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: August 18, 2021

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

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Final Minutes of the July 21, 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's Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, July 21, 2021, from 9:00 a.m. to 1:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

Long-Term

- 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; expected completion by August.*)
- 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; expected completion by September.*)
- Kirk Truscott will work with Colville Confederated Tribe (CCT) staff to develop a model that addresses the probability of encountering natural-origin (NOR) Okanogan River spring Chinook salmon at Wells Dam (Item I-A). (*Note: this item is ongoing; expected completion by September.*)
- 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; completion depends on the outcome of the previous action item.*)
- 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 I-A). (*Note: this item is ongoing; expected completion by August.*)

Near-Term (to be completed by next meeting)

- 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.*)
- Larissa Rohrbach will file *10-year Comprehensive Review* chapters as they are completed by lead authors and distribute them to Committees for review in weekly batches (Item III-B). (*Note: this item is ongoing.*)
- Brett Farman will contact Mike Haggerty and Craig Busack (National Marine Fisheries Service [NMFS]) for their responses to a set of prepared questions from the Committees and request their participation in a future meeting on the appropriateness of the existing Proportionate Natural Influence Model for spring Chinook salmon programs in the Wenatchee Basin (Item III-C). (*Note: this item is ongoing.*)
- Todd Pearsons will add to the background information of Grant and Chelan PUD's draft Statements of Agreement (SOA) on Sockeye Salmon Obligation to provide more context on original mitigation credit agreements (Item I-A). (*Note: this item is ongoing.*)
- The *2024–2033 Recalculation Data Summary* will be revised by the PUDs, with outreach to other Representatives, to address the following (Item III-A):
  - Highlight which methods have been modified compared to the previous recalculation effort.
  - Add additional notes on how calculations were performed.
  - Share the Entiat Hatchery spring Chinook salmon spawning ground report with the PUDs for comparison to other potential adult count data sources proposed for hatchery production recalculation (Matt Cooper).
  - Consider whether the ratio of NOR fish at Wells Dam (run composition) should be used to adjust calculations for unclipped hatchery summer Chinook salmon and steelhead in a similar approach for both species.
  - Ensure that adjustments for fish that moved into the Wenatchee River are derived from stock assessments done at Dryden Dam for steelhead and Tumwater Dam for spring Chinook salmon.
  - Verify whether adult count data for Rock Island spring Chinook salmon reflect numbers before or after adult management (fish removal) at Tumwater Dam.
  - Verify whether the years identified for smolt-to-adult return (SAR) data are continuous and not overlapping with the years used in the previous recalculation effort.
  - Add SAR data sources to the data summary document.
- Keely Murdoch will verify whether the sensitivity analysis was done for the PUD's subject fish in addition to federal hatchery subject fish for the previous hatchery production recalculation effort (Item III-A).

- Relevant representatives will inform the Committees of any evacuation actions or deviations from normal protocols at Methow Basin hatcheries or acclimation sites due to wildfires (Item III-F).

Rock Island/Rocky Reach HCP-HCs

- None.

Wells HCP-HC

- All Committees members will provide feedback on the alternative mating strategies proposed for Wells Hatchery summer Chinook Salmon to Greg Mackey by August 4, 2021, for approval in next month's meeting (Item IV-A).

PRCC HSC

- None.

Decision Summary

- None.

Agreements

- None.

Review Items

- The *Draft 2024–2033 Recalculation Data Summary* was distributed by Larissa Rohrbach on July 21, 2021, with preliminary comments due to Greg Mackey as soon as possible. An updated draft will be distributed for additional discussion by August 9, 2021, and approval of data sources in September.
- *The Hankin Mating Strategy and Implementation in the Wells Hatchery Summer Chinook Programs* was distributed by Larissa Rohrbach on July 21, 2021, with comments due to Greg Mackey by August 4, 2021.
- The *10-year Comprehensive Review* chapters that are currently available for review were distributed by Larissa Rohrbach on July 21, 2021. A corrected review schedule was sent by Rohrbach on July 23, 2021.

Finalized Documents

- None.

I. Welcome

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

Tracy Hillman welcomed the HCP-HCs and PRCC HSC and read the list of attendees. The meeting was held via conference call and web-share because of travel and group meeting restrictions resulting from the coronavirus disease 2019 (COVID-19) pandemic. Hillman reviewed the agenda and asked for any additions or changes to the agenda. The following additions were made to the agenda:

- A short discussion from Washington Department of Fish and Wildlife (WDFW) and DPUD on the risk of three wildfires currently burning in the Methow Basin affecting the Winthrop National Fish Hatchery, Methow Hatchery, and various acclimation sites
- A discussion on potential adjustment of the timing of Methow summer Chinook salmon broodstock at Carlton due to high water temperatures
- A brief update on Chiwawa spring Chinook salmon collection and bull trout encounters at the Chiwawa Weir

All HCP-HCs and PRCC HSC representatives approved the revised agenda.

Revised minutes from the June 16, 2021, meeting were reviewed and approved by all members of the HCP-HCs and PRCC HSC that were present. Casey Baldwin abstained for the Colville Confederated Tribes (CCT) as neither he nor Kirk Truscott (CCT) attended the June meeting.

Action items from the HCP-HCs and PRCC HSC meeting on June 16, 2021, were reviewed and discussed *(Note: italicized text below corresponds to action items from the previous meeting*).

Joint HCP-HCs and PRCC HSC

Long-Term

- *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; expected completion by August.)*
- *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; expected completion by July.)*
  This item will be discussed in today's meeting. This item is complete.
- *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; expected completion by September.)*

- *Kirk Truscott will work with Colville Confederated Tribe (CCT) staff to develop a model that addresses the probability of encountering natural-origin Okanogan River spring Chinook salmon at Wells Dam (Item I-A). (Note: this item is ongoing; expected completion by September.)*
- *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; completion depends on the outcome of the previous action item.)*
- *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 I-A). (Note: this item is ongoing; expected completion by August.)*

Near-Term (to be completed by next meeting)

- *Mike Tonseth and Greg Mackey will solicit input from hatchery managers on effective methods to count surplus fish (Item I-A).*
  This item is ongoing.
- *Todd Pearsons and Rod O'Connor (Grant PUD) will compile data from 2011 through 2020 to be used for No Net Impact (NNI) recalculations, for distribution prior to the July meeting (Item II-B).*
  This item will be discussed in today's meeting. This meeting is complete.
- *Larissa Rohrbach will file 10-year Comprehensive Review chapters as they are completed by lead authors and distribute them to Committees for review in weekly batches (Item II-C).*
  This item has been completed for July; it is ongoing through October.
- *Brett Farman will contact Mike Haggerty and Craig Busack (National Marine Fisheries Service [NMFS]) for their responses to a set of prepared questions from the Committees and request their participation in a future meeting on the appropriateness of the existing Proportionate Natural Influence (PNI) Model for spring Chinook salmon programs in the Wenatchee Basin (Item II-D).*
  This item is ongoing.
- *Larissa Rohrbach will obtain past meeting minutes on discussions of the 2010 Statements of Agreement, on PUD funding and mitigation credit for the Skaha and Okanagan Lakes sockeye salmon hatchery and reintroduction programs (Item II-E).*
  This item is complete.
- *Todd Pearsons will add to the background information of Grant and Chelan PUDs' draft Statements of Agreement on Sockeye Salmon Obligation to provide more context on original mitigation credit agreements (Item I-A).*
  This item is ongoing. Todd Pearsons said the SOAs will be prepared for approval in the next meeting.

II. Rock Island/Rocky Reach

A. Chiwawa Spring Chinook Salmon Broodstock Collection at Chiwawa Weir

Scott Hopkins updated the Committee on recent spring Chinook salmon broodstock collection activities for the Chiwawa program. The target was to capture 78 adult fish (39 male and 39 female) at Tumwater Dam and Chiwawa Weir collectively. A total of 39 hatchery-origin returns (HOR) were preemptively collected at Tumwater Dam; 84 natural-origin returns (NOR) were collected at Tumwater Dam and Chiwawa Weir, collectively. Excess HOR and NOR will be released after scale analysis has been done. Trapping began on July 8, 2021. During 6 days of the 20 allotted for trapping, 38 bull trout were encountered out of an allowed 105 encounters for 2021. The Chiwawa spring Chinook salmon program is fully stocked after a short collection period. Crews believe they were trapping at the peak of the run and the return was higher than expected.

Catherine Willard provided an update on the Chiwawa Weir bull trout bypass. The bypass was originally set up with a 4-inch space to allow smaller fish like bull trout to swim below the weir while retaining spring Chinook salmon, similar to an approach taken in the Imnaha River in Oregon. During the first day of trapping, staff noticed Chinook salmon were able to pass through and closed the exterior bypass gate to reduce the gap to 3 inches, but Chinook salmon were still escaping. Fish were passing under the floor that mechanically lifts. Staff acted quickly to rescue 11 bull trout, 23 HOR spring Chinook salmon, and 11 NOR spring Chinook salmon from under the floor. In a separate incident on the same day, 3 spring Chinook salmon became wedged under the bull trout bypass gate overnight and 2 HOR fish died; subsequently, the bull trout bypass was closed. Continuing to pilot the bull trout bypass can be discussed further in a future meeting but, at this time, Chelan PUD recommends not using it in the future because the program has been able to collect their full broodstock target over the past 2 years by starting in early July rather than mid-June.

Matt Cooper asked if the timing of the spring Chinook salmon run was different this year compared to other years. Willard said Chinook salmon arrived at Tumwater Dam a bit earlier this year, but then high-water levels limited the ability to see or otherwise detect fish passing the dam. It appears the fish paused their upstream movements during the high runoff event.

Bill Gale asked if spring Chinook salmon that were able to access and move through the bull trout bypass were jacks or were from other age classes. Willard said Chiwawa Wier staff thought they included other ages in addition to jacks.

