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14 N. Wenatchee Avenue, Suite 139
Wenatchee, Washington 98801
509.888.2070
ANCHOR QEA

Memorandum

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

Document Date: March 15, 2023

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

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Minutes of the February 15, 2023, 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 virtually on Webex, on Wednesday, February 15, 2023, from 10:00 a.m. to 2:30 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Long-Term

Joint HCP-HCs and PRCC HSC

- 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 date to be determined.)*
- Members of the HCP-HCs and PRCC HSC will provide feedback to the Washington Department of Fish and Wildlife (WDFW)-revised version of questions on recalculation for Policy Committees (Item I-A). *(Note: This item is ongoing.)*

Near-Term (to be completed by next meeting)

Joint HCP-HCs and PRCC HSC

- Mike Tonseth will work with Matt Cooper to distribute an analysis showing feasibility of the Methow spring Chinook Salmon outplanting plan based on historical run-size data and proportionate natural influence targets (Item I-A). (*Note: This item is ongoing.*)
- Mike Tonseth will prepare a clean copy of the 2023 Broodstock Collection Protocols to be distributed for authors to make final revisions (Item II-B).
- Mike Tonseth and Chelan PUD will add placeholder language in the 2023 Broodstock Collection Protocols to indicate that Chelan PUD, Grant PUD, and WDFW will develop recommendations in the coming year for reducing stress and mortality from disease for individual rearing groups at Eastbank Hatchery (Item II-B).

RI/RR HCP Hatchery Committee

- Catherine Willard will revise the RI/RR HCP Action Plan to reflect a more accurate schedule for developing the executive summary of the 10-Year Comprehensive Report, and add the Tumwater Dam construction timeline (Item III-A).

Wells HCP Hatchery Committee

- Tom Kahler and Betsy Bamberger will prepare a plan for the collection of steelhead eggs at Wells Fish Hatchery to monitor baseline thiamine levels (Item IV-A).

Decision Summary

- None

Agreements

- None

Review Items

- A revised version of the 2023 Broodstock Collection Protocols was distributed on February 22, with comments and edits due by March 3, for approval in the March 15, 2023, meeting (Item II-B).

Finalized Documents

- None

I. Welcome

A. Agenda, Approval of Past Minutes, Action Item Review

Tracy Hillman welcomed the HCP-HCs and PRCC HSC, reviewed the agenda, and asked for any additions or changes to the agenda. The agenda was approved without additional changes.

Action items from the HCP-HCs and PRCC HSC meeting on January 18, 2023, were reviewed. *(Note: Italicized text below corresponds to action items from the previous meeting.)*

Long-Term

Joint HCP-HCs and PRCC HSC

- *Kirk Truscott will work with Confederated Tribes of the Colville Reservation (CTCR) staff to develop a model that addresses the probability of encountering natural-origin return (NOR)*

Okanogan River spring Chinook Salmon at Wells Dam (Item I-A). (Note: This item is ongoing; expected completion date to be determined.)
Truscott requested that this item be removed from the Action Items tracking list.

- *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.)*
  Truscott requested that this item be removed from the Action Items tracking list.
- *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; a presentation will be given in early 2023.)*
  Murdoch said this item is ongoing.
- *Members of the HCP-HCs and PRCC HSC will provide feedback to the WDFW-revised version of questions on recalculation for Policy Committees prior to the next meeting (Item I-A). (Note: This item is ongoing.)*
  Hillman said this item is ongoing.

Near-Term (to be completed by next meeting)

Joint HCP-HCs and PRCC HSC

- *Mike Tonseth will work with Matt Cooper to distribute an analysis showing feasibility of the Methow spring Chinook Salmon Outplanting Plan based on historical run-size data and proportionate natural influence targets (Item I-A). (Note: This item is ongoing.)*
  Tonseth said they are preparing updated run-size data. This item is ongoing.
- *PUD authors and contractors contributing to the 2023 Broodstock Collection Protocols will make revisions to the shared version, in preparation for distribution for Committee review on February 3, 2023.*
  This item will be discussed during today's meeting.

II. Joint HCP-HC and PRCC HSC

A. Okanogan Sockeye Salmon Annual Update

Ryan Benson, Okanagan Nation Alliance (ONA) fisheries biologist and Skaha Lake Sockeye Salmon Reintroduction Program coordinator, provided an annual update presentation on the hatchery program and the monitoring and evaluation program entitled *Okanagan Basin Sockeye Salmon Reintroduction Program Update* (Attachment B).

Highlights from his presentation include the following:

- Various broodstock collection and spawning methods were piloted starting in 2014. Since 2019, a streamlined, routine procedure has been established that provides high egg-to-fry survival rates. Previously, females were returned to the river if not fully ripe; now, if they are within a few days of becoming fully ripe, they are held in the raceways until they are ready to spawn.
- In 2022, the returning females looked healthy and had good fecundity and egg quality despite relatively high river temperatures.
- Fry from the 2022 brood may all be planted to Okanagan Lake, depending on approval by Canadian Okanagan Basin Technical Working Group and the Province of British Columbia (BC). The concept was based on an original plan approved in 2017.
- Escapement to Penticton Channel reached record high numbers in 2022. Unfortunately, the estimated capacity of the channel is lower than the number of Sockeye Salmon now returning, and some redd superimposition may have occurred.
- A successful commercial fishery harvested 81,000 returning Sockeye Salmon (in Osoyoos Lake), so there were plenty of Sockeye Salmon available for distribution among the ONA community.
- Dave Duvall (Grant PUD) asked what proportion of the escapement to Penticton Channel are kokanee versus Sockeye Salmon. Benson answered that in Osoyoos Lake, kokanee numbers are very low based on nearly 20 years of monitoring, so escapement of kokanee is not tracked. Duvall asked whether the video monitoring for adult passage was allowing Sockeye Salmon and kokanee to be tracked separately. Benson said, anecdotally, kokanee have appeared to increase in number in recent years, and he could reach out to other managers for any data.
- A long-term plan, finalized in 2020, allows for planting up to 3,500,000 fry in Okanagan Lake. Since 2016, the Canadian government has supported the UN Declaration on the Rights of Indigenous People, which opened up a forum that encourages listening to indigenous perspectives and comanaging the resource. ONA leadership met with the BC Ministry of Forests, Lands, Natural Resources Operations and Rural Development, and the result was that the Province of BC would not impede any salmon passage into Okanagan Lake, including any of the Pacific salmon species (Sockeye Salmon, Chinook Salmon, steelhead, and maybe even Coho Salmon).
- Passage was monitored by video; there were some limitations due to low light, and it is suspected many fish were passing at night.
- Based on tags and thermal marks, it appears that the majority of adults homed to the tributaries of their release as fry. Telemetry data showed many fish moved to other tributaries first.
- A fish passage subcommittee of the Canadian Okanagan Basin Technical Working Group is working on strategic planning for release of this year's fry based on habitat availability, access, flow, and obtaining political agreements between parties.

Benson concluded his presentation and asked for any questions.

Tom Scribner noted that the ONA hatchery program is terrific. Scribner asked whether the existing broodstock collection protocol is working toward the goal of achieving an egg-take of 8 million eggs. Benson said the early planning was for 5 million eggs, with a hatchery footprint that could accommodate 8 million in the long-term, without the assumption that up to 5,000 females would be held on site. There is a need to discuss several options with Grant PUD and Chelan PUD managers for increasing adult holding capacity. The limitations at this time are the number of staff available and the short spawning window of 2 to 3 weeks. It would help to have more raceways and infrastructure to hold more adult females. There have also been some discussions about water reuse. Originally, when the hatchery was being planned, it was set up to use groundwater; however, there has since been a lot of nearby development and increasing concerns about potential future water shortages due to global warming. The ONA is in the initial stages of identifying different water-conserving options. The ONA also wants to do what makes sense biologically. Strategic outplanting to this point involved collecting all fish possible for broodstock; now the question is whether there is a need to collect 5 million eggs just because they are available, or alternatively, when there is a strong natural run, to allow more to spawn naturally. These discussions are also in the early stages.

Scribner said there appears to be some uncertainty around funding, infrastructure needs, and staffing, and he is worried about a disconnect with the HCP-HC and PRCC HSC. He said there is a recently approved statement of agreement (SOA) to achieve a program of 8 million eggs within a few years, and given those uncertainties, Scribner said he is concerned that the program may not meet, or may not want to meet, the mitigation level that has been agreed to, which may compromise the agreement. Benson said, from the beginning, this hatchery has been framed as a conservation hatchery, and the program was never intended to follow a production paradigm. The intent was to jump start the population. The Skaha natural escapement is well over what could be produced with hatchery production, and it may be close to being a self-sustaining population. Once the Okanagan Lake population is established, perhaps the program would move on to kick-starting the next population (e.g., Mission Creek). The ONA has also been working on habitat improvement to increase productivity across the basin with potential for expansion to the headwaters in the long run.

Scribner asked whether Benson thought that habitat in Lake Okanagan will really be limited with the number of fish that the ONA is producing. When there are a lot of fish, it might not be looked upon as surplus necessarily but as additional opportunity for harvest. Benson said Okanagan Lake is not the pristine lake it once was at the beginning of the century; even though there are Sockeye Salmon and potentially Chinook Salmon reaching the lake, there is still a lot of work to do in the tributaries and the lake. Whether there are nutrient limitations remains unknown. Okanagan Lake is nearly oligotrophic, and actual productivity per acre is much less than Skaha and Osoyoos lakes, but based on volume, Okanagan Lake has potential to support more fry than Osoyoos and Skaha combined. Benson said hopefully, within his lifetime, it will produce self-sustaining Sockeye Salmon and even Chinook Salmon populations.

Catherine Willard said the SOA that was approved by the Rocky Reach HCP-HC and PRCC HSC on January 18, 2023, states that after the ONA is prepared to move ahead with expansion, the PUDs will then support expansion to an 8 million-egg program. The ONA is working on the biological implications; concurrently, Chelan PUD and Grant PUD are looking at the infrastructure, water, and staff needs for both the 5 million and future 8 million-egg levels of production. Chelan PUD and Grant PUD have contracts with the ONA through 2060 to meet mitigation obligations and are moving forward with the feasibility assessment to identify what it will take to meet those mitigation obligations. Scriber asked whether the programs are on schedule to meet the time frame identified in the SOA. Willard said the SOA states that capital upgrades would occur within 3 years of the ONA notifying the PUDs that they are prepared to move forward with the expansion. Willard said the PUDs are preparing with placeholders for getting contracts in place to look at water availability and to evaluate infrastructure. Evaluation of ways to maximize water availability and potentially reuse water is moving forward this year. The PUDs are assessing the feasibility of expanding or modifying the infrastructure while ONA evaluates the feasibility of increasing production. Benson said there has been a lot of work done to lay the groundwork for additional development. At this time, there is a need to assess feasibility. Scribner asked whether a decision could be made this year resolving uncertainties around water use and infrastructure. Benson said it would be premature to say. He added that there are many options, and the parties are practicing their due diligence to evaluate them. At a biological level, the program may have reached a limit of 5 million eggs before the program is mining the natural population. With Okanagan Lake opened up, there could also be opportunities for broodstock collection there without mining the population.

Murdoch said an idea that has been previously discussed was to evaluate the feasibility of a contingency broodstock plan for years like 2015 when fish are available in the Columbia River or the Okanogan River south of the border in the United States, but the environmental conditions don't allow survival of those fish to the Canadian Okanagan. As a committee, there is a need to be engaged with the ONA on the feasibility of that concept. Benson said it's been under consideration by the ONA since 2015, and again last year the ONA talked with CTCR senior level biologists to start those discussions in anticipation of poor survival; however, that contingency was not ultimately necessary. Licensing with the Canadian federal government is one of the hurdles, which requires transported fish to be confirmed to be disease-free. Progress was made last year, and Benson agreed it's a worthwhile discussion to continue. Kirk Truscott said development of a contingency broodstocking strategy was central to the recently approved SOA. The discussions between CTCR and the ONA were preliminary in nature; it's imperative that a more concerted effort be made to open the discussions again to meet the obligations to all signatory parties. The central unknown during last year's discussions was whether there was holding capacity at the hatchery. All parties that signed the SOA recognize the need for a plan to respond to extremes in environmental conditions as the amplitude and frequency of environmental conditions appear to be increasing. Thus, there is a need to be proactive in developing a contingency broodstocking strategy.

Truscott asked whether the ONA might consider stocking fish across Okanagan and Skaha lakes in 2023 to spread the risk. Benson said the capacity of Skaha Lake to support juvenile production is limited by competition with kokanee and available food supply. One of the big constraints is flow through Skaha Lake. High turnover washes zooplankton out of the lake, resulting in a winter growth check and possibly a limit to winter survival. Okanagan Lake does not appear to have that productivity limitation. Benson said all options should be considered, but there is a high level of suspicion that planting all fry into Skaha Lake might limit survival. Truscott asked whether productivity is monitored every year. Benson said yes, that is a monitoring effort that was developed in response to hypotheses that additional adult Sockeye Salmon limit productivity in the lakes. So far there has been no limitation on kokanee production observed due to hatchery Sockeye Salmon production. Truscott asked whether anyone is sampling the kokanee population to identify their origin and whether the resurgence of kokanee in Lake Osoyoos is potentially a result of reintroduced Sockeye Salmon. Benson said there has been limited kokanee monitoring in Lake Osoyoos; the Province of BC monitors kokanee abundance in the lake, and just recently received approval for funding genetic work to determine their origin. Sockeye Salmon exhibit a high degree of life-history plasticity; there has been some plasticity observed (e.g., kokanee that have moved to the ocean or outplanted Sockeye Salmon that have residualized).

Hillman thanked Benson for his presentation and Benson left the meeting.

B. 2023 Broodstock Collection Protocols Development

Mike Tonseth reviewed minor updates to the 2023 Broodstock Collection Protocols that are still needed.

- There is a new Technical Advisory Committee forecast for steelhead; however, this will not substantially change anything in the body of the document.
- Appendix H, the Wenatchee steelhead rearing and release plan, sunsets with releases in 2024. There is a need to add some language to describe a process for next steps for the 2023 brood. WDFW and Chelan PUD will be deleting the current version of the plan and inserting a placeholder until a revised version for the 2023 brood is provided during late summer or early fall.
- The U.S. Fish and Wildlife Service (USFWS) and CTCR need to review and update Appendix B, the table for marking and release locations and release timing.
- There is a need to ensure table footnotes are in the correct order throughout the document.

Mike Tonseth will reissue a clean copy with re-ordered footnotes, and members will make final edits to the clean version by March 3.

The objective is to have an approved 2023 Broodstock Collection Protocol for submittal to NOAA Fisheries by April 15. The Wells HCP Coordinating Committee will need to approve trapping operations during their March 28 meeting.

C. Redd Superimposition

Bill Gale introduced the topic of redd superimposition based on conversations that the HCP-HCs and PRCC HSC had in 2022 regarding potential for redd superimposition and survival in the Methow River Basin. Gale introduced Greg Fraser, who works in the USFWS Hatchery Evaluation program and is the lead biologist on the Entiat Basin work. He organizes redd surveys for spring and summer Chinook Salmon in the Entiat River and has done work to evaluate redd superimposition and egg-to-fry survival with WDFW in recent years.

Greg Fraser gave a presentation entitled *Entiat River Redd Superimposition,* summarizing methodology and future plans, which may inform work in other basins (Appendix C). The following are key points from his presentation:

- The majority of spring Chinook Salmon spawners are of natural origin since ceasing hatchery production of spring Chinook Salmon in 2009.
- Most hatchery-origin summer Chinook Salmon spawn close to the hatchery, but redd superimposition is a concern in the upper portion of the accessible reaches of the Entiat River. Spring Chinook Salmon are at their upstream limit in the Entiat River; however, summer Chinook Salmon can easily continue to increase their range from downstream sites upstream. There are more hatchery-origin summer Chinook Salmon moving into spring Chinook Salmon spawning habitat as a result of increased hatchery production and better returns in recent years. There is a risk spring Chinook Salmon are running out of room.
- To assess spawning, each reach is walked once per week during the spawning season in all areas where spring and summer Chinook Salmon spawning occurs.
- Because it is difficult to assign identity as hatchery-origin returns (HOR) or NOR while fish are spawning, they use the known ratio of HOR to NOR from carcasses in each area to estimate the degree of superimposition by HOR fish. The biological opinion for the Entiat National Fish Hatchery (NFH) limits redd superimposition by HOR to 15%. With small changes in NOR or HOR abundance, the superimposition rate could increase to the limits in the biological opinion. Kirk Truscott asked whether the 15% limit is an annual limit or a running average. Fraser interpreted it to be an annual limit. Gale noted it is specific to Entiat NFH fish and does not include superimposition by other HOR strays.
- The USFWS has used a methodology developed by Trent DeBoer, previously with WDFW, to assess the effects of superimposition on egg-to-fry survival. It was not known what level of mortality should be assumed when direct or indirect superimposition was observed. In past years, egg boxes were left in the gravel until 1,000 accumulated temperature units were reached; this year and next year egg boxes will be pulled out of the gravel at the end of the summer

Chinook Salmon spawning season to assess the impact immediately, without additional impacts from winter conditions (like freezing). Next year will be the final year of study.

- Genetics (family effects) had a strong effect on egg-to-fry survival in earlier studies, so crosses were made according to a protocol that would allow tracking of family effects. Control groups were reared at the hatchery to isolate genetic effects from environmental effects.
- At the end of the incubation period, egg boxes were pulled out of the gravel and survivors were counted. Multiple predictor variables will be brought into a Bayesian approach for analysis.
- Some debate exists around whether exposed eggs can actually survive.

Keely Murdoch asked whether there is a possibility that if a spawning fish encountered an egg box, they would find the area unsuitable and move on. Fraser said the Chinook Salmon in the Entiat River are large, and boxes are often observed having been knocked out of their places, so it's likely the fish do not notice them. One hypothesis about redd superimposition is that later-arriving fish may prefer already-disturbed sediments because the gravel is easier for them to move.

Kirk Truscott asked whether there is any information or anecdotal observations about the quality of the spawning substrate with an increase in summer Chinook Salmon spawning in the reach. That is, is there any evidence that larger numbers of summer Chinook Salmon "condition" gravels for spring Chinook Salmon, and therefore spring Chinook Salmon benefit from large numbers of summer Chinook Salmon spawning in the area? Fraser said there are more and more summer Chinook Salmon in the downstream reach every year, and there are also massive habitat projects implemented in recent years. There are some log jams that are moving downstream, but it is uncertain how much gravel is continuing to move downstream.

Todd Pearsons said it looked like there was high survival throughout the spring Chinook Salmon area and asked whether a head-to-head comparison has been made between areas where there is known superimposition to areas with no superimposition. Fraser said that is the intent of the analysis to be conducted. The analysis will evaluate both direct effects from superimposition and indirect effects resulting from fish spawning just upstream, which releases fine sediment that settles on top of buried egg boxes. At other sites, aggradation could affect emergence and survival. Pearsons said that survival was approximately 70% throughout the reach, so even at a reach scale, survival still appears to be high. Fraser said those data shown were averages, and there were boxes that had high survival, but in a natural condition, those eggs would likely not have survived. We will have to deal with how to show the data for boxes that are disturbed or smothered by fine sediments. Gale concluded the discussion by noting that while redd superimposition is assumed to be a negative impact, it is complicated.

Tonseth said, relative to conversations on redd superimposition in the Methow River, the discussions have focused on the area near the hatcheries, below the area that can become dewatered in the late summer. Tonseth said the difference in the Methow is that superimposition is occurring by spring

Chinook Salmon on top of spring Chinook Salmon redds, so those eggs are only days to weeks old, and perhaps there is a difference in durability between the eggs surviving in the Entiat compared to those being disturbed in the Methow. This consideration may inform the comfort level and decisions around whether to allow fish to spawn in an area where redd superimposition is more likely to happen versus allowing spawning in areas that become dewatered.

Charles Frady noted that biologists have observed summer Chinook Salmon redds superimposed on spring Chinook Salmon redds in areas around Foghorn Dam, upstream in the Big Valley Reach, and also in the lower Chewuch River. He said he will review the egg-to-fry survival reports with Chris Johnson (WDFW) to confirm.

Murdoch said there is a lot we don't know about the impacts of redd desiccation and redd superimposition, and they are both controlled by different factors. Redd superimposition is related to density and spawning escapement, while redd desiccation is more driven by the water year conditions. In the end, spreading out the distribution of spawners would overall reduce risk to the population and increase diversity in spawning locations.

Gale agreed that Tonseth and Murdoch had strong points. Gale said it is complicated and we will not really know unless we carry out an egg-to-fry study to evaluate this in the reaches where desiccation is occurring and redd superimposition is occurring.

Tonseth said the question around continuing Goat Wall acclimation for spring Chinook Salmon was whether mortality associated with dewatering of redds near the Goat Wall area was at or below the mortality associated with redd superimposition due to spawning in an area near the hatchery. Truscott said that is one question that is unanswered; there were other concerns based on data presented by the YN about rearing, smolt-to-adult returns, and smolt survival. It's difficult to determine whether desiccation or freezing with low water levels is a lesser impact to survival and overall productivity than redd superimposition.

Fraser asked whether there are plans to survey Coho Salmon spawning in the Entiat River. He said the USFWS is observing more Coho Salmon incidentally and also in smolt traps, but no one is performing surveys upstream of Chinook Salmon spawning areas or later than the Chinook Salmon surveys in November. Cory Kamphaus said at this time, the major focus is in the Wenatchee and Methow basins, and that YN relies on PIT tag detections to estimate spawner escapement into the Entiat River.

Fraser said he would like to present updated results in approximately one year from now.

D. Eastbank Fish Hatchery Disease Management

Megan Finley gave a presentation entitled *Bacterial Kidney Disease at Eastbank* (Appendix D). The following highlights were discussed:

- Prior to 2014, bacterial kidney disease (BKD) management involved doing many things all at once to reduce mortalities. We are now left with the question of which things are necessary.
- Tonseth said a contributing factor to pre-spawn mortality in 2014 could have been the location of broodstock collection. In 2014, broodstock were collected at Tumwater (HOR only) and via tangle netting for the Nason Creek program. The mortality represented for Nason spring Chinook Salmon in 2014 was in the wild fish collected via tangle netting.
- Finley said no difference in BKD levels were observed in adults after experimentation with different prophylactic treatments or in 2 years after ceasing prophylactic injections.
- Mortalities due to BKD specifically are relatively low comparable to mortalities due to other diseases, including losses due to handling and transport. Other stressors contributing to BKD outbreaks could be better managed.
- Other programs experience BKD losses on the order of 25% to 30%.
- Finley concluded with recommendations to not inject broodstock for the last year of the prophylactic treatment study, try to reduce stressors, and possibly allow a higher thresholder for concern about BKD. She noted that losses are less acceptable in Endangered Species Act-listed programs than in other mitigation programs.

Catherine Willard said the HCP-HCs and PRCC HSC should weigh in on Finley's recommendation to continue with the current plan not to treat the broodstock prophylactically and to go down the path of managing stress during rearing.

