FINAL

23 S. Wenatchee Avenue, Suite 220
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

Date: February 17, 2021

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

cc: Larissa Rohrbach, Anchor QEA, LLC

Re: Final Minutes of the January 20, 2021, HCP Hatchery Committees and PRCC Hatchery Subcommittee Meetings

The Wells, Rocky Reach, and Rock Island Hydroelectric Projects Habitat Conservation Plan Hatchery Committees (HCP-HCs) and Priest Rapids Coordinating Committee Hatchery Subcommittee (PRCC HSC) meetings were held by conference call and web-share on Wednesday, January 20, 2021, from 9:00 a.m. to 1:00 p.m. Attendees are listed in Attachment A to these meeting minutes.

Action Item Summary

Joint HCP-HCs and PRCC HSC

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

- Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) will present pre-spawn mortality data during the February 2021 HCP-HC and PRCC HSC meeting (Item I-A). (*Note: this item is ongoing*.)
- Kirk Truscott will work with Colville Confederated Tribes (CCT) staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook salmon at Wells Dam (Item I-A). (*Note: this item is ongoing*.)
- Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item I-A). (*Note: this item is ongoing*.)
- Mike Tonseth will check on the WDFW policy for releasing unmarked surplus fish (Item I-A). (*Note: this item is ongoing*.)
- Mike Tonseth and Greg Mackey will solicit input from hatchery managers on effective methods to count surplus fish (Item I-A). (*Note: this item is ongoing*.)
- Representatives will review the NOAA research summary and Hatchery and Genetic Management Plans (HGMPs) presentation distributed by Tracy Hillman and consider whether to request the authors attend a future committee meeting to discuss their research (Item I-A). (*Note: this item is ongoing*.)
- HCP-HC and PRCC HSC members will review the list of NOAA points-of-contact for programs and permits provided by Brett Farman in an email distributed on December 18, 2020 (Item I-A). (*Note: this item is ongoing*.)
- Tracy Hillman will coordinate a workshop to discuss desired outputs and management scenarios to support Mark Sorel's (University of Washington) Wenatchee spring Chinook salmon integrated population model (Item II-B).
- Kirk Truscott will provide, and Larissa Rohrbach will distribute, information about a virtual meeting on the Chief Joseph Hatchery program to occur in March (Item I-E).

RI/RR HCP-HCs

- Catherine Willard and Mike Tonseth will coordinate with U.S. Fish and Wildlife Service (USFWS) regarding potential modifications to the Chiwawa Weir to allow bull trout passage during 2021 spring Chinook salmon broodstock collection.

Wells HCP-HC

- None.

PRCC HSC

- None.

Decision Summary

- None.

Agreements

- None.

Review Items

- The draft *Priest Rapids Hatchery Monitoring and Evaluation Annual Report for 2019–2020* was distributed for review by Larissa Rohrbach via email on January 14, 2021, with comments to be returned to Todd Pearsons by February 16, 2021.
- *Chelan PUD's 2021 Action Plan* was distributed via email by Larissa Rohrbach on January 20, 2021 for approval in the February meeting.
- *Douglas PUD's 2021 Action Plan* was distributed via email by Larissa Rohrbach on January 21, 2021 for approval in the February meeting.

Finalized Documents

I. Welcome

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

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

Hillman reviewed the agenda and asked for any additions or changes to the agenda. Catherine Willard added the following two items to the agenda for discussion:

- The 2021 Rock Island/Rocky Reach HCPs Action Plan
- Wenatchee steelhead egg collection to determine baseline thiamine levels

No other additions were made to the agenda and all HCP-HCs and PRCC HSC representatives approved the agenda. Revised minutes from the December 16, 2020, meeting were reviewed and approved by all committee members.

Action items from the HCP-HCs and PRCC HSC meeting on December 16, 2020, were reviewed, and follow-up discussions were addressed *(note that italicized text below corresponds to action items from the previous meeting)*:

Joint HCP-HCs and PRCC HSC

- *Brett Farman will discuss with National Oceanic and Atmospheric Administration (NOAA) staff and Mike Tonseth the potential use of a multipopulation model for estimating proportionate natural influence (PNI) for the Nason and Chiwawa spring Chinook salmon programs (Item I-A).*
  Farman said he and Tonseth had talked and agreed that a presentation to the HCP-HCs and PRCC HSC should be provided to discuss the implications of the methods (e.g., how to divide populations) and to receive feedback to ensure those calculations are useful. Farman suggested presenting in March to receive that feedback from the groups.
  Todd Pearsons asked if there were any parties that would be opposed to using the multipopulation model. Pearsons said it seems necessary when tracking populations coming from multiple locations. Farman said the multipopulation model has been used in other consultations without opposition. He said the question is how the populations are divided to structure the model correctly. This item is ongoing.
- *Greg Mackey will work with Mike Tonseth to test a modeling approach and prepare a white paper on the method for determining a range for the number of females to be collected for a given broodstock in the upcoming year (Item I-A).*
  Mackey said he has worked on this extensively and will present a summary to the HCP-HCs and PRCC HSC in the next month or two. This item is ongoing.
- *Greg Mackey will prepare a plan for alternative mating strategies based on findings described in his previously distributed literature review (Item I-A).*
  Mackey said he will prepare this for discussion with the HCP-HCs and PRCC HSC. This item is ongoing.
- *Mike Tonseth will distribute the analysis showing feasibility of the Methow Spring Chinook Outplanting plan based on historic run-size data (Item I-A).*
  Tonseth said this item is ongoing.
- *All parties will provide updates on changes to monitoring and evaluation plans due to the impacts of COVID-19 on operations as updates become available (Item I-A).*
  This item will be discussed in today's meeting.
- *Kirk Truscott will determine the number of scales that should be collected from spring Chinook at Wells Dam for elemental signature analysis to discern Okanogan River spring Chinook from Methow River spring Chinook (Item I-A). (Note this item is ongoing.)*
  Truscott said progress on this item depends on whether scales sampled at Wells Dam would be sufficient. This item is ongoing.
- *Mike Tonseth will check whether the scales from spring Chinook salmon sampled at Wells Dam are archived, and if so, whether any contamination from the acetate impression process could affect elemental signature analysis (Item I-A).*

Tonseth emailed Kirk Truscott and Tracy Hillman on December 24, 2020. Tonseth said the laboratory does retain archived scales; however, most of the scales are not read and results are not released until after the run season. The goal of this monitoring would be an in-season reading of the scales; therefore, the Wells Dam collection may not be useful for this purpose. Tonseth said scales may need to be collected elsewhere, though perhaps fewer scales could be collected for age analysis to minimize the area affected on the fish for the health of the fish. Truscott said he would take on this task again (see preceding action item). This item is complete.

- *Andrew Murdoch (Washington Department of Fish and Wildlife [WDFW]) will present pre-spawn mortality data during the February 2021 HCP-HC and PRCC HSC meeting (Item I-A).*
  This item is ongoing.
- *Kirk Truscott will work with Colville Confederated Tribes (CCT) staff to develop a model that addresses the probability of encountering natural-origin Okanogan spring Chinook at Wells Dam (Item I-A)*. This item is ongoing.
- *Keely Murdoch and Mike Tonseth will update the retrospective analysis for Wenatchee spring Chinook salmon using estimates of female pre-spawn mortality (Item I-A).*
  Tonseth said he has received necessary information from Andrew Murdoch and analysis is ongoing.
- *Brett Farman will provide a listing of NOAA points-of-contact for programs and permits related to the HCP-HCs and PRCC HSC and update the HCP-HCs and PRCC HSC on who is covering Allyson Purcell's (NOAA) duties while she is on leave (Item I-A).*
  Farman distributed this information by email on December 18, 2020. Farman has asked that members respond to him to ensure all permits and programs have been captured in his spreadsheet.
- *HCP Hatchery Committees and PRCC HSC Representatives will consider desired outputs of Mark Sorel's (University of Washington) model (Item I-A).*
  This item will be discussed in today's meeting.
- *Mike Tonseth will check on the WDFW policy for releasing unmarked surplus fish (Item I-A).*
  Tonseth said clarifications will be available for drafting the 2021 Broodstock Collection Protocols (BCPs).
- *Mike Tonseth and Greg Mackey will solicit input from hatchery managers on the methods used to quantify surplus fish (Item I-A).*
  Mackey said some responses have been collected and he will summarize them for addition to an appendix of the 2021 Broodstock Collection Protocols on the distribution of surplus fish.
- *Representatives will review the NOAA research summary and Hatchery and Genetic Management Plans (HGMPs) presentation distributed by Tracy Hillman and consider whether to request the authors attend a future committee meeting to discuss their research (Item I-A).*

The HCP-HCs and PRCC HSC have requested more time to review the presentations. This item is ongoing.

II. Joint HCP-HCs and PRCC HSC

B. Upper Columbia Life History and Management Model

Tracy Hillman welcomed Mark Sorel from the University of Washington. Sorel has worked at NOAA's Northwest Fisheries Science Center (NWFSC) and is currently working on his Ph.D. His Ph.D. advisor is Sarah Converse, unit leader at the Washington Cooperative Fish and Wildlife Unit.

Slide 1 - Sorel gave a presentation entitled "*An integrated population model for Wenatchee spring Chinook salmon*".

Slide 2 - Sorel outlined the presentation, including objectives of his model development, and comparisons to other models, and noted that he would like to query this group on the utility of the model.

Slides 3 and 4 - Sorel's work is supported by the NWFSC, the Washington Cooperative Fish and Wildlife Research Unit, and the Northwest Climate Adaptation Science Center (whose mission is to provide actionable science to adapt to changing climate). Data have been provided by several of the HCP-HCs and PRCC HSC member organizations, the Comparative Survival Study, the Pacific States Marine Fisheries Council, Washington Department of Ecology, and the U.S. Geologic Survey. Sorel acknowledged various project partners, including other population modelers who have worked on Wenatchee River salmon life cycles.

Slide 5 - Objectives:

- Develop an integrated population model that is a technologic advancement over previous models.
- Understand population processes that may apply to other populations; use the Wenatchee Basin as a case study as it is a data-rich system.
- Support decision makers so they can use this model as a tool to understand uncertainty, the effect of hatchery supplementation, etc.

Slide 6 - Differences between his model and existing models:

- Ability to develop an integrated population model (IPM; described further in subsequent text)
- Ability to track alternative juvenile life history strategies as a new life cycle model element.

Slide 7 - IPM has two components:

1. Integrated, in this context, means analyzing multiple datasets together, or taking different models that may be analyzed separately (i.e., mark-recapture survival modeling and screw trap estimates of juvenile abundance) and putting them together in this analysis.
2. It is a population model that tracks abundance or biomass of a population based on birth, immigration, death, and emigration (i.e., the model allows for new animals to come in and animals to leave).

Slides 8 to 12 - Advantages of Integrated Population Model:

Why is it worth investing in another life cycle model, given that other models are already available in the Wenatchee system? As an example of a very simple stable life cycle, the number of births, birth equals the number of deaths. To know how many fish there are, data are collected from the population to estimate numbers at various life stages (i.e., spawners, juveniles, and survival from one stage to the next, etc.), but there is some uncertainty (expressed as confidence intervals) around those estimates. At times there are inconsistencies between expected and observed numbers. IPM estimates the number of spawners, and juveniles, and survival as unknown quantities that are informed by data collected (rather than trying to force incompatible data sets together), and these unknown quantities are then used in the model. This reduces bias, increases precision, and propagates uncertainty. This separates observation error in the data from error in model.

Slides 13 to 17 - Alternative Juvenile Life Histories

Alternative juvenile life histories are tracked in the model. Juvenile counts of various life history types (e.g., migrants as fry, summer parr, fall parr, and smolts) come from observations at screw traps in tributaries. The next observation point is McNary Dam, then Bonneville Dam, and then their return to Bonneville Dam as adults. Why account for these different life histories? It is a convenient way to account for unexpected features in the data, and to model ecologically interesting life histories with different mortalities associated with them. The easiest way to incorporate the data into models would be to count fish based on those passive integrated transponder (PIT)-tagged at screw traps. There may be some interesting population-level dynamics that drive these life histories. There are consequences of the location at which fish rear throughout the year, with implications for habitat restoration in tributaries and natal streams.