Katy Shelby asked if the video observations of the bull trout bypass were working. Willard said they were able to collect video observations but have not yet reviewed the video. Observations of fish moving through were made directly by the hatchery staff.

III. Joint HCP-HCs and PRCC HSC

A. Hatchery Production Recalculation: Data Source Review

Greg Mackey reminded the Committees that the intent of the recalculation data source review today is to present the data sources and calculation processes for each site and species. The documents shown in the meeting will be provided to the Committee for suggested revisions and the datasets will be approved in next month's meeting.

Adult Count Data

Greg Mackey led a discussion on adult count data at various projects for relevant brood years. A summary of those data was projected in the meeting, shown for each species in the draft document entitled *2024–2033 Recalculation Summary* (to be updated prior to the next meeting based on today's feedback).

Where possible, data were gathered from the most recent monitoring and evaluation (M&E) reports. Some data were gathered from Columbia River Data Access in Real Time (DART). Each data table cites the data source in footnotes.

The nadir approach for discerning different runs of Chinook salmon was compared to the approach used in M&E reporting. The nadir approach was used for the last recalculation. At Wells Dam there are better M&E data that are more accurate than the nadir approach. Willard said both methods were presented because the nadir method yielded a couple of very low and very high estimates in some years, and they wished to ground truth the methods using the M&E approach. Results from using the numbers from the two methods come out similarly.

For **Wells spring Chinook salmon and steelhead**, numbers from WDFW reflect a roll up of fallbacks, double counts, and other adjustments to numbers due to removals for broodstock collection or other activities.

For **Rocky Reach spring Chinook salmon**, the NOR observations at Wells Dam were used and adjusted for conversion between Rocky Reach to Wells Dams, and for escapement to the Entiat River between the two sites. Keely Murdoch asked why spring Chinook salmon counts at Rocky Reach were not used directly, which would be a simple approach rather than the sequence of calculations shown. Tracy Hillman asked if this method was used last time, consistent with the document shown in the past meeting. Catherine Willard said it is the same method as last time. Mackey said there may be better stock assessment data at Wells Dam, and the passive integrated transponder (PIT)-tag conversion rate is used to walk back to Rocky Reach Dam. Some fish move up the Entiat River and would not then be encountered at Wells Dam. Scott Hopkins agreed this was more accurate than counts at Rocky Reach Dam. Todd Pearsons said it is difficult to assign fish by origin with window counts like those at Rocky Reach Dam. Mackey said a better assessment of origin is done at Wells Dam because broodstock collection is done there using scale analysis which is not done elsewhere.

Matt Cooper asked why the 2018 Winthrop National Fish Hatchery Annual Report and WDFW Salmon Conservation and Reporting Engine data were used rather than the US Fish and Wildlife Service's Entiat Chinook salmon spawning ground report. Mackey said he would be interested to know if there is a superior data source. Cooper agreed to compare those sources.

For **Rocky Reach steelhead**, Cooper asked if the counts from DART are used, noting there are the same challenges, as with spring Chinook salmon, to identify the origin of fish that do not have external marks. Cooper asked if the analogous run composition data from Wells Dam could be used to back-calculate the unclipped hatchery component passing over Rocky Reach Dam and whether that has been done in that DART calculation. Mackey said it is likely the NOR return ratio at Wells Dam overall would have been used to make that adjustment without trying to parse out the ad-present hatchery component at Wells Dam. Cooper said because of the similarities between spring Chinook salmon and steelhead treatment at Wells Dam, calculating the data in the same way should be considered.

Rocky Reach summer and **Rocky Reach fall Chinook salmon** were treated separately. Willard added that fallback rates are calculated separately for each species by Skalski Statistical Services (Dr. John Skalski [University of Washington, Columbia Basin Research]). Cooper asked if fallback rates are similar between HOR returns and NOR? Willard said it is unknown because Skalski has not been asked to calculate them separately.

For **Rock Island sockeye salmon (Wenatchee River sockeye salmon only),** counts were adjusted by subtracting the fish passing over Rocky Reach from fish passing over Rock Island and correcting for fallback rates. Murdoch asked if the fallback correction is based on PIT tags. Willard confirmed they are based on PIT tags observed falling back over Rocky Reach and for recension over Rock Island to correct for double counting those fish. Murdoch asked for clarification on why the Rocky Reach fallback correction is needed. Hopkins said it is used for calculating the number of sockeye salmon moving into the Wenatchee River, which is the delta between Rocky Reach and Rock Island counts after correcting for fallbacks.

For **Rock Island spring Chinook salmon**, fallback corrections are applied for Rocky Reach and Rock Island passage. The Wenatchee River spring Chinook salmon are accounted for by using the delta between counts at Rocky Reach and Rock Island.

Murdoch asked that it be highlighted in the data summary document which methods have been adjusted and which are the same as the last recalculation effort. Mackey said this document is to communicate what will be done for this recalculation effort and also will serve as a record for the next recalculation. Willard and Mackey agreed to write a descriptor for each calculation method and whether it differs from the last recalculation effort.

Mike Tonseth asked whether the observations are for the run escapement before or after adult management (removal of fish) at Tumwater. Willard and Hopkins will review the methods to provide an answer.

Rock Island steelhead were calculated similarly to Rocky Reach steelhead starting with DART counts to obtain the delta from Rock Island to Rocky Reach, then corrected for fallbacks, and for Wenatchee River NOR escapement using the PIT-tag expansion approach.

Rock Island summer and fall Chinook salmon were discerned from each other using the nadir approach. An additional correction for unclipped HOR overshoots was included to increase the accuracy of estimating NOR fall Chinook salmon. Rod O'Connor said the correction for overshoots was included because the Priest Rapids M&E showed there is some portion of ad-present HOR fish that are composed of overshoots from Priest Rapids Dam. Willard noted the overshoot is only for fall Chinook salmon.

Priest Rapids fall Chinook salmon counted at Rock Island Dam were discerned from summer Chinook salmon by the nadir approach. O'Connor stated that the Rock Island fall Chinook NOR salmon estimate is used for Grant PUDs recalculation purposes because Grant PUD already fully mitigates for fall Chinook salmon in the Grant PUD project area through its inundation mitigation. This was the same approach agreed to in the last recalculation. Counts are corrected for fallbacks and reascensions at Rock Island Dam and for overshoot of HOR ad-present fish over Priest Rapids Dam.

For **Priest Rapids spring Chinook salmon,** counts at Priest Rapids Dam were adjusted using a nadir approach and then further adjusted for origin. Pearsons said the deviation from the past calculation is to include the reascensions.

Priest Rapids steelhead followed a similar calculation method.

Tonseth noted for both Priest Rapids Dam and Rock Island Dam mitigation calculations, stock assessment data used to correct for escapement to the Wenatchee River are actually from two locations; data from Dryden Dam should be used for steelhead where that stock assessment sampling is done, and data from Tumwater Dam stock assessment should be used for spring Chinook salmon where that sampling is done. Murdoch agreed, as a certain number of steelhead move into Peshastin Creek. Mackey agreed to review the sources in the M&E Reports to determine if those were in fact the data used and recorded as a typo.

For **Priest Rapids summer Chinook salmon**, similar corrections were applied for reascension and the NOR component of the run.

To finish the discussion, summary datasets were shown of unavoidable project mortalities for each project and distribution of NOR spawners and spawner distributions. Spawner distributions may be used as needed to help spatially allocate mitigation programs. Project survival rates were applied to the historical calculated hatchery compensations to illustrate the proportion allocated to specific hatcheries for comparison to past methods.

Hillman asked how the PUDs want to share these calculation records. Mackey said the source spreadsheets may be difficult to interpret; a better approach may be to show the mathematical equation in the provided document used at each blue arrow to obtain one dataset from another. Committee members and PUD representatives will contact one another to resolve additional questions and revise this document in time for distribution and approval in the next meeting.

Larissa Rohrbach will distribute the version shown today for Committee members to review and comment as soon as possible. PUD staff will make revisions based on comments heard today and redistribute a revised version of this document by August 9, 2021, for review. Additional discussion will be held on August 18, 2021, for final approval of the data sources and calculation methods in September.

Hatchery Recalculation Smolt-to-Adult Returns

Mackey presented an overview of methods for calculating SAR for determining mitigation (Attachment B).

Murdoch said during the previous recalculation effort, Steve Hays (Chelan PUD) clarified the Biological Assessment and Management Plan (BAMP) calculation is not a back-calculation from adults to number of smolts that would have passed the project; it is actually a forward calculation using the average SAR from a given hatchery to account properly for missing adults (recorded in the April 20, 2011, meeting notes, page 10). There is only the need to determine the SAR of the hatchery in which they would be raised to make this correction.

Murdoch asked whether the years of the datasets proposed for use for calculating SARs pick up where the last recalculation effort left off. Mackey said the first relevant brood years show the earliest cohort that makes sense to apply to the 2011 to 2020 returns, the agreed-to return years for mitigation recalculation. Murdoch said although they would align with the adult return years to be used, this may not add up to a 10-year dataset and, she would like to ensure the SAR datasets are also continuous. The other concern under this concept is that the most recent data should be used. Mackey agreed to confirm which years were used for subject hatchery SAR data in the past recalculation effort to determine whether there would be a gap in the data.

Pearsons said he thought the intent of the BAMP calculation was to make sure the adult return data at the dam was geographically similar to the SAR data. Murdoch said she remembers the past discussion about whether SAR to the dam or hatchery are needed and about the connection between how many adults would have come back and how many juveniles need to be released to replace those adults. Using hatchery SARs works fairly cleanly for the hatchery releases; SAR to the dam could be used but would not fully replace the number of adults to the hatchery. Pearsons said there are two points to resolve: first, the geographic point at which you end your calculation (spawning ground, hatchery, or dam); and second, which hatchery the fish are coming from in order to know which SAR to apply. Murdoch agreed and said this is apparent in one category of the sensitivity analysis, the SAR adjustments for Winthrop National Fish Hatchery and Leavenworth National Fish Hatchery, which was overly confusing. Murdoch said the SARs needs to match up with the hatchery that's going to be doing the mitigation (e.g., using the Chiwawa program SAR for Chelan PUD, Nason program SAR for Grant PUD, and sometimes the nearest SAR available was substituted).

