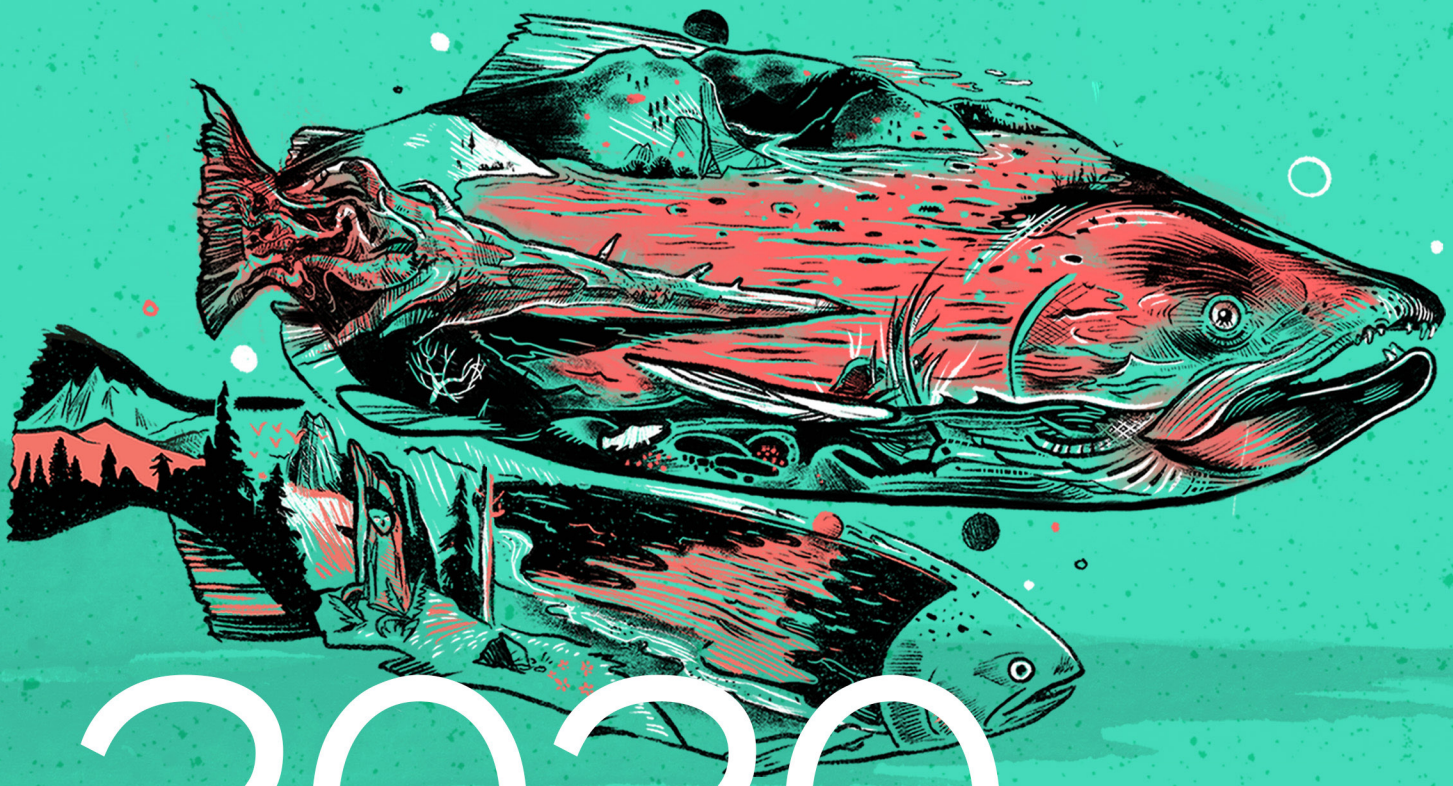
Upper Columbia Science Conference

—

January 22-23, 2020

Wenatchee, WA



# 2020 VISION

**FINDING FOCUS IN SHARED SCIENCE**

**uc2020.org**

UPPER COLUMBIA SALMON RECOVERY BOARD

## OUR GENEROUS SPONSORS

Yakama Nation Fisheries

UCUT
UPPER COLUMBIA UNITED TRIBES

WASHINGTON STATE RECREATION AND CONSERVATION OFFICE
Governor's Salmon Recovery Office

HABITAT SUBCOMMITTEE
OF THE PRIEST RAPIDS COORDINATING COMMITTEE

inter·fluve inc.

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

W2R
WOLF WATER RESOURCES

---

DOUGLAS COUNTY Est. 1883

PNP
PACIFIC NETTING PRODUCTS
INCORPORATED

WASHINGTON DEPARTMENT OF FISH AND WILDLIFE

Rocky Reach Habitat Conservation Plan

Rock Island Habitat Conservation Plan

Wells Habitat Conservation Plan

Aspect CONSULTING

Natural Systems Design

BONNEVILLE POWER ADMINISTRATION

---

CASCADIA CONSERVATION DISTRICT

ANCHOR QEA

BioAnalysts, Inc.

CRAMER FISH SCIENCES
Oregon • California • Washington • Idaho • Alaska

Snake River Salmon Recovery

sitka technology group

FOUR PEAKS ENVIRONMENTAL
Science & Data Solutions

DAVID EVANS AND ASSOCIATES INC.