Slides 18 to 20 - Preliminary Results and Timeline

Primary data include spawner abundance from redd surveys, juvenile abundance of different life history types from smolt traps, and survival estimates based on detection history at dams, which is modeled to adult return to Tumwater Dam.

Juvenile migration data show average juvenile emigrants per day at the Chiwawa screw trap with four peaks over 2 different calendar years, indicating four life history types (i.e., fry, summer parr, fall parr, and smolt). These data may inform habitat-use patterns and density-dependent responses to habitat (e.g., fish leaving sooner if there were more spawners the previous year, producing more offspring than average).

Spawner to juvenile transitions are plotted as the number of emigrants per spawner by life history type. Modeled curves show density dependence in the production of fall parr and spring smolts, but not in summer parr and fry. In fact, there may be a density response causing more fry and summer parr to leave early, if there are more spawners the previous year. The juveniles that remain in the natal stream may stay there until fall emigration or spring smolt emigration. These relationships are incorporated into the model to describe the transition from spawners to juveniles for each life history type. Sorel is currently working on modeling survival rate and maturation rate based on PIT-tag data.

A working version of the model will be developed within this year to evaluate population viability under alternative management scenarios.

Slide 21 - Sorel posed the following questions to encourage further discussion:

- Any comments and questions on the presentation?
- What model outputs would be useful for making management decisions?
- Could management scenarios be generated and evaluated with this model?
- Is there interest in participating in a workshop of experts with local knowledge to further develop scenarios to test in the model?

Todd Pearsons thanked Sorel and asked a question about life histories. Pearsons said that in the Yakima River basin, production of precocious males is a major concern. Though precocious males are perhaps not as prevalent in the Wenatchee River basin, it may be worth looking into and recognize it in a diagram of juvenile life histories as a "grayed out" pathway. Sorel noted the White River stands apart from the Nason Creek and Chiwawa River spawning aggregates as a potential source of different life history types due to passage through and potential rearing in Lake Wenatchee.

Greg Mackey introduced himself and said that with matrix models, one can identify sensitivities and elasticities in the model; one can identify how increasing survival at a given life stage helps the population and that information can be used for making management decisions. Mackey asked Sorel for his thoughts about that approach and how useful his model may be for making management decisions around life stages. Sorel said the model should be able to do those things by using scenario testing, and by looking at uncertainty around those parameters. Sorel said one can test the sensitivity of the model by asking how a given scenario propagates to population growth rate or extinction probabilities. Sorel said one can also examine responses in the model to scenarios such as

restoration projects or hatchery management to determine how sensitive the population metrics are to those changes.

Kirk Truscott introduced himself and said it appears integrated modeling is an effort to utilize multiple population models in a new way. Truscott asked what are the sideboards for selecting these individual models for inclusion into this integration model? Sorel responded that regarding how to decide on all the data that should be included in the model, it would be preferable to make those decisions in consultation with this group. Truscott noted there are a number of people on the HCP-HCs and PRCC HSC with many years of experience to contribute.

Tracy Hillman noted that Sorel's presentation shows evidence of density dependence and said that he and Andrew Murdoch have observed this as well. In the Chiwawa River basin, spring Chinook parr during summer reach capacity at about 150,000 juveniles. As adult escapements produce juveniles that exceed the capacity, numbers of emigrants increase, which is what Sorel's figures show. Hillman also noted that the timing of when summer parr leave the system has shifted over time and it would be interesting to know more about what drives this change, such as flow, temperature, or hatchery production. Hillman added that Kevin See's (Biomark) Quantile Regression model, which estimates capacity based on habitat in the Chiwawa River basin, supports this observation of density dependence in the Chiwawa River basin. Sorel said it is an interesting line of reasoning and an important part of population processes. It is important to know where fish are spawning and any deficit, so to speak, resulting from hatchery fish impacts. Sorel added there is some information in the data and model on relative reproductive success of natural-origin returns and hatchery-origin returns and number of juveniles produced; however, the data may be too noisy to be useful. However, other datasets (e.g., produced by Mike Ford) or genetic analyses may be useful. It is possible to include an adjustment parameter in the model to treat hatchery spawners and their potential effects on survival and abundance. Hillman said Jeff Jorgensen is trying to address this in his model by using proportionate natural influence (PNI). It may be something to consider in the IPM and, if possible, the IPM could evaluate hatchery effects not only on abundance and productivity but also diversity and spatial structure. Sorel agreed, as spatial structure and diversity are a function of the other viable salmon population metrics.

Keely Murdoch asked how Sorel's model compares with Jorgensen's model. Sorel said he thought about how to model alternative life histories and considered how these life history alternatives could be incorporated into Jorgensen's model. The development of the integrated model may allow for this, but it may be useful to integrate both models together in the future. The juvenile component of the IPM could be integrated into Jorgensen's model.

Given that large numbers of juvenile Chinook rear in the Wenatchee River, Murdoch asked if there is a similar density-dependent curve for the Wenatchee River. This information may help determine

which life history strategies produce the majority of adults. Sorel said once PIT-tag-based survival estimates are analyzed, one can look at survival by life history type and determine the role of the mainstem Wenatchee in producing adult returns.

Murdoch asked whether the model will be expanded to other basins such as the Methow and Okanogan. Sorel said, yes, he has a strong interest in expanding the model to other areas. He is aware of similarly intensive monitoring in the Methow, so this model could be applied to those other populations.

Hillman suggested the committee take additional time to consider Sorel's final discussion questions and return responses to Sorel. Hillman confirmed that there are several people on this committee interested in participating, some directly collecting the data. Larissa Rohrbach and Hillman will assist with coordinating a workshop among the members to help Sorel with feedback on his model. Unlike some areas, there are a lot of data in the Wenatchee and it is nice to compile those data. Hillman asked if others had final comments.

Murdoch agreed that a workshop would be a good way to share information. Pearsons agreed this would be useful for helping the committees to better understand the correct sizing of hatchery programs.

Hillman thanked Sorel for his presentation and his advisor for her time and thanked Pearsons for recommending that Sorel present to the committees.

C. Okanagan Sockeye Salmon Annual Program Summary

Hillman welcomed Ryan Benson (Okanagan Nation Alliance; [ONA]) to the meeting.

Slide 1 - Benson gave his annual update presentation entitled, "*Okanagan Sockeye Re-Introduction Program Update*".

Slide 2 - Brood Year 2019 Juvenile Release Update

The program has a new approach to improve the post-release survival rate for fry releases. Historically all fry were released in the spring. In 2017, releases were designed to mimic the natural fry emergence period based on the bell curve of fry emergence observations in the Okanagan River. Early-, mid-, and late-season releases were carried out to look for any change in fry survival. So far there has been no statistically significant increase in survival; however, the limnologist points out that there was no decrease in survival and suggested continuing this experiment. For brood year (BY) 2019, a late release group was added in September, and fish were held in the hatchery all summer. The September release group were much larger in size than the earlier release groups (19.3 grams (g) versus 1 to 2 g mean weight). Releasing fish at a larger size may reduce predation, and perhaps

releasing fry into colder water later in the summer coincides with lower predator activity, such as predation from bass. Data analysis is ongoing. Releases are volitional into Shingle Creek (the outflow from the hatchery).

Slide 3 - Hatchery Production of Fry Outplants Update

In 2019, the total number of fry released was relatively low compared to the previous release years. In 2015, somewhat of an adult population crash occurred due to warm river temperatures and mortality (in the Columbia and lower Okanagan rivers). Total egg survival from the 2015 brood was very low, fry condition was low, and 2019 was the final return year from that cohort. Females collected in 2019 were in poor condition. The broodstock collection period was extended and efforts were expanded to a full month, with the addition of netting in Penticton Channel. All fry were released into Skaha Lake in 2020 (rather than release of some into Okanagan Lake) to try to rebuild that cohort in the future.

Slide 4 - Hatchery Operation Summary 2015 to 2020.

A good run occurred in 2020, with the second highest escapement since 2014. Starting in 2016, an experiment was started to capture large females in Oliver, BC, to be transported and raised to maturity in the hatchery raceways. It was uncertain whether this could be done, with the potential for disease and it was unknown whether fish could become mature in captivity. Efforts in 2016 were successful and in 2019 every female was brought to the hatchery. Males were processed in the field (in Oliver) by live-squeezing them for milt and returning them to the river without euthanization. These efforts were repeated again in 2020. This approach is a logistical improvement—there is no need for multiple teams working on the river as disease sampling, egg take, and other biologists can be stationed at the hatcheries. A small transport crew goes down river to collect females and milt. Methods were also preferable for maintaining safe work practices during the COVID-19 pandemic. In 2019, egg-to-fry survival was 82% (slightly lower than in prior years); however, this could have been an effect of the poor quality of the BY 2015 cohort. Egg take has improved over the years.

Slide 5 - Okanagan Sockeye Salmon Escapement.

Okanagan sockeye salmon escapement was large in 2020. Escapement to Penticton Channel was over 26,000 fish. Shingle Creek escapement was record-breaking. Some females were observed swimming into the hatchery pipe. More than half of the females sampled in Shingle Creek had partially spawned. A working hypothesis is that there is not much spawning habitat in Shingle Creek, with a lot of large substrate (cobble and boulder) that is not suitable for spawning. Thus, most of the females in Shingle Creek did not find suitable spawning habitat before maturing and dropping eggs. There is potential to pursue projects to rehabilitate Shingle Creek to improve the amount of suitable spawning habitat there. Total Okanagan Basin escapement estimate was probably a record in 2020.

Slide 6 - Skaha Lake Natural Production

In 2011, there was an accidental discovery of adult hatchery sockeye salmon in Penticton Channel as a result of high flows. Since then, a variable natural escapement to the channel has occurred depending on total strength of the run and how gates are operated at McIntyre Dam and Skaha Dam. In 2020, record flows were observed in spring and many adults were, again, able to access Penticton Channel and Skaha Lake. Escapement numbers still need to be confirmed, but initial numbers have been used to produce a rough estimate for natural smolt production.

Slide 7 - In-Lake Monitoring Summary

- A synthesis over 12 years of work was submitted for publication to the North American Journal of Fisheries Management last November and is undergoing minor revisions, likely to be published in the next month or two, representing a large milestone for the program.
- Fry survival was largely affected by high mortality immediately after release. Net juvenile hatchery-origin survival is higher than natural-origin fish; however, this is largely due to high egg-to-pre smolt survival in hatchery.
- Skaha Lake carrying capacity is potentially determined by mysid abundance (food), kokanee abundance (competition), and lake-rearing sockeye salmon. The amount of production in the lake can change due to flow through the lake; higher flows can flush zooplankton out of the lake. A maximum loading density estimate for fry is determined each year. This is a complex estimate by limnology experts to develop optimal loading density, which can vary year to year.
- The Skaha Lake Kokanee stock is exceeding expectations. The largest in-lake biomass since initiation of the program occurred in years after sockeye salmon fry releases. Studies have determined that 2- and 3-year-old kokanee have the largest impact on zooplankton compared to sockeye salmon fry releases. Prior to 2003, competition from sockeye salmon fry that would negatively impact the kokanee population was one of the British Columbia Provincial government's major concern. The reason for the success of the kokanee is not clear. Benson theorized that kokanee may benefit from marine derived nutrients brought back to the system with the return of sockeye salmon.

Slide 8 - Okanagan Lake Program Summary

- The original program goal was to bring sockeye salmon back to Okanagan Lake, starting with Skaha Lake to evaluate success of reintroductions and then move upstream to Okanagan Lake. In 2017, ONA sought and was granted approval by the Department of Fisheries and Oceans Canada (DFO) to release up to 3.5 million fry, conditional on developing a monitoring and evaluation (M&E) program to address potential issues raised in the DFO peer review. The

M&E program has been developed since 2017 and finalized and approved by the Canadian Okanagan Basin Technical Working Group (COBTWG) in 2020. Stocking in Okanagan Lake started in 2016 with a 10,000 fry ceremonial release at three sites that likely would never be detected in such a large lake. Releases have increased to as many as 4.2 million fry in 2019. The number released in 2020 was low (9,538) due to slow recovery of the BY 2015 cohort.

