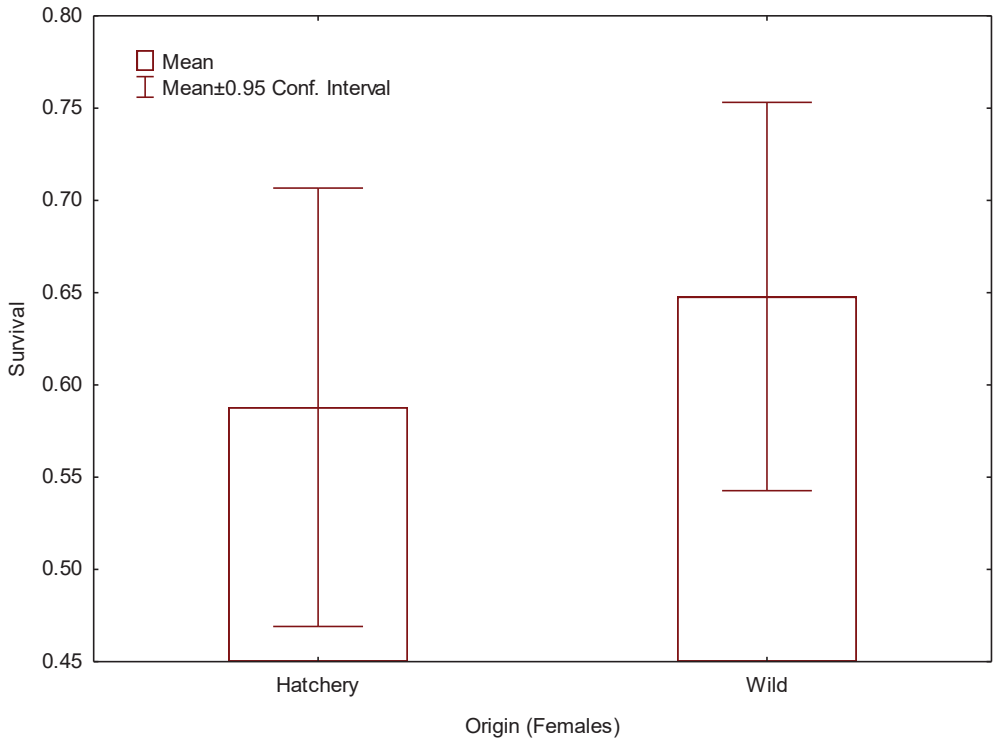
Mean Survival by Sex



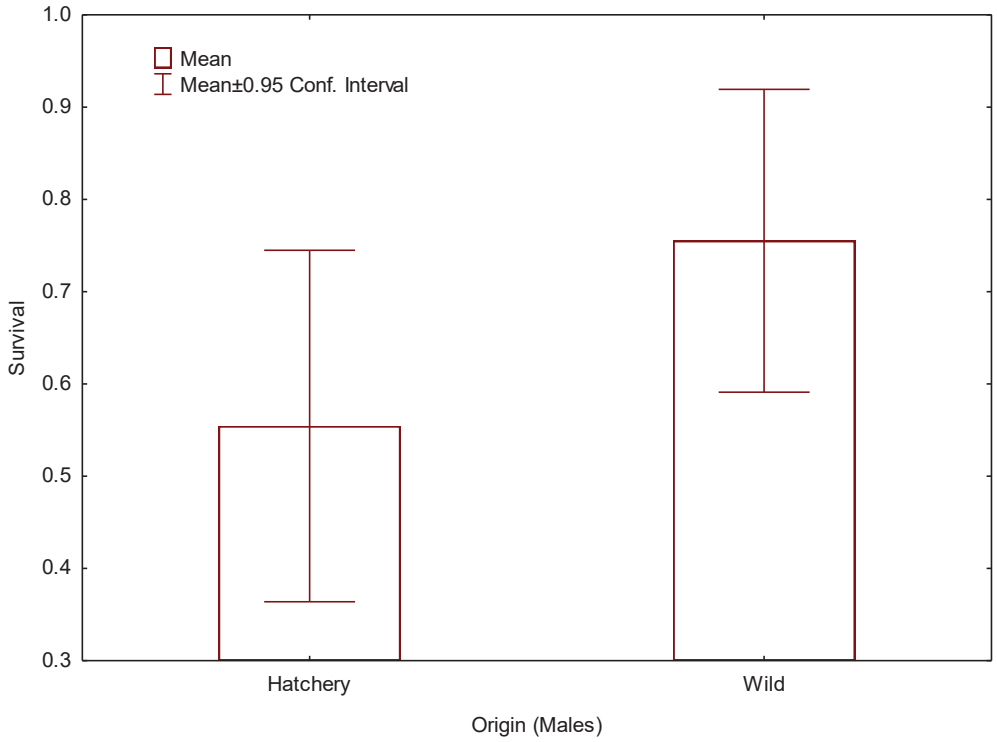


Comparing Male and Female Survival

Mean Female Survival by Origin



Mean Male Survival by Origin



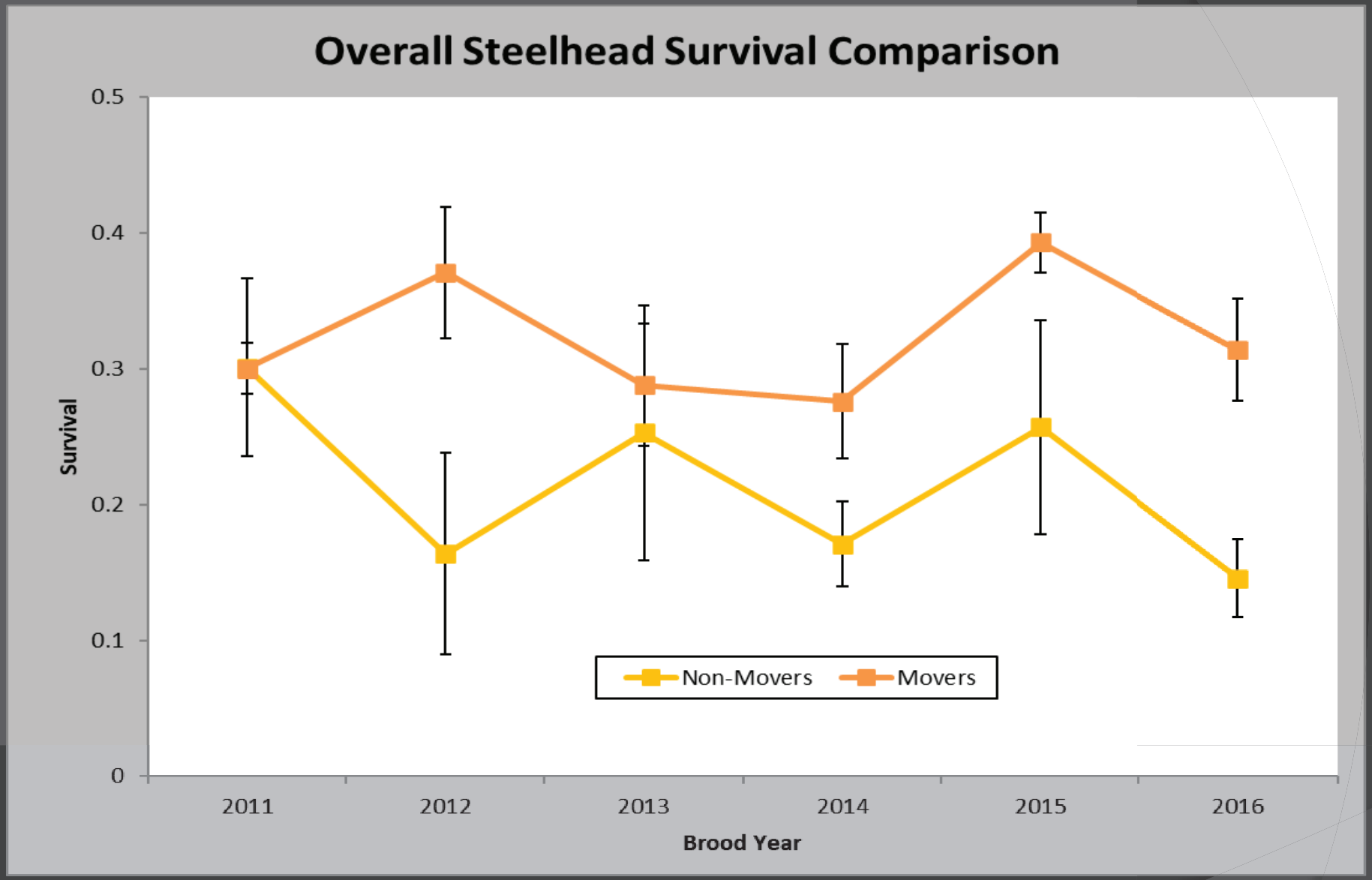
Next Steps

- Complete analysis for Nason Creek
- Make recommendations for sparse data streams
  - Small spawning population
  - Low or unrepresentative carcass sample
- Complete analysis for Little Wenatchee and White
- Complete run reconstruction for spring Chinook time-series
- Compare to carcass-based estimates (Bowerman et al. 2020)
- Expand to Methow and Entiat (i.e., PRD OLAFT)
- Estimates of PSM will be used to model and identify important limiting factors

Questions

- 2012 to 2017 “screened” fish
  - Non-movers lower Wenatchee
  - Movers to upper Wenatchee, Nason and Chiwawa