Tonseth said Finley's recommendation is sound, and we need to continue with 1 more year without prophylactic injections for adults and culling high-level groups using the enzyme linked immunosorbent assay (ELISA) The conversation is still ongoing with WDFW and PUD staff regarding juvenile outbreaks. There are five programs reared at Eastbank Hatchery: three summer Chinook Salmon and two spring Chinook Salmon programs. Chelan Falls appears to be the least problematic of the programs. For the others, any recommendation is going to have to be specific to that program because there are differences in how those fish are reared in anticipation of transfer to their final rearing locations. One approach discussed internally was to develop recommendations for each program to bring back to the Committees for their feedback. In the meantime, WDFW welcomes any feedback to Finley's presentation today and suggestions that could be brought forward into a management plan.

Bill Gale said if there are some recommendations to approve, it would be helpful to have those in writing. Betsy Bamberger asked about the function of the Committees with regard to approving health recommendations. She said she has concerns about setting a precedence for requiring

Committee approval for fish health decisions and asked why BKD is a major concern compared to other disease issues that also cause mortalities. Tonseth said BKD has been the trigger for discussing many sources of mortality within the hatchery environment, including other pathogens and predation. The Committees are involved where recommendations will affect activities like timing of marking or transfer activities, which are activities that are directed by the Section 10 permits. Decisions around treatment of diseases are not something the Committees should interfere with.

Gale said the Committees have a critical oversight role. They are tasked with providing oversight of these mitigation programs, which includes fish health. The Committees have never rejected recommendations of fish health experts and veterinarians and would not want to do anything to impede expedient decisions on treatments. But it is well within the purview of these committees to understand how management would be carried out with these programs, although it may not necessarily rise to the level of requiring approval. Bamberger said she appreciated the insight, considering the many fish health approaches she is managing within Douglas PUD.

Willard thanked Finley and volunteered to continue coordinating the discussions between Chelan PUD, Grant PUD, and WDFW.

III. RI/RR HCP-HC

A. Chelan PUD's 2023 Action Plan

Catherine Willard described the elements of Chelan PUD's Rock Island and Rocky Reach HCP 2023 Action Plan, which was distributed on January 31, 2023.

Regarding the 10-Year Comprehensive report, the Lake Wenatchee Sockeye Salmon chapter is currently being developed, but will look quite different from the other chapters. Timelines match the Wells HCP Action Plan for completing the comprehensive report, executive summary prepared by the HCP-HCs and PRCC HSC, and updating the 5-Year Hatchery Monitoring and Evaluation Plan. Mike Tonseth asked about the new timeline for distribution of the revised 10-Year Comprehensive Report. Knowing that will help to better understand the timeline for development of the executive summary. Tom Kahler said the revised complete Comprehensive Report will be distributed for review within the next 2 weeks.

Willard said that in 2015, Mike Ford and Andrew Murdoch shared the results of the Wenatchee Relative Reproductive Success Study. There is a need to finalize an SOA that the study was in fact completed.

Bill Gale asked whether the Tumwater Dam maintenance project, which is going to construction this fall, would be tracked or reported out to the HCP Committees. Willard said the fishway is not being modified but it is attached to the dam and agreed it could be added to this action plan to be tracked.

Willard will make revisions based on feedback heard today and share the action plan with the RI/RR HCP Coordinating Committee for approval.

IV. Wells HCP-HC

A. Thiamine Status in Steelhead Above Wells Dam

Tom Kahler said thiamine (Vitamin B_1) deficiency is a problem in certain watersheds and aquaculture systems. Initially, thiamine deficiency was identified in Lake Trout and Chinook Salmon in the Great Lakes. It is becoming an emerging issue on the west coast, especially in Oregon and California. A pilot evaluation was done in the Methow River Basin in 2022 to evaluate thiamine levels in steelhead eggs.

Betsy Bamberger (Douglas PUD aquatic veterinarian) said there has been more concern in the Pacific Northwest because some fry populations of steelhead and Chinook Salmon have had high out-of-hatch mortality that is unresolved, with no link to pathogen or disease, and were found to be thiamine deficient. The deficiency is thought to be related to lack of certain prey in the ocean that increases reliance on prey species that are naturally rich in thiaminase, an enzyme that breaks down thiamine. For populations that have been found to be thiamine deficient, thiamine treatments have been piloted, which have been largely successful in reducing mortality and morbidity in early fry. In Eastern Washington, it was decided by fish health professionals there was a need to determine whether there has been thiamine deficiency. Eggs were tested last year from programs that were willing to provide them. Winthrop NFH provided egg samples from 10 different spawned females, and results were recently returned. Total thiamine was used to determine deficiency levels, and 7 out of 10 of the fish sampled appeared to be severely deficient relative to published thresholds for those species. Douglas PUD has decided to collect eggs from the Columbia Safety Net (CSN) steelhead at Wells Fish Hatchery to submit for testing. Fish from this group are more abundant and less regulated, allowing eggs to be collected from more individuals to obtain data that can be analyzed statistically. Eggs will be collected each year for up to 3 years to obtain information on thiamine levels and to inform future treatment options if needed. There is a need to collect samples from 30 to 60 fish. Only a small handful of eggs (5 grams, or 50 eggs) are needed from each female. They are then flash frozen and shipped overnight to the lab for analysis. At Wells Fish Hatchery, there are no clinical indications of thiamine deficiency or high mortality, but hatchery staff want to carry out due diligence to evaluate the concern. Douglas PUD may propose a study if it's determined there is a need to supplement thiamine for eggs or fry. Douglas PUD proposes to collect eggs this spring to establish baseline levels.

Kahler added that the interest in sampling the CSN group is also because of the interconnectedness between Winthrop NFH and Wells Fish Hatchery programs.

Bill Gale said that the USFWS was alarmed by the results that 7 out of 10 of the females had concerning levels of thiamine deficiency. The USFWS fish health programs are tracking this issue at all the NFHs. At this time, their plan is to collect baseline data, mostly in steelhead, throughout the region. The USFWS is tracking with what Bamberger and Kahler are proposing, hoping to carry forward additional sampling at Winthrop NFH and Wells Fish Hatchery. The USFWS's plan at this time is to proactively treat all wild brood at Winthrop NFH with thiamine. The risks of overdose associated with supplementing with thiamine are very low, and the likelihood of infection at the injection site is low, whereas the risk of mortality due to deficiency is very high. The USFWS has decided to take a risk averse approach to supplement and track performance of these fish.

Kahler said there is more than one way to supplement with thiamine. The best way based on efficacy is intermuscular injection into the females; however, that treatment eliminates the ability to determine baseline thiamine levels. That is the reason for testing the baseline levels in the CSN fish. A less effective but still beneficial method is a thiamine bath for the eggs just prior to water hardening. While working out a potential approach to both track the baseline levels and test effects of supplementation, the programs are looking to increase the sample size to understand baseline levels. There could be some local variation in susceptibility to various thiamine levels that we know nothing about. Gale said the question of local adaptation or local differences is very interesting and will be examined over the next decade. The biologists should also be considering spring Chinook Salmon programs because that species appears to suffer thiamine deficiency mortality in Oregon and Northern California.

Bamberger said the symptoms include neurological consequences, difficulty swimming, lethargy, and overt mortality. Some problems that are suspected but not proven to be true with sublethal levels of deficiency include long-term consequences related to immune function and ability to evade predators, forage, and return as adults. Gale said he has been told by his fish health group that anecdotally, in Oregon and Northern California, there are differences in how thiamine deficiency is manifesting in spring Chinook Salmon and steelhead, with spring Chinook Salmon showing more of the neurological effects that are more apparent visually. In steelhead, the effect looks more like failure to thrive in early fry stages, and it may be more difficult to identify. Bamberger agreed and said it may present itself differently in different species.

Todd Pearsons said a symposium on thiamine deficiency is planned for the World Fisheries Congress in Seattle in March 2024.

Kahler will present a written sampling recommendation to the Wells HCP-HC for approval and to hear whether there are concerns or questions. The level of effort will be to collect 50 eggs per female from a minimum of 30 fish and potentially from up to all 53 females from the broodstock (*Note: Douglas PUD's proposed sampling plan was distributed to the HCP-HCs and PRCC HSC on February 22, 2023*).

V. Administration

A. Next Meetings

The next regular HCP-HCs and PRCC HSC meetings will be held on Wednesday, March 15, 2023; Wednesday, April 19, 2023; and Wednesday, May 17, 2023. The HCP-HC and PRCC HSC agreed they would meet in person from March through November. Virtual access will also be available for those who cannot attend the meeting. The meetings will start at 10 a.m.

VI. Attachments

Attachment A: List of Attendees
Attachment B: Okanagan Basin Sockeye Salmon Reintroduction Program Update
Attachment C: Entiat River Redd Superimposition
Attachment D: Bacterial Kidney Disease at Eastbank

Attachment A
Attendees

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*‡°	Confederated Tribes of the Colville Reservation
Betsy Bamberger°	Douglas PUD
Andrew Gingerich°	Douglas PUD
Tom Kahler*°	Douglas PUD
Brandon Kilmer°	Douglas PUD
Dave Duvall°	Grant PUD
Rod O'Connor*‡°	Grant PUD
Deanne Pavlik-Kunkel°	Grant PUD
Todd Pearsons‡°	Grant PUD
Tim Taylor°	Grant PUD
Brett Farman*‡°	National Marine Fisheries Service
Ryan Benson°	Okanagan Nation Alliance
Clint Deason°	Washington Department of Fish and Wildlife
Sean Fitzmaurice°	Washington Department of Fish and Wildlife
Alf Haukenes°	Washington Department of Fish and Wildlife
Katy Shelby°	Washington Department of Fish and Wildlife
Mike Tonseth*‡°	Washington Department of Fish and Wildlife
Rhiannon Volking°	Washington Department of Fish and Wildlife
Keely Murdoch*‡°	Yakama Nation
Cory Kamphaus*‡°	Yakama Nation
Tom Scribner°	Yakama Nation
Greg Fraser°	U.S. Fish and Wildlife Service
Bill Gale*‡°	U.S. Fish and Wildlife Service

Notes:
* Denotes HCP-HCs member or alternate
‡ Denotes PRCC HSC member or alternate
° Joined by Webex

Attachment B
Okanagan Basin Sockeye Salmon Reintroduction Program Update

Okanagan Basin Sockeye Salmon Reintroduction Program Update

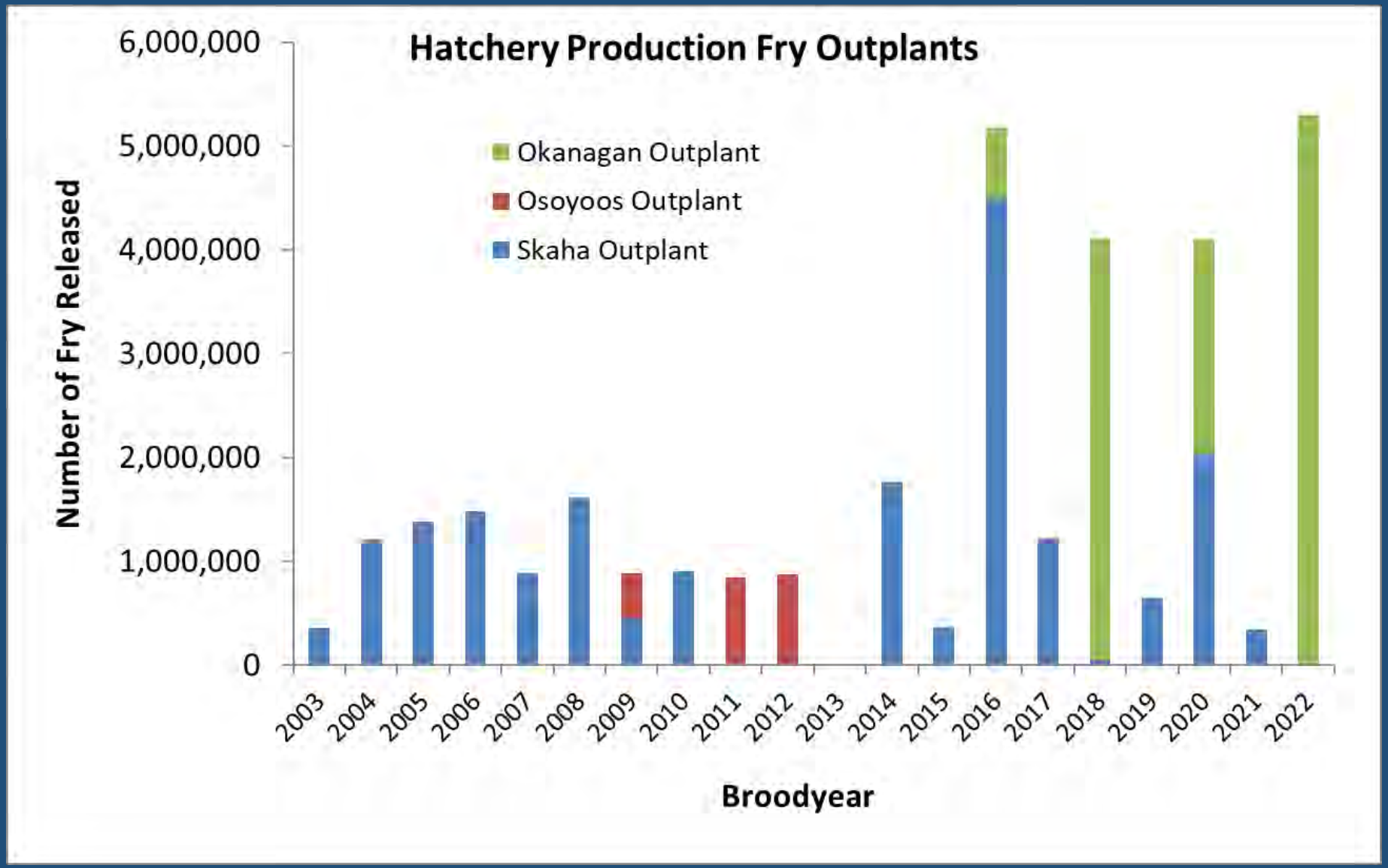
Ryan Benson, ONA Fisheries Biologist & Skaha Lake Sockeye Reintroduction Program Coordinator

HCP Hatchery Committee and PRCC Hatchery Sub-Committee

February 15, 2023

Hatchery Summary

Brood Year	Fecundity	Green Eggs	Trap and Transport	Egg to Fry Survival
2014	2,439	2,451,783	N/A	71.8%
2015	2,096	507,990	N/A	72.0%
2016	2,144	5,498,281	800,000	94.2%
2017	2,095	1,312,429	585,000	93.9%
2018	1,864	4,520,064	847,060	90.8%
2019	1,930	856,844	856,844 (all)	80.0%
2020	1,983	4,714,553	4,714,553 (all)	88.2%
2021	1,951	440,843	440,843 (all)	85.2%
2022	2,215	5,317,540	5,317,540 (all)	96.0% (eyed)


Hatchery Production Fry Outplants
Okanagan Outplant
Osoyoos Outplant
Skaha Outplant
Number of Fry Released
6,000,000
5,000,000
4,000,000
3,000,000
2,000,000
1,000,000
0
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Broodyear

Sockeye & kokanee Escapement

- Penticton Channel AUC – **39,000**
  - o Record high (previous 25,500 in 2020)
- Shingle Creek AUC – **657**
- Okanagan R. AUC – **79,600**
- kokanee AUC – 40,200 (2nd highest run)

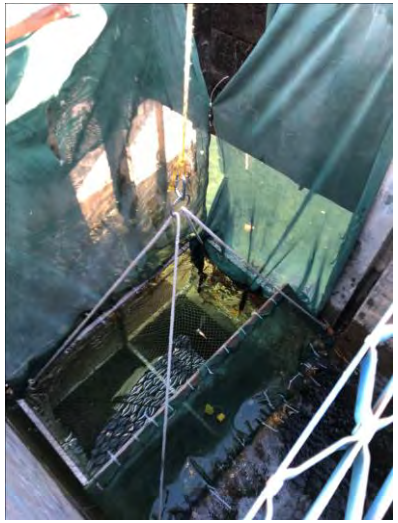
Okanagan Lake Program

- Okanagan Lake Salmon re-introduction was the original goal (1990's)
  - Okanagan Basin Salmon Restoration Sub-Committee (COBTWG)
  - Monitoring and Evaluation Plan is finalized; Working on implementation
  - Full fish passage granted in September 2022
    - ONA Chiefs Executive Council and BC Ministry of Indigenous Relations and Reconciliation (MIRR)

- Hatchery stocking:
  - 2016 – 9,994
  - 2017 – 683,656
  - 2018 – 10,110
  - 2019 – 4,200,000
  - 2020 – 9,538
  - 2021 – 2,000,000
  - 2022 – 10,000

Okanagan Lake Fish Passage

- Fishway activated October 2019; operational September – October 2020-2022
- Acoustic telemetry 2020-2022; transmitter tags 40-42 each year
- 2022: full passage 20 hours/day, trap monitor 3-4 h/day
- Additional 34 spaghetti tags
- Adult spawner/carcass surveys in 8 tributaries
- Video monitoring for jump efficiency



Preliminary Results

- 67 – 78% homing to fry release tributaries (3 North, Central, South Basin)
- Total escapement approx. 5,000 (95% CI= 2,414-9,235)
  - AUC, Peak Live x 1.5, Mark-Recapture
- Video monitoring still on-going, but current fishway is inefficient
- Fish Passage Sub-Committee (COBTWG)
- Strategic hatchery releases in 7 tributaries based on current spawning capacity

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OKANAGAN NATION AQUATIC ENTERPRISES LTD.

syilx Okanagan Nation Alliance

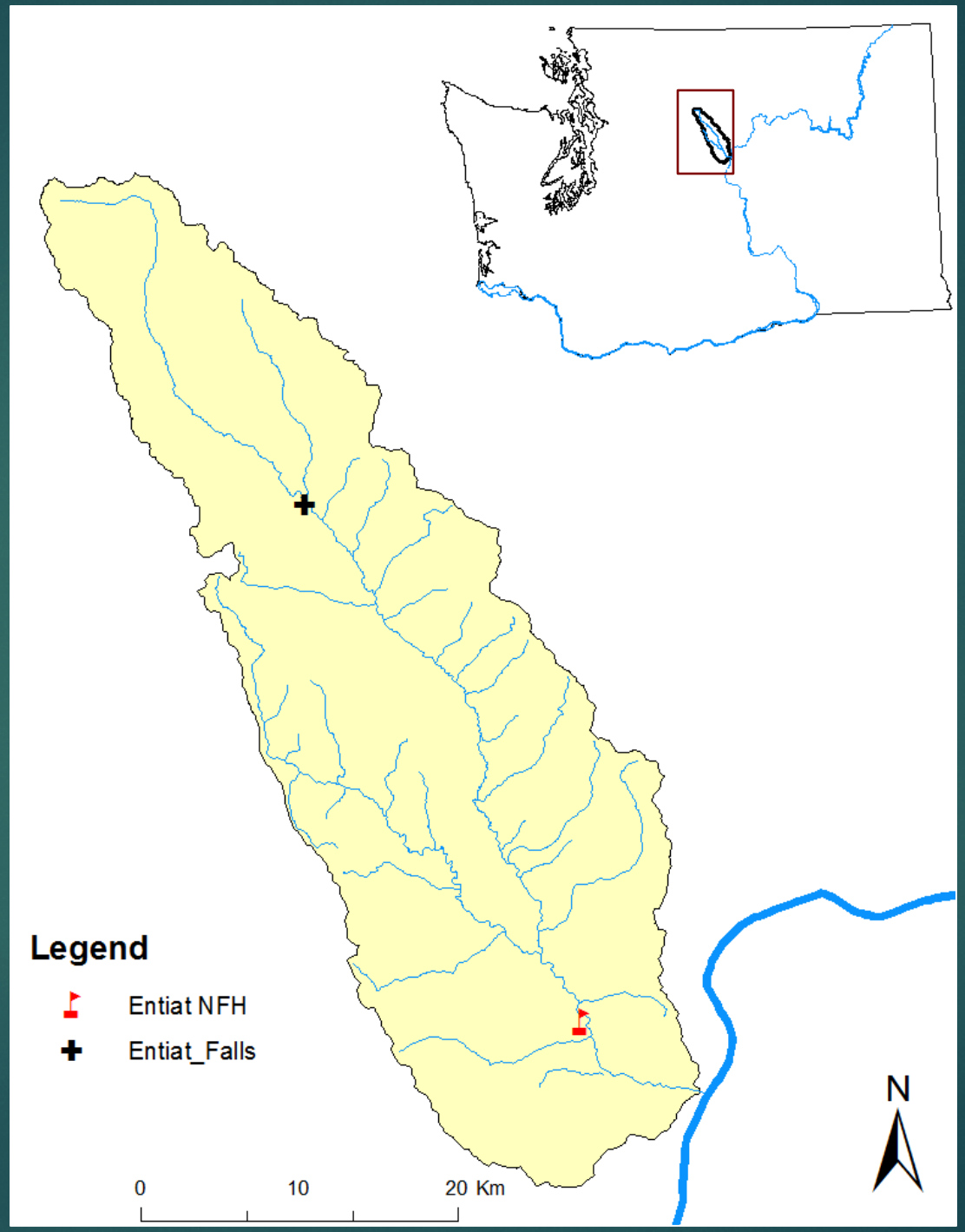
Attachment C
Entiat River Redd Superimposition