Slide 9 - Penticton Dam (Okanagan Lake Outlet) Passage.

- In 2009, the ONA worked on an initiative to retrofit the flow gates to allow passage at Penticton Dam.
- Upstream migration to the dam has been observed over several years. In 2019, the fishway was reactivated late in the season. The migration was missed due to late approval for operation, but operations confirmed that flow over 1-foot jump heights would work. Fish were observed dropping back downstream. In 2020, flow gates were operated again to test jumping efficiency, hydraulics, attraction efficiency, and determine whether improvements to passage efficiency could be made similar to those made at Skaha Dam.

Slides 10 to 13 - Okanagan Lake Fishway and Telemetry.

The program obtained approval from COBTWG to release 100 adults into Okanagan Lake as a small-scale experiment to determine if adults could ascend the fishway and to observe their behavior in Okanagan Lake. Vemco acoustic receivers were deployed at topographic pinch points in the upper lake and near tributaries to observe movement. Vemco acoustic tags were implanted by the esophagus. Tagged fish were also marked with spaghetti tags and with an operculum punch using methods developed in the Skaha Lake program. Preliminary results indicated that kokanee, sockeye salmon, and trout were able to ascend the fishway, and an assumption is that larger fish species would also be able to ascend. Hydraulics seem to push fish and debris to the east bank and may need to be addressed in the future to improve passage efficiency. Forty-one fish were tagged and relocated upstream. Following the meeting, Benson shared a video showing dip-netting efforts.

- Final known fate of acoustic-tagged sockeye salmon is as follows:
  - 1/3 dropped back downstream due to stress or desire to spawn in downstream areas.
  - 5 carcasses were observed downstream; 4 carcasses from the Shingle Creek-captured group were later recovered downstream, perhaps actively returning to Shingle Creek.
  - The next highest number of detections occurred in Mission Creek, a highly productive tributary for kokanee and suspected to be highly productive for Chinook salmon.
  - It was promising and surprising to see fish migrating as far as Equisis Creek at the far north end of the lake near Vernon, BC.

- Other fish trickled into various tributaries along the lake.
- Three tagged fish were observed in Mission Creek by technicians along with numerous large *nerkids* in Mission Creek and late spawning. There were reports from fish guides of large sockeye salmon in Mission Creek all summer long, many more than were transported for the tagging study. Overall, numerous non-acoustic tagged hatchery sockeye salmon were observed in the lake that were not intentionally transported and must have passed through flow gates volitionally. It is theorized that very high flows caused flow gates to remain open for a long period early in the summer, and large sockeye salmon may have entered the lake ascending under gates. The first official documentation of a Chinook salmon in Okanagan Lake was also made (Okanagan Basin Chinook salmon recovery is a separate, ongoing program).
- Data analysis is ongoing to identify key areas for sockeye salmon in Okanagan Lake, but preliminary results are very promising for the program.

Benson concluded by noting that the smolt PIT-tagging program, which usually runs in the spring (March), was cancelled in 2020 due to the risk of COVID-19 transmission. This was unfortunate due to many ongoing programs such as Skaha and Okanagan fry releases and plans to observe outmigration patterns. Cancelation of PIT-tagging efforts is a possibility again for 2021 but is still to be determined. Broodstock collection was successful following typical COVID-19 safety protocols and no outbreaks occurred. Benson noted that the Okanagan Valley and BC interior has had relatively lower COVID-19 rates compared to Alberta and Ontario.

Mike Tonseth asked about the downward trend in egg-to-fry survival since 2016. Benson said lower egg-to-fry survival rates occurred in 2019 due to collecting from partially spawned females, which resulted in poor quality eggs from those females and subsequent disease during incubation. Managers decided it was not worth collecting from partially spawned females in the future. Benson said conditions were good in 2020 and expects survival to be better. Benson said compared to sockeye salmon hatcheries across the basin, the egg-to-fry survival is very high in the Penticton Hatchery. Benson said 95% survival observed in 2016 in Okanagan sockeye salmon is actually above the target of 70%, (based on literature and other programs). Kim Hyatt, DFO lead scientist for the program, follows the adage that 10 to 20 years of data should be collected before drawing conclusions.

Tonseth asked if the planned path forward is to trap and transport broodstock to be held at the hatchery rather than streamside gamete collection. Benson confirmed this is true for females and it has worked well while collecting milt from males streamside.

Kirk Truscott asked about smolt release locations for the Okanagan Lake outplants. Benson said smolts were trucked and transported to the lake near Equisis Creek in the upper lake (northern end

of the lake), to Power Creek near Kelowna, and to the lake near Trout Creek in the lower lake (southern end of the lake). Numbers were balanced between release groups with the same mark on all fish. In the past, smolts were released to Penticton channel, in which a volitional release now occurs.

Tonseth asked about what the timeline is for unrestricted adult passage above Penticton Dam. Benson said it has not been discussed and will depend on discussions with COBTWG, the restoration committee, and with BC Provincial and DFO biologists. There are many unknowns about how fish would behave and where fish would spawn. Some engineering fixes to the fishway also need to be identified. Conceivably, this coming fall, the fishway may be opened, or the Province may request additional study in future years. A more left-leaning government signing on to United Nations Declaration on the Rights of Indigenous Peoples has removed some of the obstructionist hurdles to the reintroduction. The reintroduction efforts have been surprisingly successful in Skaha Lake, where there is, a more or less, self-sustaining population.

Tonseth asked, challenges with Penticton Dam aside, are there other passage points that need to be addressed upstream of that point for adults or downstream passage issues with man-made structures for juveniles? Benson said Okanagan Dam is the most upstream barrier on the mainstem with a few smaller obstructions to tributaries upstream. There are several good-quality tributaries that are accessible and currently used for kokanee spawning. In the future, passage to the headwaters of Okanagan Lake could be considered. Juvenile passage was a key objective of last year's smolt monitoring program, (e.g., testing for a potential difference in survival between hatchery smolts released to Okanagan and Skaha lakes); however, the program was not able to carry out the monitoring due to the pandemic. There should be an opportunity in the future to test the survival of Okanagan Lake fry outplants.

Tonseth asked whether in-lake monitoring showed a change in the size of natural-origin smolts based on spawner escapement and juvenile abundance in years of larger hatchery returns. Benson said no. Generally, Skaha Lake smolts tend to be larger than Okanagan Lake smolts.

David Duvall (Grant County PUD) asked what the public perception is to the release of sockeye salmon into Okanagan Lake. Benson said, last fall ONA was inundated with requests for interviews with a lot of positive engagement with the press. Generally, the public is very supportive of returning fish to the lake, people support restoration, and large returns in recent years have enhanced positive feelings. ONA members are ecstatic and profoundly moved to have sockeye salmon returning. Benson said the Province would do well to follow the lead of the positive response from constituents.

Duvall asked about adult spawning in the Okanagan Lake system (in tributaries or along the shoreline) based on tagging that has been done. Benson said no hot spots for shore spawning have

been observed; however, acoustic receiver detections were not precise enough (at the scale of 0.5 kilometers) to answer the question. There are a lot of shore-spawning kokanee. Known kokanee shore spawning areas were examined with side-scanning sonar and findings showed shore areas have gravel that appears to be much deeper than expected, with the potential for large areas of good spawning habitat. Incidentally, some pre-dam underwater village sites were also located.

Hillman thanked Benson for this presentation. Benson and Howie Wright (ONA) will join the February meeting to summarize the program's comprehensive evaluation.

D. Broodstock Collection Protocols

Tracy Hillman shared *Topics for HCP-HC and PRCC HSC Discussion in 2020* and reviewed the topics in the document.

Regarding Chiwawa spring Chinook salmon marking, Catherine Willard said she will provide information during the February meeting.

Regarding options for differentiating natural-origin spring Chinook salmon from other natural-origin Chinook salmon during broodstock collection, Kirk Truscott said no additional discussion is needed on this item currently, but he will provide an update during the review of action items when one is available.

Regarding options for outplanting surplus Methow Composite spring Chinook salmon adults, Mike Tonseth said the 2017 plan will continue to be included in the 2021 Broodstock Collection Protocols. He will attempt to complete the analysis for the February meeting.

Regarding Wenatchee spring Chinook salmon pre-spawn survival estimates, Tonseth said this item will be discussed in February 2021 with Andrew Murdoch's presentation.

Regarding the sizing of Upper Columbia River conservation programs, supporting information has been recently obtained and analyses are ongoing (e.g., pre-spawn mortality estimates).

Regarding authorship of sections to be revised, Greg Mackey said he rewrote the section for steelhead broodstock. Mackey sent an edited version of the BCPs to Larissa Rohrbach just prior to the meeting with updates to steelhead and Methow Spring Chinook salmon, representing the first round of Douglas PUD's edits to the 2021 BCPs.

Regarding consistent declarations of surplus (contained in Appendix G), a method will be outlined in the first draft provided by Tonseth next week.

Willard will provide an update on Chiwawa spring Chinook salmon broodstock collection in today's meeting.

Mackey said throughout the BCP document there are tables with run projections for the different species, and he asked who will generate them this year. Tonseth said they are under development and he is waiting for information from last year's returns, and he is hopeful some of those numbers will be available for the February BCP review. Mackey acknowledged it is always an item that comes in last minute.

Mackey said the results of the new Wells Dam survival study will affect production targets in the 2021 BCPs. Tom Kahler said there is a multiyear average survival rate (this was a 4-year average, now with a fifth year added). The new average survival was 96.04% for yearling Chinook salmon, coho salmon, and steelhead. This update affects No Net Impact (NNI) production commitments for those species, increasing from 3.7% to 3.96%. Steelhead production targets increased from 8,000 to 8,562 and spring Chinook salmon production targets changed from 29,123 to 31,169. Douglas PUD has edited the BCPs to reflect the correct numbers of females to be collected. Kahler will send the SOA that was approved in the Wells HCP-CC, which summarizes these changes (SOA was distributed to the HCP-HCs and PRCC HSC by Rohrbach on January 21, 2021).

Tonseth said he was under the impression that recalculation of NNI production targets occurred every 10 years. Kahler said yes, there are two different recalculations, a 10-year NNI target recalculation (commonly referred to as "recalc") according to Section 8.4.5 (Adjustment of Hatchery Compensation – Population Dynamics) of the Wells HCP, and an adjustment of hatchery compensation based on Section 8.4.4 of the Wells HCP (Adjustment of Hatchery Compensation – Survival Studies). This is an adjustment of the survival number that is applied to the number of fish passing the project. Kahler said, originally this was based on a 3-year average of passage survival, and additional years were added to the average after survival evaluations were completed in 2010 and 2020. After 2010, hatchery production commitments changed to 3.7%, and are now adjusted to 3.96% after the 2020 study.

Tonseth said after the last 10-year recalculation, an SOA was produced, and asked if it needs to be updated. Kahler said he did not think so because that SOA covers the number of fish produced. Tonseth said if needed, it may be a simple decision to adopt what the HCP-CC approved.

Bill Gale said that if each of those passage survival study results is combined into an average survival number, this assumes that 2020 does not represent major changes from the last survival study. Kahler said yes, that's what the HCP specified, noting that survival standards were achieved, but this is a 50-year agreement, so the intent is to ensure that despite potential changes to the dam structures or operations, the survival standards are still achievable and achieved. The HCPs state that survival studies have to be performed during "representative" environmental conditions (flow) avoiding outlier flow years as the basis for what is a representative survival rate. Those curves were updated based on recent discharge at the project and operations have not changed (they are very

consistent, and no changes in project facilities or configuration of the dam or operations have occurred). Kahler said the passage survival metric does not start over every 10-years; it is verifying that nothing has changed substantially. Kahler said if the dam fails to meet survival standards, additional years of study must be performed to ensure the lower survival was not "just a fluke." Gale asked whether these numbers will be the basis for calculations over the next 10 years. Kahler said yes.

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

Tracy Hillman asked each committee member to provide an update on impacts of the COVID-19 pandemic on monitoring and evaluation activities.