Brood year	Release location[a]	Crosses[b]	Type of release	Rearing scenario[c]	Number of tagged fish released	Survival to McNary Dam	Travel time to McNary Dam (d)	SAR to Bonneville Dam
	Nason	WxW	Movers	Circular	1,105	0.416 (0.083)	15.5 (5.3)	NA
	Nason	WxW	Non-movers	Circular	916	0.408 (0.113)	14.9 (5.1)	NA
	L Wenatchee	Mixed	Non-movers	RCY	1,658	0.252 (0.075)	13.0 (6.5)	NA
	U Wenatchee	Mixed	Movers	RCY	2,773	0.342 (0.032)	16.3 (7.9)	NA
	U Wenatchee	Mixed	Non-movers	RCY	1,435	0.469 (0.094)	19.7 (8.9)	NA
	U Wenatchee	WxW	Movers	Circular	1,061	0.555 (0.079)	13.9 (7.3)	NA
	U Wenatchee	WxW	Non-movers	Circular	849	0.362 (0.065)	12.7 (5.5)	NA
	Wenatchee	HxH	Vlitional	Blackbird	2,337	0.364 (0.039)	42.1 (8.5)	NA
	All	Mixed	NA	Circ or RCY	1,381	0.167 (0.105)	19.4 (10.8)	NA
2016	Chiwawa	Mixed	Movers	RCY	2,254	0.382 (0.093)	16.9 (9.8)	NA
	Nason	Mixed	Mixed	RCY	1,084	0.392 (0.136)	21.8 (9.9)	NA
	Nason	WxW	Movers	Circular	3,436	0.227 (0.044)	21.1 (11.5)	NA
	Nason	WxW	Non-movers	Circular	753	--	90.6 (155.2)	NA
	L Wenatchee	Mixed	Non-movers	RCY	2,134	0.285 (0.114)	45.1 (102.5)	NA
	M Wenatchee	Mixed	Non-movers	RCY	3,452	0.135 (0.030)	54.8 (109.1)	NA
	U Wenatchee	Mixed	Movers	RCY	2,712	0.312 (0.063)	14.8 (6.5)	NA
	Wenatchee	HxH	Volitional	Blackbird	2,512	0.209 (0.055)	25.9 (11.1)	NA
	All	Mixed	NA	Circ or RCY	1,481	0.200 (0.096)	9.7 (7.7)	NA



*RCY, RAS, WxW, HxH, multiple release locations and days

- Residualism (NMFS Section 10(a)(1)(A), 2017)
  - “Minimize residualism rates for hatchery releases and maximize the rate and probability of downstream migration.”
- Haush and Melnychuck (2012)
  - Characteristics of hatchery steelhead that influences individual fish to residualize.
  - Hatchery release practices that influence the number of fish that are likely to residualize.

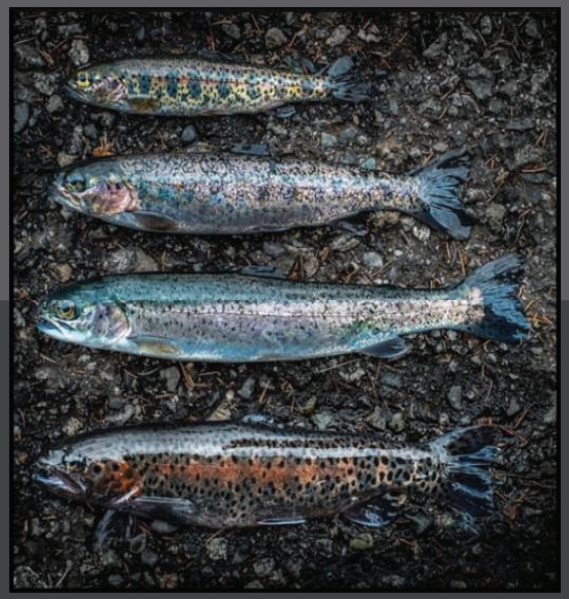


Photo: M. Humling, USFWS

- 2018 to 2020 release plan focused on evaluating individual fish characteristics to determine size and K of fish that are likely to outmigrate.
  - Eliminated covariates (release location, release day, HxH, WxW, RAS, RCY)
  - Evaluate survival based on size at release
  - Smolt index data
  - Sizes associated with PIT tags prior to release
  - GSI sampling

Table 1. Treatments for evaluation.

Vessel	Brood Origin	Treatment	Estimated # PIT-tagged	Treatment PIT release size
RCY2	HxH	Size	5,500 small	11,000 Small Mixed
RCY2	WxW	Size	5,500 small	
RCY2	HxH	Size	5,500 medium	11,000 Medium Mixed
RCY2	WxW	Size	5,500 medium	
RCY 2	WxW	Vessel Type	11,000	11,000 WxW RCY 2
RAS1/RAS 3	WxW	Vessel Type	11,000	11,000 RAS1/RAS 3

- 2021 release plan
  - Does “screening” fish separate potential residuals from non-residuals?
  - Collect data on movers and non-movers
    - Size, smolt index, GSI
  - Different from previous years by eliminating some covariates (RAS, multiple release locations, release date) and increase PIT-sample size for evaluation.

- Timeline
  - Spring Chinook are forced out by April 20th.
  - Open gate between RCY1 and RCY2 to begin screen process April 21.
  - Release the RAS fish sometime between April 21st to April 27th to Chiwawa.
  - Start tagging movers April 28th to May 3rd into RAS 3.
  - Shut gate between RCY 2 and RCY 1 May 4th.
  - Tag non-movers May 4th to May 8th into RAS 1.
  - Start releasing RCY 1 non PIT-tagged movers May 4th.
  - Start releasing RCY 2 non PIT-tagged non-movers May 9th.
  - Release all PIT-tagged fish on May 11th.