# ACKNOWLEDGEMENTS


**Upper Columbia Salmon Recovery Board – Board of Directors**

Chuck Brushwood, Chair, Colville Confederated Tribes
Doug England, Chelan County
Andy Hover, Vice Chair, Okanogan County
Marc Straub, Douglas County
Paul Ward, Yakama Nation

**Steering Committee**

Adrienne Roumasset, Chelan County Natural Resources Department
Andrew Murdoch, Washington Department of Fish and Wildlife
Jennifer Bayer, U.S. Geological Survey & Pacific Northwest Aquatic Monitoring Partnership
Jeremy Cram, Washington Department of Fish and Wildlife
John Crandall, Methow Restoration Council & Confluence Aquatics
Catherine Willard, Chelan County Public Utility District
Ken Muir, Cascadia Conservation District
Steve Kolk, Bureau of Reclamation
Todd Pearsons, Grant County Public Utility District
Tracy Hillman, BioAnalysts

**Organizing Committee**

Barbara Carrillo, Upper Columbia Salmon Recovery Board (now with All Points Planning and Consulting)
Nicole Jordan, Upper Columbia Salmon Recovery Board
Jessica Raley, Bantam Design

---

*I would like to thank the many individuals who dedicated time and expertise to making this Science Conference a success. Planning and organizing this event has been a team effort from the start and I could not have done it without the support of our amazing Board of Directors, Executive Director, Steering Committee and Organizing Committee. The quality of this event is a reflection of the quality of people we are privileged to work with. Thank you to all of you.*

**Greer Maier, Science Conference Chair**
**Science Program Manager, UCSRB**

UPPER COLUMBIA SCIENCE CONFERENCE

# 2020 VISION

## WEDNESDAY 1/22

| | | |
|---|---|---|
| 7:00 – 5:30 | Registration Open | |
| 7:00 – 8:00 | Welcome Social – Coffee and Light Breakfast Items Available | |
| 8:00 – 8:10 | UCSRB Welcome – Chuck Brushwood, Chair & Melody Kreimes, Executive Director | |
| 8:10 – 8:20 | 20/20 Vision – Greer Maier, UCSRB Conference Chair | |
| 8:20 – 9:00 | Keynote Speaker – Guido Rahr, Wild Salmon Center | p. 6 |
| 9:00 – 9:30 | Plenary Talk – Mike Ford, NOAA Northwest Fisheries Science Center | p. 7 |
| 9:30 – 10:30 | Morning Session – Status of the Species | p. 7 |
| 10:30 – 11:00 | Break and poster session, including *Strongholds* book signing by Guido Rahr | |
| 11:00 – 12:30 | Morning Session – Status (Continued) and Ocean & Estuary Conditions | p. 8 |
| 12:30 – 1:30 | Lunch – On Your Own | |
| 1:30 – 3:00 | Afternoon Session – Adult Migration and Juvenile Migration | p. 11 |
| 3:00 – 3:30 | Break and Poster Session – Coffee and Snacks | |
| 3:30 – 3:45 | Plenary Talk – John Sirois, Upper Columbia United Tribes | p. 13 |
| 3:45 – 4:15 | Afternoon Session – Predation | p. 14 |
| 4:15 – 5:00 | Plenary Talk – Matt Polacek, Washington Department of Fish and Wildlife | p. 15 |
| 5:30 – 9:00 | Evening Social at Pybus Market – Drinks, Appetizers and Silent Auction | |

**uc2020.org**

UPPER COLUMBIA SCIENCE CONFERENCE

# 2020 VISION

## THURSDAY 1/23

| | | |
|---|---|---|
| 7:00 – 10:00 | Registration Open | |
| 7:00 – 8:10 | Morning Social (Coffee and Light Breakfast Items) and Welcoming Remarks | |
| 8:10 – 8:45 | Keynote Speaker – Dr. Ellen Wohl, Colorado State University | p . 17 |
| 8:45 – 9:45 | Morning Session – Watersheds | p. 18 |
| 9:45 – 10:15 | Break and Poster Session – Coffee and Snacks | |
| 10:15 – 10:45 | Plenary Talk – Rebecca Flitcroft, U.S. Forest Service PNW Research Station | p. 19 |
| 10:45 – 11:30 | Morning Session – Habitat | p. 19 |
| 11:30 – 12:00 | Plenary Talk – Maisie Richards, Inter-Fluve | p. 21 |
| 12:00 – 1:00 | Lunch – On Your Own | |
| 1:00 – 1:30 | Plenary Talk – Carson Jeffres, UC Davis Center for Watershed Sciences | p. 21 |
| 1:30 – 2:30 | Afternoon Session - Floodplains | |
| 2:30 – 3:00 | Break – Coffee and Snacks | |
| 3:00 – 3:30 | Plenary Talk – Warren Colyer, Trout Unlimited | p. 24 |
| 3:30 – 4:30 | Afternoon Session – Restoration & Prioritization | p. 24 |
| 4:30 | Closing Remarks | |

**uc2020.org**

## WEDNESDAY 1/22

7:00 – 5:30 Registration Open

7:00 – 8:00 Welcome Social

8:00 – 8:10 UCSRB Welcome – Chuck Brushwood, Chair & Melody Kreimes, Executive Director

8:10 – 8:20 20/20 Vision – Greer Maier, UCSRB Conference Chair

8:20 – 9:00 **Keynote Speaker – Guido Rahr, Wild Salmon Center**

*The fate of wild salmon across the North Pacific: reports from the Russian Far East to the Pacific Northwest*

While salmon are a keystone species in river systems that feed the North Pacific, runs are declining on both sides of the Pacific Rim, triggering multibillion dollar restoration efforts. How can we ensure this charismatic and ecologically critical species continues to thrive in the face of human development and climate change? Guido Rahr will describe the status of salmonid fish across the northern Paciifc Rim and major threats to their survival. He will describe place-based efforts to protect salmon strongholds in the Russian Far East, Bristol Bay Alaska, British Columbia and the Washington and Oregon coast.

*About Guido Rahr*

Under Mr. Rahr's leadership as President and CEO, Wild Salmon Center has developed scientific research, habitat protection and fisheries improvement projects in dozens of rivers in Japan, the Russian Far East, Alaska, British Columbia and the US Pacific Northwest, raising over $100 million in grants, establishing eight new conservation organizations, and protecting three million acres of habitat including public lands management designations and eight new large scale habitat reserves on key salmon rivers across the Pacific Rim.

Mr. Rahr earned a BA in English Literature from the University of Oregon and a Masters of Environmental Studies from Yale University. Before coming to the Wild Salmon Center, he developed conservation programs for Oregon Trout, the United Nations Development Programme, the Rainforest Alliance and Conservation International.

Mr. Rahr is a member of the World Conservation Union (IUCN) Salmon Specialist Group, and is a passionate fly fisherman and fly tyer. He lives in Portland, Oregon with his wife, Lee, and their three sons.