- Brett Farman reported no changes from NOAA.
- Keely Murdoch reported no changes from the Yakama Nation.
- Kirk Truscott said he has no updates related to COVID-19. He noted that Chief Joseph Hatchery data presentations are upcoming in March, and the CCT is internally trying to figure out the best date as it will be a virtual meeting. Truscott will send out additional information on participation.
- Matt Cooper reported no updates from USFWS.
- Mike Tonseth and Katy Shelby reported no changes from WDFW.
- Catherine Willard reported no changes from Chelan PUD.
- Greg Mackey reported no changes from Douglas PUD.
- Todd Pearsons said Grant PUD has discussed COVID-19 testing for staff working at the off-ladder adult fish trap. Deanne Pavlik-Kunkel said it would be exclusive to anyone coming in contact with people in operations departments but it is on hold at this time.

III. Rock Island/Rocky Reach HCP-HCs

A. Chiwawa Spring Chinook Salmon Broodstock Collection

Willard reintroduced the ongoing topic of challenges in collecting adequate Chiwawa spring Chinook salmon broodstock to meet PNI targets while reducing bull trout encounters at the Chiwawa Weir.

Willard reminded the HCs that the conclusion in 2020 was to modify trap operations to operate the weir during the day to collect broodstock, and to lower the weir at night to allow for bull trout passage. During the broodstock collection season, staff switched back to the previous operating protocol (used in 2019), due to low numbers of spring Chinook salmon collected. Willard said it was unclear if lower numbers of bull trout were encountered in 2020 because trapping did not begin until later in the season (July 6, 2020) compared to previous years, and there was a desire to revisit the issue for 2021.

In 2020, Bill Gale had shared the example of modifications to the Imnaha River Weir which allows bull trout passage through resident fish ports in the weir. Willard said ideas for modifying the Chiwawa Weir included the possibility of creating a bull trout bypass in the future when bank stabilization work would be done. Willard said, alternatively, a bull trout bypass in the trap box may allow bull trout to continue upstream, and there is actually a submerged hole or orifice in the trap box that had since been sealed. She said perhaps this could be retrofitted so that a slip gate at the trap box or V weir in the tunnel would allow bull trout passage but not spring Chinook passage. Willard said Chelan PUD and WDFW (Mike Tonseth) are currently developing protocols for evaluating a bull trout bypass located within the trap box. They will coordinate with USFWS and obtain their approval for collecting broodstock at the Chiwawa Weir in 2021 while reducing bull trout encounters. Willard said work is ongoing, but they may be able to meet with USFWS to approve plans before the February HCP-HCs meeting.

Katy Shelby (WDFW) asked Willard to explain further the intent to collect all broodstock at the Chiwawa Weir. Willard answered that in the past, trapping at the Chiwawa Weir was stopped just days into the trapping season due to high numbers of bull trout encounters that exceeded the operating permit conditions. As a result, hatchery-origin Chinook were collected at Tumwater Dam to backfill Chiwawa broodstock, which is a conservation program with 100% natural-origin broodstock. Willard noted that fish that were previously PIT-tagged as juveniles in the Chiwawa River and collected at Tumwater Dam as an adult return would still be retained for Chiwawa broodstock and not all broodstock will be collected at the Chiwawa Weir.

Matt Cooper asked if modifications would be made to the weir and trap box or just the trap box. Willard confirmed just the trap box would be modified as it would be easier and could be done within the year; modifications to the weir would take much longer. Mike Tonseth said one other option would be modification of a weir panel closest to the trap structure that may be pursued in the future. Cooper asked about the diameter of the submerged orifice. Willard said Ian Adams (Chelan PUD) will measure the opening within the coming days. Cooper asked whether bull trout that passed through this orifice could be monitored and enumerated. Willard said they are evaluating the possible use of cameras; however, they do not want to introduce any lighting that may affect bull trout passage. Tonseth said their discussion included how to retrofit the passageway and also to document that bull trout actually use it to inform assumptions from the numbers of encounters. Tonseth said they plan to have a means in place to count the number observed and the number leaving the trap. Cooper said this monitoring would validate the efficacy of spring Chinook salmon trapping and ensure smaller Chinook salmon are not being lost. Tonseth said it is an acceptable tradeoff to reduce the number of bull trout encounters if a few smaller spring Chinook salmon pass upstream.

B. 2021 Rock Island/Rocky Reach Action Plan

Catherine Willard noted the new items added to this year's Rocky Island and Rocky Reach Action Plan, including the following:

- The Chelan Falls temporary weir to collect Chelan Falls broodstock will be piloted in 2021 (it was canceled due to COVID-19 in 2020).
- Chelan PUD plans to continue examining rehabbing the Chelan hatchery.
- Chelan PUD plans to continue examining permitting bank stabilization activities at the Chiwawa Weir.
- A feasibility analysis will be done to construct permanent predation prevention at Eastbank Hatchery. Last year predation on spring Chinook salmon was observed, and some temporary measures were taken.
- Regarding the comprehensive evaluation of the Okanagan sockeye salmon program, Chelan PUD is preparing a Statement of Agreement (SOA) for the HCP-HCs to agree to the success of the program and another SOA confirming the next 10-year plan for mitigation.
- Chelan PUD will develop an SOA on recalculation methodology for confirming new broodstock collection numbers for collection in 2022 (to be released in 2024).
- July 1 is the due date for the 2021 Comprehensive Report that has been established with the HCP-HCs.

Mike Tonseth asked whether the collection of steelhead eggs for thiamine baseline evaluation was included in the action plan. Willard said it was not included as a specific action item because it was recently proposed.

Tracy Hillman asked the RI/RR Committees to review Chelan PUD's 2021 Rocky Reach/Rock Island Action Plan for approval during next month's meeting.

C. Wenatchee Steelhead Egg Collection

Megan Finley (WDFW veterinarian) contacted Catherine Willard yesterday about establishing a baseline measurement of thiamine levels in the eggs of Wenatchee steelhead. Thiamine levels are a growing concern in USFWS-raised populations in California and Oregon. Mortality in early life stages is tied to low levels of thiamine, though early life stage mortality has not been observed in the Wenatchee programs. Finley plans to collect samples to establish a baseline this year to be able to observe a potential change in thiamine levels in the future. WDFW intends to collect 100 eggs from six females, for a total of 600 eggs. Willard said Wenatchee steelhead hatchery spawning is currently occurring. Mike Tonseth asked if the target is to collect eggs from hatchery-origin or natural-origin spawners, or three of each. Willard said Finley did not think it would matter but agreed it would be better to collect eggs from both natural-origin and hatchery-origin steelhead.

Greg Mackey said Betsy Bamberger was also approached for eggs from Douglas PUD's program. Mackey said he would coordinate with USFWS on which Methow Basin fish should be targeted for egg collection.

IV. PRCC HSC

A. Review Agenda, Announcements, Approve Past Meeting Minutes

The PRCC HSC representatives approved the December 16, 2020, meeting minutes.

B. Priest Rapids Hatchery M&E Annual Report

Todd Pearsons reminded the PRCC HSC that the draft 2019–2020 Priest Rapids Hatchery M&E Annual Report is available for a 30-day review, distributed to the PRCC HSC via email by Larissa Rohrbach on Thursday, January 14, 2021. Comments should be sent to Pearsons by February 16, 2021. Pearsons said there were no major changes from the preceding year's report. Pearsons said PNI for Hanford Reach fall Chinook salmon was 0.85 in 2019, which was the sixth consecutive year that PNI exceeded the target of 0.67. Pearsons said final formatting of tables and figures will be done after PRCC HSC review.

C. Administrative Items

Grant PUD requested the addition of Brandon Kilmer (Douglas PUD) to the HCP-HCs and PRCC HSC secondary distribution list, mainly to receive monthly hatchery production reports. There were no objections from the HCP-HCs and PRCC HSC representatives. Tracy Hillman will pass this recommendation to the HCP Coordinating Committees for approval.

V. Next Meetings

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

VI. List of Attachments

Attachment A List of Attendees
Attachment B An integrated population model for Wenatchee spring Chinook salmon, Mark Sorel, UW
Attachment C Okanagan Sockeye Annual Program Summary, Ryan Benson, ONA

Attachment A
List of Attendees

Name	Organization
Sarah Montgomery	Anchor QEA, LLC
Tracy Hillman	BioAnalysts, Inc.
Catherine Willard*	Chelan PUD
Scott Hopkins*	Chelan PUD
Ian Adams	Chelan PUD
Kirk Truscott*‡	Colville Confederated Tribes
Greg Mackey*	Douglas PUD
Tom Kahler*	Douglas PUD
David Duvall	Grant PUD
Deanne Pavlik-Kunkel	Grant PUD
Todd Pearsons‡	Grant PUD
Peter Graf‡	Grant PUD
Brett Farman*‡	National Marine Fisheries Service
Ryan Benson	Okanagan Nation Alliance
Mark Sorel	University of Washington
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
Charlie Snow	Washington Department of Fish and Wildlife
Keely Murdoch*‡	Yakama Nation

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

An Integrated Population Model for Wenatchee Spring Chinook Salmon

Mark Sorel, University of Washington

An integrated population model for Wenatchee spring Chinook salmon

Mark Sorel and Sarah Converse

Washington Cooperative Fish and Wildlife Research Unit,

School of Aquatic and Fishery Sciences, University of Washington

Priest Rapids Coordinating Committee Hatchery Subcommittee Meeting

January 20, 2021

Outline

- Acknowledgements
  - Funding, data, partners
- Objectives
  - Model development, population processes, support decision makers
- Differences between our model and others
  - Integrated analysis, juvenile life history pathways
- Some preliminary findings
- Questions/ discussion
  - Next steps, interest in collaboration?

Acknowledgements

- Funding
  - NOAA Northwest Fisheries Science Center
  - Washington Cooperative Fish and Wildlife Research Unit
  - Northwest Climate Adaptation Science Center
- Data
  - Grant and Chelan County PUDs
  - Washington Department of Fish and Wildlife
  - Yakama Nation Fisheries
  - Comparative Survival Study
  - Pacific States Marine Fisheries Council
  - Washington Department of Ecology
  - U.S. Geologic Survey

Acknowledgements

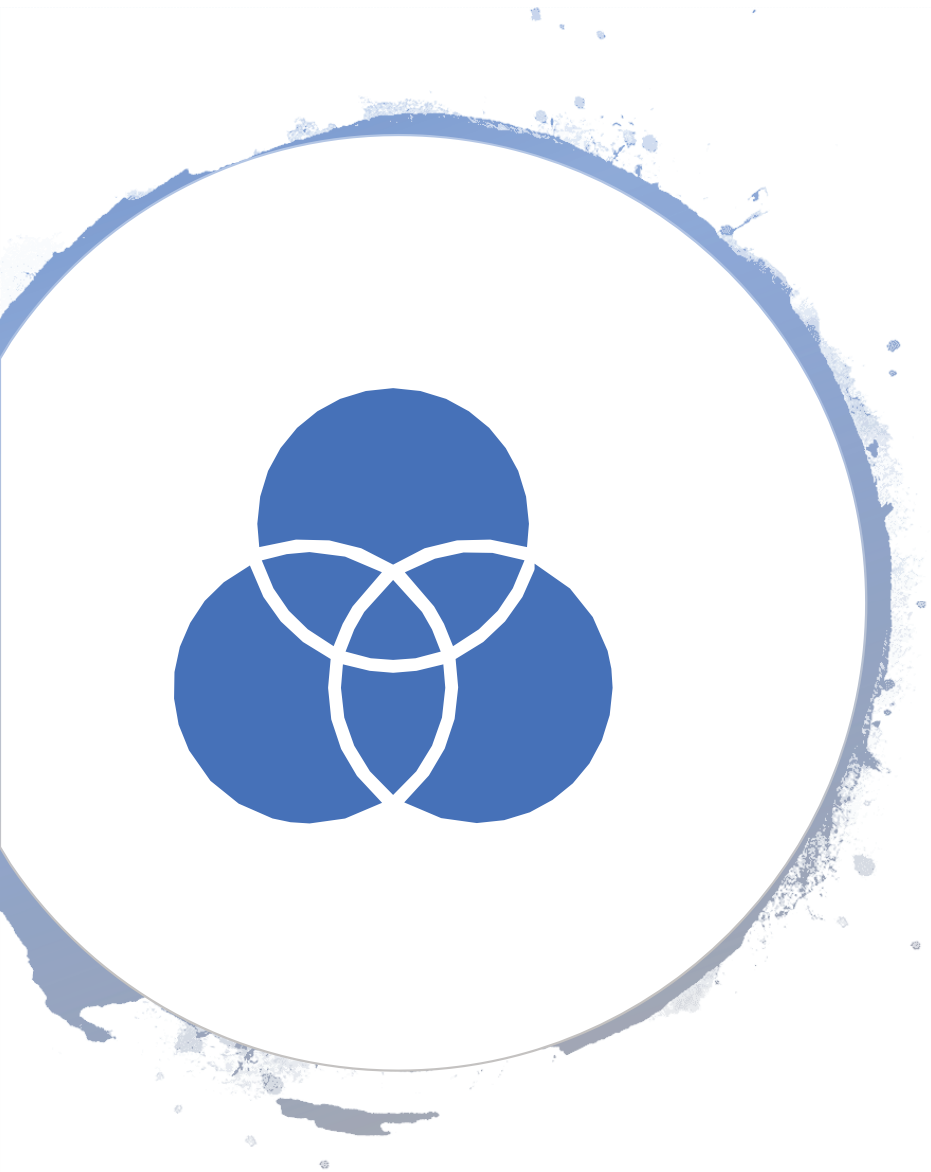
- Project partners
  - Rich Zabel, NOAA Northwest Fisheries Science Center
  - Andrew Murdoch, Washington Department of Fish and Wildlife
  - Jeff Jorgensen, NOAA Northwest Fisheries Science Center
  - Mark Scheuerell, Washington Cooperative Fish and Wildlife Research Unit
  - Eric Buhle, Biomark
  - Cory Kamphaus, Yakama Nation Fisheries