Pearsons asked if Committee members have noted any fatal flaws in the proposed method for using the tag detections and accounting for harvest and survival shown in the presentation. None were noted in the meeting. The PUDs will include these data sources in the same *2024–2033 Recalculation Data Summary* document shown today for review by the Committees in August, and approval by Committees in September.

Sensitivity Analysis

Mackey presented a review of the sensitivity analysis that was done in the previous recalculation effort (Attachment C). An example using Winthrop National Fish Hatchery's 400,000 fish release was shown to demonstrate what would be needed to achieve 400,000 fish at the downstream end of the Mid-Columbia hydrosystem.

Murdoch asked about mitigating for impacts to NNI mitigation programs. The issue was relative to Grants NNI releases in the Methow Basin that have to pass through all the dams such that the other PUDs would also have to mitigate for losses to Grant's NNI program. Murdoch said, at that time, there was a collective agreement that each PUD would not have to compensate for the other PUDs' NNI programs. Factor "d" of the sensitivity analysis would include mitigation for all PUD programs and not just federal programs. Keely asked, where is the number that shows how Douglas and Chelan make Grant's mitigation whole? Mackey said this was not applied to natural populations or PUD hatchery programs, only the federal programs. Murdoch disagreed and thought one of the sensitivity analyses was done for the NNI programs as well and said this was a major point of disagreement last time. Mackey said he thought the compromise was to do this for the federal programs. Pearsons said one area where PUD mitigation for NNI mitigation was considered was for inundation; the federal programs do not include mitigation for inundation. Murdoch said she would review the notes describing this past discussion to confirm the intent of the mitigation for NNI.

B. Comprehensive Monitoring and Evaluation Report: Review Check-in

Regarding email distribution of chapters for the first review period, there has been some confusion about which chapters are available for review and which should be reviewed first.

Todd Pearsons said there are two productivity chapters that haven't been distributed yet that originally were intended for review in July (one on juvenile spring Chinook salmon, summer Chinook salmon, and steelhead productivity, and another on adult steelhead productivity). The PUDs suggested extending review periods through the end of the next month from when the reports are distributed. Pearsons said for people who want to work ahead, the Priest Rapids fall Chinook salmon chapters are almost all available on the Sharepoint site.

Larissa Rohrbach will distribute an updated email following the meeting with all the documents that are available for review and an update to the schedule (shown in Attachment D) indicating which should be reviewed first.

C. Proportionate Natural Influence Modeling for the Wenatchee Basin

Brett Farman has received no additional revisions to the questions prepared for Craig Busack and Mike Haggerty, since discussions during the last meeting. Farman will request that Busack and Haggerty participate in the August or September meeting.

D. Coronavirus Disease 2019 and Monitoring and Evaluation Activities

Tracy Hillman asked Committees' members to provide their monthly updates on impacts of COVID-19 restrictions on M&E activities.

- Mike Tonseth said there has been some relaxation of rules from WDFW. Fully vaccinated individuals can start visiting the office and participating in in-person meetings; however, people cannot be asked if they have been vaccinated. Katy Shelby said the guidance for people working on M&E field work is the same.
- Brett Farman had no new updates from NMFS. There are no plans for re-entering the office or traveling. There may be national guidance forthcoming this week, but this would not necessarily change the regional guidance.
- Keely Murdoch had no additional guidance from the Yakama Nation for attending meetings. Some requirements for field crews have been relaxed for vaccinated individuals regarding masking and riding together in vehicles.
- Matt Cooper said national guidance from the Department of the Interior and U.S. Fish and Wildlife Service is forthcoming. People willing to disclose vaccination status can work in the offices; people riding in vehicles together must still be masked.
- Casey Baldwin noted no changes for the CCT. Vaccinated individuals can attend meetings, enter offices, and conduct field work without restrictions.

- Scott Hopkins said as of July 6, Chelan PUD staff have returned to the office. Vaccinated individuals are not required to wear masks. Hopkins will check on guidance for external meetings.
- Tom Kahler had no new updates from Douglas PUD; he will check on guidance for external meetings.
- Todd Pearsons said people do not have to wear a mask in the workplace if they provide proof of vaccination. If they do not provide proof of vaccination, they must mask and maintain social distancing. These guidelines also apply to contractors.

Hillman noted Committees could meet in person in August, acknowledging that some parties may not be able to participate. A virtual meeting will be planned but an in-person meeting may be possible.

E. Wildfire Impacts on Hatcheries

Mike Tonseth noted several wildfires that may threaten hatchery infrastructure in the Methow Valley, including the Cedar Creek fire near Mazama that is working its way down valley. The Cub Creek 2 fire in the Chewuch River drainage is moving toward the town of Winthrop. Fires could coalesce rapidly if appropriate conditions occur. Tonseth asked whether U.S. Fish and Wildlife Service or Douglas PUD representatives have discussed the potential of a Level 3 evacuation (get out now) notice and whether broodstock should be evacuated. Tonseth also asked if there is any concern of possible contamination of surface water with flame retardants. The Cub Creek 2 fire has likely damaged the Chewuch acclimation facility.

Tom Kahler said he had not talked to anyone about what is happening at the Chewuch acclimation pond. The fire outline seems to exclude the acclimation site and perhaps it was defended. Brandon Kilmer (Douglas PUD hatchery manager) is on vacation and its uncertain at this time if anyone has been allowed to look at the site. Shane Bickford (Douglas PUD Assistant PUD Manager) is also on vacation, so the typical chains of communication are not available. Kahler will call to obtain updates. The Methow Hatchery is supplied with 100% groundwater right now and there is less concern about contamination by flame retardant chemicals. Tonseth suggested contingency planning be considered for continuing to care for those fish on station.

Matt Cooper said the Winthrop National Fish Hatchery staff met yesterday to talk about the potential for evacuation in terms of employee safety and protecting equipment. There is no plan to transport fish or carry out emergency releases of juveniles yet. If evacuation of the staff was necessary, adult fish would survive with contingency power provided by a 1000-gallon fuel tank that would allow adults and juveniles to survive for up to a week.

Keely Murdoch said the Yakama Nation acclimation sites near Early Winters and Eight Mile in the Chewuch are near the fires but there are no fish or staff there at this time.

Tonseth said these fires are going to impact spawning ground surveys for spring Chinook salmon. There may be coded wire tag and PIT-tag data that can be relied upon. Conditions in the spring may result in post-fire flooding.

IV. Wells HC

A. Alternative Mating Strategies

Greg Mackey provided a presentation on *Hatchery Broodstock and Mating Practices for Wells Hatchery Summer Chinook* Salmon (Attachment E) and the potential benefit described in a white paper entitled, *Hankin*[1] *Mating Strategy and Implementation in the Wells Hatchery Summer Chinook Programs* (Appendix G).

Mackey said Douglas PUD is proposing to change approaches to mating strategies to minimize or avoid reductions in size-at-age caused by hatchery practices and harvest. Artificial selection is inevitable in the hatchery setting. Programs tend to be unintentionally selective even when attempting to mate randomly. The 2020 broodstock was shown as an example for how this mating strategy could work. A modeled comparison was shown for the frequency of matings that can occur if the male was larger than the female using size-selective mating compared to random mating.

Selecting males that are at least slightly larger than females allows for a larger number of Hankin et al.-type matings. Size-selected matings are low risk and may provide long-term benefit by emulating natural spawning. It is not their recommendation to sort through all the males to keep finding those that are larger than a chosen female, but the workflow could be simple to implement if fish are sorted by size during collection.

Mackey would like to implement size-sorted mating, and as feasible, collect larger males for broodstock to increase the number of desirable matings. The effect may not be detectable for many years, but the program would go forward on faith that this is a best practice for the population. There would not be a control population for comparison, though the wild population at Wells Dam could be used for comparison.

Mike Tonseth said age and size are used interchangeably to describe this, but during the warm ocean blob, older fish were returning at about the same size as younger age classes. Tonseth asked if there would be some matching according to age. Tonseth also asked if age is more influential than size, and whether age should be the target for selection rather than size. Size can be used as a proxy but perhaps there could be another proxy for age that should be used. Mackey said Hankin et al.

[1] Methods were first discussed in the February 20, 2020 meeting, based on those described in Hankin, D. G., J. Fitzgibbons, and Y. Chen, 2009. Unnatural random mating policies select for younger age at maturity in hatchery Chinook salmon (*Oncorhynchus tshawytscha*) populations.

used size as a reasonable proxy for age of the fish. Tonseth said PIT tagging of broodstock and scale collection at the time of broodstock collection would allow for tracking relative size, gender, and age of those fish. Mackey said this is possible but may be more complicated than desired at this time. It would be difficult to repeatedly sort through PIT-tagged fish. At this time Douglas PUD is envisioning a fairly streamlined application.

Tonseth asked if the same results would be expected for programs releasing subyearling or yearling progeny. Mackey said he did not think the life-history of the progeny would matter; Hankin et al. does talk somewhat from the scientific perspective about the application across variable stocks. Mackey said there is some evidence of differences in trends in size at return for adult fish that originate from subyearling releases and yearling releases.

Tonseth said he is supportive of evaluating this approach, but wonders if a paired treatment could be set up to monitor changes in the population over time. Mackey said for research purposes he would prefer to do this, though it is unclear what difference could be detectable between treatment and control groups, or how long it would take to observe an effect. Offspring could he held separately until marked with different coded wire tags, and once marked they could be treated the same.