## STATUS OF THE SPECIES

9:00 – 9:30 **Plenary Talk – Mike Ford, NOAA Northwest Fisheries Science Center**

*Status of ESA listed Upper Columbia River spring Chinook salmon and steelhead and relationship to southern resident killer whales*

In this talk I will provide an overview of the current status of the ESA-listed spring Chinook salmon and steelhead Evolutionarily Significant Units (ESUs) in the Upper Columbia River region and how this status assessment will be updated in the upcoming 5-year ESA status review. These populations have been listed under the ESA for more than 20 years. Over this time there have been some improvements in abundance and some metrics of diversity, but productivity remains low and the ESUs remain far below their recovery goals. Habitat and hydro improvements along with changes to hatchery programs have likely lowered the risk of extinction and hopefully made the populations more robust. Factors outside of the Upper Columbia area, particularly varying ocean conditions and predation, play a dominant role in determining the abundance of these ESUs. The effects of current conservation efforts therefore may become most important and apparent if there is another period of prolonged poor ocean survival. In addition to discussing the ESA status of Upper Columbia salmon, I will also review our current understanding of the importance of these populations and other salmon populations coastwide as prey for endangered southern resident killer whales.

9:30 – 9:45 **Greg Fraser, U.S. Fish and Wildlife Service**, Matt Cooper

*Termination of a spring Chinook hatchery in the Entiat River and the response of natural-origin spring Chinook a decade later*

In 2007, Entiat National Fish Hatchery (NFH) released the last spring Chinook Salmon yearlings of a program that began in 1974. The hatchery switched to summer Chinook Salmon to minimize risk to natural-origin spring Chinook Salmon that are listed as endangered. Since the termination of the program, the abundance of Entiat NFH-origin spring Chinook Salmon found on the spawning grounds decreased to zero, as predicted. However, out-of-basin hatchery-origin Chinook Salmon have persisted, and in recent years hatchery-origin fish have made up nearly half of the spawning population. The delisting criteria for this population is a 12-year mean of 500 individuals. In 2018, less than 100 spring Chinook Salmon returned to the Entiat River to spawn, and half were out-of-basin hatchery-origin fish. Poor returns and a high proportion of hatchery-origin fish raise critical questions about the resilience of the natural-origin population of spring Chinook Salmon and management of both Chinook runs in the Entiat River.

9:45 – 10:15 **Michael Hughes, Washington Department of Fish and Wildlife**, Andrew Murdoch, Kevin See

*Estimating the Spawning Escapement of Hatchery- and Natural-Origin Spring Chinook Salmon Using Bias Corrected Carcass Recovery Data*

Carcass recoveries are commonly used to generate estimates of the age, sex, and origin compositions of spawning populations. Previous studies have shown that carcass recoveries may not be representative of the spawning population at large; whereby, females have a higher recovery probability than males, and of the males, larger fish have a higher recovery than smaller ones (e.g., jacks and/or mini-jacks spawners). Furthermore, hatchery-origin fish have been shown to return at an earlier age and smaller body size than natural-origin counterparts and, as a result, may negatively bias the proportion of hatchery carcasses recovered on the spawning grounds. We applied the bias corrections generated from our carcass recovery probability model to several years of existing recovery data to develop accurate estimates of spawner demographics and abundances. These results show that correcting for recovery biases in abundance estimates can translate into increased hatchery fish survival while reducing natural-origin survival.

10:15 – 10:30 Q & A

10:30 – 11:00 Break and poster session, including *Strongholds* book signing by Guido Rahr

11:00 – 11:15 **John Crandall, Methow Salmon Recovery Foundation**

*Status of Bull Trout*

In the realm of ESA-listed fish population recovery in the Upper Columbia, bull trout have received noticeably less attention compared to their anadromous counterparts. While it is assumed that much of the anadromous-focused habitat restoration and protection efforts also benefit bull trout, it is necessary to recognize the specific aspects of bull trout life history that differentiate them from other salmonids. Integrating bull trout-centric knowledge into habitat restoration and protection planning is a necessary component of a thoughtful, comprehensive approach to fish recovery in the Upper Columbia region.

Understanding the status and trends of the various local populations inhabiting the Upper Columbia region is an important component of informed species recovery. Yet, only recently have efforts arisen that will more fully support a comprehensive population assessment. This effort will provide information critical to the evaluation of species viability and recovery determination.

11:15 – 11:30 **Tyler Beals, Yakama Nation Fisheries**, Ralph Lampman, Dave'y Lumley

*Pacific Lamprey – Translocation Monitoring in the Upper Columbia*

Pacific Lamprey Entosphenus tridentatus commonly called "eels" by tribal members and others, is an incredibly important species for the Columbia River tribes in terms of food, medicine, and culture. They also serve many roles in the stream ecology, benefiting many, many native species. Pacific Lamprey numbers have declined throughout the Columbia River Basin, and determining the current distribution and relative abundance is a priority for lamprey conservation. Beginning in 2015 Pacific Lamprey distribution changed as a result of adult translocations conducted by the Yakima Nation (Wenatchee and Methow subbasins) and Colville Confederated Tribes (Okanogan Subbasin). In addition, Grant and Douglas County PUDs have begun translocation starting in 2018 in partnership with others. Yakama Nation Fisheries used several tools to assess Pacific Lamprey presence and relative abundance throughout the Mid-Columbia Region, including targeted electrofishing and eDNA sampling. Initial targeted and occupancy electrofishing surveys in 2012-2015 detected no Lamprey in the Wenatchee River upstream of Tumwater Dam, despite records of historic occupancy. Following multiple translocation releases upstream of Tumwater Dam, PIT tag, eDNA, and electrofishing detections indicate that Pacific Lamprey now occupy many river miles in the Wenatchee River and some of its tributaries (including Nason and Icicle creeks). Pacific Lamprey are now also detected in other new locations, including Upper Methow River (upstream of Chewuch River) and Omak Creek (Okanogan Subbasin) where they have been absent for decades or more. In the Okanogan River, juvenile Pacific Lamprey were last documented in 2010. Numbers of Pacific Lamprey at mainstem Columbia River dams in 2017 were the highest since 2002. This large group of spawners, in combination with contributions from translocated adults, may re-define Pacific Lamprey distribution throughout the Mid-Columbia. Finally, information about how to identify lampreys at various life stages and plans for new monitoring in the region will be shared.