Objectives

- Model development
  - Template for other populations
- Understand population processes
  - Density dependence
  - Life history diversity
  - Variability (relationships with environmental variables)
  - Population viability
- Support decision makers
  - Hatchery supplementation
  - Habitat restoration

Differences between our model and existing models

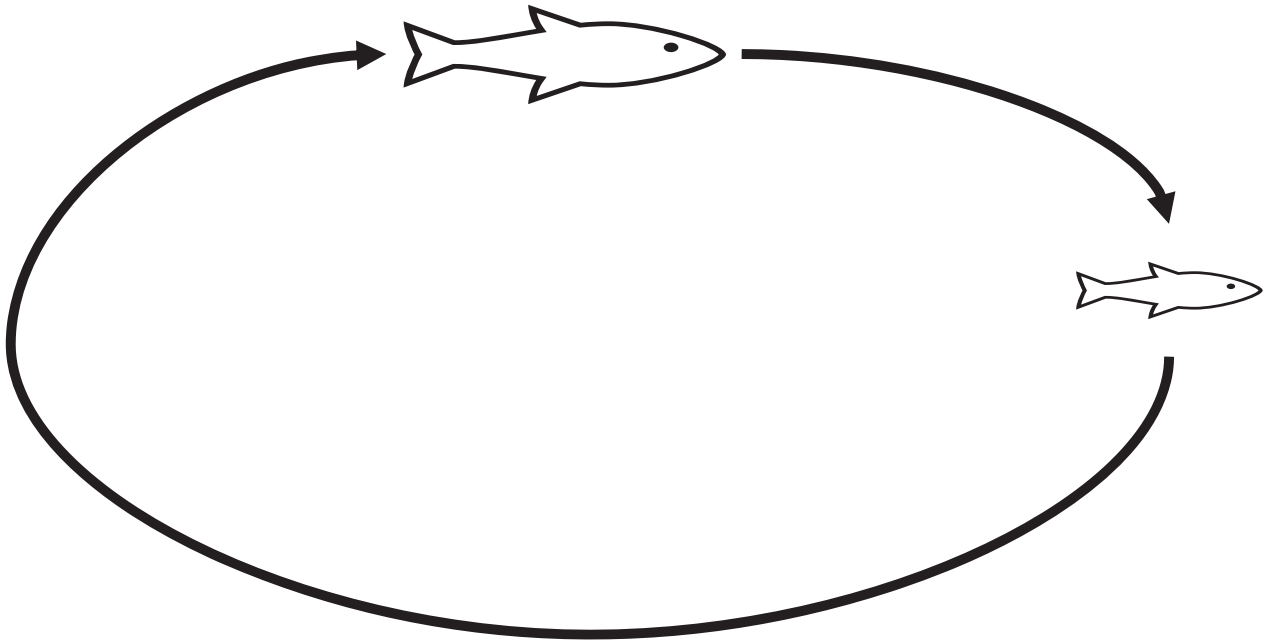
- Analyzed as an integrated population model (IPM)
- Tracking alternative juvenile life history pathways



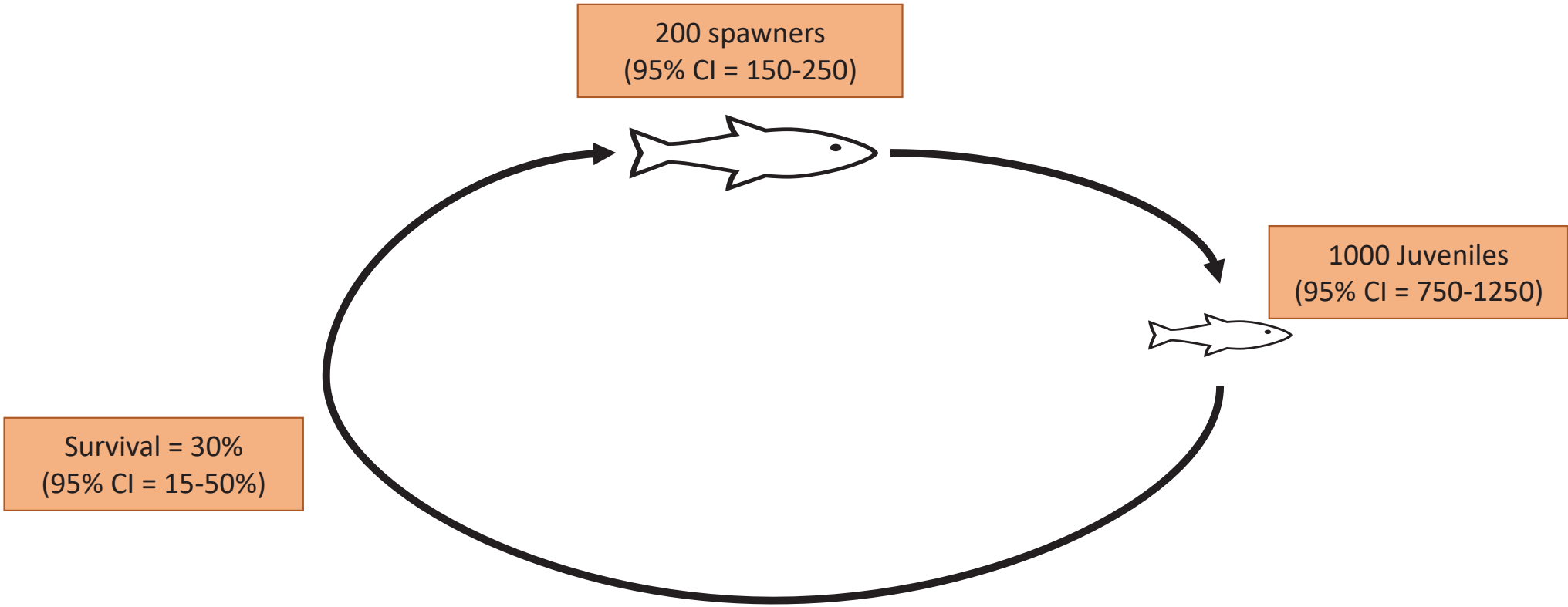
Integrated population models (IPMs)

- Integrated
  - Multiple data sets analyzed together
- Population model
  - Birth, immigration, death, and emigration