Bill Gale wondered if the program is already collecting size data on broodstock and sampling 100% of fish for genetics for parentage-based tagging. If so, could one look back through crosses to identify cases where a larger male was used with a smaller female and then look at the family level for differences among fish returning from that cross rather than setting up an experiment. Mackey said he is not familiar with what parentage-based tagging has been run on Wells summer Chinook salmon. Tonseth said most programs track which male spawned with a given female; in some cases the males are not tracked; and in some cases a primary male is used with a backup male. Therefore, it is unknown which male made the contribution to the offspring.

Brett Farman said logistically it sounds like a paired study would be a lot of work. Size-selective mating is typically a challenging topic and because this is not a listed program, this program is less of a concern for NMFS. Farman said he would be supportive of this mating approach, regardless if spawners could be split into a control and treatment group.

Tonseth said the broodstock collection protocols already restrict use of age-2 and age-3 males for spring and summer Chinook salmon. This approach would go to the next step among age-4 fish and older to restructure the mating crosses to be more intentional.

Mackey said in the future the offspring from the control and treatment groups would not be discernable and the effect for the overall population would be diluted. Tonseth agreed but this would force the program to commit to that course without the ability to correct if adverse impacts are detected in the future.

Keely Murdoch said she has concerns about selecting for larger males which seems to go against trying to collect broodstock from throughout the run. Murdoch is willing to go through with this program and see how it goes. Tonseth asked for clarification that the intent is for females to be paired with males that are larger, not necessarily only selecting broodstock collection for larger males. Mackey said yes, though the second part of what he presented was to demonstrate that the ability to make these selective crosses increases if larger males are selected at the time of collection.

Matt Cooper said this is an approach the USFWS has also been interested in but sees the difficulty in implementation. It does seem prudent to push toward using males that are slightly larger in size while preserving the other components to maintain genetic diversity. Bill Gale agreed and said the idea has a lot of merit.

Casey Baldwin asked what the mechanism would be for larger offspring to result if you don't selectively collect for large males and just selectively mate within a randomly collected group. Mackey said he would have to refer to the Hankin et al. paper for these nuances, but there may be a way to optimize the heredity for size at the family level. Baldwin suggested considering what the unintended consequences of crossing small fish with small fish. Baldwin said he is supportive of the method to potentially select large males for broodstock while surplusing small fish to counteract the trend observed across the basin of smaller returning fish.

Mackey said spawning is in October. He asked the Committees to provide their feedback in time to refine the proposed methods for final discussion and approval next month.

V. PRCC HSC

A. Summer Chinook Collection at Carlton Hatchery

Todd Pearsons said the water temperatures have been unusually high in the Columbia River this year. The fish pathologist and culturists for the summer Chinook salmon program recommended collecting as many of the Carlton summer Chinook salmon broodstock now to collect viable eggs. Over the past 2 weeks they have balanced collection throughout the run by collecting the target number for the given week as well as the number suggested for the following week. Now there is a new request to collect all remaining brood this week. Pearsons asked the Committees whether the method used so far would be preferable or whether the brood should be filled now while there is still cooler water.

Mike Tonseth said he would have appreciated knowing about the change in protocol when it was initiated. Pearsons said it is a challenge to know whether a decision rises to a level that should be brought to the Committees, especially when decisions need to be made quickly. Pearsons said that if adjustments are made in the spirit of the Broodstock Collection Protocols, he typically does not bring them as decisions before the PRCC HSC, but in this case potentially collecting all broodstock in one week seems to rise to the level of asking for agreement by the Subcommittee. Tonseth said an email to the Subcommittee would have been sufficient notification of a change in operations, not necessarily requesting a decision.

Tonseth asked, of the 128 broodstock targeted for the program, how many are left to be collected? Pearsons said he is trying to obtain that information but understands they are past the 50% collection targets. (Pearsons later forwarded an email from Grant PUD staff that 108 fish [54 pairs] had been collected to date with the last 20 fish [10 pairs] to be collected tomorrow.) Tonseth said, from the fish health perspective, he agrees it would be better to collect those fish sooner than later, especially to avoid *Columnaris* outbreaks. Tonseth said he agrees with taking advantage of fish in hand and to hold them as they are collected, but once targets are met, to continue with the monitoring to try to fill out the run composition. Brett Farman, Keely Murdoch, Matt Cooper, and Casey Baldwin said they support that collection approach. Cooper said they are wrestling with the same challenge in the Entiat River.

Baldwin said temperatures in the mainstem rivers this year do not appear quite as bad as in 2015. In 2015 in the Okanogan River, there was an increase in egg retention. If hatcheries have data on egg viability in 2015, it would make sense to review that information to help justify the recommendation and to develop a temperature and broodstock acceleration contingency plan for the future, as these events may become more frequent. Tonseth said a rapid decline in gamete quality with time spent in warmer water is one reason the Wells Hatchery has a more truncated collection period.

VI. Administrative Items

A. Next Meetings

The next HCP-HCs and PRCC HSC meetings will be Wednesday August 18, 2021; Wednesday September 15, 2021; and Wednesday, October 20, 2021, held by conference call and web-share until further notice.

VII. List of Attachments

Attachment A	List of Attendees
Attachment B	Hatchery Recalculation Smolt-to-Adult Returns
Attachment C	Hatchery Recalculation Sensitivity Analysis
Attachment D	Updated Schedule for Review of Comprehensive Report
Attachment E	Hatchery Broodstock and Mating Practices for Wells Hatchery Summer Chinook Salmon
Attachment F	Hankin Mating Strategy and Implementation in the Wells Hatchery Summer Chinook Programs

Attachment A
List of Attendees

Name	Organization
Larissa Rohrbach	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Scott Hopkins*	Chelan PUD
Catherine Willard*	Chelan PUD
Casey Baldwin*‡	Colville Confederated Tribes
Tom Kahler*	Douglas PUD
Greg Mackey*	Douglas PUD
Peter Graf‡	Grant PUD
Rod O'Connor	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Matt Cooper*‡	U.S. Fish and Wildlife Service
Bill Gale*‡	U.S. Fish and Wildlife Service
Mike Tonseth*‡	Washington Department of Fish and Wildlife
Katy Shelby	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

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

Attachment B
Hatchery Recalculation Smolt-to-Adult Returns

Hatchery Recalculation SARs

Objectives

- Use the most accurate method for estimating SARs
- Maximize use of available data
- Align brood years with relevant adult return years (2011-2020)
- Repeatable methodology

SAR Data

Calculation Options Depend on Available Data

- CWT (Chinook)
- PIT (Chinook and Steelhead)
- Run reconstruction if no hatchery is present (Wenatchee Sockeye)

SAR Data Characteristics

- CWT Only
  - CWT data do account for harvest and spawner numbers but do not allow for SAR calculations at individual projects or account for pre-spawn mortality.
  - CWT data require time for CWT tags to be processed. As a result, calculations of SARs are not accurate until several years after brood year has returned.
- PIT Only
  - PIT data account for survival to individual projects but do not account for downstream harvest
  - Data are available immediately after detection (no lag time for processing)
  - Many programs began releasing PIT tags in mid/late 2000's, but records may not be complete for all brood years

SAR Data Characteristics

- CWT + PIT Hybrid
  - Option for Chinook only
  - Accounts for survival to project and downstream harvest
  - SAR calculated from first relevant brood year through the most recent brood year in which CWT data are mature
  - Early brood years that lack PIT data have mature CWT data. CWT data are used for any brood year that lack PIT data
  - CWT harvest data is drawn directly from M&E report
  - CWT harvest data is only used to account for fisheries downstream of projects
  - Summer Chinook CWT harvest components include 1) Ocean fisheries, 2) Zone 1-5 Commercial Fisheries. Recreational and tribal harvest is not included
  - Spring Chinook CWT harvest components include 1) Ocean fisheries, 2) Zone 1-5 Commercial Fisheries, 3) Tribal, and 4) Recreational fisheries.

Proposed SAR Method

Spring Chinook

- Hybrid method to account for harvest and survival to project
- Most hatchery fish return at total age 4 and 5
- First relevant BY = 2007
- Most recent BY in M&E Report = 2015
- Data sources:
  - PIT
  - CWT (harvest component)

Proposed SAR Method

Summer Chinook

- Hybrid method to account for harvest and survival to project
- Most hatchery fish return at total age 3 to 6
- First relevant BY = 2006
- Most recent BY in M&E Report = 2014
- Data sources:
  - PIT
  - CWT (harvest component)

Proposed SAR Method

Steelhead

- Limited options for SAR calculations—limited recovery of post-spawn individuals
- Most hatchery fish return as 1 or 2-ocean
- First relevant BY = 2008
- Most recent BY in M&E Report = 2015
- Data sources:
  - Elastomer (2008-2010)
  - PIT (2011-Present)

Proposed SAR Method

Wenatchee Sockeye

- No hatchery program-wild fish run reconstruction
- First relevant BY = 2008
- Last Complete Brood Year = 2016
- Data sources:
  - Juvenile smolt data from M&E program
  - Adult return data from M&E program

Attachment C
Hatchery Recalculation Sensitivity Analysis

Recalculation Sensitivity Analysis

July 2021

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	Components of compensation for hatchery smolts *(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	Components of compensation for hatchery smolts *(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Natural-Origin Compensation calculated using adult return data, hatchery program SARs, and unavoidable project mortality.

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species			Components of compensation for hatchery smolts				
		(a) Natural Origin Compensation i.e., BAMP	*(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Subject Hatchery Compensation calculated for the Program Release Number multiplied by the Unavoidable Project Mortality.

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	*(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	Components of compensation for hatchery smolts *(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Subject Hatchery Compensation (b) adjusted by the Performance Ratio of the Subject Hatchery SAR and the PUD Hatchery SAR. The idea is that it adjusts the hatchery compensation to match the subject hatchery adult return production.

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	*(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Components of compensation for hatchery smolts: columns (b)–(g).