11:30 – 11:45 Q & A

## OCEAN & ESTUARY CONDITIONS

11:45 – 12:00 **Brian Burke, NOAA Northwest Fisheries Science Center**

*Mixed Signals: A Report Card from Ocean Surveys in 2019*

For the past 22 years, staff from the NWFSC have been studying the ecology of young salmon when they first enter the ocean to better understand marine growth, migration, and survival. Three projects, covering different spatial and temporal extents, contribute to this effort: the Newport Hydrographic Line (NH Line), the coast-wide Pre-recruit survey, and the Juvenile Salmon and Ocean Ecosystem Survey (JSOES). Results from this year's efforts suggest that ocean conditions for salmon that migrated to sea in 2019 were mixed, with some metrics showing average conditions and others still in an anomalously poor state.

Catch per unit effort of juvenile coho and Chinook salmon was in the middle range of observed values in the last 22 years. Off of Newport, OR, the biomass of the northern species of copepods has been low for several years, but has increased over the past several months to levels not seen since mid-2014. In contrast, our data on winter larval fish biomass, which includes just the nearshore species that tend to dominate during years of high salmon survival, was the 3rd lowest in the 22 year time series. During 'the blob', fish species such as Pacific pompano and jack mackerel (a potentially important salmon predator) were caught regularly in our trawls; in 2019, these species continued a downward trend towards the low levels observed prior to the blob. Nevertheless, the continued presence of pompano and jack mackerel in our surveys suggests that some ecosystem level effects of the blob still linger. Indeed, California market squid only decreased slightly after the blob, and have significantly increased in the last two years, exemplifying the fact that particular biological responses to warm conditions is difficult to anticipate.

12:00 – 12:15 **Catherine Corbett, Lower Columbia Estuary Partnership**

*The Columbia River Estuary: Fish Use, Habitat Status and Restoration Efforts*

Research over the past decade or so has documented the importance of the lower Columbia River to juvenile outmigrating salmon and steelhead. In general, we consistently find subyearling smolts using offchannel emergent marsh habitats for days to weeks (even months) while yearling smolts (and late season subyearlings) use the mainstem for much shorter periods, e.g., 6-7 days. Interior stocks of Chinook, steelhead, and sockeye are consistently well represented in our results, and stomach fullness indicate that both subyearling and yearling smolts benefit from prey produced by lower river marsh habitats. However, the lower Columbia River ecosystem has lost 114,050 acres, approximately 50%, of its native historic habitat since the late 1800's from anthropogenic changes. Over 28,387 acres have been restored or protected by regional partners in the past 20 years, a significant effort to reverse the trajectory of degradation. To ensure our conservation reserve network is protective of common species and provides a basis of recovery for those that are imperiled, we established habitat coverage targets, using generalized conservation biology approaches. The targets include: 1) no net loss of native habitats as of the 2009 baseline and 2) recovery of 40% (i.e., 22,480 acres) of historic extent for priority habitats by 2050. Meeting these targets would increase the overall extent of native habitat to 60% of historic coverage with a range of 45% -88% by river reach. We are presently intentionally integrating climate smart conservation approaches into our restoration program including planning for increased flooding from sea level rise and more intense storms, warming temperatures, and increased summer dry periods. This presentation will briefly touch on conservation biology approaches for integrating shifting climate conditions into conservation reserve networks and how we are integrating climate adaptation measures into individual restoration project designs in the lower Columbia River.

12:15 – 12:30 Q & A

12:30 – 1:30 Lunch - On Your Own

## ADULT MIGRATION

1:30 – 1:45 **Jared Siegel, NOAA Northwest Fisheries Science Center**, Lisa Crozier

*Drivers of steelhead migration behavior and survival in the lower Columbia River*

Many adult summer steelhead encounter high river temperatures in the lower Columbia River during their spawning migration. While some steelhead pass through the lower Columbia River in a matter of days, others use tributary habitats as temperature refuges for periods that can last months. We fit quantitative models to travel time between Bonneville and McNary Dam for each major population group (MPG) in the interior Columbia using PIT tag data from adult return years 2004-2016. The probability of spending weeks to months in the lower Columbia River depended primarily on river temperature and population; for example upper Columbia steelhead were the least likely to delay migration at a given temperature while middle Columbia steelhead were the slowest migrating group. However, migration delay was also associated with dam spill and other fish traits. While upper Columbia steelhead were the least likely to delay migration, their survival to McNary Dam was the most sensitive to high temperatures out of all MPGs. Although high temperatures reduced survival in all populations, survival remained relatively high (73-90%) and consistent from 2004 to 2017, despite record breaking temperatures during this period.

1:45 – 2:00 **Ben Truscott, Washington Department of Fish and Wildlife**, Andrew Murdoch

*Abundance and Migration Success of Overshoot Steelhead in the Upper Columbia River Basin*

The Washington Department of Fish and Wildlife utilizes an instream PIT tag detection site based patch-occupancy model to estimate the abundance of natural and hatchery origin steelhead returning to each population within the Upper Columbia River DPS. Recent improvements to analyses have provided estimates of overshoot adult steelhead from Snake and Mid Columbia River Steelhead DPS populations. Estimates of total steelhead overshoots above Priest Rapids Dam, as well as those that successfully returned to their natal population downstream, are now generated on an annual basis. Additionally, overshoot distribution within the Upper Columbia River DPS, and the relationship between distribution and successful downstream migration will be discussed. Given the prevalence and magnitude of overshoot behavior within steelhead populations, it is critical for overshoot estimates to be incorporated into status and trend monitoring programs, as well as identifying and implementing measures to facilitate downstream movement of adult steelhead in order to minimize impacts to downstream populations.