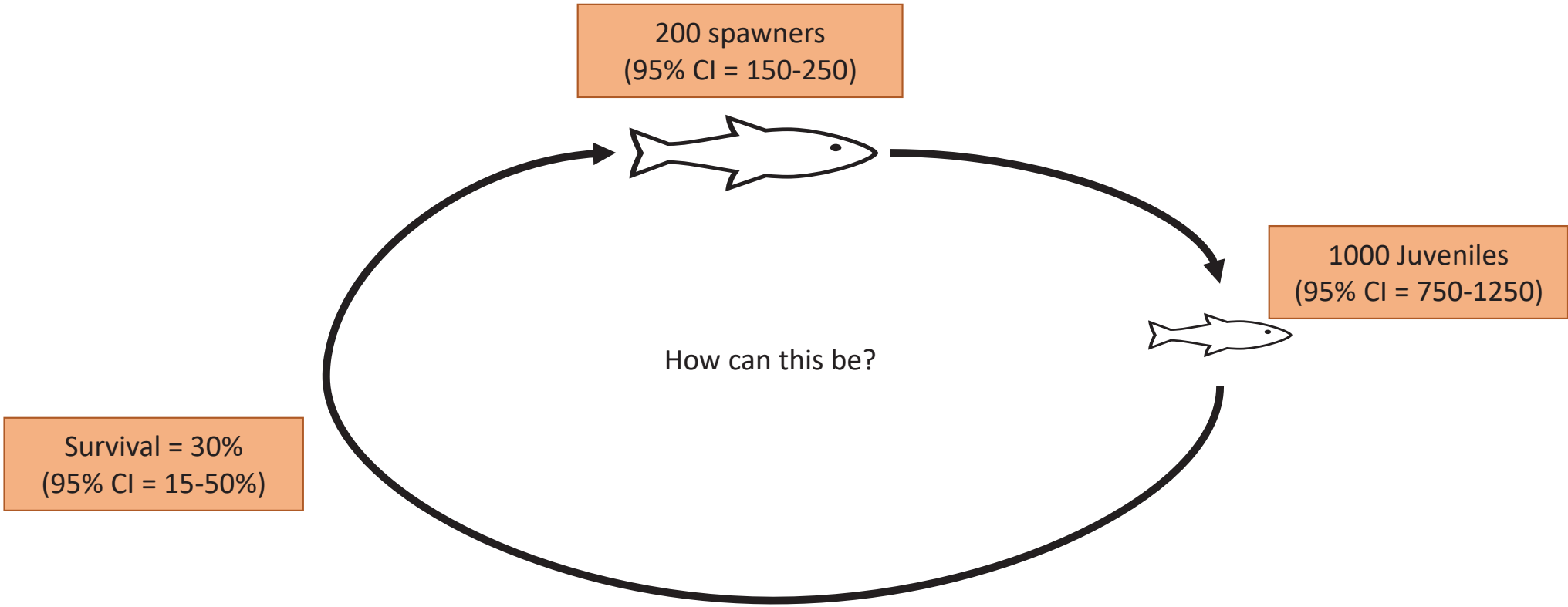
IPM advantages



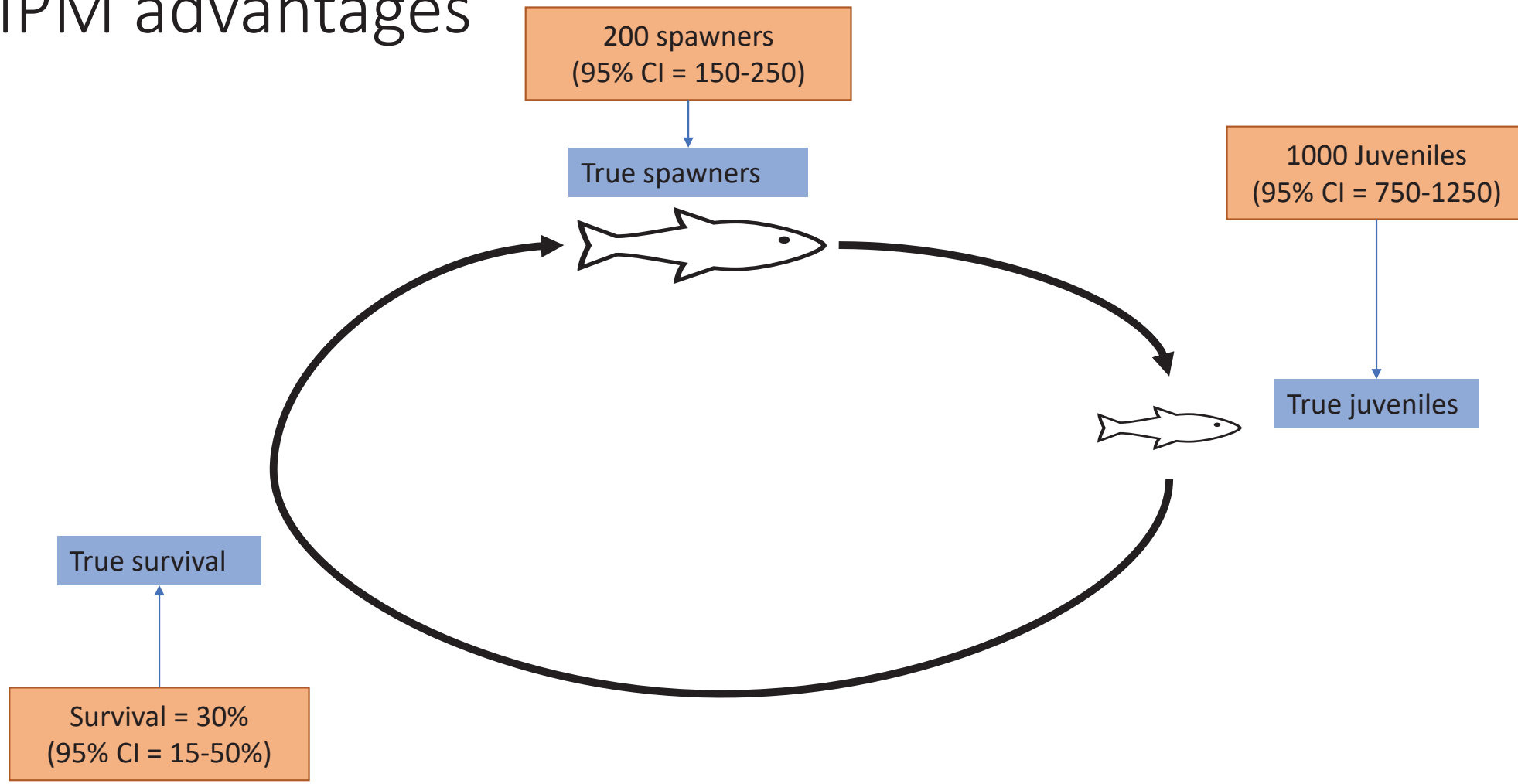
IPM advantages



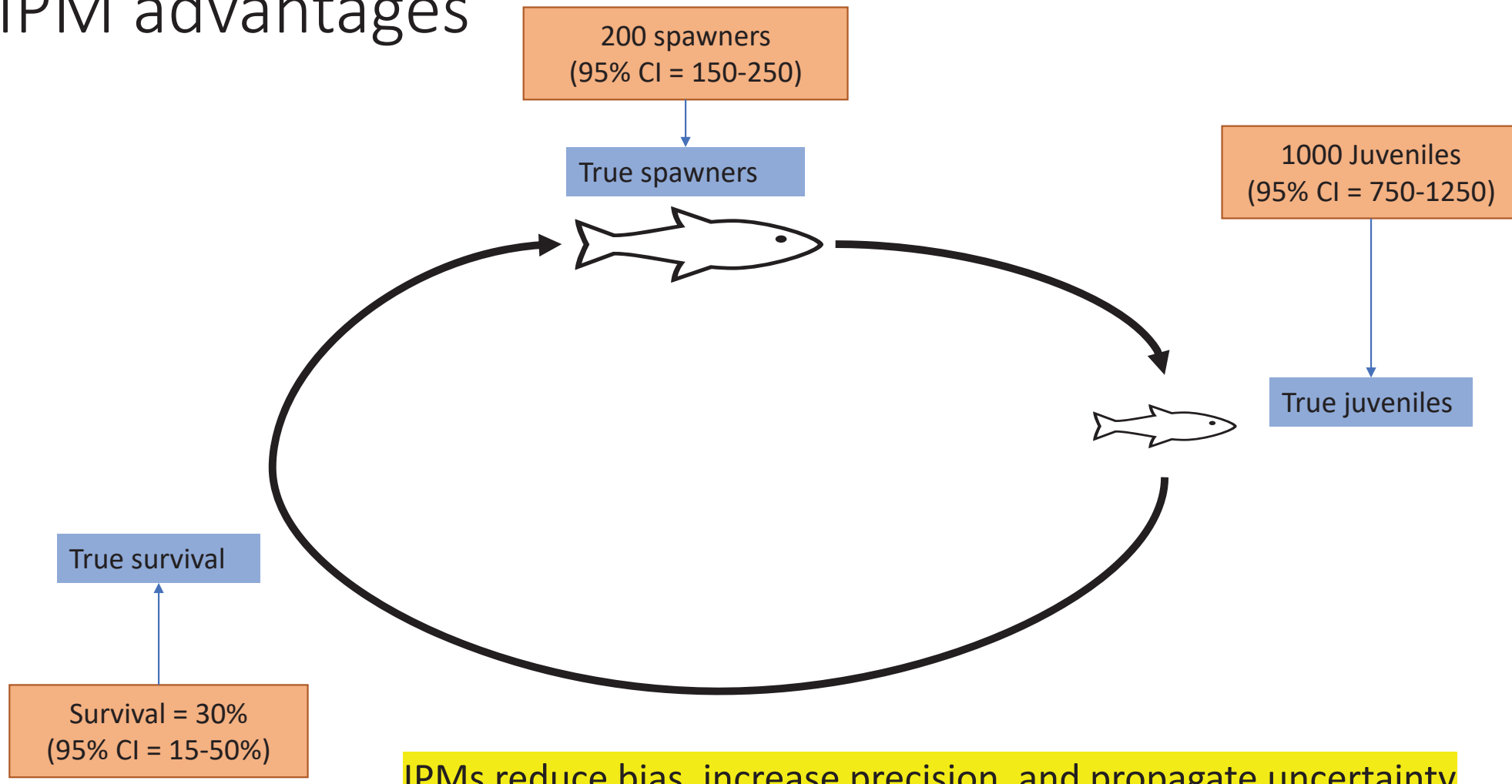
IPM advantages



IPM advantages

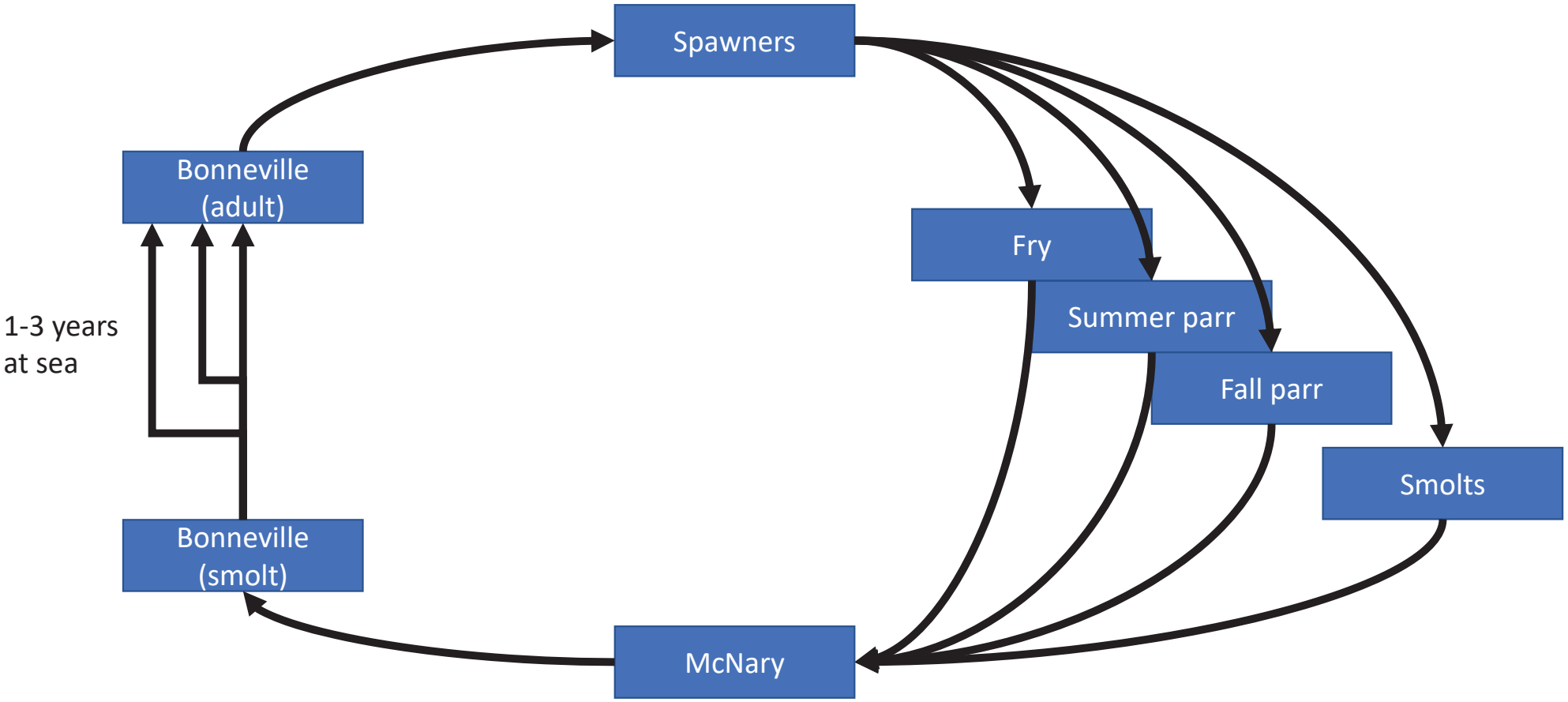


IPM advantages

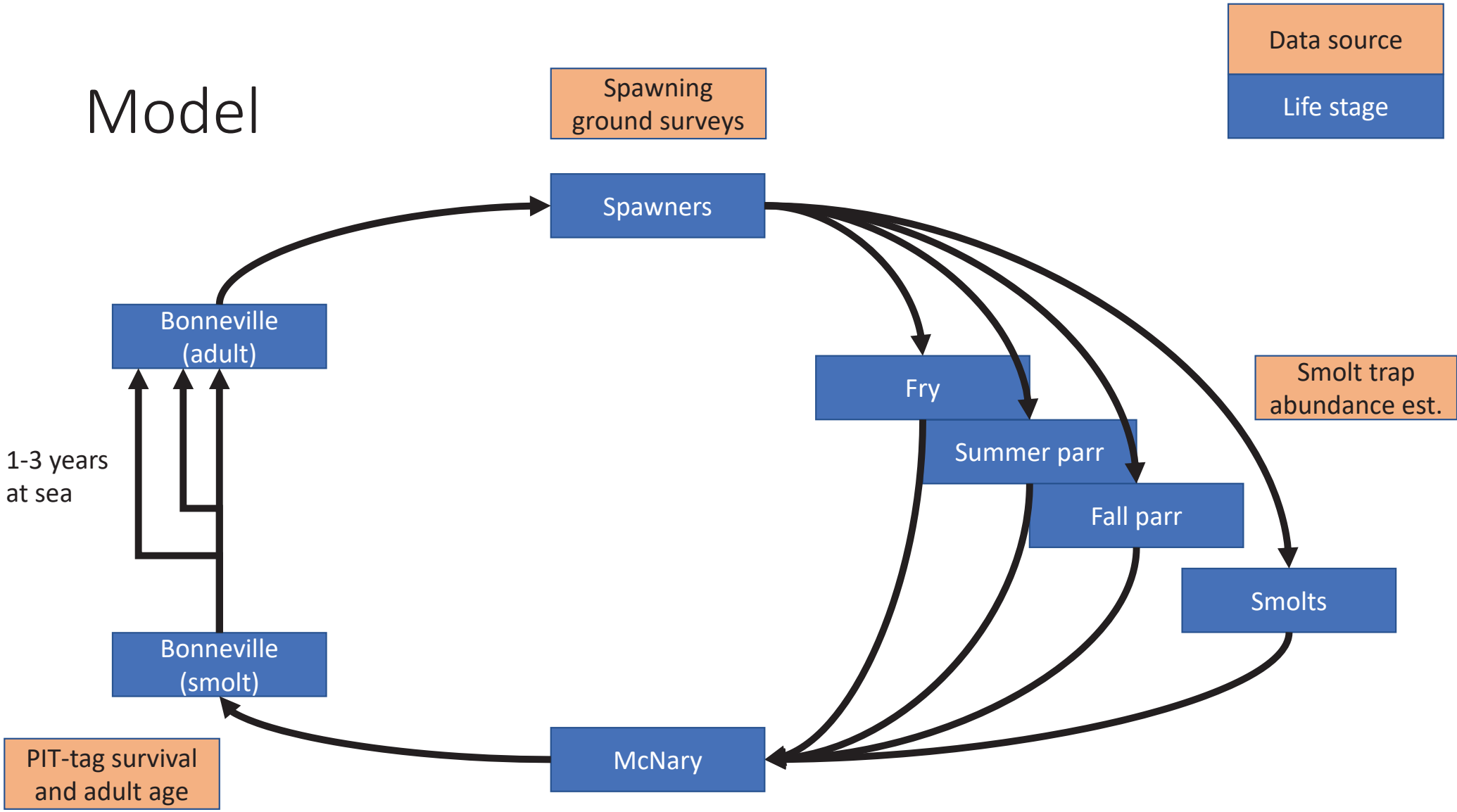


IPMs reduce bias, increase precision, and propagate uncertainty

Model (tracking alternative juvenile life histories)