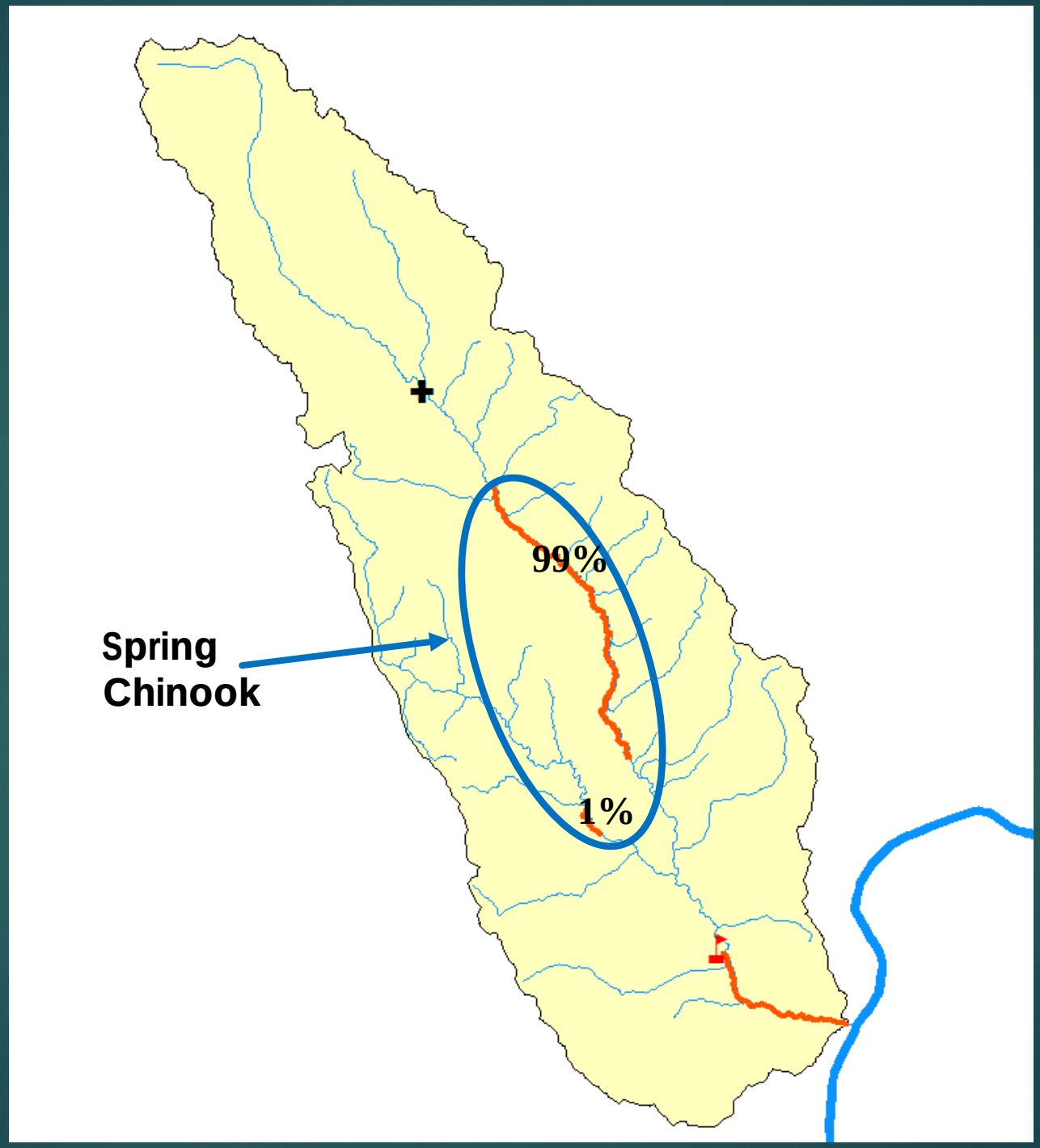
Entiat River Redd Superimposition

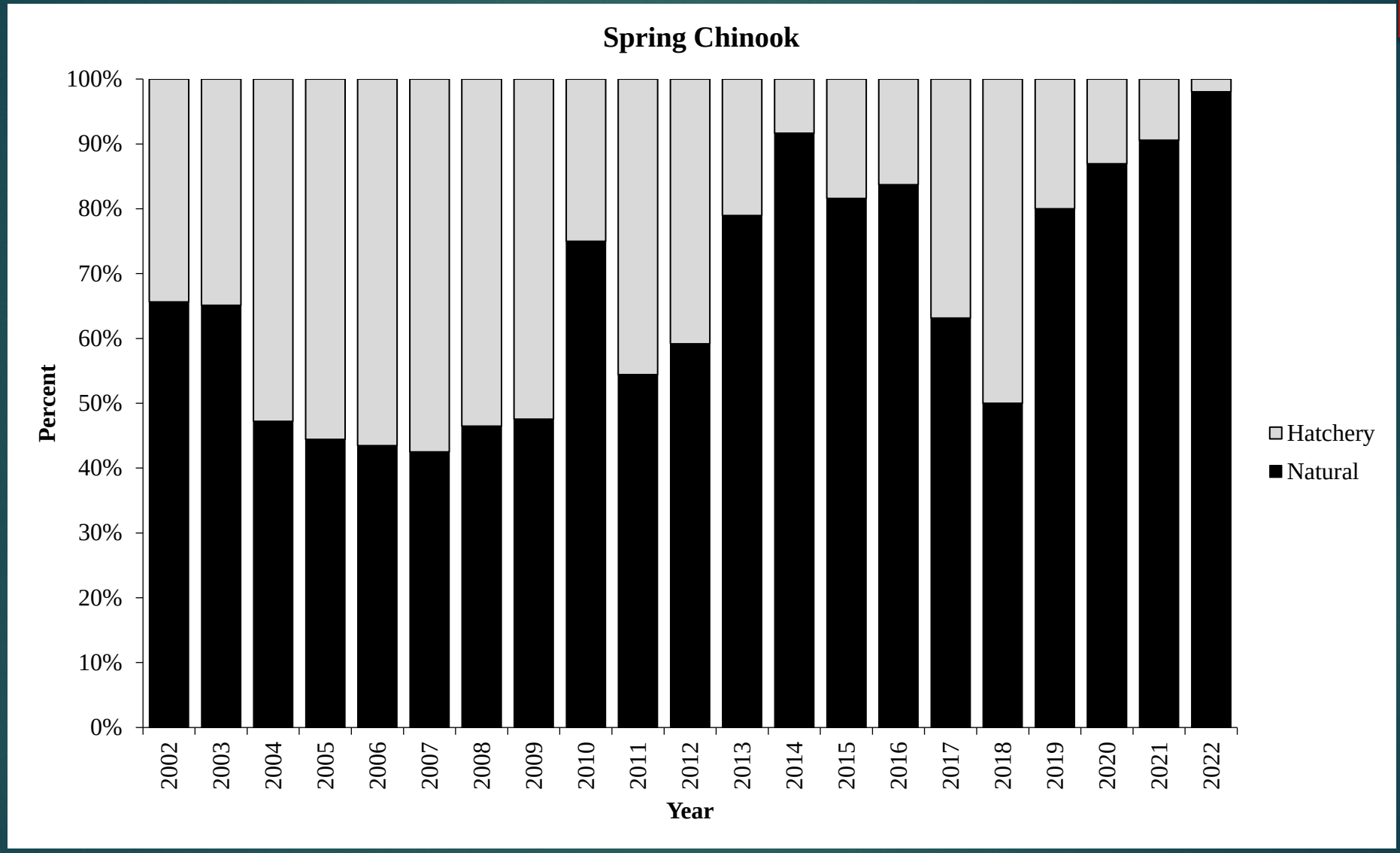
- Summary of Entiat River basin
- Spatial distribution of Entiat River Chinook spawning
- Egg to fry methodology
- Egg to fry future plans

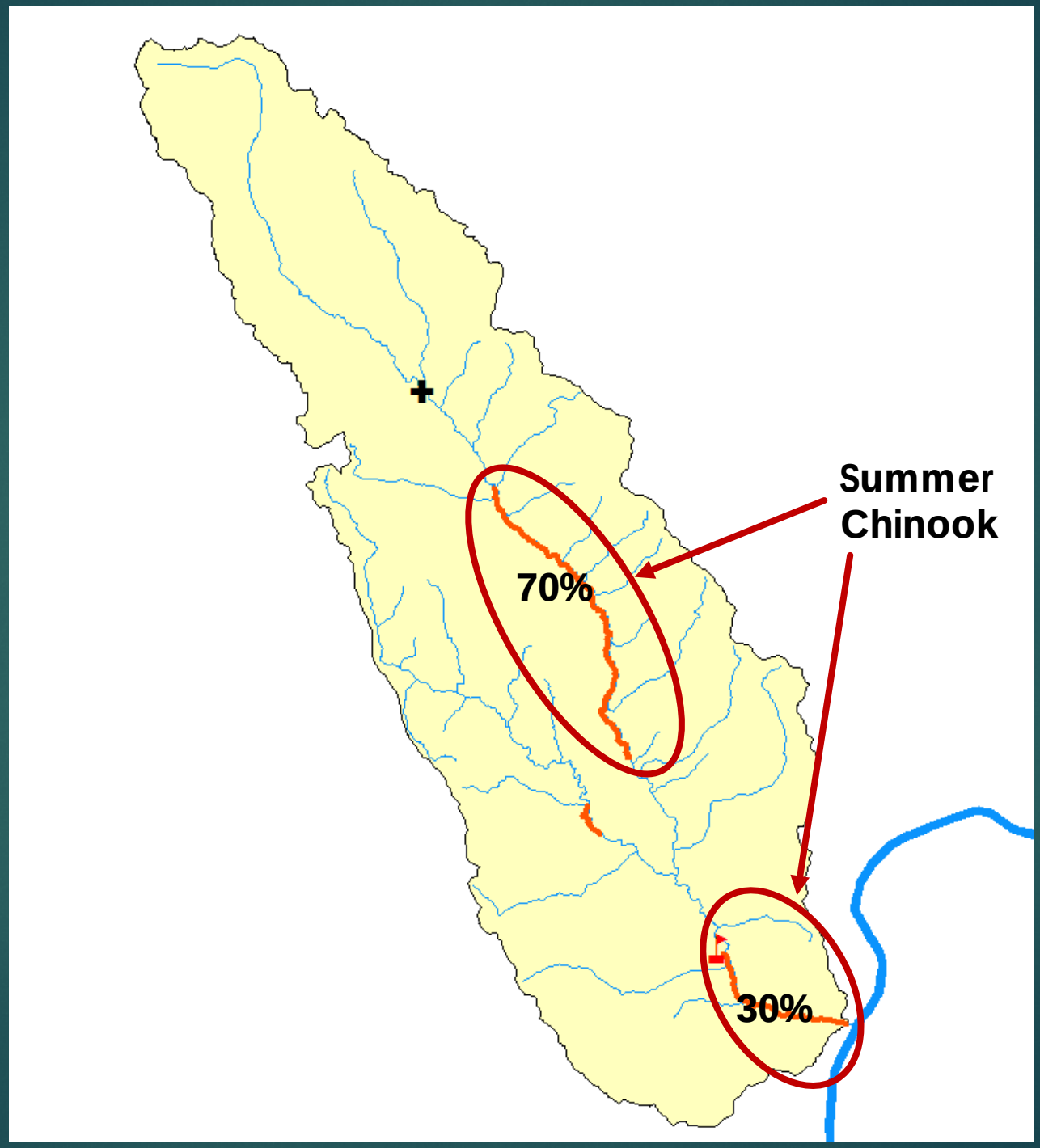
Entiat NFH Brief History

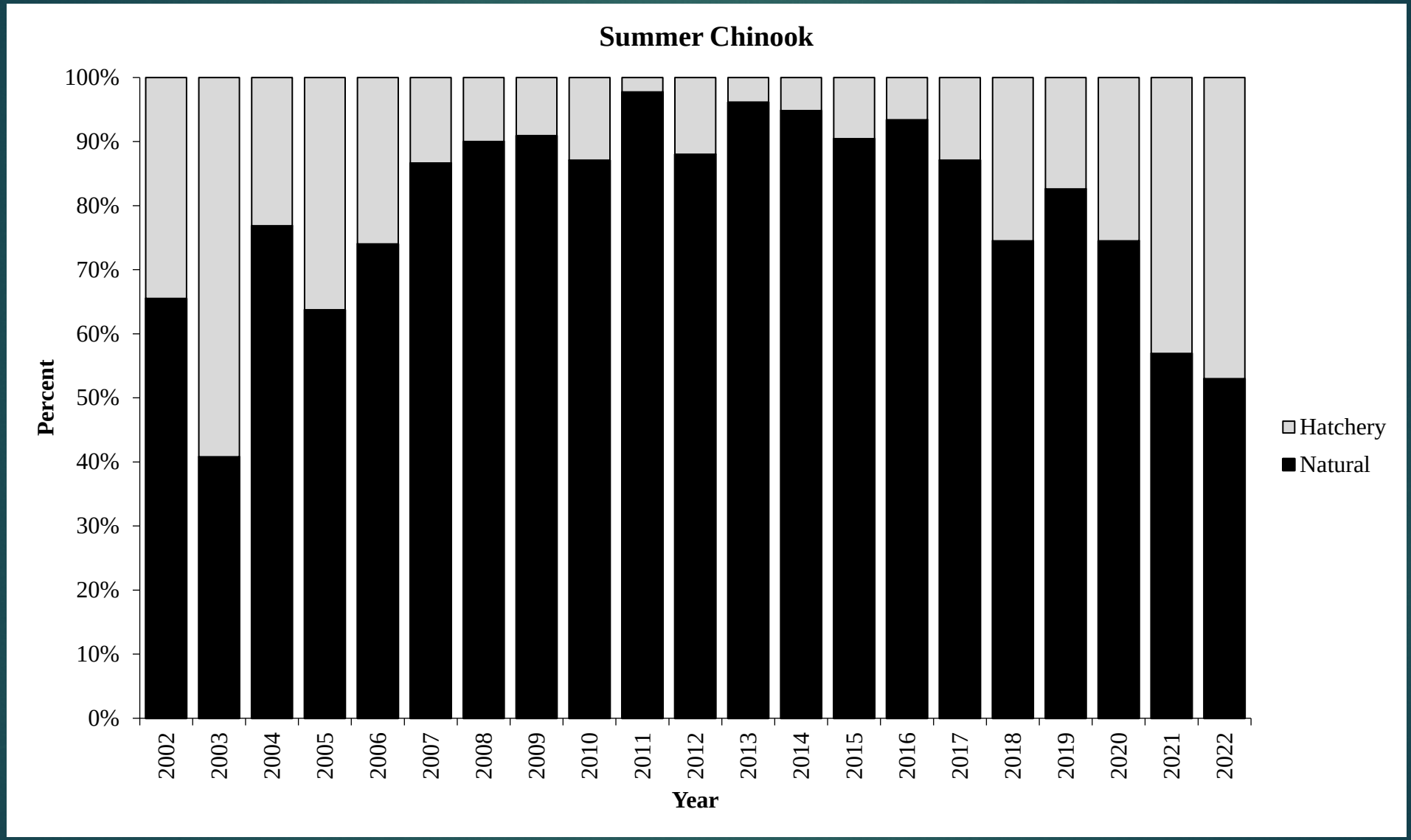
- Began raising fish in 1942
- Raised many species until 1975
  - Spring and Summer Chinook, Steelhead, Brook Trout, Coho, Sockeye, Cutthroat Trout
- 1975-2007 focused on spring Chinook
- 2009-present focused on summer Chinook, 400K release goal
  - Impacts of hatchery fish increasing superimposition?
  - Entiat NFH BiOp “less than 15% superimposition rates”

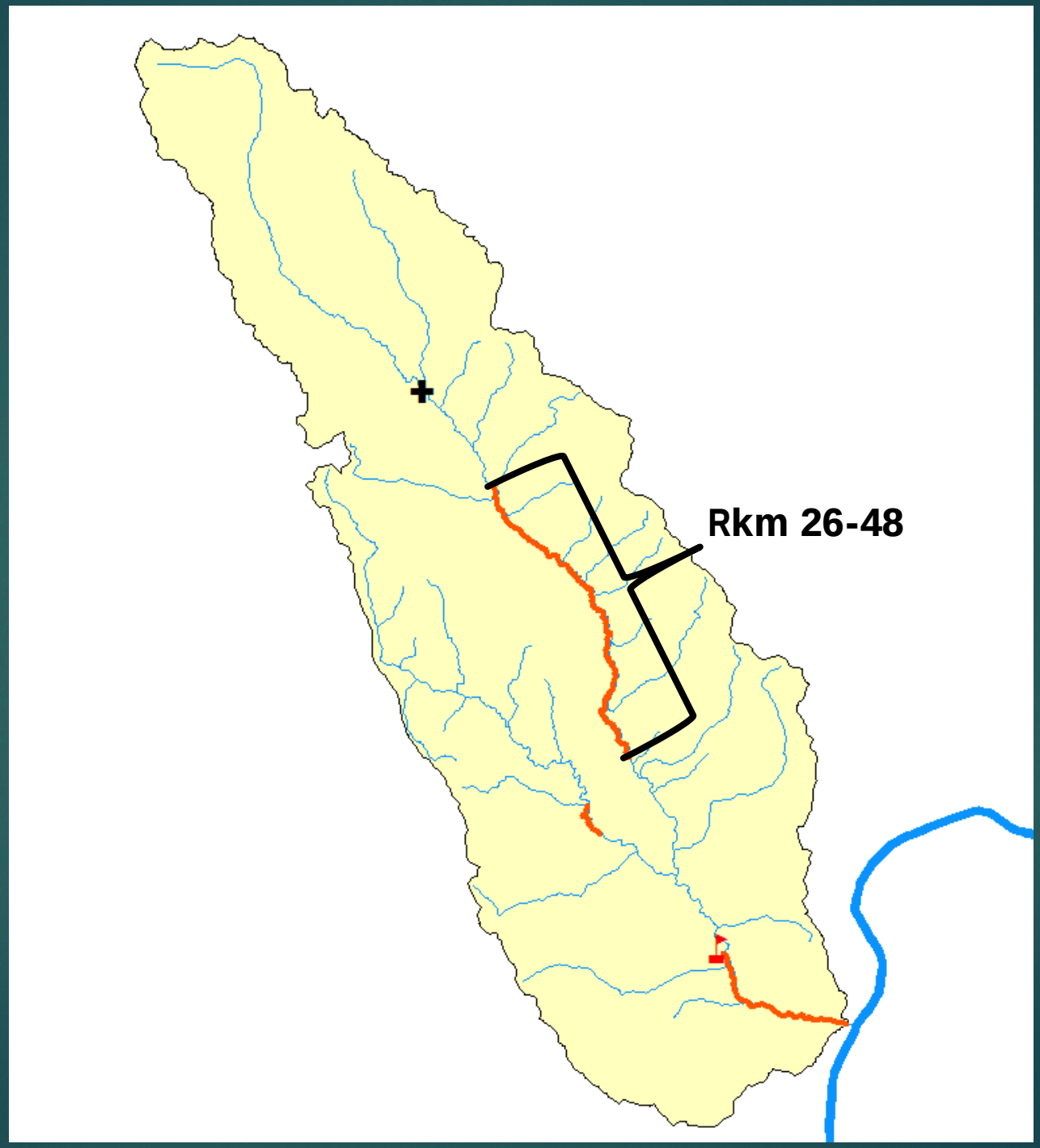

Legend
Entiat NFH
Entiat_Falls
0
10
20 Km
N

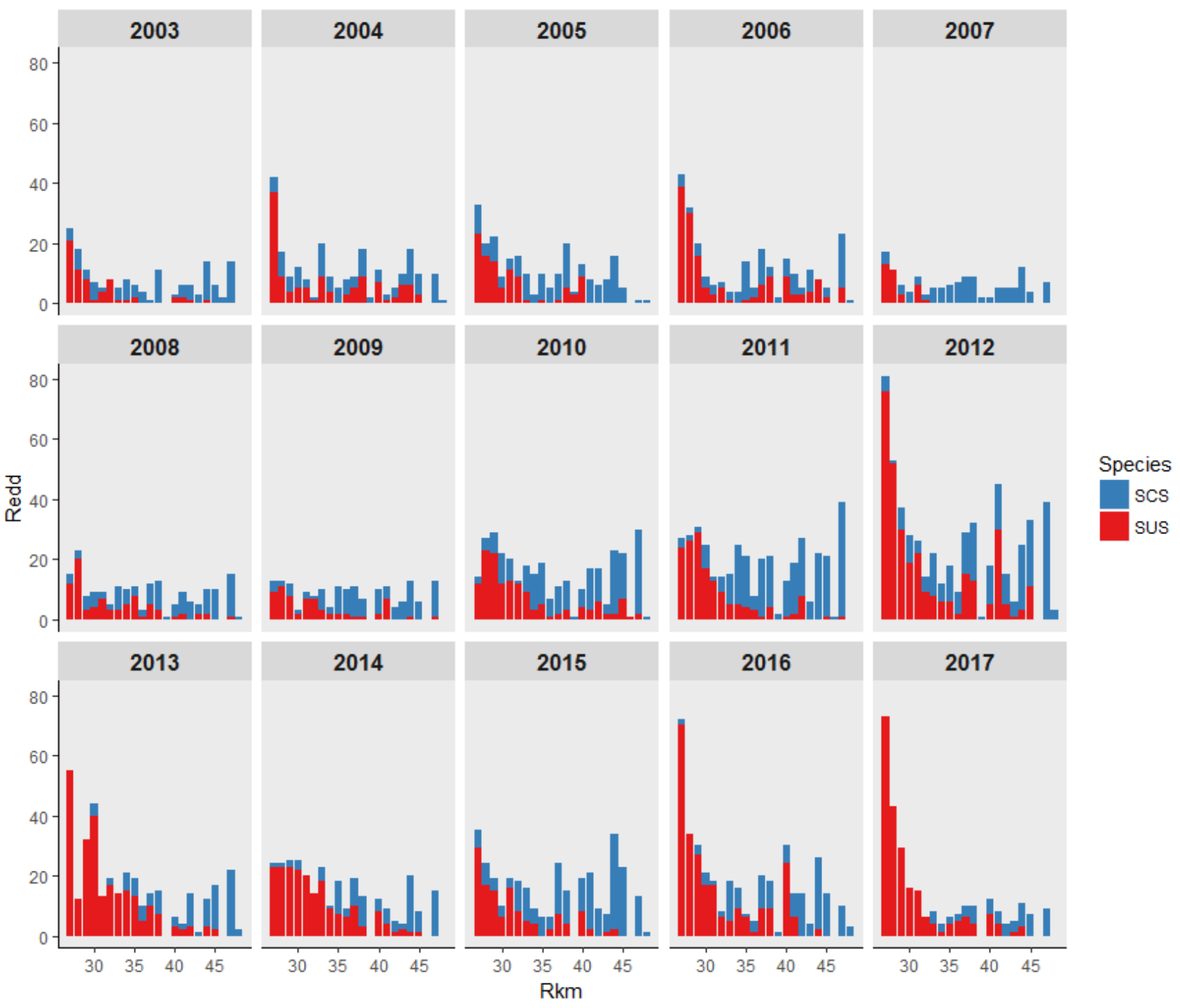

99%
1%
Spring
Chinook

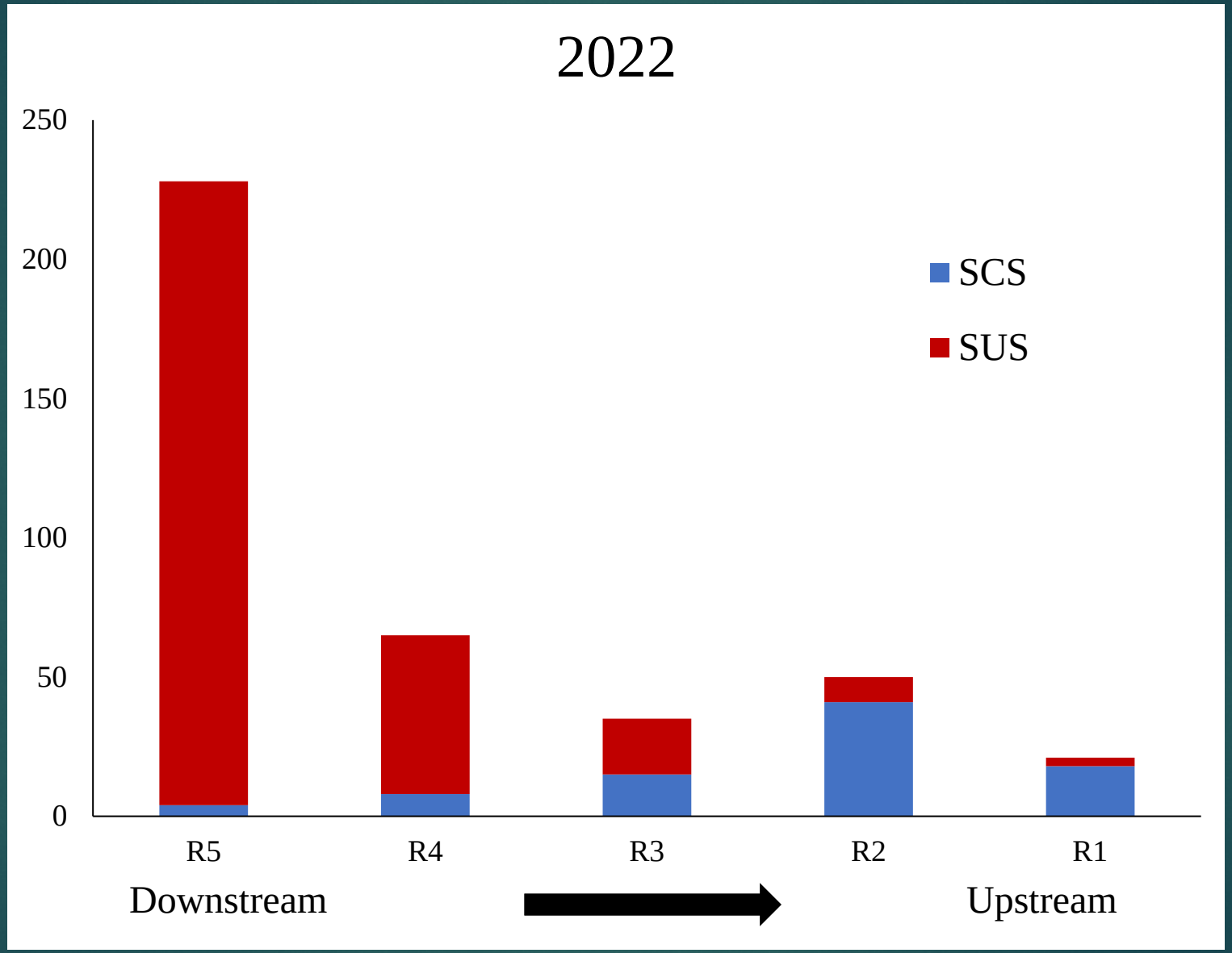

Spring Chinook
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
Hatchery
Natural