## JUVENILE MIGRATION

2:00 – 2:15 **Ryan Harnish, Pacific Northwest National Laboratory**, Kenneth Ham, Tao Fun, Xinya Li, John Skalski, Rich Townsend, Jim Lady

*Juvenile Salmon and Steelhead Passage and Survival through the Snake and Columbia River Hydrosystem during Spring Gas Cap Spill, 2018*

A court ruling ordered federal dams on the Snake and Columbia rivers to spill at the maximum level that achieved 115% total dissolved gas (TDG) in the forebays and 120% TDG in the tailraces (i.e., gas cap spill) in 2018. This study was conducted to evaluate the effects of gas cap spill on the passage and inriver survival of yearling Chinook salmon (CH1) and juvenile steelhead (STH) migrating through the Snake and Columbia River hydrosystem. Run-of-river CH1 and STH were collected from the juvenile fish facility at Lower Granite Dam (LGR) and McNary Dam (MCN), implanted with acoustic and PIT tags, and released at multiple locations in the Snake and Columbia rivers. Dead acoustic-tagged hatchery smolts were released at LGR, Little Goose Dam (LGS), MCN, and Bonneville Dam (BON) to estimate dam passage survival using the ViRDCt release-recapture model. Acoustic receiver arrays were deployed to identify route of passage at LGR and LGS and to estimate survival from LGR to MCN, MCN to BON, and LGR to BON.

Spill discharge generally met or exceeded gas cap spill targets throughout the study period. Dam passage survival probability exceeded 0.96 for CH1 and STH at all projects at which that metric was estimated. From LGR to BON, CH1 had an estimated survival probability of 0.5549 (SE = 0.0251) and a median travel time of 9.7 days. STH had an estimated survival of 0.5677 (0.0217) and median travel time of 8.5 days. Comparisons to dam passage, reach, and system-wide survival estimates from past acoustic telemetry studies indicate smolts migrated through the hydrosystem more quickly during the high flow and spill conditions of 2018 than past years. However, the available evidence does not indicate that inriver survival was appreciably higher or that powerhouse passage rates were appreciably lower in 2018.

2:15 – 2:30 **Daniel Rawding, Washington Department of Fish and Wildlife**

*A Multistate Model to Estimate Upper Columbia River Spring Chinook Life Cycle Survival from Passive Integrated Transponder Tagging and Detection*

The Upper Columbia River spring Chinook Evolutionary Significant Unit (ESU) was listed for protection under the US Endangered Species Act in 1999 and a recovery plan was developed to rebuild the spring Chinook Salmon in the ESU. Despite over 15 years of efforts, in the last status review NOAA Fisheries concluded this ESU remained at a high extinction risk. We developed an integrated population life cycle model that uses Passive Integrated Transponder (PIT) tagged parr and smolts in the Methow, Entiat, and Wenatchee rivers to estimate survival from tagging to adult return in each of these rivers. We present the juvenile and adult reach survival estimates for Upper Columbia spring Chinook Salmon from this model.

2:30 – 2:45 **Timothy Copeland, Idaho Department of Fish and Game**

*Salmon Were Made To Move: Downstream Rearing in Interior Stocks of Chinook Salmon and Steelhead*

The classic view of stream-type salmon was that early emigrants were viewed as poor competitors that did not contribute appreciably to the population, whereas successful individuals resided in their natal reaches until smoltification. Recent work has shown there is more diversity in successful juvenile rearing patterns than previously thought. These patterns are important considerations for effective conservation and restoration. Conceptually, there are several reasons why individuals would take advantage of suitable habitat downstream, especially for steelhead. I present selected case studies of Chinook Salmon and steelhead populations to illustrate the extent and contrast in patterns of downstream rearing in Idaho. In general, most juvenile spring/summer Chinook Salmon leave their natal reaches before winter and smolt the following spring. Significant winter mortality has been observed for these fish but they often survive to adult return better. Seasonal patterns are more ambiguous for steelhead but successful smolts have been documented spending up to three winters in downstream habitats. The importance of downstream rearing to steelhead populations seems to depend on elevation and hydrology. The foregoing patterns have implications for restoration strategies. Restoration in natal reaches provides stability, which is important to preserve the target population. Natal reach restoration can increase productivity by reducing movement costs to the population because individuals are less exposed to risk. Alternatively, it could produce more robust emigrants that perform better when they go downstream. Restoration downstream can provide greater opportunities for population growth, which is important for recovery. Downstream restoration effectively increases connectivity and allows the population to expand the resources it can access. Downstream restoration may decrease winter mortality or address known or suspected constraining reaches. These examples show that a robust conservation program should consider multiple strategies in order to protect and recover target populations.

2:45 – 3:00 Q & A

3:00 – 3:30 Break and Poster Session

3:30 – 3:45 **Plenary Talk – John Sirois, Upper Columbia United Tribes**, Conor Giorgi, Casey Baldwin, Thomas Biladeau

*Reintroduction of Salmon to the Upper Columbia River*

The Upper Columbia United Tribes (UCUT) member tribes and their partners have completed the first Phase of the reintroduction of salmon into the upper Columbia River Basin; investigating potential donor stocks of salmon, risks of reintroduction, habitat conditions within the U.S. portion of the blocked area, life-cycle modeling of reintroduced stocks and potential fish passage facilities across Chief Joseph and Grand Coulee hydroelectric projects.

These assessments provide a foundation upon which the reintroduction process can build, highlighting management actions that are likely to be successful for reintroducing anadromous fish into the upper Columbia River watershed. Results from these assessments suggest the UCUT, in coordination with appropriate action agencies, proceed to Phase II of the reintroduction process where hypotheses generated from model results can be tested through experimental salmon releases.

## PREDATION

3:45 – 4:00 **Stan Gregory, NWPCC Independent Scientific Advisory Board**, Dr. Steve Schroder

*ISAB Review of Predation Impacts and Management Effectiveness for the Columbia River Basin*

The Independent Scientific Advisory Board (ISAB) recently reviewed the biological and economic impacts of native and non-native predators, effectiveness of control efforts, and potential impacts of northern pike. We recommended development of an ecosystem-wide, multi-predator, multi-prey approach for understanding predation impacts.

The current efficacy of the pikeminnow control program is unknown and needs to be updated and do more than count pikeminnow removed. Large numbers of Caspian terns and double-crested cormorants are believed to be one of the greatest sources of mortality for emigrating juvenile steelhead and yearling Chinook salmon from the upper Columbia River. Lethal removal of sea lions may provide relief at Bonneville Dam and Willamette Falls, but its efficacy must be assessed as part of a Basin-wide predation evaluation.