Subject Hatchery Compensation for each PUD project is proportionally increased so as to release additional fish to compensate for cumulative losses through the PUD hydrosystem. The end result is that the combined Subject Hatchery NNI fish number immediately downstream of Priest Rapids is equal to the Subject Hatchery program release number.

$MNNI_x$ Example: WNFH Spring Chinook

Release = 400,000

Project	**Project Mortality**	**Initial NNI Mitigation**
Wells	0.0396	15,840
Rocky Reach	0.0700	28,000
Rock Island	0.0625	25,000
Wanapum-Priest	0.1341	53,640
	Total	122,480

MNNI$_x$ Example: WNFH Spring Chinook

		Release = 400,000
Project	**Survival**	**Passage Through Hydrosystem**
Wells	0.9604	384,160
Rocky Reach	0.9300	357,269
Rock Island	0.9375	334,940
Wanapum-Priest	0.8659	290,024
	Loss	109,976

$MNNI_x$ Example: WNFH Spring Chinook

		WNFH Release = 400,000	NNI Release = 122,480
Project	**Survival**	**Passage Through Hydrosystem**	
Wells	0.9604	384,160	117,630
Rocky Reach	0.9300	357,269	109,396
Rock Island	0.9375	334,940	102,558
Wanapum-Priest	0.8659	290,024	88,805
	400,000 - 290,024 =	109,976	88,805

109,976 - 88,805 = 21,171

MNNI_x Example: WNFH Spring Chinook

$$[PRN_x \div (S_{Wells} * S_{RR} * S_{RI} * S_{WANPRD})] - [PRNx(UPM_{Wells} + UPM_{RR} + UPM_{RI} + UPM_{WANPRD} + 1]$$

This is the total number of fish that must be released to achieve the subject hatchery release number at the end of the PUD Hydrosystem

This is the subject hatchery release number + the NNI total

The difference is the number of additional fish needed to add to NNI to achieve the subject hatchery number at the bottom of the PUD hydrosystem

$MNNI_x$ Example: WNFH Spring Chinook

$$[PRN_x \div (S_{Wells} * SRR * SRI * SWA_{NPRD})] - [PRNx(UPMWells + UPMRR + UPMRI + UPMWA_{NPRD} + 1]$$

$$[400{,}000 \div (0.9604 * 0.9300 * 0.9375 * 8659)] - [400{,}000(0.0396 + 0.0700 + 0.0625 + 0.1341 + 1]$$

$MNNI_x$ = 29,198

122,480 + 29,198 + 400,000 = 551,678

$MNNI_x$ Example: WNFH Spring Chinook

		WNFH + NNI + $MNNI_x$ 400,000+122,480+29,198=551,678
Project	**Project Survival**	**WNFH + NNI Mitigation**
Wells	0.9604	529,832
Rocky Reach	0.9300	492,744
Rock Island	0.9375	461,947
Wanapum-Priest	0.8659	400,000

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

		Components of compensation for hatchery smolts						
PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	*(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

$MNNI_x$ adjusted by the performance ratio of the Subject Hatchery SAR and the PUD Hatchery SAR. The idea is that it adjusts $MNNI_x$ to match the Subject Hatchery adult return production.

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species		Components of compensation for hatchery smolts					
		(a) Natural Origin Compensation i.e., BAMP	*(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

The Inundation Production for a PUD

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	Components of compensation for hatchery smolts *(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

The Inundation Production for a PUD multiplied by the unavoidable project mortality.

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

PUD	Species	(a) Natural Origin Compensation i.e., BAMP	Components of compensation for hatchery smolts					
			(b) Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Table 2. Range of recalculated values based upon options 1, 2, and 3.

PUD	Species	Option 1 *a+c+f*	Option 2 *a+c+e+f*	Option 3 *a+b+d+f+g*

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

			Components of compensation for hatchery smolts					
PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	*(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Table 2. Range of recalculated values based upon options 1, 2, and 3.

PUD	Species	Option 1 *a+c+f*	Option 2 *a+c+e+f*	Option 3 *a+b+d+f+g*

Sensitivity Analysis

Table 1. Summary of factors contributing to recalculation options 1, 2 and 3.

			Components of compensation for hatchery smolts					
PUD	Species	*(a)* Natural Origin Compensation i.e., BAMP	*(b)* Subject Hatchery Mortality (PRN_x x UPM_p)	*(c)* SAR Credit for Adult Equivalents [(PRN_x x UPM_p) x RHP_z]	*(d)* Mitigation for NNI ($MNNI_x$)	*(e)* SAR credit for Adult Equivalents [($MNNI_x$) x RHP_z]	*(f)* Inundation Production (IRN_i)	*(g)* Mitigation for Inundation (IRN_i x UPM_p)

Table 2. Range of recalculated values based upon options 1, 2, and 3.

PUD	Species	Option 1 *a+c+f*	Option 2 *a+c+e+f*	Option 3 *a+b+d+f+g*

Instructions for accessing and reviewing chapters are as follows:

- Navigate through all available chapters filed according to their M&E Objective on the Douglas PUD Extranet Site under **Draft Documents > 10-Year M&E Report 2021.**
- File names include the relevant M&E Objective(s).
- In some cases, one chapter meets several objectives, as is the case for Fall Chinook Objectives 1 through 4. Chapters that apply to multiple objectives will be filed only once in the first objective folder.
- Please send comments and edits to Larissa Rohrbach (lrohrbach@anchorqea.com) in a Word file that includes the chapter title and a citation to the line number. Some journal publications will serve as chapters; comments on the publications are not expected but not precluded if they pertain to the M&E program. If commenting on a publication, refer to comments by paragraph and page number (e.g., second paragraph on page 5).

See Table 1 for the updated schedule for recommended review periods. Feel free to work ahead and review any of the materials that are available now, though responses are not expected until the dates shown.

Table 1
Comprehensive Report – Recommended Review Periods

Objective	Objective Description	Target Review Period	File names	Email Distribution Date(s)
1	Determine if conservation programs have increased the number of naturally spawning and naturally produced adults of the target population and if the program has reduced the natural replacement rate (NRR) of the supplemented population.	First 30 days 7/1/21-7/31/21	• 2021_06_22 PUDs Obj 1_2_3_4_Abundance and productivity PRH FAC chapter_HSC review.pdf • 2021_06_22 PUDs Obj 1_3_Supplementation SPC in the UC_HSC review.pdf • 2021_06_30 PUDs Obj 1_Steelhead Productivity Chapter_HSC review.pdf • 2021_07_06 PUDs Obj 1_3_SUC BACI chapter_HSC review.pdf	6/22/2021, 6/30/2021, 7/21/2021 (Complete)
2	Determine if the proportion of hatchery fish on the spawning grounds affects the freshwater productivity of supplemented stocks.	FAC First 30 days 7/1/21-7/31/21 SPC/SUC/STH Third 30 days 9/1/21-9/31/21	• 2021_06_22 PUDs Obj 1_2_3_4_Abundance and productivity PRH chapter_HSC review.pdf • 2021_08_06 PUDs Obj 2 SPC SUC STH pHOS Freshwater Productivity_Q2 HC Review.pdf	FAC distributed 6/22/2021, 7/21/2021 SPC/SUC/STH distributed 8/9/2021 (Complete)
3	Determine if the hatchery adult-to-adult survival (i.e., hatchery replacement rate) is greater than the natural adult-to-adult survival (i.e., NRR) and the target hatchery survival rate.	First 30 days 7/1/21-7/31/21	• 2021_06_22 PUDs Obj 1_2_3_4_Abundance and productivity PRH chapter_HSC review.pdf • 2021_06_22 PUDs Obj 1_3_Supplementation SPC in the UC_HSC review.pdf • 2021_07_06 PUDs Obj 1_3_SUC BACI chapter_HSC review.pdf	6/22/2021, 6/30/2021, 7/21/2021 (Complete)

Objective	Objective Description	Target Review Period	File names	Email Distribution Date(s)
4	Determine if the proportion of hatchery-origin spawners (pHOS or PNI) is meeting the management target.	FAC First 30 days 7/1/21-7/31/21 SPC/SUC/STH Third 30 days 9/1/21-9/31/21	• 2021_06_22 PUDs Obj 1_2_3_4_Abundance and productivity PRH chapter_HSC review.pdf • 2021_06_22 PUDs Obj 4_Pearsons et al. 2020 Fisheries_Hatchery Reform.pdf	FAC distributed 6/22/2021, 7/21/2021 (SPC/SUC/STH pending)
5	Determine if the run timing, spawn timing, and spawning distribution of the hatchery component is similar to the natural component of the target population or is meeting program-specific objectives.	FAC Second 30 days 8/1/21-8/31/21 SPC/SUC/STH Third 30 days 9/1/21-9/31/21	• 2021_06_22 PUDs Obj 5_Run and spawn time fall Chinook salmon_HSC review.pdf • 2021_06_22 PUDs Obj 5_Distribution FAC carcasses in the Hanford Reach_HSC review.pdf	FAC distributed 7/21/2021 (SPC/SUC/STH pending)
6	Determine if the stray rate of hatchery fish is below the acceptable levels to maintain genetic variation among stocks.	Second 30 days 8/1/21-8/31/21	• 2021_06_22 PUDs Obj 6_Pearsons_and_O'Connor_2020_TAFS_natural_straying.pdf • 2021_06_22 PUDs Obj 6_Stray rates of Hatchery salmon_HSC review .pdf • 2021_06_22 PUDs Obj 6_Stray recipient compositions_HSC review.pdf	7/21/2021 (Complete)
7	Determine if genetic diversity, population structure, and effective population size have changed in natural spawning populations as a result of the hatchery program.	Third 30 days 9/1/21-9/31/21		Pending