Model


Data source
Life stage
Spawning ground surveys
Spawners
Bonneville (adult)
Fry
Smolt trap abundance est.
Summer parr
1-3 years at sea
Fall parr
Smolts
Bonneville (smolt)
PIT-tag survival and adult age
McNary

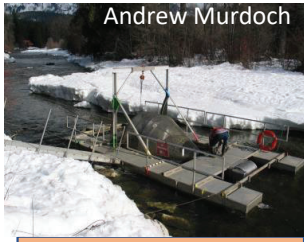
Model

Spawning ground surveys

Data source

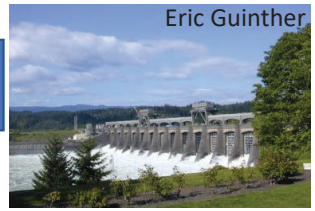
Life stage

Spawners



Smolt trap abundance est.

Bonneville (adult)



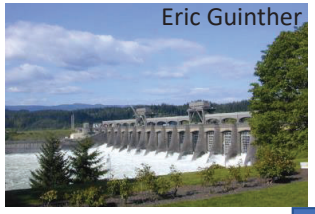
Fry

Summer parr

Fall parr

Smolts

1-3 years at sea



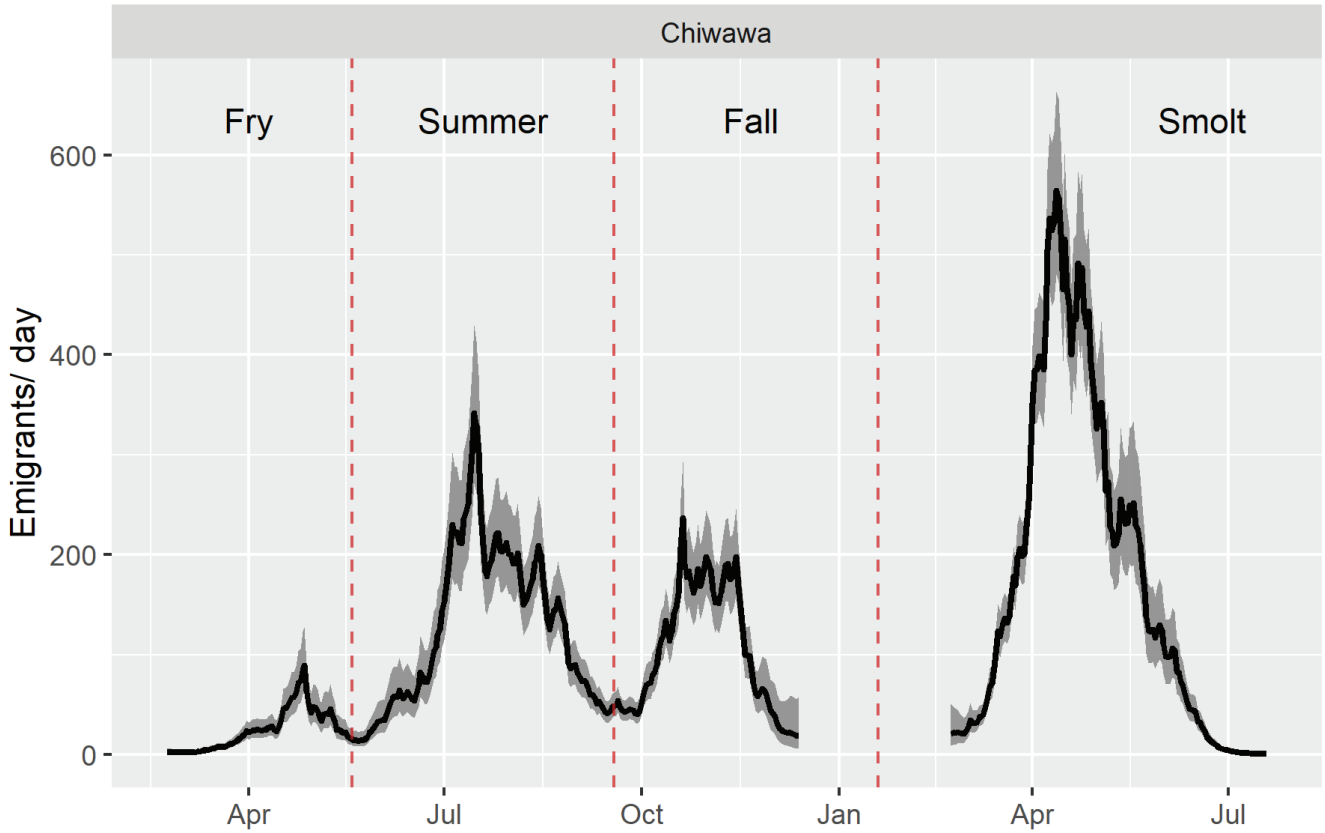
Bonneville (smolt)

PIT-tag survival and adult age

McNary

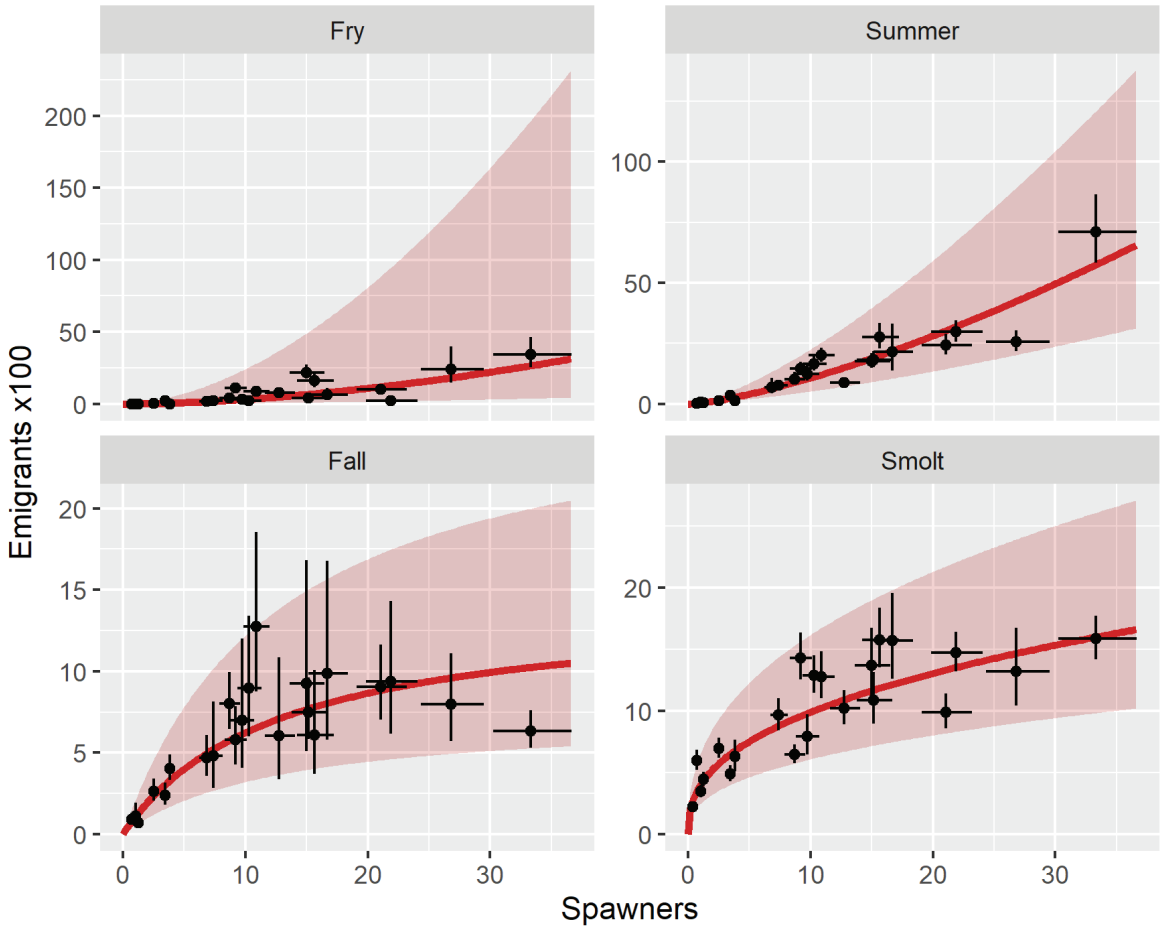
Juvenile life history diversity

- 4 windows of emigration from natal stream
  - Alternative juvenile life histories
  - Emigration timing may be density dependent
  - Habitat use depends on emigration timing

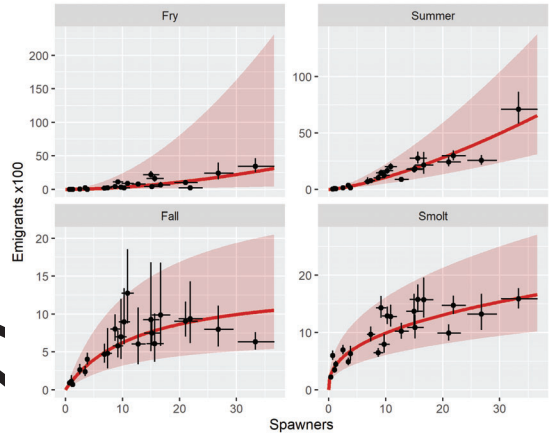


Spawner to juvenile transitions (preliminary)

- Positive density dependence in fry and summer parr production
- Negative density dependence in fall parr and smolt production
- Therefore, a larger proportion of emigrants will be fry and summer parr at higher spawner abundance



Model



Spawners

Bonneville (adult)

Fry

Summer parr

Fall parr

Smolts

1-3 years at sea

Bonneville (smolt)

McNary

Where we are at

- Preliminary spawner-to-juvenile transitions developed
- Developing juvenile-to-spawner transition

Timeline

- Plan to have a working model within the next year
- Then the model can be used to evaluate population viability
  - Alternative management scenarios

Discussion

- Comments and questions about presentation?
- What outputs would you be interested in using to support management decision making?
- Could you generate management scenarios to evaluate w/ model?
- Would you be willing to participate in a workshop to help develop the model and scenarios to evaluate?