Northern pike are likely to substantially reduce salmonid abundance, especially in low-gradient river segments with wide floodplains. Even with the best predator management, pike likely will invade lower anadromous reaches eventually. Nevertheless, reducing the numbers of fish emigrating from Lake Roosevelt is likely to reduce the chances that pike will establish new populations downstream and hence delay the invasion. It is essential to develop an early detection monitoring program and a rapid eradication response program. Control efforts will need to be extensive and continuous to successfully reduce mortality of salmonids.

Evaluation of predator control programs must do more than simply count the number of predators removed. Compensatory mortality is the most important uncertainty to address when developing predation management plans. Predation evaluation must monitor responses from other predators to the predator removals and evaluate responses of the salmon over the remainder of its life cycle. A basin-wide, ecosystem-based approach for assessing and managing predators collectively is needed to create more effective predator-control actions.

4:00 – 4:15 **Erika Rubenson, Four Peaks Environmental Science & Data Solutions**, Julian Olden, Joshua Murauskas, Joseph Miller

*Using eDNA to determine the distribution of an invasive species at broad scales in the Columbia River Basin*

Nonnative species are a leading threat to native salmonid species throughout the Columbia River Basin, and climate change, illegal introductions, and habitat alteration are contributing to increases to many nonnative species distributions. Protecting critical salmonid habitat from invasion can be greatly enhanced by predictive models that highlight regions most at risk, especially when paired with tools that enable early detection. Unfortunately, management-relevant distribution data are largely lacking for most invasive species and early detection is complicated by the scale of the problem. To address this, we combined species distribution modeling with environment DNA (eDNA) to locate range boundary regions of smallmouth bass (Micropterus dolomieu), a widespread nonnative predator in the Columbia River Basin, and evaluate its overlap with native salmonids throughout the entire Columbia River Basin. We predicted that smallmouth bass is currently distributed across approximately 18,000 river kilometers and overlaps with 3-62% of rearing habitat of salmonids (species dependent). Under a moderate climate change scenario, smallmouth bass is predicted to expand its range by two-thirds, totaling approximately 30,000 river kilometers by 2080. Basin-wide models were sufficiently accurate to identify upstream invasion extents to within 15 km of the eDNA-based boundary and including eDNA data improved model performance at critical range boundary regions. Our research highlights how eDNA approaches can supplement large geospatial datasets to result in more accurate modeling predictions and can also provide rapid detection of small populations in large streams throughout the Columbia River Basin. These techniques could easily be transferred to other species of interest, including northern pike, walleye, or channel catfish, guiding future nonnative species management efforts.

4:15 – 4:45 **Plenary Talk – Matt Polacek, Washington Department of Fish and Wildlife**, David Beauchamp, Carlos Polivka

*Stream-and Lake Rearing Strategies of Spring Chinook in the Lake Wenatchee Basin*

Spring Chinook Oncorhynchus tshawytscha spawn in the White and Little Wenatchee Rivers and express two life history strategies prior to migrating out of the lake in the spring as smolts; 1) rear in their natal river and 2) migrate into the lake to overwinter. Both strategies offer unique survival and potential growth trade-offs. Northern Pikeminnow Ptychocheilus oregonesis and Bull Trout Salvelinis confluentus are the apex fish predators in Lake Wenatchee. High densities of juvenile Sockeye Salmon Oncorhynchus nerka and littoral fishes provide annual forage in the lake. The extent of predation on juvenile Spring Chinook Salmon is unknown. The objectives were to 1) estimate the predatory impact on Spring Chinook Salmon as they rear and migrate through the lake, 2) estimated the relative contribution and fate of different life history strategies to smolt production, and 3) examine patterns consistent with the prediction that predators modulate the vigilance behaviors of sub-yearling Chinook.

Northern Pikeminnow and Bull Trout occupied similar habitats and depth strata as sub-yearling Chinook, and their numbers increased near the outlet as salmon migration peaked. Bull Trout consumed primarily Sockeye with 4% of their diet consisting of Chinook salmon, while no Chinook were detected in Northern Pikeminnow diets. Seasonal and habitat-specific scale growth comparisons suggested strong size selective mortality against Chinook that reared primarily in nearshore lake habitats during summer-fall. First year growth for juvenile Chinook was slower in the Little Wenatchee River than in the White River, and nearshore lake-rearing juveniles were significantly smaller than in the streams. Growth trajectories of outmigrating smolts in spring were significantly larger than the smolts migrating down the White River during spring, suggesting that these larger individuals overwintered in the lake. The most common growth strategy contributing outmigrating smolts from the lake system appeared to be the faster-growing White River juveniles that grew primarily in the stream then overwintered in the lake. Based on stable isotope signatures, 5% of Spring Chinook smolts reared primarily in pelagic lake habitat. They exhibited similar mean size to other Spring Chinook smolts but weighed nearly twice as much as the concurrently outmigrating Sockeye smolts that had co-occurred in pelagic habitats the previous growing season. In addition to lethal effects, non-lethal effects of predators can determine the behavior and habitat use of prey. Time and energy invested in predator detection instead of foraging affects life history traits that may be correlated with future fitness. This conceptual framework describes both how the allocation of risk-taking may affect among-individual variation in body condition and how that variation may have consequences at the population level. Preliminary data from sub-yearling Chinook in Lake Wenatchee and the tributaries were consistent with these predictions.

4:45 – 5:00 Q & A

5:00 Adjourn

5:30 – 9:00 Social Event at Pybus Public Market – Visit uc2020.org/social for information

## THURSDAY 1/23

7:00 – 10:00 Registration Open

7:00 – 8:10 Morning Social and Welcoming Remarks

8:10 – 8:45 **Keynote Speaker – Dr. Ellen Wohl, Colorado State University**

*Messy Rivers are Healthy Rivers: The Role of Spatial Heterogeneity in Sustaining River Ecosystem Processes*