Objective	Objective Description	Target Review Period	File names	Email Distribution Date(s)
8	Determine if hatchery programs have caused changes in phenotypic characteristics of natural populations.	Second 30 days 8/1/21-8/31/21	• 2021_06_22 PUDs Obj 8_Bias in PRH FAC carcass recovery_HSC review.pdf • 2021_06_22 PUDs Obj 8_CWT_bias_manuscript_HSC review.pdf • 2021_06_22 PUDs Obj 8_Egg retention and egg characteristics_HSC review.pdf • 2021_06_22 PUDs Obj 8_Size age sex at maturity PRH carcass_HSC review.pdf • 2021_07_21 PUDs Obj 8_SPC and SUC Age Size and Fecundity_072121.pdf	7/21/2021 (Complete)
9	Determine if hatchery fish were released at the programmed size and number.	Third 30 days 9/1/21-9/31/21	• 2021_07_06 PUDs Obj 9_PRH Release numbers and metrics_HSC review.pdf	7/21/2021 (SPC/SUC/STH pending)
10	Determine if appropriate harvest rates have been applied to conservation, safety-net, and segregated harvest augmentation programs to meet the HCP/ Salmon and Steelhead Settlement Agreement goal of providing harvest opportunities while also contributing to population management and minimizing risk to natural populations.	Third 30 days 9/1/21-9/31/21	• 2021_07_06 PUDs Obj 10_Harvest Chapter_HSC review.pdf	7/21/2021 (Complete)
	Executive Summaries for each taxa	Third 30 days 9/1/21-9/31/21		Pending
	Bonus chapters	Third 30 days 9/1/21-9/31/21		Pending
Entire Sockeye Report	Relevant objectives	Third 30 days 9/1/21-9/31/21		Pending
Entire set of comprehensive Reports Approval	Authors respond to comments and finalize report.	Fourth 30 days 10/1/21-10/31/21		Pending

Attachment E
Hatchery Broodstock and Mating Practices for Wells Hatchery Summer Chinook Salmon

Hatchery Broodstock and Mating Practices for Wells Hatchery Summer Chinook

Greg Mackey
Douglas PUD
July 21, 2021

Wells Summer Chinook Inundation Programs

- Harvest Programs
- Return Large Adult Fish
- Minimize negative ecological impacts
- Minimize negative genetic impacts

Minimize Negative Genetic Impacts

- Artificial selection is inevitable in hatcheries
- How to counter?

Key Factors

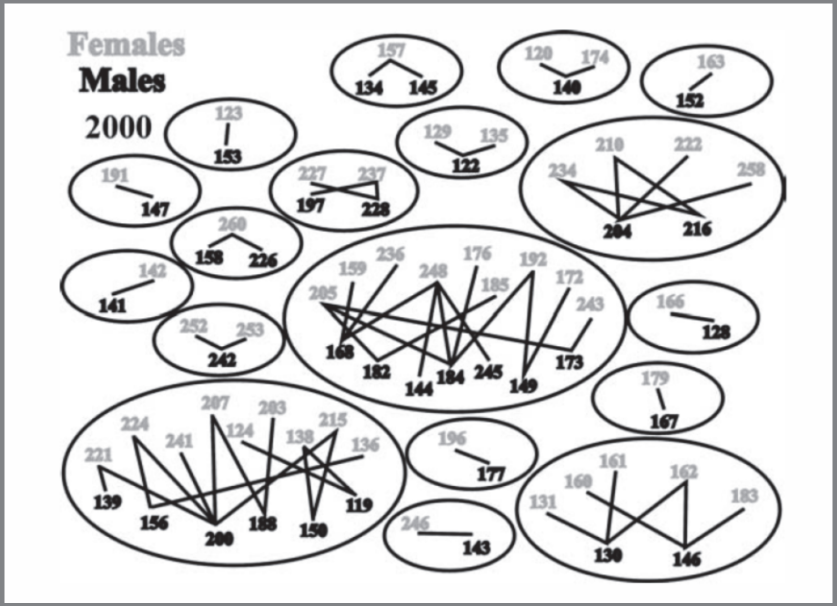
- Broodstock Collection
  - Run timing
  - Selection for size, age, sex, appearance, etc.

Key Factors

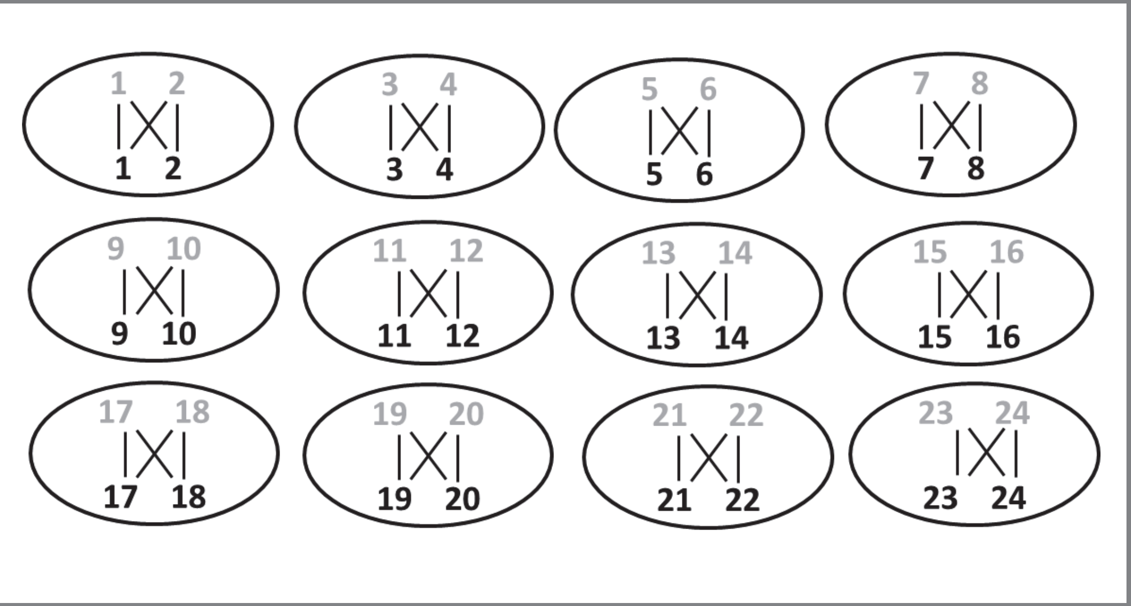
- Fisheries and Hatcheries
  - Select for younger age at maturity
  - Synergistic because hatcheries allow greater exploitation which can increase selection on size and age of fish

Mating Systems

Wild



Hatchery



Monogamy
Polygany
Polygynandry

Polygynandry

Adapted from Seamons et al. 2004

Hankin et al. (2009) Approach

- Counter artificial selection in hatchery for younger age at maturity
- Counter fisheries effect for younger age at maturity
- Emulate mate choice structure found in wild
  - Spawn females with larger males to drive population towards older age at maturity

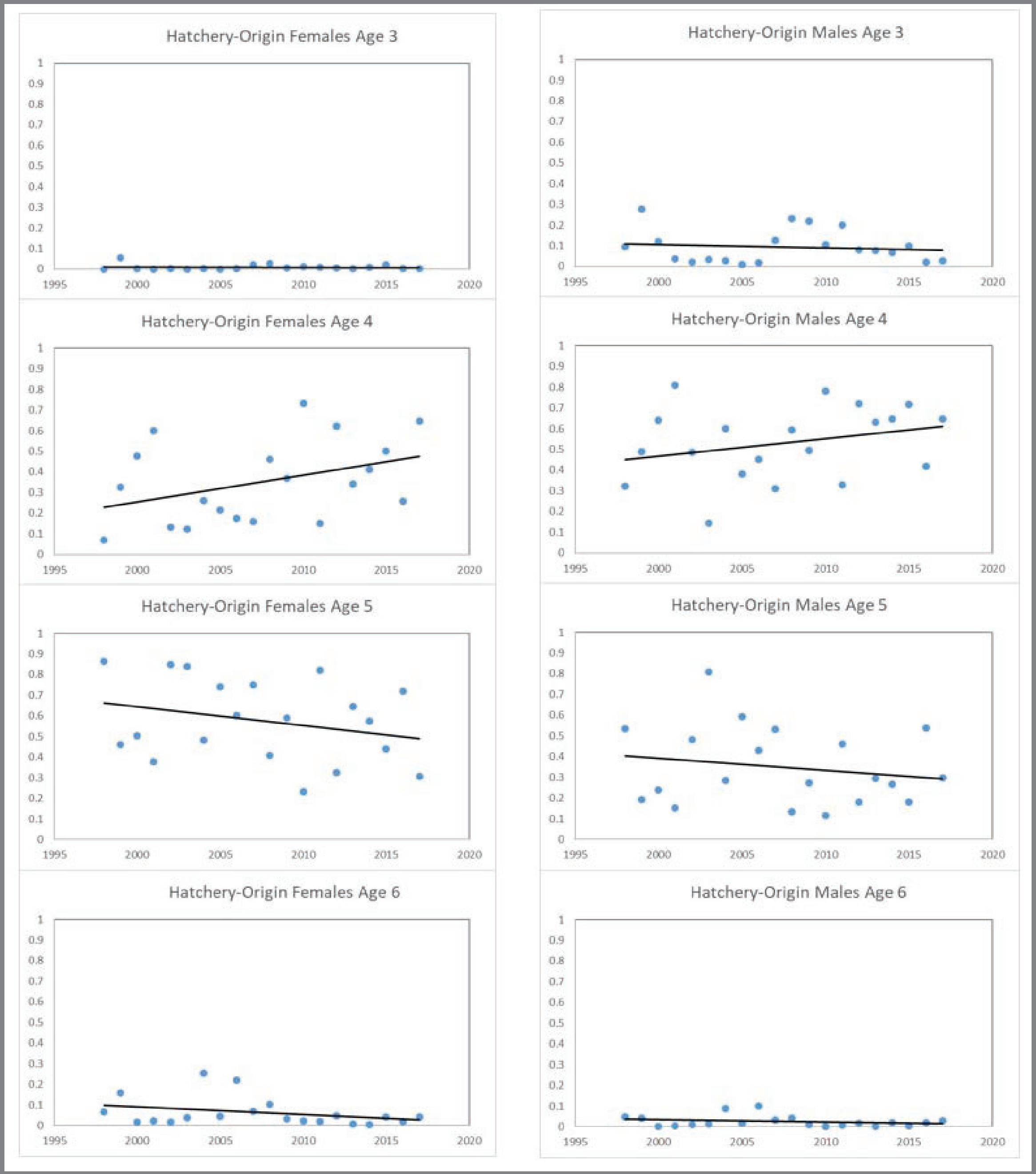
Other Aspects of Broodstock Management

Random Selection

- Likely during mating, brood are not randomly chosen in terms of phenotypic traits (Mclean et al. 2005).