Summer
Chinook
70%
30%


Summer Chinook
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
Hatchery
Natural


Rkm 26-48


2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
Redd
Rkm
0
20
40
60
80
30
35
40
45
Species
SCS
SUS


2022
250
200
150
100
50
0
SCS
SUS
R5
R4
R3
R2
R1
Downstream
Upstream

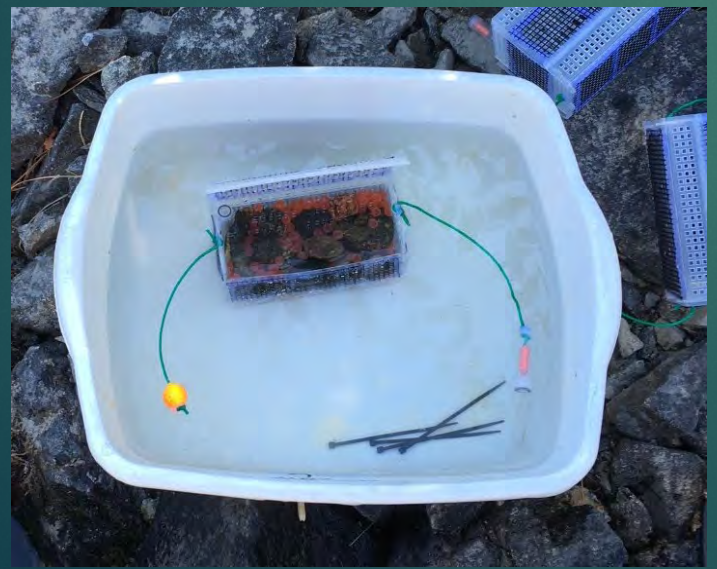
	Redds				SUS				
Year	SCS	SUS	SCS SI by SUS	SCS SI	NOR	HOR	NOR SI	HOR SI	ENFH SI
2013	99	249	19	19.2%	97%	3%	18.6%	0.6%	0.3%
2014	102	196	28	27.5%	95%	5%	26.1%	1.4%	1.4%
2015	202	172	28	13.9%	90%	10%	12.5%	1.4%	0.2%
2016	141	242	22	15.6%	93%	7%	14.5%	1.1%	0.9%
2017	63	221	6	9.5%	87%	13%	8.3%	1.2%	0.9%
2018	65	144	10	15%	82%	18%	12.8%	2.8%	1.8%
2019	58	113	0	0%	83%	17%	0%	0%	0%
2020	51	122	5	10%	75%	25%	7%	2.5%	2.18%
2021	81	107	3	3.7%	51%	49%	2%	1.8%	1.74%
2022	86	313	11	12.8%	53%	47%	6.8%	6.0%	<6.0%[1]

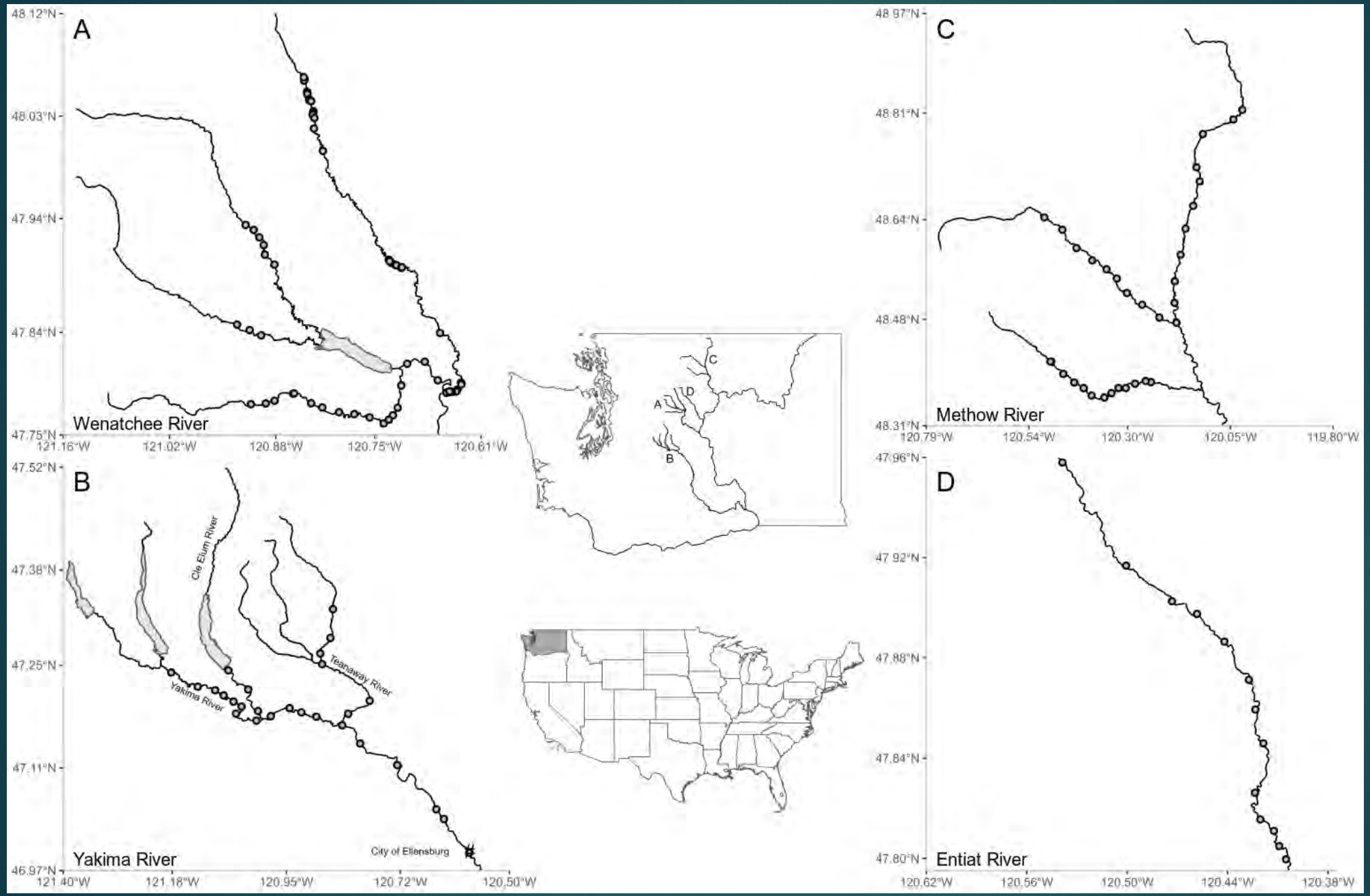
Entiat River Egg to Fry Study

- Evaluate early life history survival differences across the riverscape
  - Can spring Chinook survive upstream of current distribution (thermal & superimposition refugia)
- Quantify the impacts of superimposition
  - Spatial distribution of spring and summer Chinook in the Entiat River overlap and hatchery production may exacerbate overlap
  - ENFH BiOp “less than 15% superimposition rates”

Entiat River Egg to Fry Study

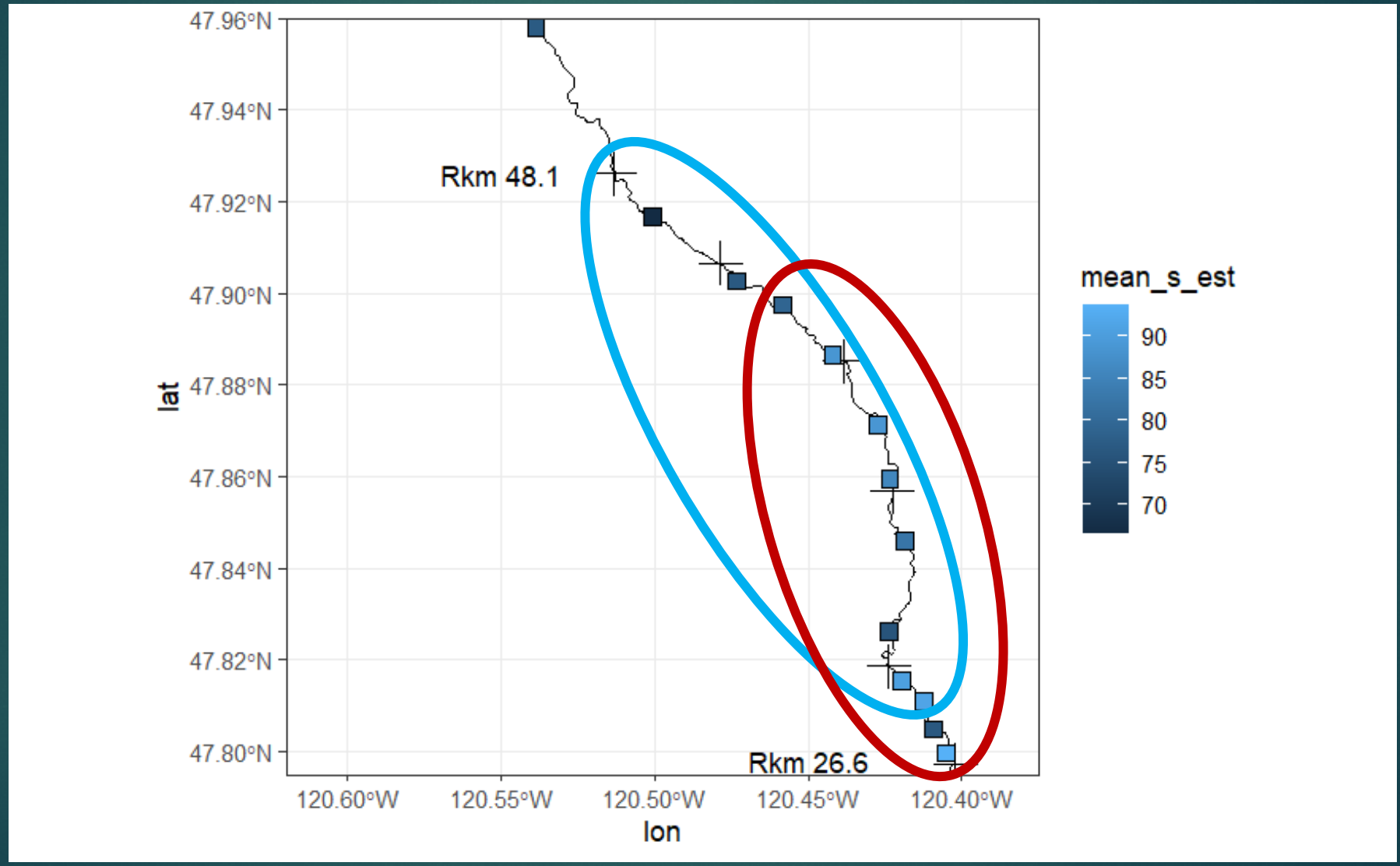
- First 2 years (2020-21) of study = close partnership with WDFW with large spatial distribution of egg boxes
  - 13 sites across riverscape covering all known spawning distribution
  - Including upstream of Box Canyon
- Final 2 years (2022-23), WDFW partnership reduced
  - Focus on superimposition areas, downstream 6 sites, more egg boxes/site
  - Pulled all egg boxes after summer Chinook spawning complete





Site Distribution

Entiat River Egg Box Distribution



Day 1: Site Preparation

Day 1: Site Preparation

1) Dig redds 6 per site 2022

2) Place buckets

Buckets

BOTTOMLESS BUCKETS KEEP REDDS FROM FILLING IN OVERNIGHT

SCOUR CHAINS

- Sliding bead scour chains are placed ½ meter behind each redd
- Measure scour and aggregation

Day 2: Gamete Collection

- WNFH provided gametes from 3 males and 3 females
- Eggs enumerated
  - 100/bag
- Eggs and milt preserved with Oxygen

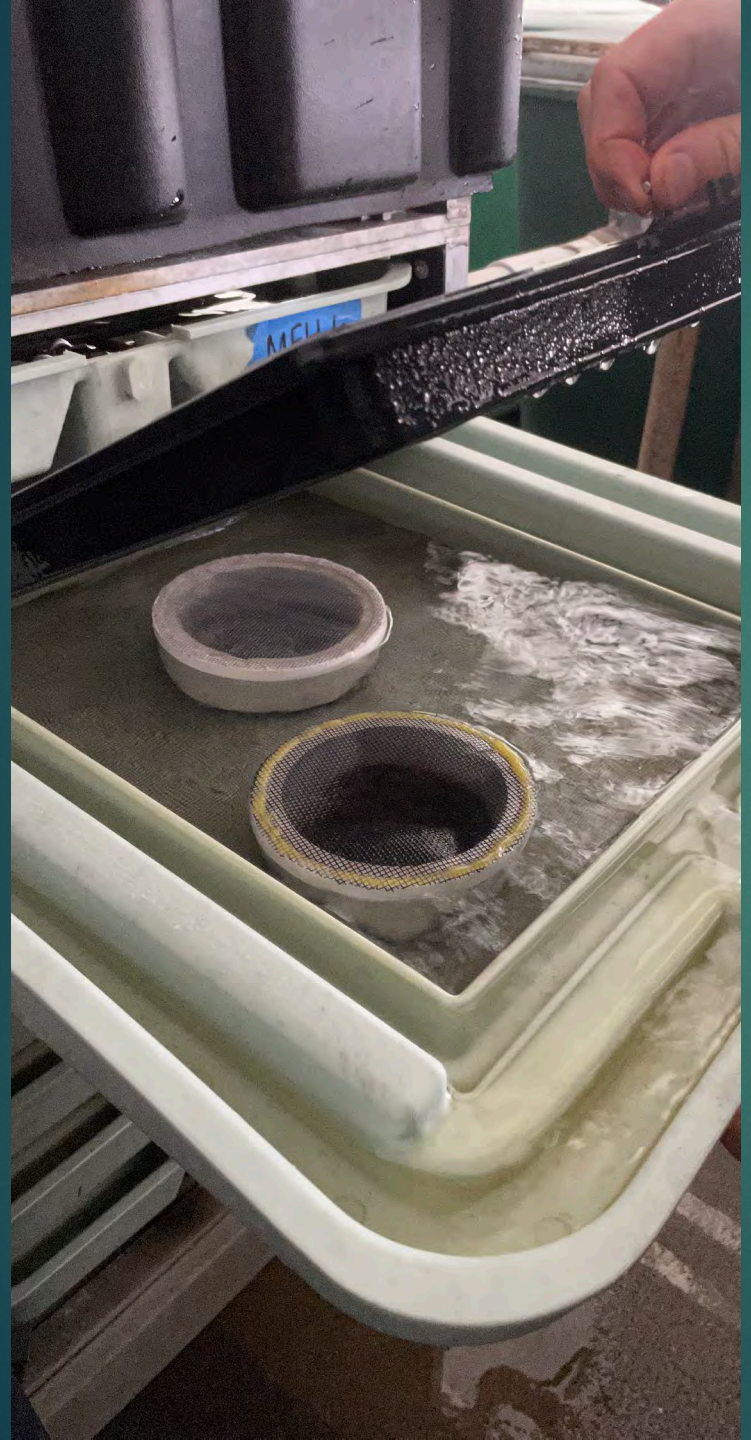
Day 2: Gamete Collection

- Genetics found to be the biggest driver of survival in early egg-fry studies (Johnson et al. 2012)

- 3 males (A, B, C) and 3 females (A, B, C) used each year and same pairings at each site

  A x A B x B C x C

- Eggs and milt preserved with Oxygen



Day 3: Control

- Fertilize a control group of eggs at WNFH
  - Enables assessment of genetic impact on survival
- Transport gametes to Entiat River

Day 3: Fertilize and Bury

- Fertilize eggs streamside
- Transfer fertilized eggs to egg box

Day 3: Fertilize and Bury

- Bury egg box in the prepared redds
- Dump clean gravel on egg boxes
- Remove buckets, final scour chain bead count, go home

Supervisor Workload

Routine Surveys

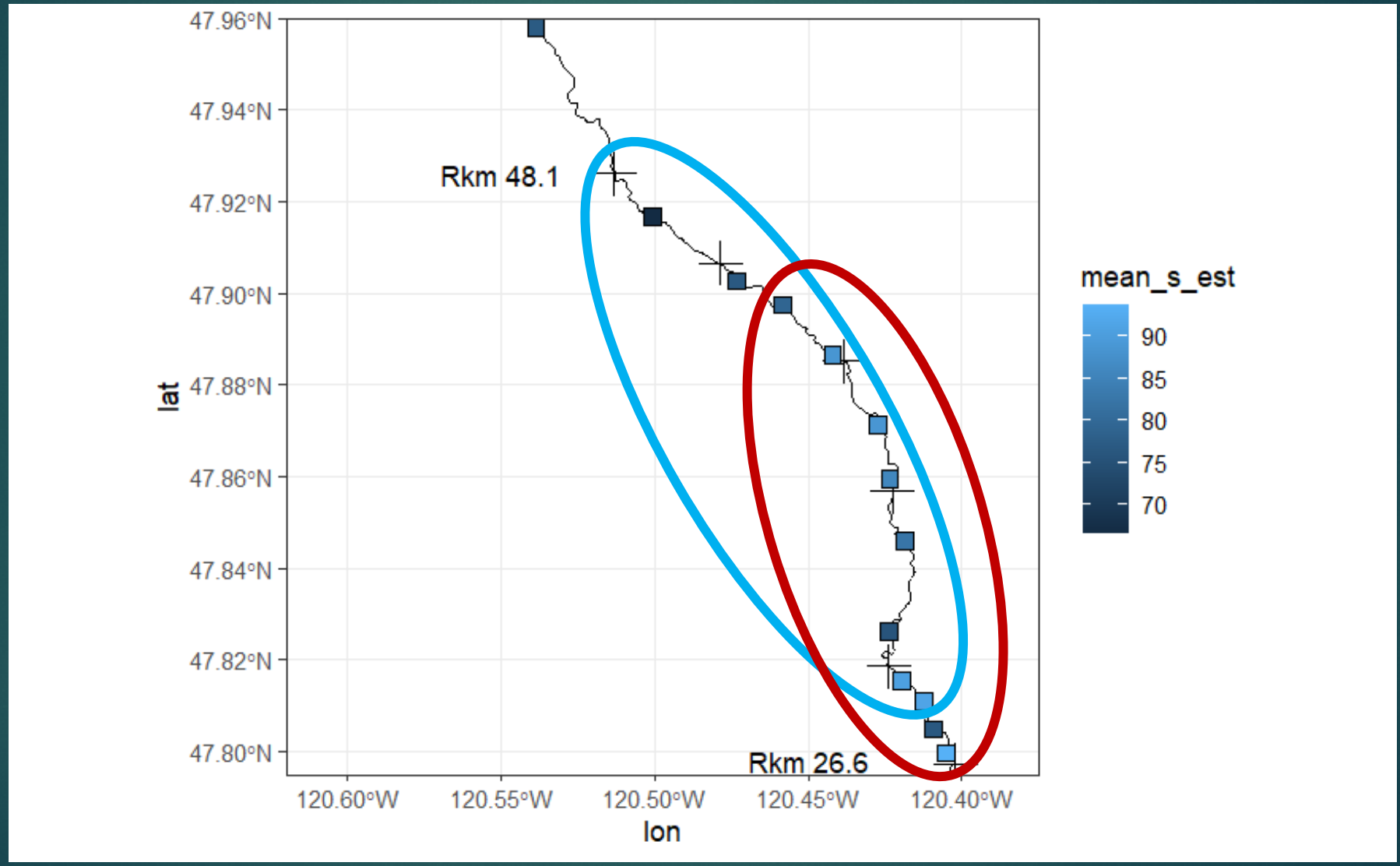
- Entiat SGS surveys scout egg-fry sites weekly September - November

- Requires highly trained professionals to determine if egg boxes have been exposed

Egg Box Extraction

- Extracted most egg boxes at 1000 ATUs (2020-21)
  - Late March – early May
- 12 of 51 egg boxes extracted in mid-November to evaluate the immediate impact of superimposition for 2 years
- 3rd year of study WDFW involvement reduced focus shifted to superimposition, boxes pulled after summer Chinook spawn