Okanagan Sockeye Annual Program Summary

Ryan Benson, Okanagan Nation Alliance

Okanagan Sockeye Re-Introduction Program Update

syilx Okanagan Nation Alliance

January 20, 2021

Presented to HCP Hatchery Committee and

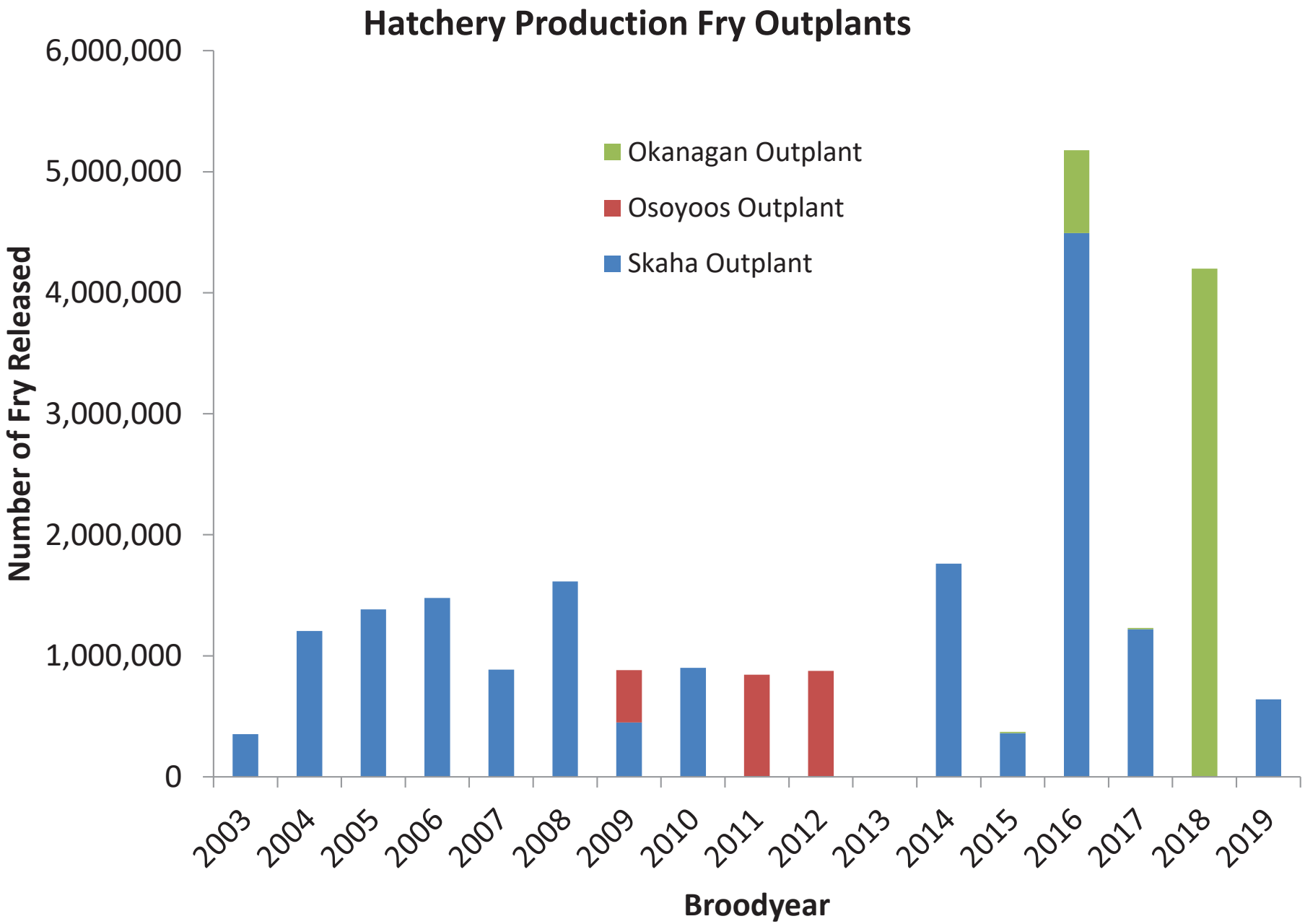
PRCC Hatchery Subcommittee

OKANAGAN NATION AQUATIC ENTERPRISES LTD.

BY 2019 Hatchery Fry Release

Date	Number of Fry Released	Mean Weight (g)
March 27	152,068	0.92
April 15	159,003	1.84
April 29	209,812	1.70
September 23	120,299	19.30

- Experimental strategy to increase post-release survival.
- Fall release addresses potential predation
- All fry volitionally released into Shingle Creek


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
Broodyear

Hatchery Operation

Attribute	2014 (start up)	2015	2016	2017	2018	2019	2020
Fecundity mean	2,439	2,096	2,144	2,095	1,864	1,930	1,983
Total eggs collected	2,452,000	508,000	5,256,000	1,312,429	4,148,460	856,844	4,584,920
Trap & Transport eggs	N/A	N/A	800,000 (15%)	514,000 (39%)	847,060 (20%)	**100%**	**100%**
Egg to fry survival	71.8%	72.0%	95.1%	93.9%	90.9%	82.0%	N/A
Cryofreezing samples	40 males	33 males	23 males	35-40 males	40 males	24 males	20 males

Sockeye Escapement

- Penticton Channel AUC – **25,589**
  - Previous record was 23,500 in 2018
- Shingle Creek AUC – **11,963**
  - Previous record was 758 in 2018
  - 40-60% partially spawned,
  - probable spawning habitat limitations
- Channel kokanee AUC– 39,184
- Total Okanagan Basin Escapement – 85,700

Skaha Lake Natural Production

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

In-Lake Monitoring Summary

- 12-year Bioenergetic and In-lake synthesis submitted to N. American Journal of Fisheries Management (1st round of revisions).

- BY 2004-2017 mean hatchery survival
  - Fry to pre-smolt – 40.7% (56% lower than Osoyoos natural)
  - Egg to pre-smolt – 15.2% (102% or 3X higher than natural)

- Possibly reached Skaha L. carrying capacity
  - Potential density dependence: growth suppression in 2018, no survival reduction detected.
  - May change annually depending on conditions (nutrients & production, flushing, natural SK/KO escapement, Lake Whitefish)
  - Possible optimal/maximum loading density for hatchery fry

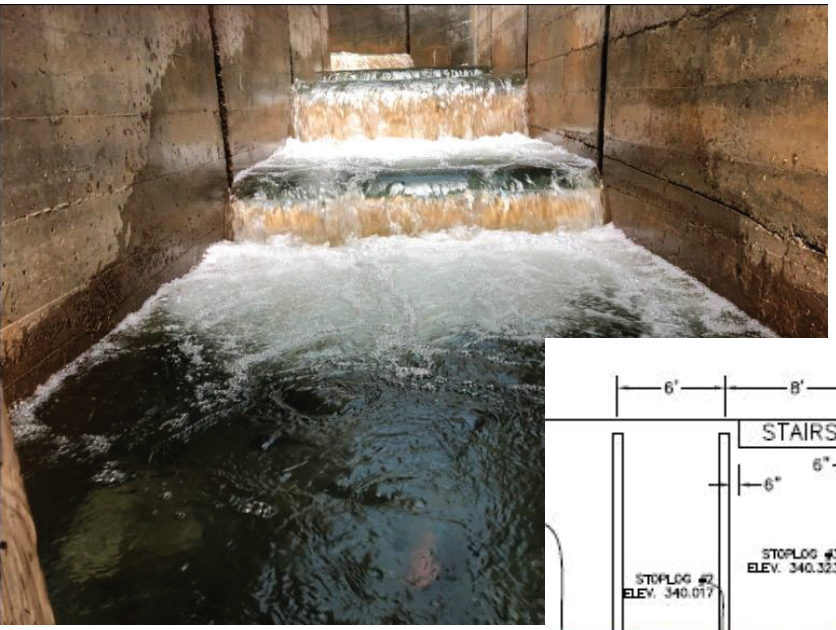
- Skaha Lake kokanee stock is better than pre-treatment
  - Escapement 770-20,000 (pre) vs. 12,000-98,000 (post)
  - 2017 in-lake biomass was highest in 12 years
  - 2-3 year old KO have the greatest impact on zooplankton

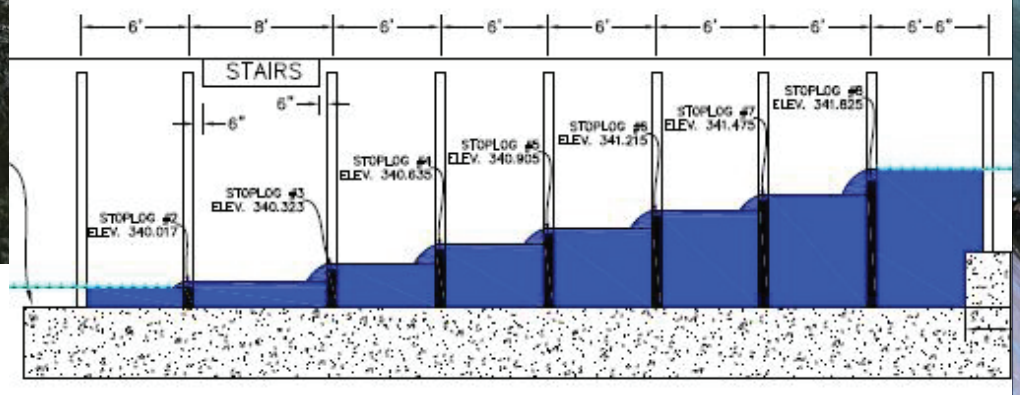
Okanagan Lake Program

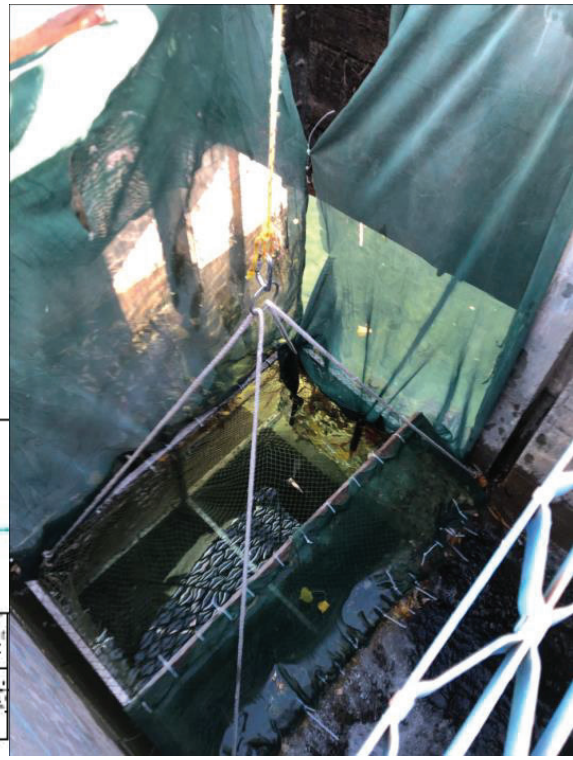
- DFO has approved long-term hatchery Sockeye outplants, conditional on M&E results
  - Okanagan Basin Salmon Recovery Sub-Committee (COBTWG)
  - M&E Plan is finalized; Working on implementation
  - Working towards Salmon passage at Penticton Dam

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

Penticton Dam (Okanagan Lake Outlet) Passage







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

Okanagan Lake Fishway and Telemetry

- Vemco VR2Tx receivers deployed August/ September
- Fishway and trap operational Sept 8 – Oct 9
- Checked most days am & pm
- Nerkids > 35 cm: spaghetti tag, V9 esophageal, operculum punch

Preliminary Results

- Fishway used by SK, KO, trout. Staged more on east bank
- 41 tagged and relocated upstream of OK Dam
  - 23 from fishway, 8 dip netted on east bank, 10 dipnetted from Shingle Cr
- 5 carcasses recovered downstream – 4 from Shingle group
- Receivers have been recovered, data analysis is underway

Final Known Fate of Tagged Sockeye (n = 41)

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

Results (continued)

- 3 tagged SK observed in Mission Creek; 1 tag near Deep Creek/ Antlers beach
- Numerous large nerkids in Mission Cr. and late spawning
  - 5 untagged carcasses recovered, confirmed to be hatchery Sockeye
  - Numerous sightings of many potential Sockeye in Okanagan L.
  - Working hypothesis: high spring & summer flows, open dam gates, Sockeye and Chinook were able to pass underneath

limləmt