Perceptions of river health are strongly influenced by expectations regarding a natural river. Many observers expect clear water, a slightly sinuous river with pools and riffles, and some riparian trees. River health, however, is much more complicated and multifaceted. The physical appearance of a river, for example, depends strongly on geomorphic context and river history. I use mountainous headwater rivers in Colorado to examine the influence of physical complexity on river health. Complexity can be described with respect to the stream bed, banks, cross-sectional form, and planform of the river and floodplain. The configuration of each of these components of a riverine system has implications for habitat abundance and diversity, sensitivity and resilience of the river to natural and human-induced disturbances, retention of water, sediment and nutrients, and connectivity within the riverine system and between the river and adjacent uplands. Many types of resource use simplify rivers to the point that the river undergoes a metamorphosis, or a thorough, sustained change in channel form and function. Loss of beaver dams and channel-spanning logjams in mountainous headwater rivers in Colorado, for example, has resulted in metamorphosis of physically complex, anastomosing channels that were highly connected to adjacent floodplains. These rivers have assumed an alternate stable state as single-thread channels with limited retention and resilience. Effective, sustainable river restoration involves (i) characterizing the magnitude of different forms of physical complexity naturally present in a particular river segment, (ii) understanding the effects of physical complexity on river ecosystem function, and (iii) assessing the degree to which this level of physical complexity can be restored or mimicked. An important part of this process may be educating stakeholders regarding the importance of physical complexity – messiness – in healthy rivers.

*About Dr. Ellen Wohl*

Dr. Wohl is a native of Ohio. She received a Bachelor of Science in geology from Arizona State University and a PhD in geosciences from the University of Arizona. She has been on the faculty at Colorado State University since 1989. Dr. Wohl has conducted fieldwork worldwide, and her research focuses on rivers, including the effects of beavers on river process and form. She is a Fellow of the American Geophysical Union and the Geological Society of America.

## WATERSHEDS

8:45 – 9:00 **Alexa Whipple, Methow Beaver Project**

*MBP Reboot: 10 Years of Partnering with Beavers for Watershed Restoration, What We've Learned & Where We're Headed*

MBP takes the lessons learned from a decade of beaver relocation and watershed restoration and applies them to today's pressing restoration questions including overall success of beaver relocations, current conditions, landscape priorities, coexistence with salmon, predictive modeling and future directions. Find out what all the "dam" fuss is about regarding the next generation of beaver mediated watershed conservation and restoration in the Pacific Northwest with the Methow Beaver Project.

9:00 – 9:15 **John Arterburn, Confederated Tribes of the Colville Reservation**, Ryan Klett

*Habitat changes at the watershed and subwatershed scale that impact salmonid survival in the Okanogan Subbasin*

The Okanogan Basin Monitoring and Evaluation Program (OBMEP) is a multi-decadal program which monitors salmon and summer steelhead and their respective habitats at the current extent of anadromy in the upper Columbia River. OBMEP integrates habitat monitoring data with a habitat performance model and a status and trends reporting tool utilizing a hierarchical spatial structure that provides information at both the subwatershed (HUC6) and watershed scales (HUC4). We used this reporting platform and model to predict 2040 climate change scenario changes in terms of summer steelhead habitat-based VSP criteria under a predicted at the watershed scale and what our current 2018 scenario shows for this population. Before showing more detailed results related to recent dramatic changes in habitat type and quality and how these changes have specifically impaired summer steelhead in two Okanogan River subwatersheds both in terms of modeled results and photographs of the sampled sites.

9:15 – 9:30 **Ryan Klett, Confederated Tribes of the Colville Reservation**, John Arterburn

*An investigation of stream habitat survey techniques utilizing orthophotography and Structure-from-Motion (SfM) derived digital surface models captured via unmanned aerial vehicle (UAV)*

Utilizing unmanned aerial vehicles (UAV's) to capture and describe stream habitat features offers promise to increase the efficiency, accuracy and consistency of existing survey methods. We evaluated the use of UAV captured orthophotography and Structure-from-Motion (SfM) digital surface models (DSM) to supplement and/or replace traditional stream survey methods on a moderately complex 2 km reach of the Similkameen River, WA. We found that habitat features including channel bathymetry and canopy structure were apparent in the DSM and

successfully captured and utilized high resolution (2.5cm pixel) orthophotography. Results from this investigation suggest that supplementing habitat surveys with a UAV component is appropriate and beneficial in some circumstances, but that several limitations to full implementation exist.

9:30 – 9:45 Q & A

9:45 – 10:15 Break and Poster Session

## HABITAT

10:15 – 10:45 **Plenary Talk – Rebecca Flitcroft, U.S. Forest Service PNW Research Station**

*Disturbance: hitting the habitat reset button*

Fishes native to the Pacific Northwest are adapted to natural disturbance regimes that create dynamic habitat patterns over space and time. Mechanisms for natural disturbance are integral to natural processes through periodic inputs of organic and inorganic material into the aquatic ecosystem. This includes naturally occurring wildfire under historic wildfire return intervals and intensities. Landslides are another important disturbance mechanism that contribute sediment and wood to stream channels. A variety of adaptive strategies from movement, shifts in life stage development timelines, and use of alternative habitats allowed many native fishes to thrive under dynamic landscape conditions. Human land use, particularly long-term fire suppression and road building, has altered disturbance regimes and the mechanisms for sediment delivery to streams. Land management has often included the installation of barriers to fish movement and migration, thereby compromising one of the strongest adaptive behaviors of highly migratory fishes. Restoration that enhances adaptive behaviors of fishes and rejuvenates habitats are likely to be most effective in enhancing population-scale recovery of native fishes. Such work allows for the expression of life history behaviors in native fishes coincident with higher functioning ecosystems.

10:45 – 11:00 **Aimee Fullerton, NOAA Fisheries Northwest Fisheries Science Center**, Christian Torgersen, Ashley Steel

*Synthesizing stream temperature research for managing thermal habitats for Pacific salmon*

Spatiotemporal variability is prevalent in natural thermal regimes, and Pacific salmon and steelhead are adapted to these diverse thermal landscapes. Projections about suitable thermal habitats in the future suggest negative responses by salmon to continued changes in land use and climate. Water temperature is generally expected to increase and summer flows will likely decrease, but there is uncertainty about the spatial organization and magnitude of these changes and how they will influence salmon and their management. Current approaches

for understanding and predicting thermal diversity in rivers require multiple data types and methods. We introduce a stream temperature handbook that can be used by practitioners to navigate the wide array of data and models available for addressing management questions about thermal regimes in rivers. We synthesize advances, insights, and ecological application of empirical monitoring (temporal patterns from in-situ sensors and spatial patterns from remote sensing) and modeling (statistical and process-based approaches that integrate space and time). We illustrate some ways that salmon may respond to existing and future thermal landscapes using species- and life stage-specific thermal facets and by considering connectivity among thermally suitable habitats. We also describe results from individual-based modeling that explicitly incorporates fish movement and integrates thermal exposure and other stressors across life stages to evaluate effects of land use and climate scenarios on growth and survival. We draw examples from our work in watersheds throughout the Pacific Northwest, including the Wenatchee River Basin, that were made possible by partnerships that have leveraged resources and expertise.