Entiat River Egg Box Distribution



Egg Box Extraction

Egg Box Extraction

Egg Box Extraction

- Count survivors
- Keep sediment

Egg Box Extraction

Lab Work

- Final survivor count
- Length and weights
- Condition factor

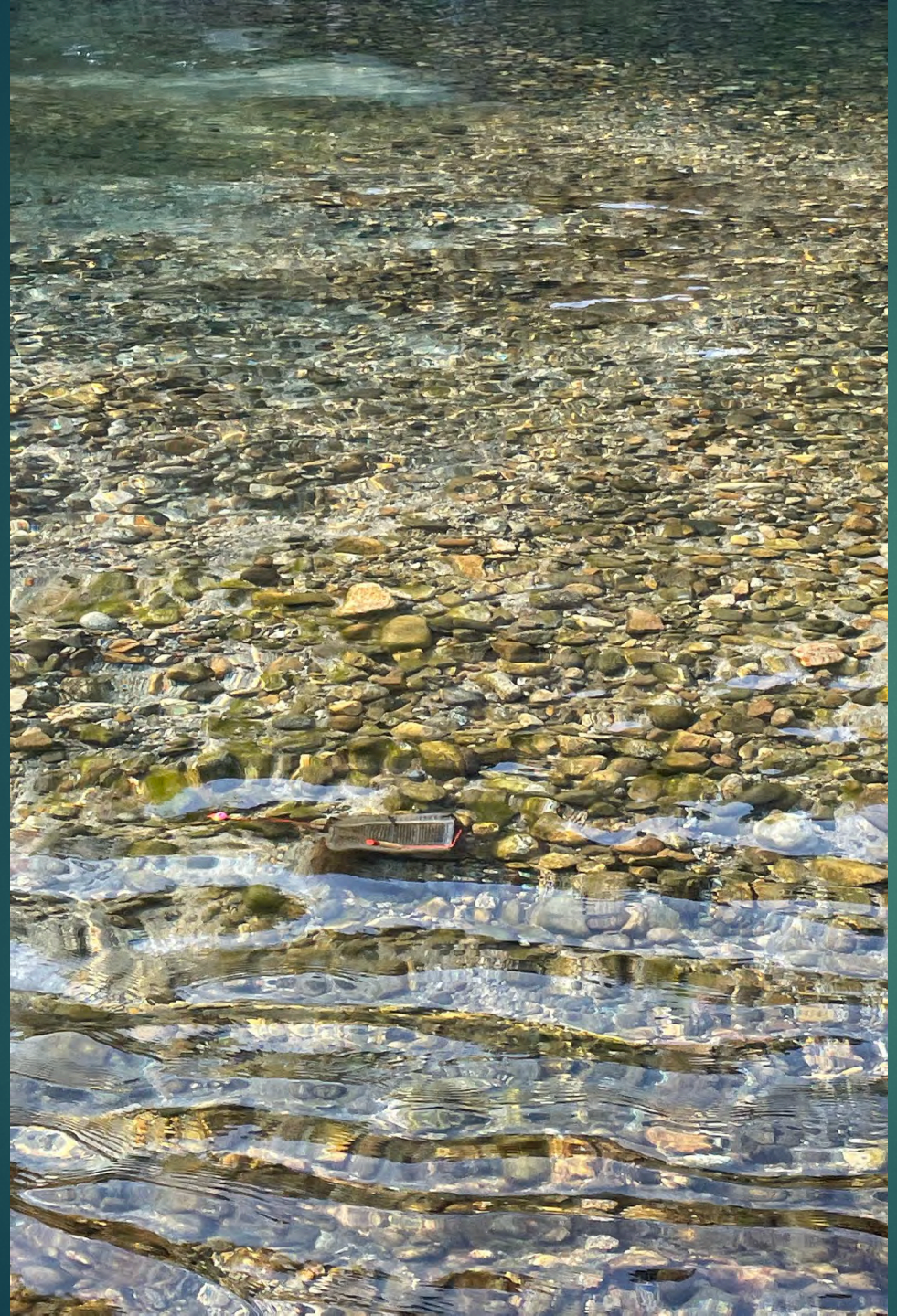
Data Collection

- Predicted variable (y) = Survival
- Predictor variables (x)
  - Superimposition
  - Scour
  - Aggregation
  - Genetics
  - Location
  - Substrate
  - Fine sediments
  - Condition factor

Questions

- Egg Box protection?
- Impacts of exposure
  - Macroinvertebrates
  - Sculpin
  - Dippers
  - UV

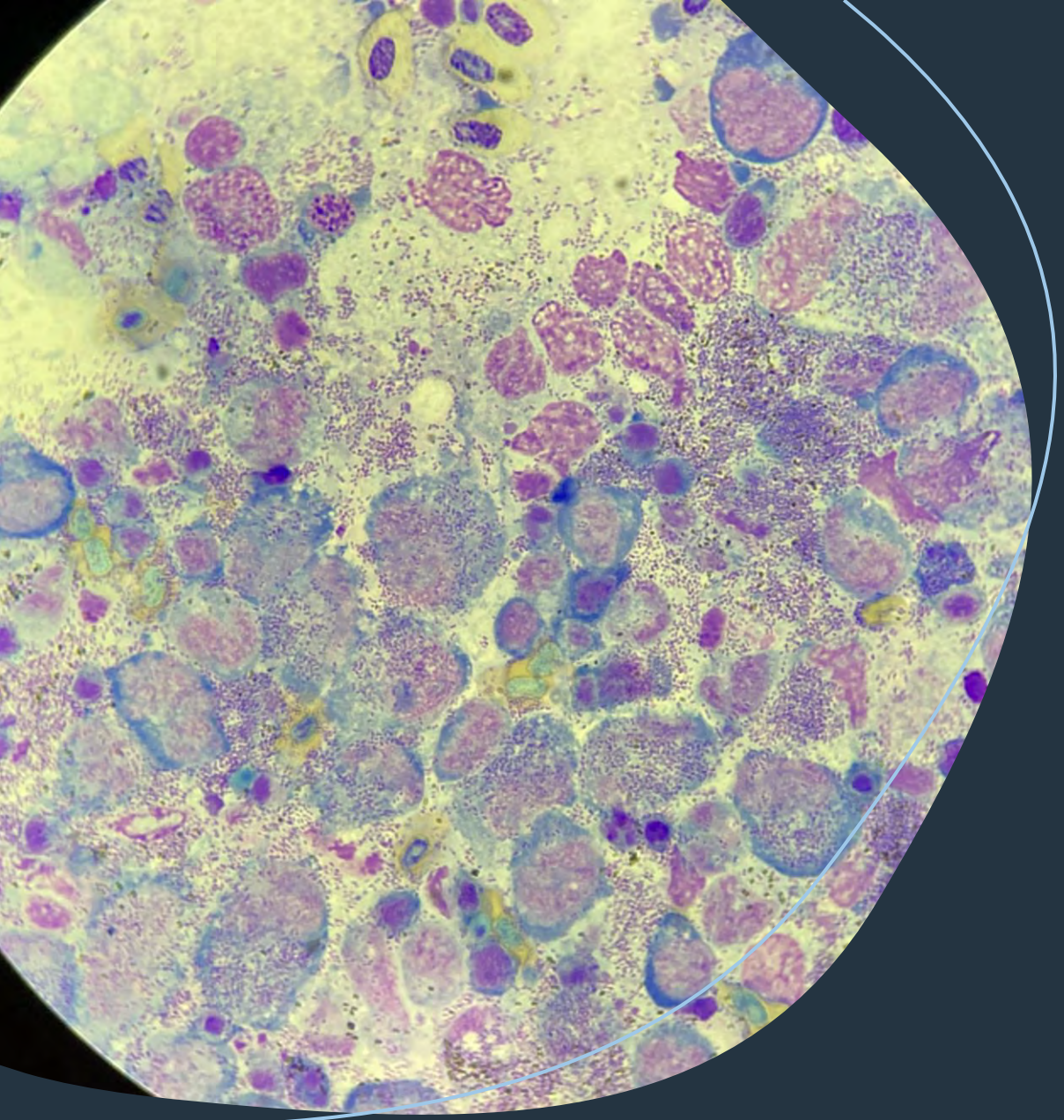
- Coho??



Coho….

- No summer or spring Chinook superimposition
- Site completely dug up
- Survival would have probably been lower without box protection (see pic)

Attachment D
Bacterial Kidney Disease at Eastbank



Bacterial Kidney Disease at Eastbank

Megan Finley, DVM, MSc

WDFW

How do we manage BKD?

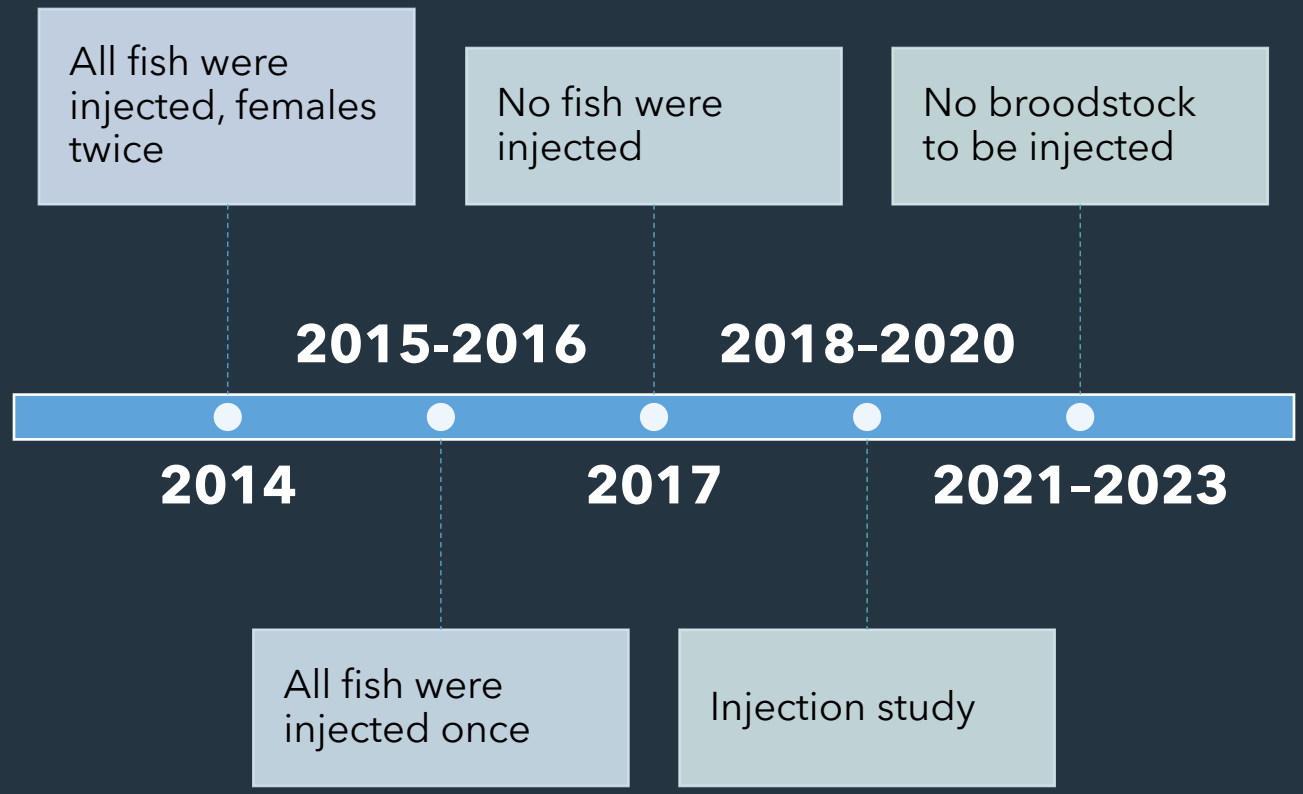
History of BKD at Eastbank

- Pre-2014: The bad years where BKD was causing havoc and there were lots of mortalities.
  - Broodstock injections: All broodstock got OTC and Erythromycin, females received a second injection just prior/during spawning
  - Juveniles treated prophylactically with Erythromycin (Aquamycin medicated feed) before marking
  - ELISA-Cull program
  - Stress reduction: densities, nutrition, handling

What was working?

- Erythromycin Feeds
  - Prophylactic treatment of juveniles (300 fpp) before marking
    - Problems with toxicity
    - Later treatments (i.e. when fish are chronic and showing signs) may not work
- Stress Reduction
  - Lowering densities and switching to high quality feeds (BioVita) worked well
- Broodstock Injections
  - Erythromycin hard to get
  - Antibiotic resistance
- ELISA-Cull
  - Are we culling too many fish from programs?

History of Broodstock Injections (Spring & Summer Chinook)

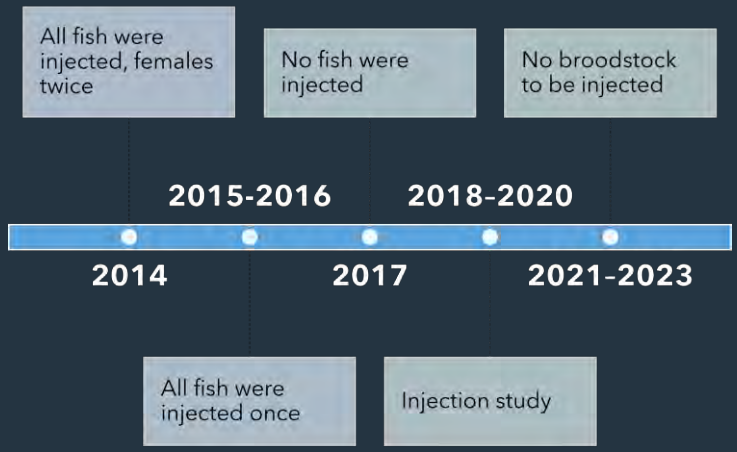


Broodstock Injections

- Reduces pre-spawn mortality
- Reduces vertical transmission if done within 1 month of spawning (Brown et al. 1990) or does it?
  - Idaho found that injecting chinook 2 weeks before spawning caused ELISA ODs to decrease but *Rsal* infections still occurred. *Rsal* was already inside the egg and antibiotics could not get in. Eggs were not culled because ODs were <0.25
- Does NOT eliminate *Rsal* infection in tissues and eggs but can reduce incidence of epizootics
- Disadvantages: Toxicity issues, egg necrosis, handling stress, other bacterial infections, limited availability of Erythromycin (INAD), Tulathromycin appears to be comparable but there needs to be more research

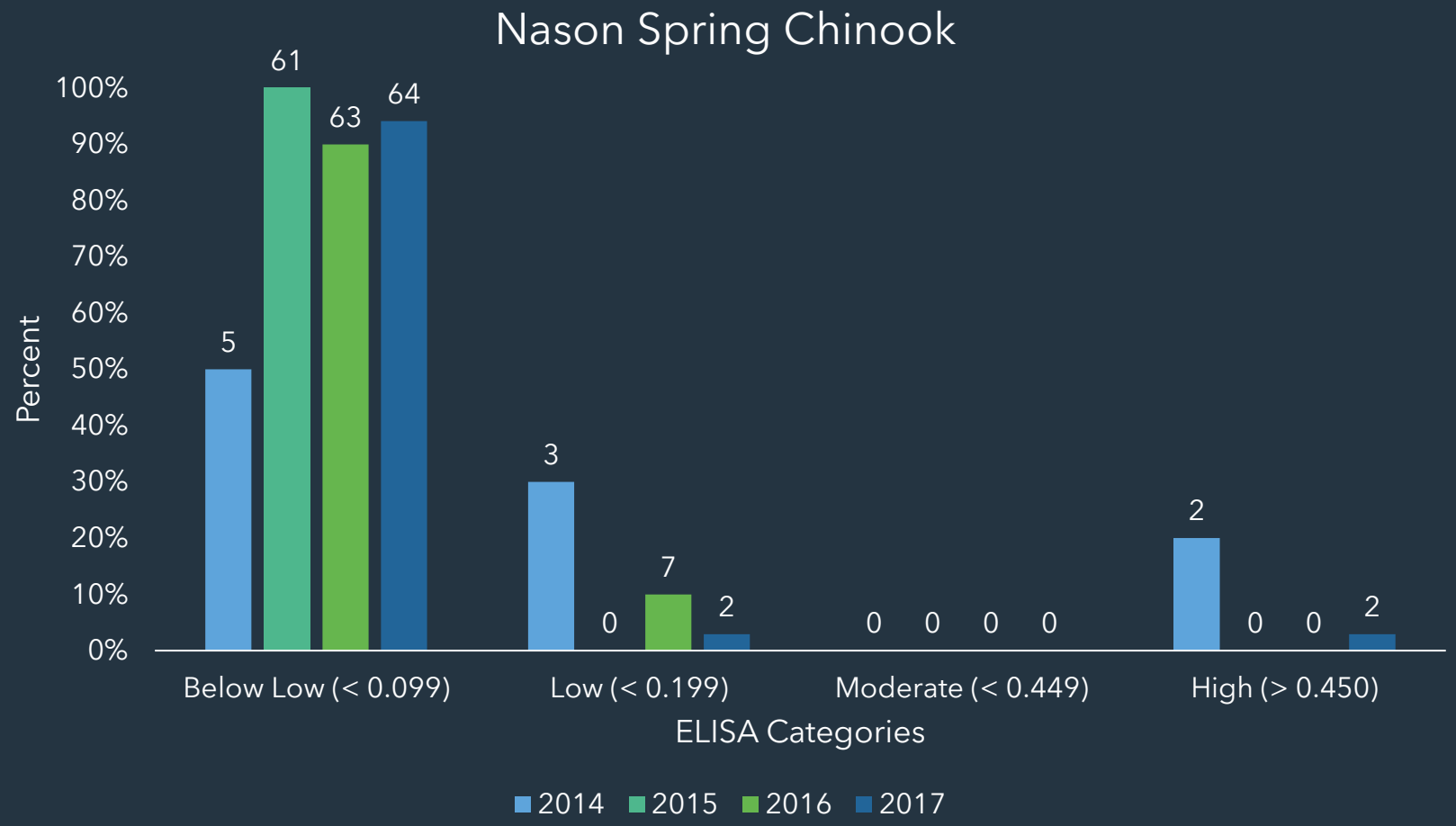
2014-2017 BKD findings

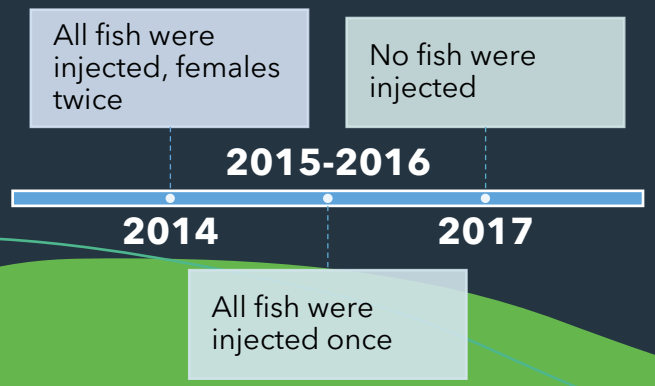
- ELISA



ELISA Results

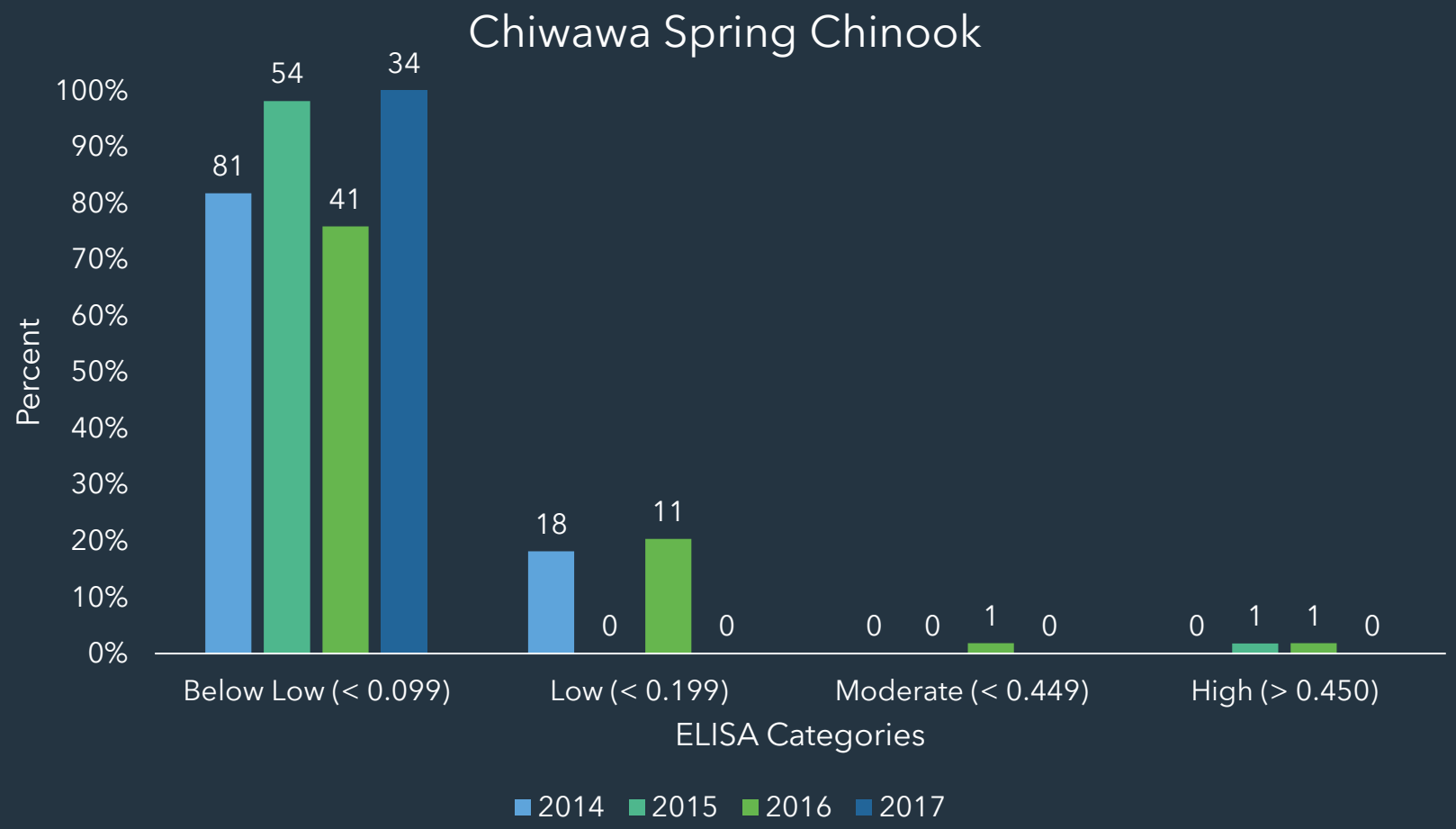
- Worst ELISA results is in 2014 (20% of the 10 fish collected).
- 2.94% of fish in 2017 were high ELISAs (2/68)