"Despite efforts by the staff to not spawn selectively, data on steelhead spawned over 7 years revealed selection for large adult body size and early reproductive timing and a tendency for size-assortative mating (i.e., large with large). Selection on size was related to selection on reproductive timing because early returning fish tended to be larger than those returning later."

Age at Return



Size at Return in 2020

Sex	Length Mean (cm)	Length sd
Female	90	5.0
Male	90	6.9

Modeling – Baseline Scenario

1. Normal distributions (length) of females and males simulated
2. Randomly drew pairings to create 100 matings
3. Repeated 10,000 times per scenario
4. Tallied number of times the male was larger than the female in a mating

Modeling – Sorted by Size Scenario

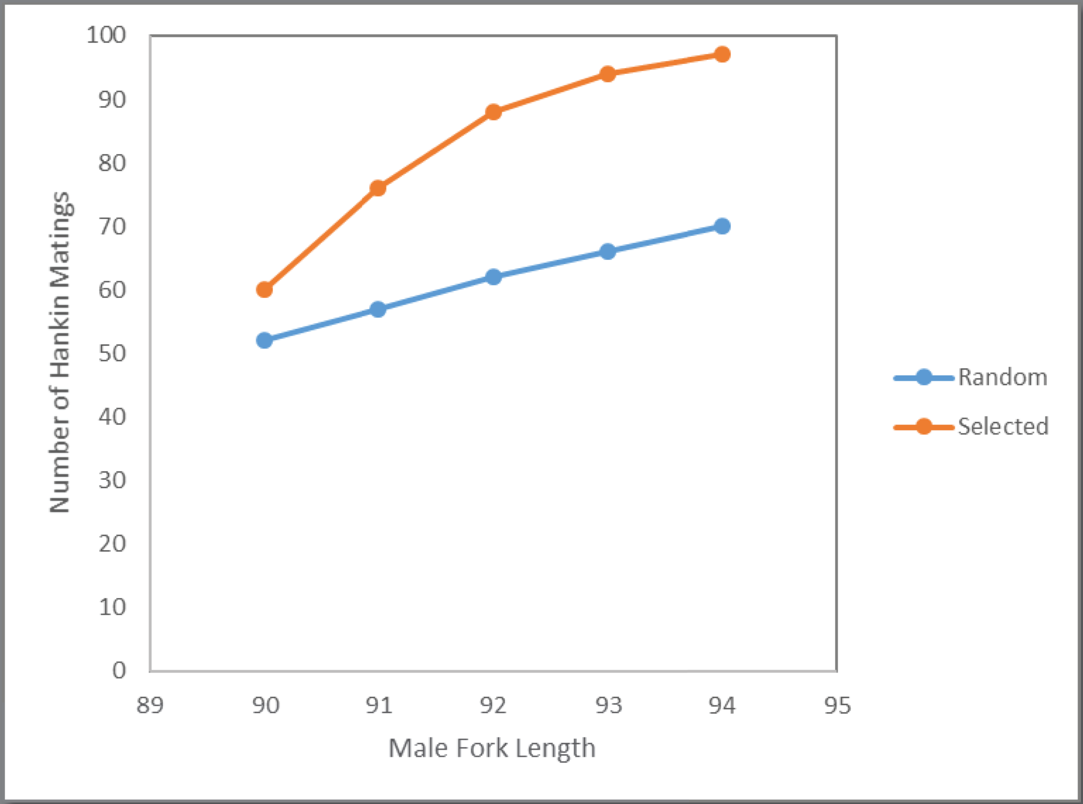
1. Normal distributions of females and males simulated
2. Sorted the females and males in descending order independently to create pairings
3. Repeated 10,000 times per scenario
4. Tallied number of times the male was larger than the female in a mating
5. Increased the male size by 1 cm for additional scenarios

Results

- Based on 100 matings
- Frequency of matings where the male was larger than the female

Scenario	Randomly Selected Matings			Size Sorted Matings			
Male Length	Lower 95% CI	Mean	Lower 95% CI	Lower 95% CI	Mean	Lower 95% CI	Percent Difference
90 cm	43	52	62	23	60	93	15
91 cm	47	57	67	43	76	99	33
92 cm	52	62	71	62	88	100	42
93 cm	56	66	75	77	94	100	42
94 cm	61	70	79	87	97	100	39

Results


Number of Hankin Matings
100
90
80
70
60
50
40
30
20
10
0
89
90
91
92
93
94
95
Male Fork Length
Random
Selected

Discussion

1. Summer Chinook may be declining in age at return, but this is not statistically supported at this time
2. Hatchery rearing and harvest are risk factors
3. Size selected matings are low risk and may provide long-term benefit
4. Emulates natural spawning pairings
5. Simple to implement with no effect on work flow

Recommendation

1. Implement size sorted mating strategy for Wells Summer Chinook Yearling and Subyearling Inundation Programs
2. As feasible, collect larger males for broodstock to increase the number of desirable matings
3. Continue to monitor the hatchery population

Attachment F

Hankin Mating Strategy and Implementation in the Wells Hatchery Summer Chinook Programs

The Hankin Mating Strategy and Implementation in the Wells Hatchery Summer Chinook Programs

Gregory Mackey

Douglas PUD

July 10, 2021

Introduction

The Wells Hatchery summer Chinook programs consist of a yearling program (320,000) and a subyearling program (484,000) for inundation compensation, plus 1,000,000 subyearlings produced to support Southern Resident Killer Whale recovery (1,484,000 subyearling production, total). The programs are operated as harvest programs, using primarily hatchery-origin fish for broodstock, but up to 10% natural-origin fish are incorporated in the inundation programs. Hatcheries and fisheries may alter the age-structure of the hatchery population, shifting the age at maturity to younger ages, and subsequently the size of the fish in the population may decrease. Populations, such as the Wells Hatchery Summer Chinook, subject to hatchery propagation and fisheries are at risk of shifts to younger age at maturity and smaller body size at return.

Typically, hatcheries collect broodstock randomly from the run (or as close to random as possible) and spawn fish randomly. Indeed, at Wells Hatchery, gametes are stripped from females and males and stored separately in plastic bags prior to fertilization of the eggs. At the time of fertilization, hatchery staff have no idea how large the fish were that they are mating. Therefore, matings are not intentionally size selective, although there could be unintentional size selective bias if fish enter the spawning process in relation to their size. Such random mating, where a much smaller younger male has the same opportunity to mate with a given female as a larger older fish, is unnatural and is in itself a selective pressure on the population that may result in younger and smaller fish (Hankin et al. 2009).

To date, the Summer Chinook hatchery population shows weak signs of a decrease the proportion of age-5 and age-6 males and females (Figure 1). The slopes of these regressions are not significantly different from 0, but suggest that the proportion of the age 5 and 6 classes are decreasing, while the younger age-4 class is increasing. The data are from broodstock that were spawned in 1998-2017. These data primarily indicate the age structure of the hatchery spawning population, but also represent the hatchery population as a whole because the sample sizes are large and there was not a concerted effort to size select the fish. Nevertheless, fish collected for broodstock may not conform to a random sample of the population because fish may be collected based on additional criteria such as apparent health and condition, run-timing, and intentional or unintentional bias for age or size. The inability to detect a statistical trend should not preclude taking management actions to minimize or prevent a trend in declining age structure from occurring.