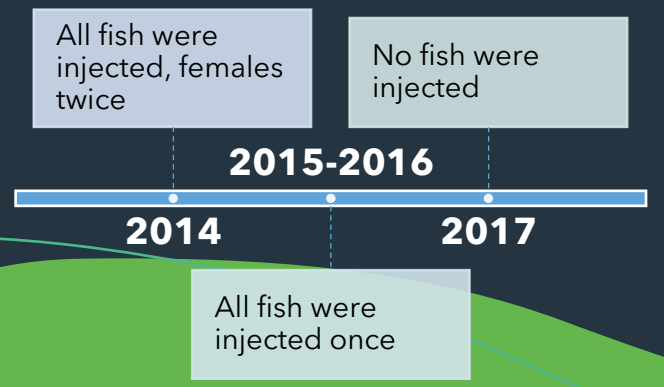




ELISA Results

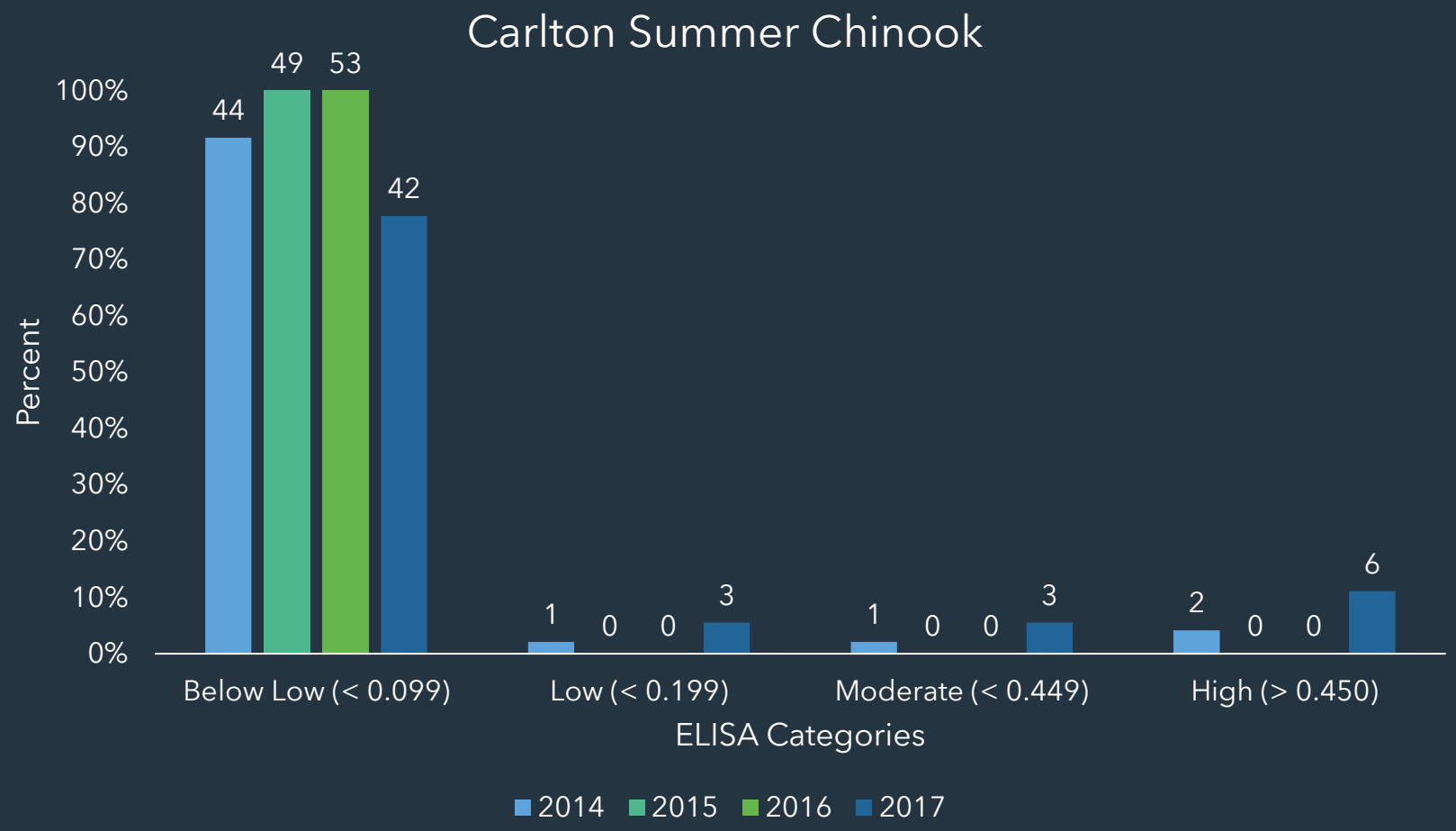
- Moderates and Highs detected in 2015 and 2016

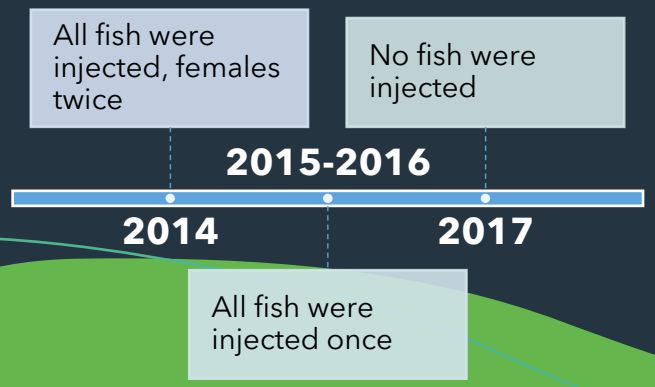




ELISA Results

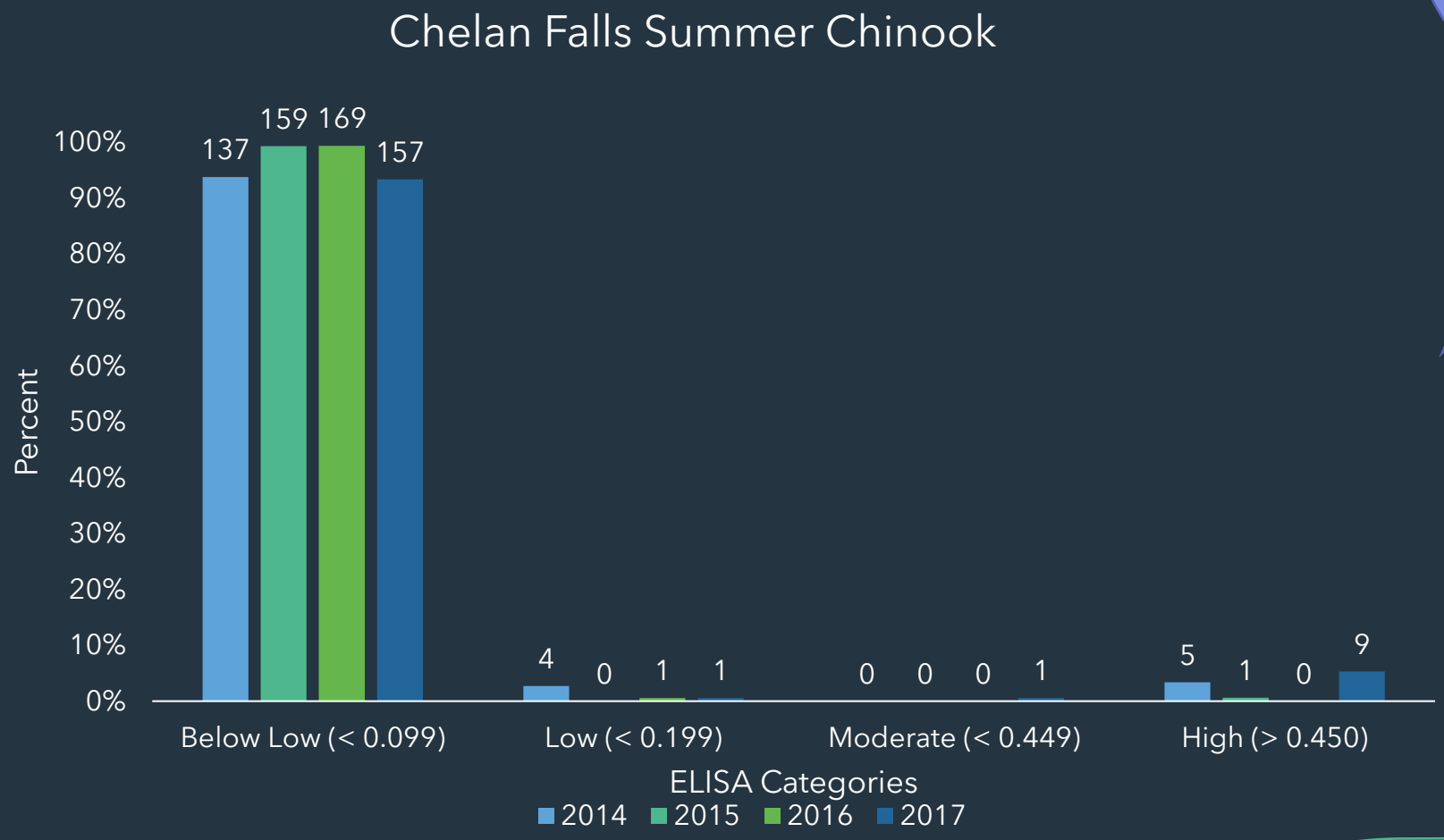
- 2014 and 2017 are the bad years, same as for the Nason Spring Chinook

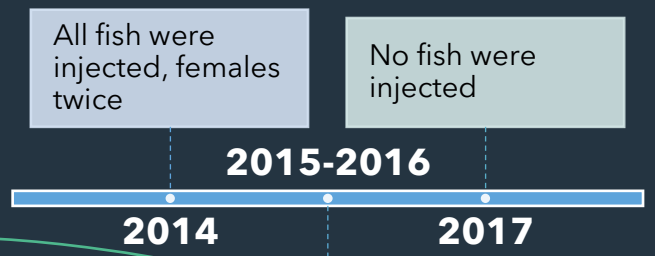




ELISA Results

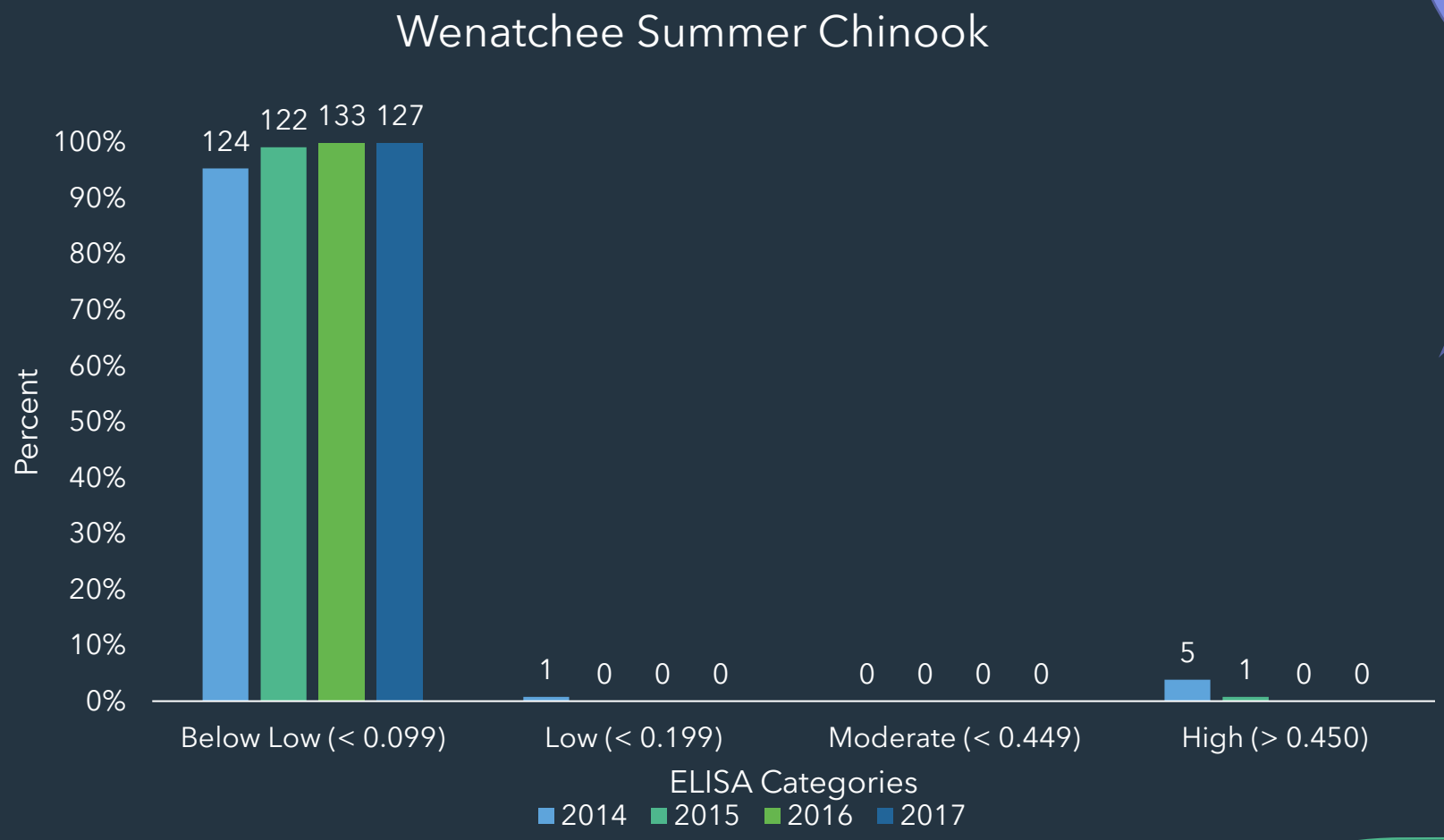
- 2014 and 2017 are the bad years (3.4% vs 5.4% high ELISA)

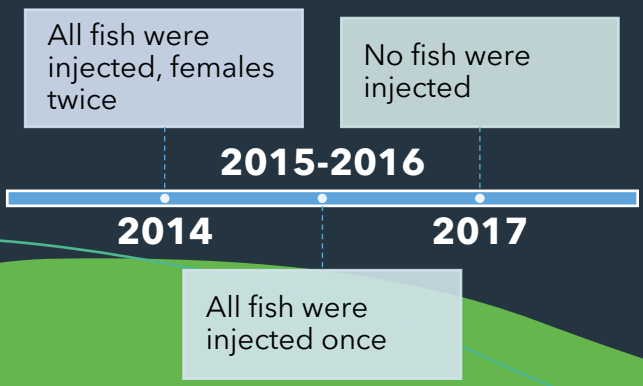




ELISA Results

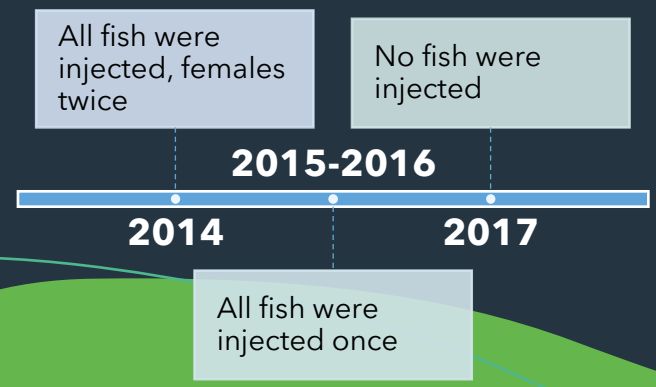
- 2014





2014-2017 BKD findings

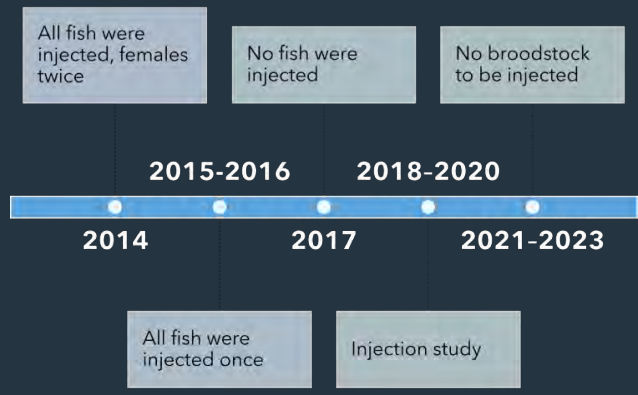
- ELISA
  - Very low number of fish were either moderate or high ELISA
  - 2014 and 2017 were the worst years
- Pre-spawn mortality?



Pre-spawn mortality

	CHIWAWA			NASON			CARLTON			CHELAN FALLS			WENATCHEE		
	M	F	%	M	F	%	M	F	%	M	F	%	M	F	%
2014	0	0	0	4	1	19.2	2	2	4	10	17	8.4	7	11	6.4
2015	0	1	0.6	0	1	1.6	0	0	0	10	15	7.2	5	4	3.5
2016	2	2	2.3	0	0	0	1	1	1.9	4	2	1.7	8	4	4.4
2017	0	0	0	2	2	2.7	3	4	5.9	9	10	5.3	4	4	3.1

Background to 2018-2020 Study



- 2017 findings of higher broodstock pre-spawn mortality and/or BKD ELISA results prompted this study on impact of antibiotic injections.
- Protocol for Draxxin (Tulathromycin) injections:
  - Chiwawa – all females
  - Nason – all NOR females
  - Carlton – every other female
  - Chelan Falls – every other female
  - Wenatchee - none

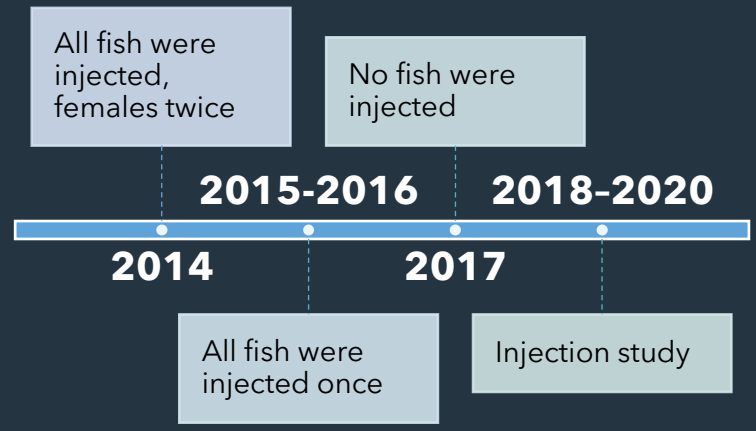
2018-2020 ELISA Findings

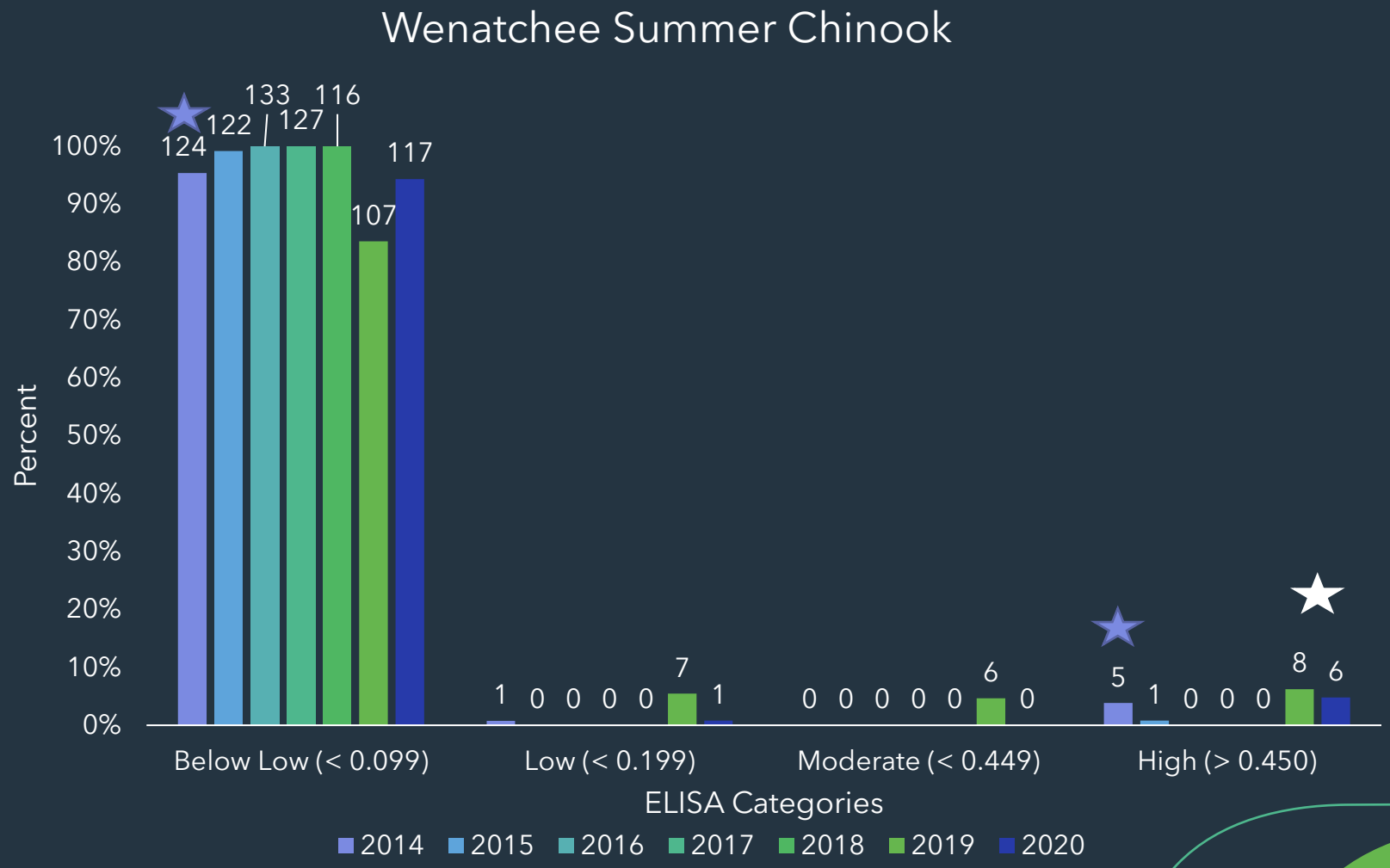
	CHIWAWA			NASON			CARLTON			CHELAN FALLS			WENATCHEE		
	Md	HI	%	Md	HI	%	Md	HI	%	Md	HI	%	Md	HI	%
2018	0	1	2.3	0	0	0	0	0	0	1	2	1.6	0	0	0
2019	0	1	2.8	1	2	4.6	0	0	0	6	19	8.5	6	8	11.2
2020	0	0	0	0	1	1.7	0	4	6.6	0	2	1.1	0	6	4.8

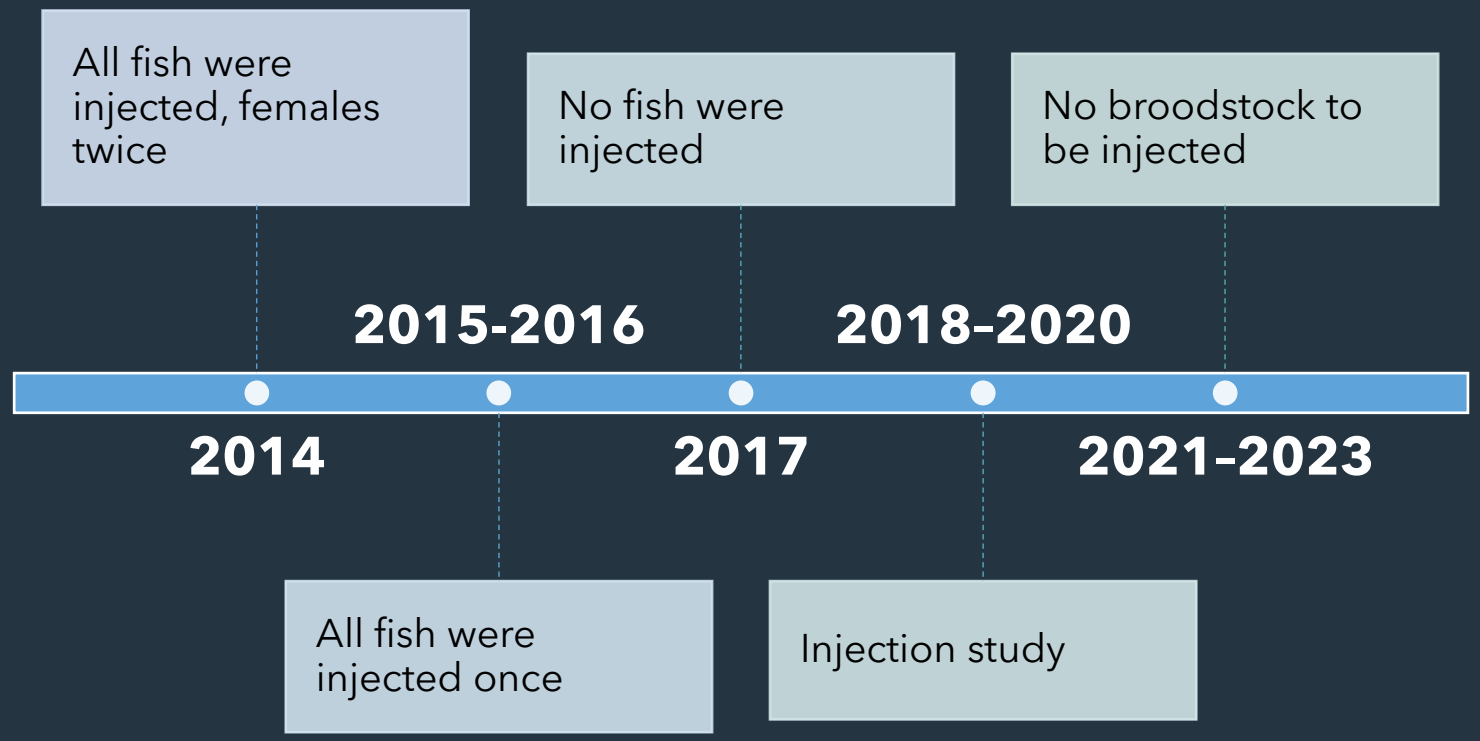
	CHIWAWA		NASON		CARLTON		CHELAN FALLS		WENATCHEE	
	PSM	%	PSM	%	PSM	%	PSM	%	PSM	%
2018	2	2.2	3	2.5	5	3.6	7	1.8	6	2.5
2019	4	5.6	4	3.0	2	1.6	14	2.4	13	4.9
2020	4	3.9	0	0	4	3.3	8	2.1	12	4.6

* WDFW reviewed SOP for ELISAs in 2018 and made significant changes. This resulted in a larger number of fish that previously would not have been considered high to now be in the high category

ELISA Results






All fish were injected, females twice
No fish were injected
No broodstock to be injected
2015-2016
2018-2020
2014
2017
2021-2023
All fish were injected once
Injection study

2021-2022 BKD Findings

	CHIWAWA			NASON			CARLTON			CHELAN FALLS			WENATCHEE		
	Md	Hl	%	Md	Hl	%	Md	Hl	%	Md	Hl	%	Md	Hl	%
2021	0	2	2.7	1	1	2	0	1	1.7	0	0	0	2	3	3.8
2022	0	1	1	2	0	2	0	0	0	0	7	4.2	0	5	3.7

	CHIWAWA		NASON		CARLTON		CHELAN FALLS		WENATCHEE	
	PSM	%	PSM	%	PSM	%	PSM	%	PSM	%
2021	4	4.9	1	0.74	10	8	70*	17.2	6	2.2
2022	0	0	3	2.4	3	2.8	19	5.5	16	5.6

* Problem with trap

Summary

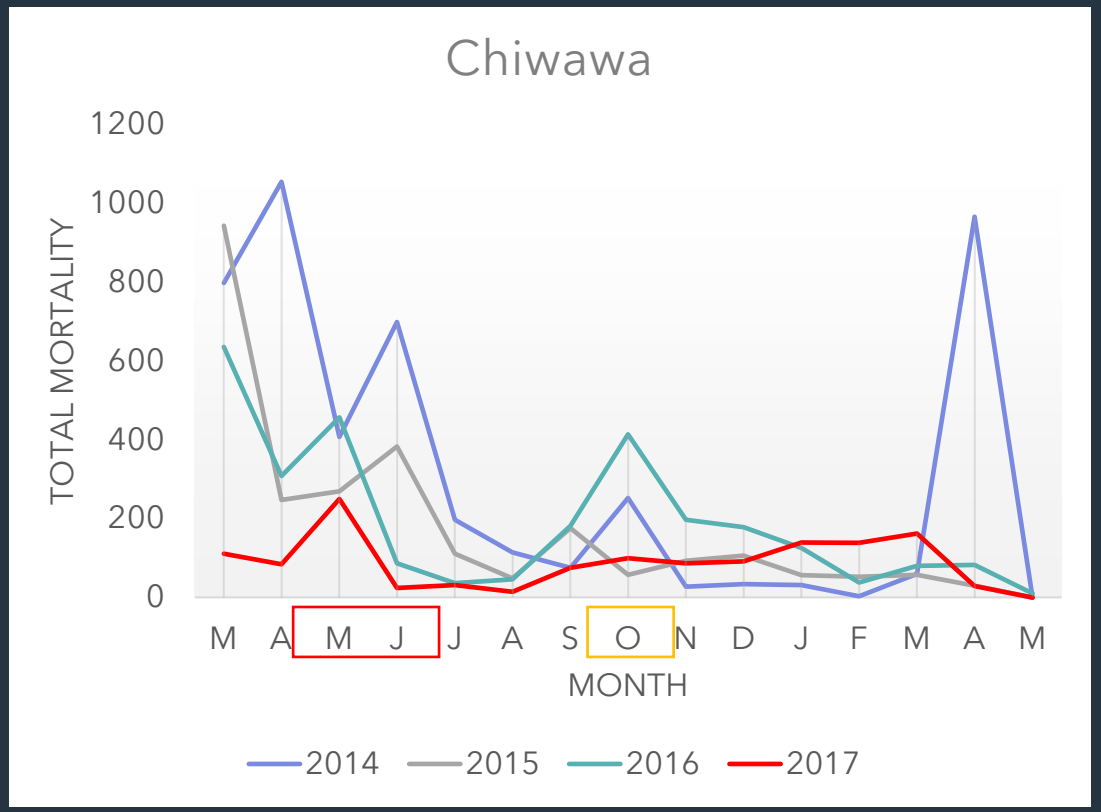
- No real difference between injected and non-injected for ELISA
  - Year to year variability
  - Wenatchee summer chinook are most commonly affected
- Pre-spawn mortality is not significantly reduced in overall numbers by injections
  - Still unknown: what percentage of the current PSM are due to BKD?

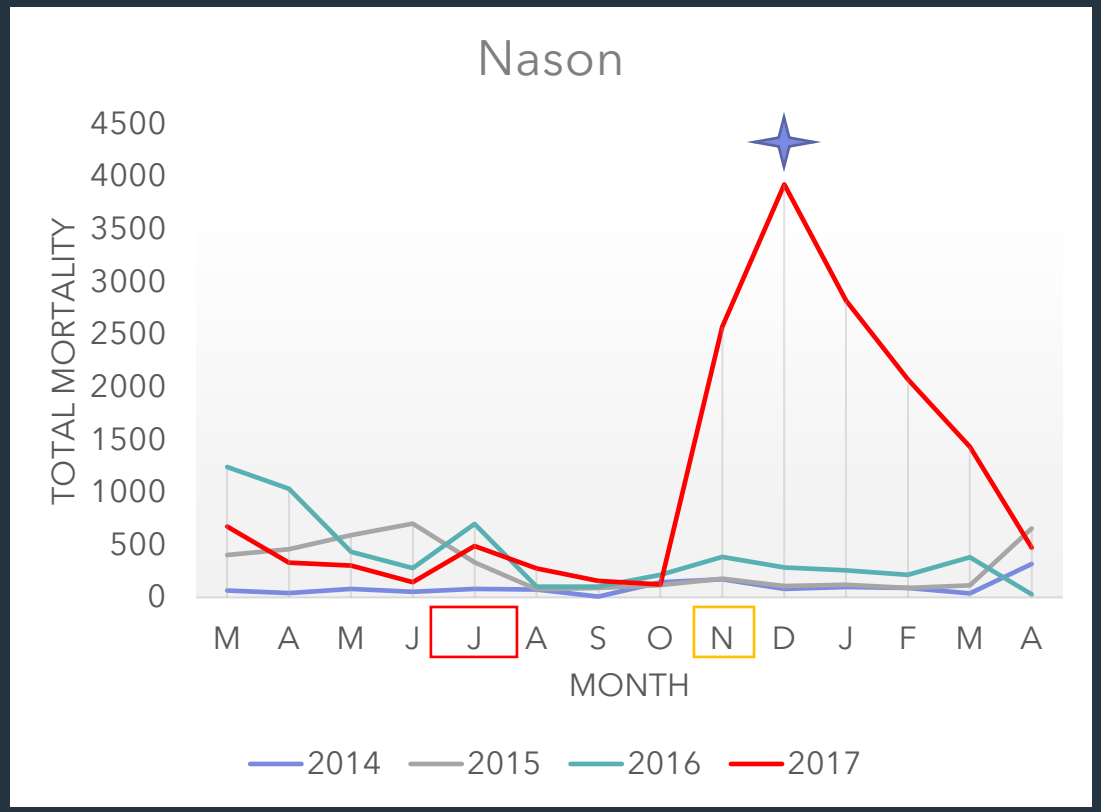
What about the juveniles?

History of BKD at Eastbank

- Pre-2014: Juveniles were treated prophylactically with Erythromycin (Aquamycin medicated feed)
  - Toxicity issues were occuring and treatments had to be stopped after 14 days
- 2015-2017: No juveniles treated.
- 2018-2022: Some BKD observed, high ELISA groups kept for Wenatchee Summers (BY19,20)

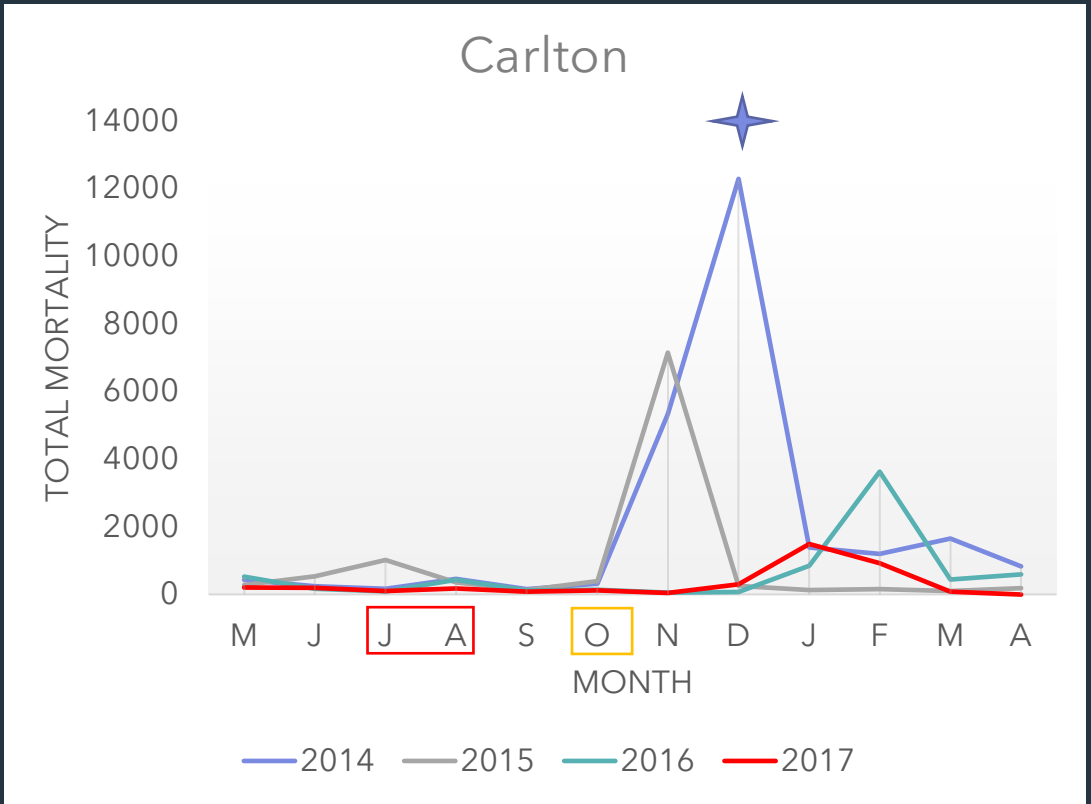
Juvenile Mortality 2014-2017

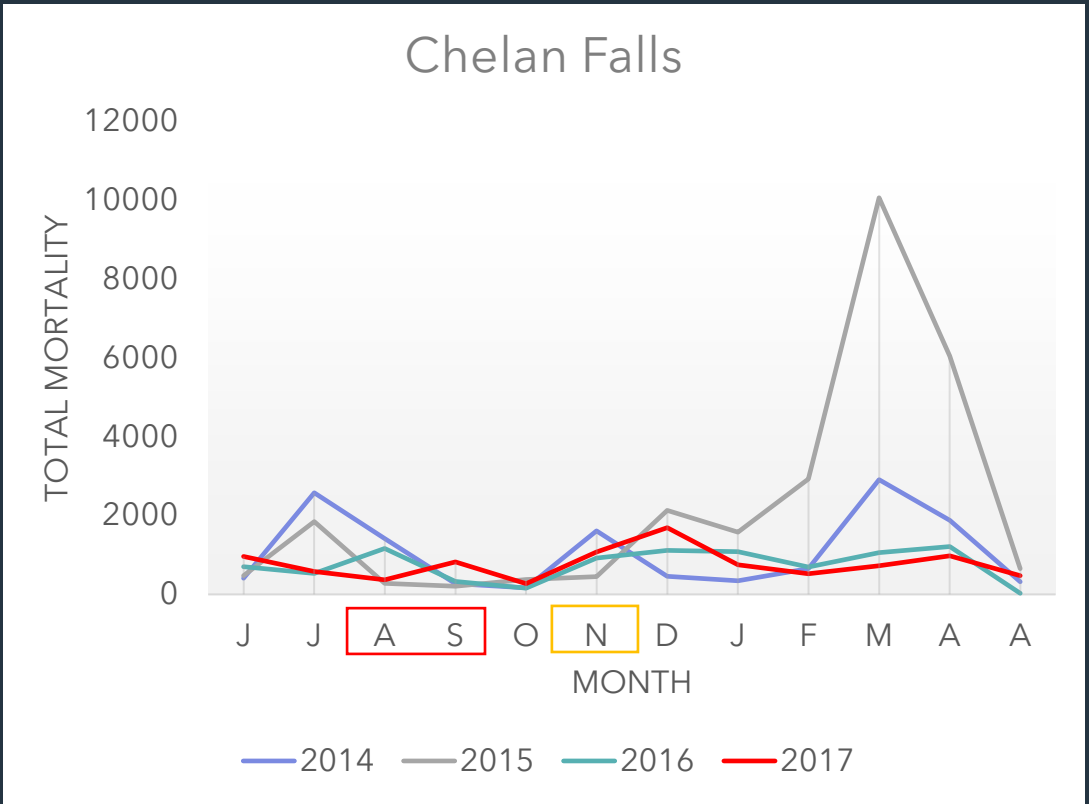




Marking Transfer to Acclimation Body Tag spinal issues/Late transfer mortality/BCWD

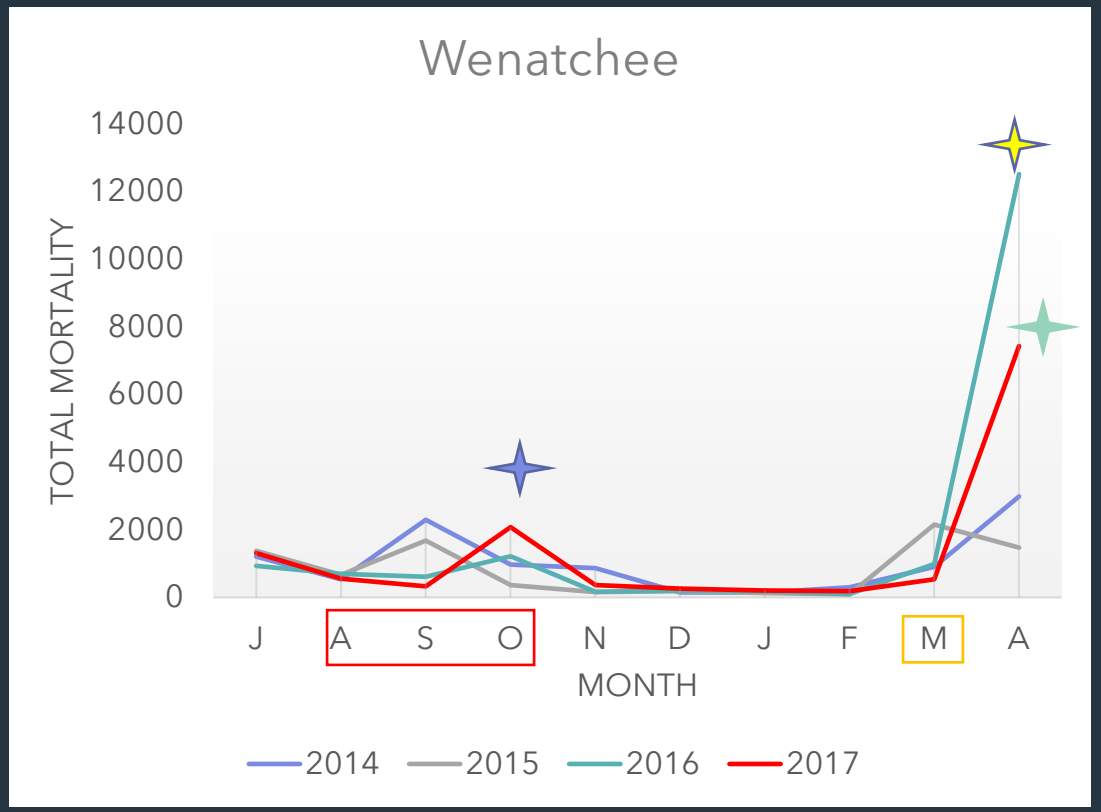
Juvenile Mortality 2014-2017





Marking Transfer to Acclimation Gill Disease

Juvenile Mortality 2014-2017



Marking Transfer to Acclimation Bird predation BKD fungus/high flow

Juvenile Mortality 2014-2017

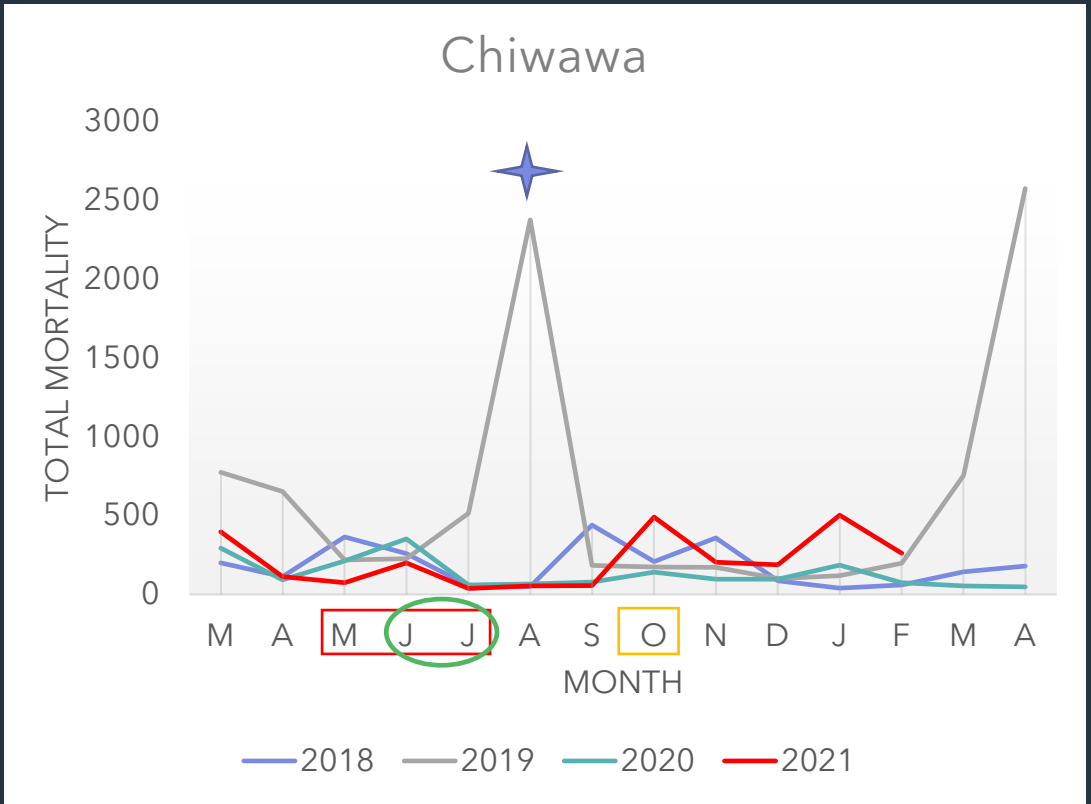
	CHIWAWA	NASON	CARLTON	CHELAN FALLS	WENATCHEE
2014	4713 (1.3%)	1343 (3.7%)	24,452 (12.7%)	13,005 (2.7%)	10,346 (1.9%)
2015	2626 (1.5%)	4037 (1.6%)	10,671(5.6%)	27,009 (5.8%)	8257 (1.6%)
2016	2871 (1.6%)	5648 (1.9%)	7078 (3.2%)	8990 (1.5%)	17,617(3.4%)
2017	1332 (0.9%)	15,786 (5.4%)	3698 (2.6%)	9209 (1.8%)	13,247 (2.7%)

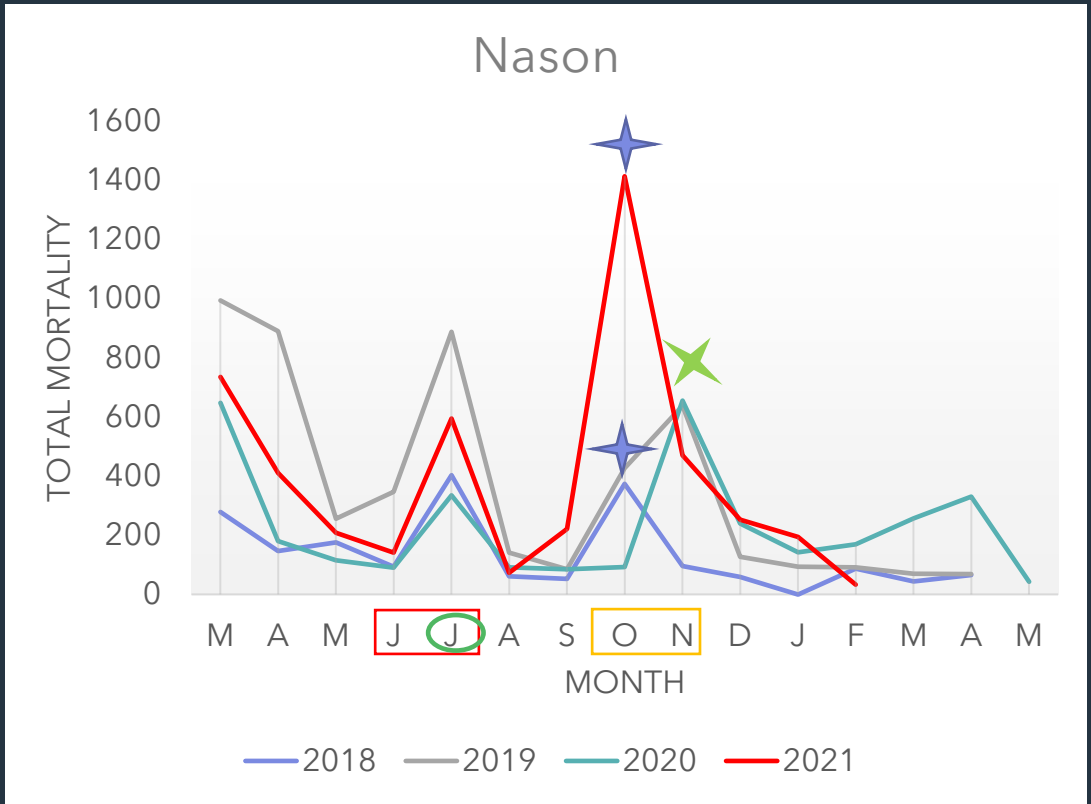
Mortalities are calculated based on known recorded losses from hatchery - estimated fry loss of 2.5%

	CHIWAWA	NASON	CARLTON	CHELAN FALLS	WENATCHEE
2014	21,182 (5.8%)	4458 (12.2%)	29,277 (14.9%)	28,289 (5.7%)	15,280 (2.8%)
2015	11,235 (6.4%)	18,190 (7.0%)	15,662 (8.1%)	38,156 (7.9%)	12,527 (2.3%)
2016	18,290 (10.4%)	109,890 (37.3%)		11,106 (1.8%)	30,877 (5.9%)
2017	552 (0.4%)	62,141 (21.1%)		1132 (0.2%)	20,272 (4.0%)

Mortalities are calculated based on # fish ponded - # fish released.