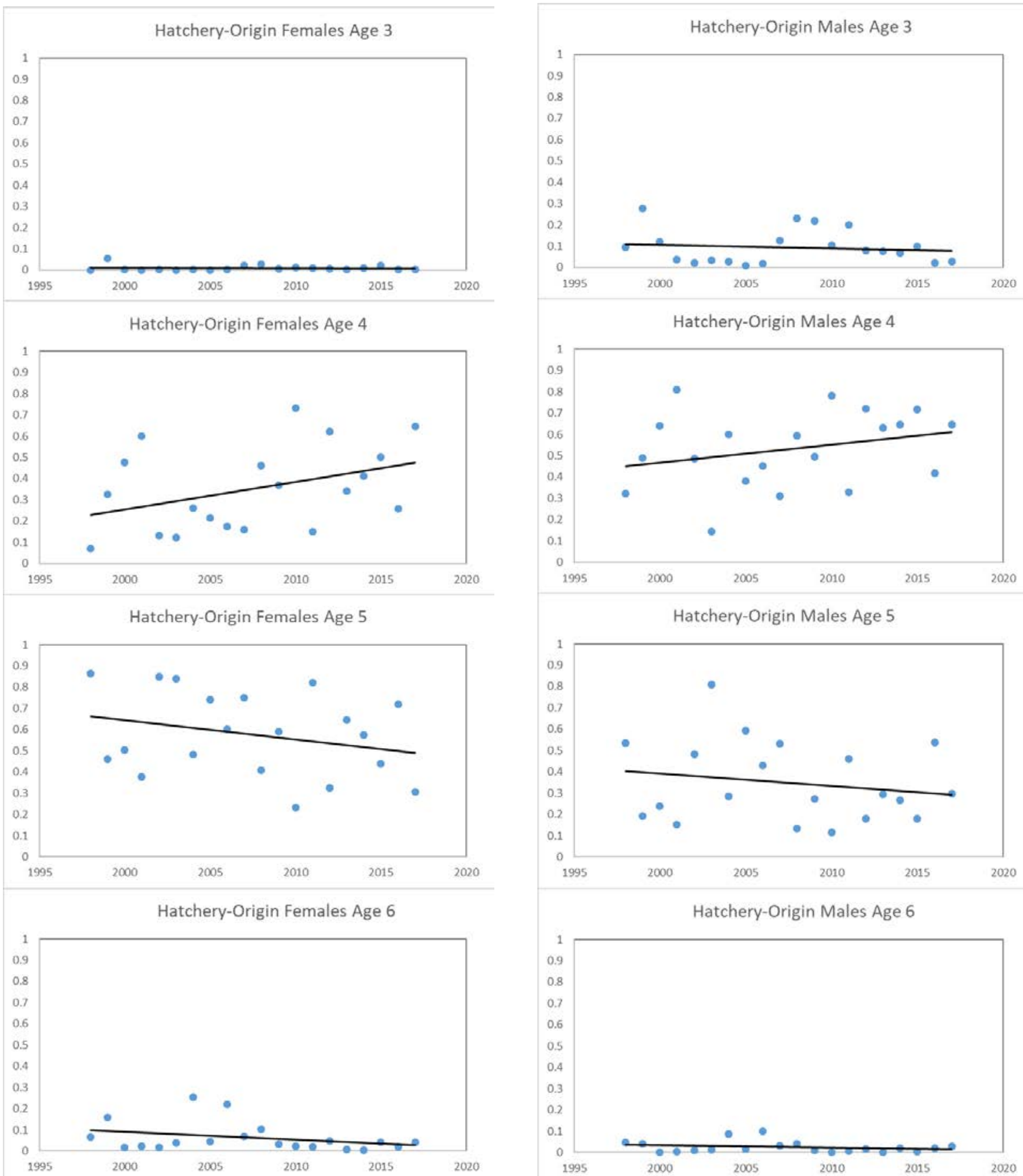


Figure 1. Proportional age structure of Wells Hatchery hatchery-origin females and males

Given the hypotheses that size and age at maturity maybe negatively affected by hatchery programs and harvest, and that the Summer Chinook population shows weak, but suggestive signs of decreasing proportion of the older age classes represented in the population over time, it is be prudent to attempt to counter this potential issue. Recall that attempting to not select fish for size at spawning is in itself a selective pressure that deviates from natural conditions. Imparting a controlled selective pressure on the population by spawning males that are larger than the females better mimics natural conditions. This strategy is low risk. The number of spawners for these program is large and remains stable. Expected results would be a stabilization of age class structure or a gradual shift to a greater representation of larger, older age classes in the population. Should the proportion of older age classes decline, it is most likely that selective pressure outside of the hatchery mating practices are stronger than those within. Ultimately, if this strategy is determined to be ineffective, the mating strategy can be discontinued, emancipating the population from this selective pressure, and the population should return to its original baseline over time.

Application of the Hankin Spawning Strategy

Application of the Hankin mating strategy is fairly simple. Fish are typically spawned across a four week period, although this can vary annually. With a single spawn date, fish are assessed for sexual maturity and mature fish are euthanized and stripped of gametes into plastic bags. Several groups (batches) of males and females maybe spawned within one day because there are often too many mature fish to be able to spawn the entire number in one group.

Within each group to be spawned, as fish are euthanized, biological staff measure their lengths and enter the data into a spreadsheet in real-time. A macro in the spreadsheet is used to independently sort both sexes by length (descending). This pairs the largest females with the largest males, and since males are often slightly larger than females, it tends to set up matings where the males are larger than the females. This approach is fast and avoids complicated searches and paring of optimal fish sizes. It is unlikely that a more complicated optimization scheme would result in a significantly greater number of desired matings because there are not extra males available from which to choose. This approach also minimizes handling of the fish, which a more complicated approach would necessitate.

Matings will continue to use a backup male. To the extent possible, the backup male used is the next largest male available in the pool of fish that are having their gametes combined. Approximately five pairs of fish have gametes combined at a time. The initial fertilization is allowed enough time to fertilize the eggs before the backup male's milt is introduced. Therefore, the backup males will normally only fertilize those eggs when the primary male's sperm is not viable. Each backup male is used as the primary male in another cross.

To assess how large an increase in matings resulted using the strategy described above verses random mating, a simulation model was developed. The model was constructed as follows:

The 2019 brood year Summer Chinook male and female length data were used to estimate mean length and variance. Males had a mean fork length 90 cm with a standard deviation of 6.9 cm. Females had a mean fork length 90 cm with a standard deviation of 5.0 cm. These statistics were used to generate a simulated normal distribution for each sex. Females and males were randomly drawn for the normal distributions to create one hundred matings, and this was repeated for 10,000 iterations for each scenario using PopTools (Hood 2011). Scenarios assessed were 1) females and males paired randomly, 2) sorted independently by size, as described above, and 3) additional simulations were performed by increasing the mean male length by 1 cm increments (from 90-94 cm fork length) while females were held at their original size distribution. The third scenario simulated selecting for larger males during broodstock collection.

Results of the modeling revealed that when males and females are the same length (despite different standard deviations), conducting matings by independently sorting the sexes by fish size to create crosses provides a modest 15% increase from 52 to 60 matings where the male was larger than the female Table 1; Figure 2). However, if broodstock collection selects for larger males, the benefit of achieving the desired matings increases rapidly. The random matings also increase, of course, because there are more males that are larger than the females. However, size selecting the matings greatly increases the frequency of mating where males are larger than females.

The greatest percent difference is achieved with males 2 cm greater in fork length than females. Absolute number of desirable matings continue to increase at 3 and 4 cm differences, but the percent differences decline (Table 1).

Table 1. Results of simulation modeling

Scenario	Randomly Selected Matings			Size Sorted Matings			
Male Length	Lower 95% CI	Mean	Lower 95% CI	Lower 95% CI	Mean	Lower 95% CI	Percent Difference
90 cm	43	52	62	23	60	93	15
91 cm	47	57	67	43	76	99	33
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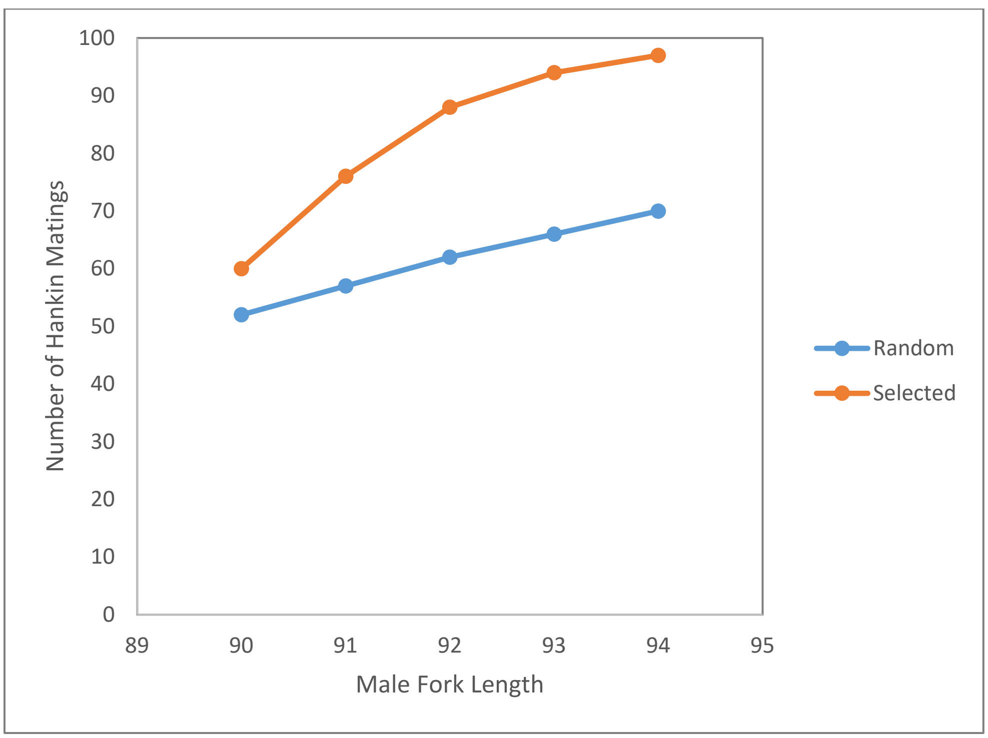

Figure 2. Results of simulation modeling

Discussion

The Wells Hatchery Summer Chinook data suggest that age at maturity may be declining in this population. However, this is not yet supported by statistical analysis. Nevertheless, hypotheses regarding declines in age at maturity and size at age related to hatchery rearing and fishery pressure suggest that the Wells Summer Chinook population may be at risk. Shifts in the population due to these selective pressures may not be statistically detectable until they have already affected the population. Implementing a mating strategy as described by Hankin et al. (2009) carries low risk to the population and is designed to counter undesirable selective pressures that likely already exists. Indeed, age-3 males ("jacks") are already excluded from the broodstock, resulting in a strong artificial selection pressure against age-3 males. Modeling suggests that implementing a size sorted mating strategy without selection for larger male broodstock size may result in a 15 percent increase in matings where the male is larger than the females. A modest increase in the mean size of males from 90 cm to 92 cm fork length results in a substantial 42 percent increase in desirable matings. I recommend that the Hankin mating strategy be implemented in the Wells Hatchery Summer Chinook programs, and that during broodstock collection, males should be selected for larger size, using a reasonable degree of trapping effort and handling. Males that are excluded from the broodstock due to size may be retained for surplus distribution.

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