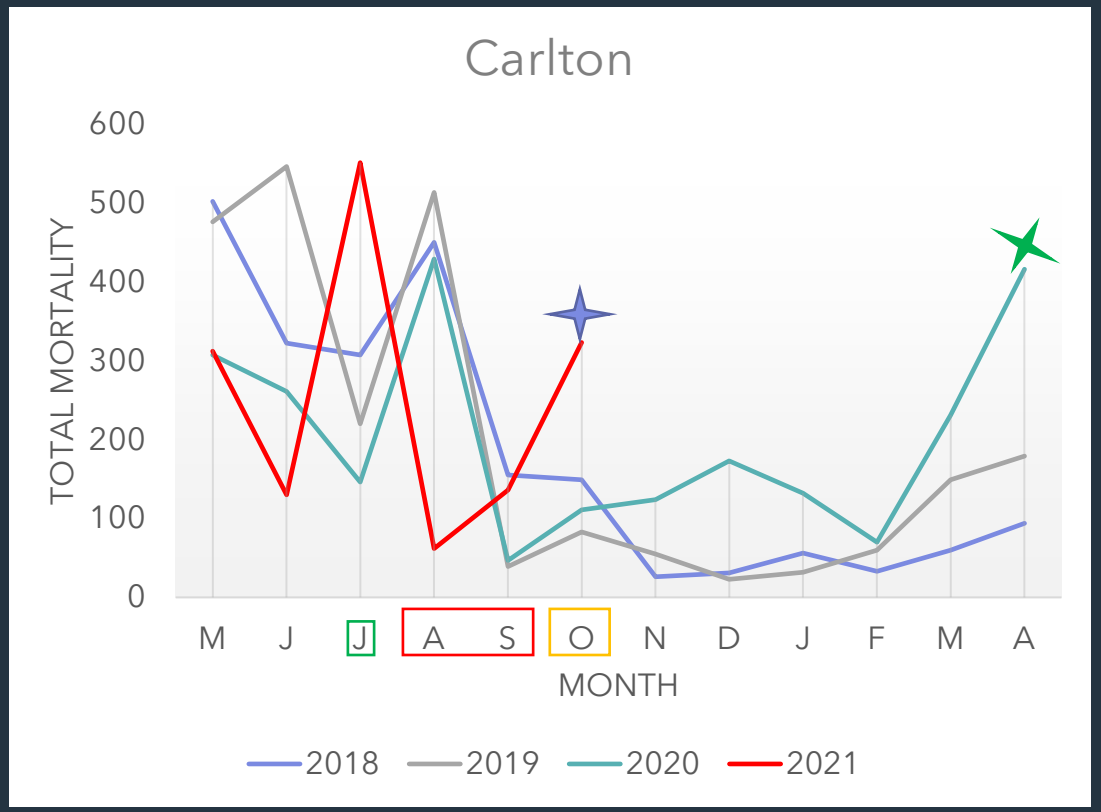
Juvenile Mortality 2018-2021

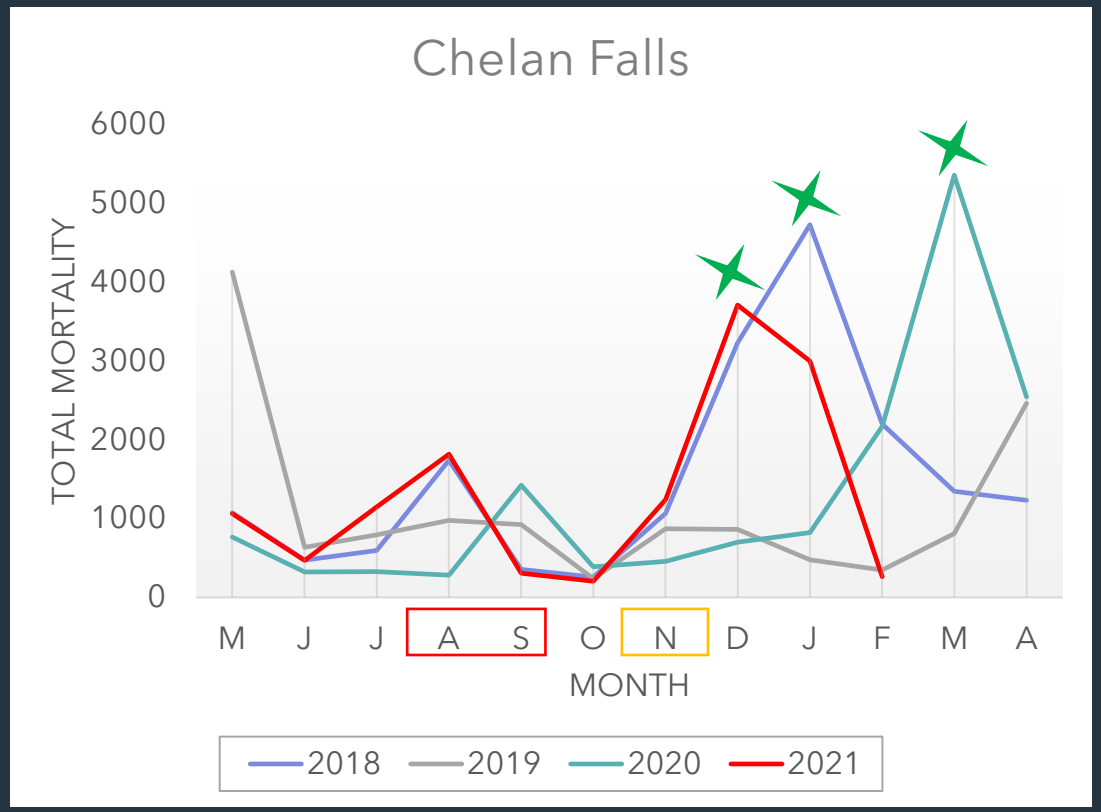




Marking Transfer to Acclimation Body Tag BKD BCWD

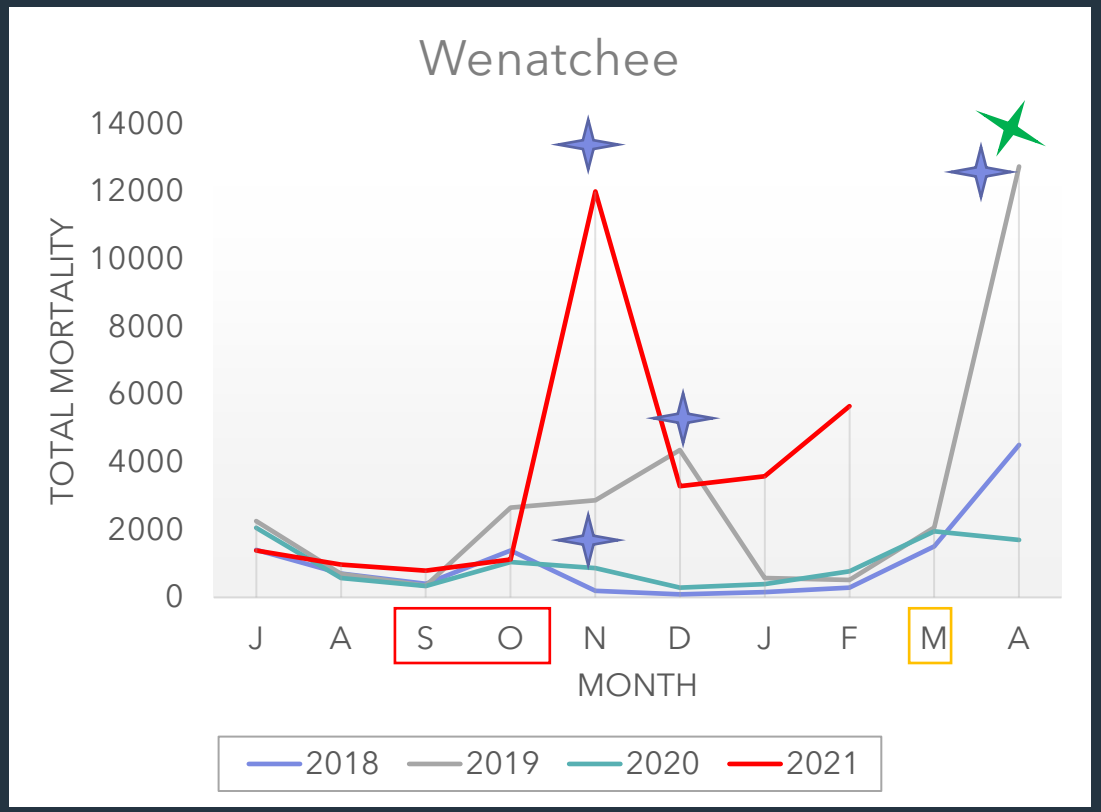
Juvenile Mortality 2018-2021





Marking Transfer to Acclimation BKD Gill Disease

Juvenile Mortality 2018-2021



- High ELISA group kept in BY2019 and BY2020.
- BY2019 – Marking prolonged due to pandemic
- BY2021 – Marking/PIT tagging longer/later

Marking Transfer to Acclimation BKD Gill Disease

Juvenile Mortality 2018-2021

	CHIWAWA	NASON	CARLTON	CHELAN FALLS	WENATCHEE
2018	2550 (1.5%)	1938 (0.9%)	2185 (0.9%)	18,271 (2.9%)	10,643 (2.6%)
2019	9028 (7.1%)	5113 (2.1%)	2375 (1.0%)	13,509 (2.0%)	29,088 (5.7%)
2020	1845 (1.1%)	3429 (1.4%)	2447 (1.0%)	15,535 (2.4%)	9990 (2.0%)
2021	2571 (1.8%)	4744 (1.9%)	1514 (0.7%)	13,198 (2.1%)	23,909 (4.9%)

Mortalities are calculated based on known recorded losses from hatchery - estimated fry loss of 2.5%

	CHIWAWA	NASON	CARLTON	CHELAN FALLS	WENATCHEE
2018	12,270 (6.9%)	25,438 (11%)		14,930 (2.4%)	3917 (0.9%)
2019	27,530 (21.2%)	45,462 (18.2%)		76,907 (10.9%)	44,063 (8.5%)
2020	17,382 (10.3%)	9375 (3.8%)		-2896 (-%)	26,975 (5.2%)
2021			211,871(1.7%)		

Mortalities are calculated based on # fish ponded - # fish released.

Approximate Losses Due To Disease

	CHIWAWA	NASON	CARLTON	CHELAN FALLS	WENATCHEE
2018	N/A	N/A	N/A	10,140* (1.6%)	N/A
2019	5900 (4.6%)	N/A	N/A	N/A	6669 (1.3%)
2020	N/A	N/A	N/A	10,056* (1.6%)	3000 (0.6%)

* Losses include handling and transport.

- 1/3 of total losses due to BKD

Summary

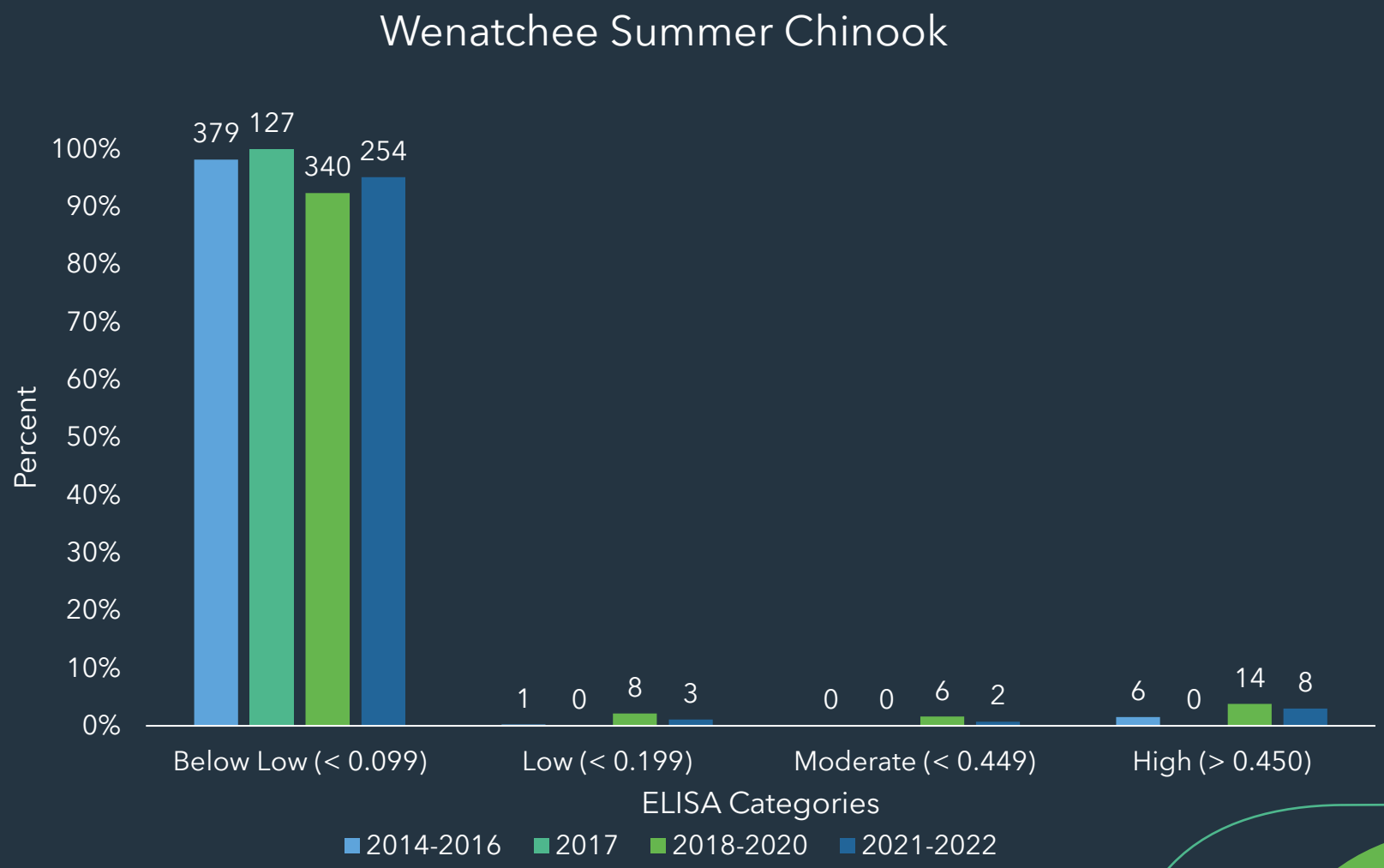
- BKD in juveniles is occurring at chronic, low levels
- Other factors are involved and contribute to losses
  - Handling, crowding, marking, predation
  - Temperature
  - Smolting
  - Other diseases

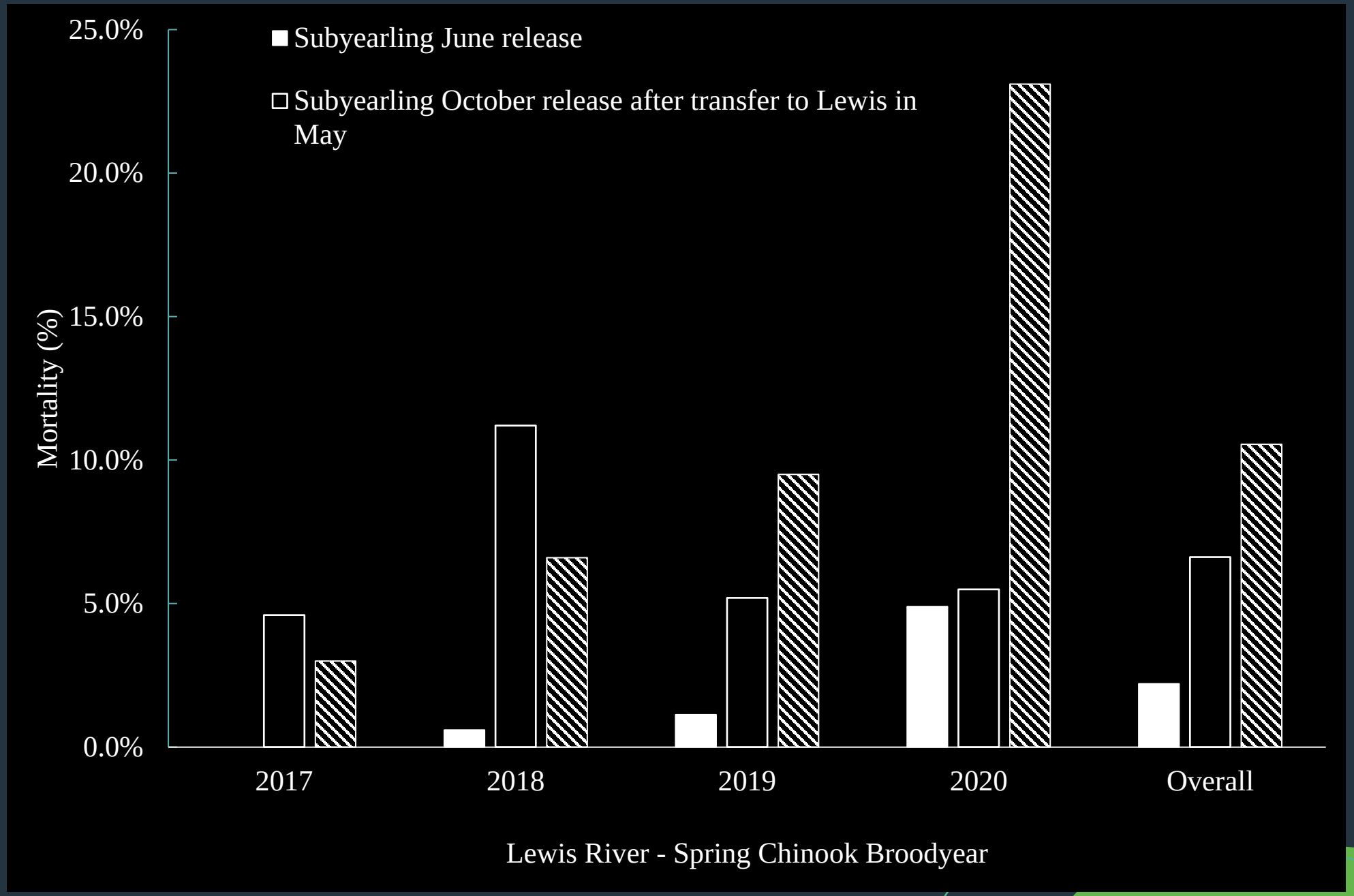
Proposal

1. Continue not injecting broodstock for the last year of study
2. Try and reduce stressors
    1. Better timing of handling events – both when they occur and how long they last ***Stress is ADDITIVE
    2. Crowd fish less and for shorter times
    3. Predation??
3. Allow for a higher threshold for concern about BKD??
    1. Wenatchee Summer Chinook has biggest risk due to increasing temperatures, reduced feed, and late transfer to acclimation
    2. How much loss is acceptable for programs?

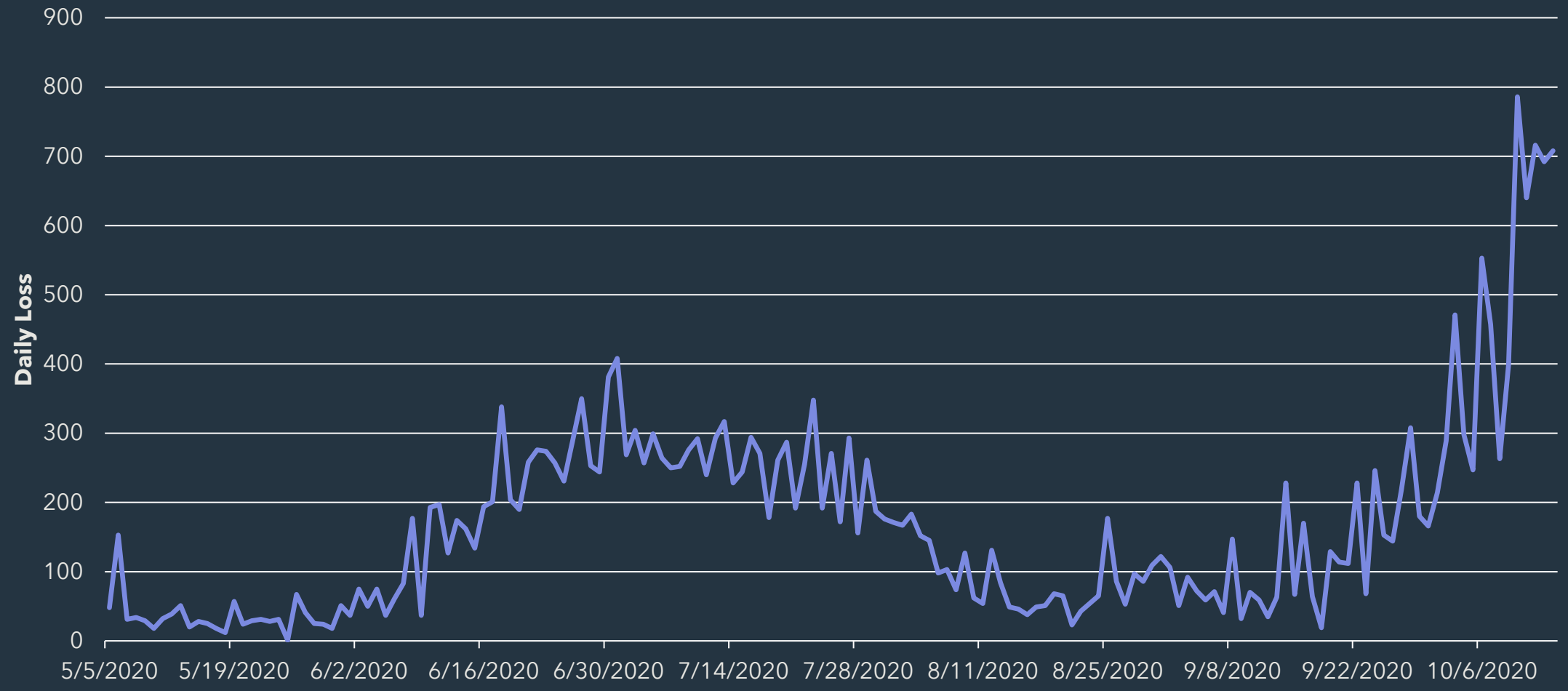
Questions???

ELISA Results




25.0%
20.0%
15.0%
10.0%
5.0%
0.0%
Mortality (%)
Subyearling June release
Subyearling October release after transfer to Lewis in May
2017
2018
2019
2020
Overall
Lewis River - Spring Chinook Broodyear

Lewis River - 2020 Daily Cumulative Loss



ELISA Results