11:00 – 11:15 **Adrienne Roumasset, Chelan County Natural Resources Department**, Lucius Cadwell

*Wenatchee Basin Thermal Refuge Assessment*

Chelan County Natural Resources Department (CCNRD) is in the final stages of compiling a Thermal Refuge Assessment, which will include location and restoration recommendations for thermal anomalies that are potential thermal refuge (now or future) for ESA-listed salmonid species. Assessment reaches are spring Chinook major spawning areas that are listed for temperature impairments, which includes a total of 50 river miles in the Upper Wenatchee basin. Field work was completed by CCNRD staff and included cold spot checking using a quick response thermometer, continuous longitudinal temperature profiles, and fixed temperature loggers. Cold spots were areas with at least a 1.5°C temperature differentials. Habitat measurements were collected on each confirmed cold spot and included two-dimensional plume size. Staff used Thermal Infrared (TIR) imagery from 2001 –2003, stream network data, and aerial imagery to help locate spots, but found several "surprises" that were not indicated on any prior data set. Results include continuous temperature profiles on 95% of surveyed reaches, location and habitat data for 21 cold seeps and 17 cold tributary confluences. "Winter" Thermal Infrared (TIR) imagery was also collected on a total of 3 river km of the Entiat and Upper Wenatchee rivers in early March 2018. This method presented several problems and as a result many lessons were learned. CCNRD is working with Cramer Sciences, LLC to develop recommended actions. The assessment (spring 2020) will include an online, public data portal that will feature location, information and recommended actions for all cold spots with associated habitat data, temperature information, and recommended actions in addition to a written Assessment. The project is a partnership between Chelan County, the UCSRB, Washington State RCO, and the Washington Department of Ecology and is one of the region's first step to restoration planning explicitly targeted at increasing the capacity of thermal refuge areas.

11:15 – 11:30 Q & A

11:30 – 12:00 **Plenary Talk – Maisie Richards, Inter-Fluve**

*Art over Acronyms: Using visuals for effective science communication*

River systems are complex. As we work to increase our understanding of these systems, improve our designs, and challenge our assumptions, we often struggle to find ways to communicate to people with differing experiences and backgrounds. It may feel as though the more we learn, the harder it is to describe our thought process to people who don't live and breathe rivers, but who nonetheless are key partners in restoration. Furthermore, within our discipline, our terminology gets increasingly specific and riddled with jargon. This language can exclude audiences that are crucial to include in the conversation.

Visual communication– a tradition well practiced by the original riverkeepers of the Columbia– can provide language that spans multiple disciplines, and includes rather than excludes. With approximately 65% of the population being visual learners, our work in river restoration needs to be effectively translated into the visual language. This can come in many forms including conceptual renderings, process diagrams and graphically facilitated conversations.

With the effectiveness and sustainability of our projects directly dependent on the willingness of landowners and stakeholders, strong visual communication can be the key to welcoming people to the conversation and increasing understanding. During this talk Maisie Richards, fluvial geomorphologist and illustrator, will demonstrate static examples of visual communication–such as concept renderings and process diagrams– and dynamic tools such as graphic recording. Attendees will leave this talk with tangible ideas for how to use visual language to improve communication and foster project involvement.

12:00 – 1:00 Lunch - On Your Own

## FLOODPLAINS

1:00 – 1:30 **Plenary Talk – Carson Jeffres, UC Davis Center for Watershed Sciences**

*Floodplains in the Foodscape: Physical Process to Productivity*

Floodplains are ephemerally flooded habitats that function neither solely as lentic or lotic habitats, but have process of each that result in exceptionally productive food webs. The seasonal flood pulse in western North American generally coincides with outmigration of juvenile salmonids from upstream spawning and rearing habitats and can provide significant food resources for rapid growth rates prior to entering downstream estuary and marine environments. During flood events, riverine waters slowly flow across the landscape and allow for increased water substrate interaction, facilitating decomposition of terrestrial material. As terrestrial material decomposes, it fuels a heterotrophic food web that results in prolific

zooplankton production. In addition to the heterotrophic pathway, the slowed water drops sediment and clears, thus resulting in in-situ autotrophic production through phytoplankton and algae. With parallel productive pathways of carbon sourcing, there is ample carbon to support prolific production of large bodied zooplankton and invertebrates which provide food resources for juvenile salmonids. The ephemeral nature of floodplain habitats allows for large bodied cladocerans such as Daphnia pulex to flourish. Under a permanently wetted environment such as lakes, permanent residents would graze the large bodied zooplankton and ultimately select for smaller bodied zooplankton. But the ephemeral nature of floodplains does not allow for permanent top-down grazing pressure and allows for the seasonal resource pulse that juvenile salmonids are able to utilize. Floodplains, as all habitats for juvenile salmon, are critical to maintaining salmon populations. Understanding how floodplains fit into the salmon foodscape in a river network can help guide management of imperiled salmon populations.

1:30 – 1:45 **Morgan Bond, NOAA Northwest Fisheries Science Center**, Tyler Nodine, Tim Beechie, Rich Zabel

*Estimating the benefits of widespread floodplain reconnection for riverine habitat in the Columbia River basin*

A primary step in understanding the rearing or spawning capacity of streams is estimating the quantity and quality of riverine habitat across the landscape. Estimating large-scale stream habitat is a challenge because although stream network models exist for the CRB (e.g. the National Hydrography Dataset), these models do not quantify the amount or diversity of habitats used by salmonids. Using satellite imagery, we measured mainstem and side channel habitats at 2093 CRB stream reaches to construct random forest models of habitat based on geomorphic and regional characteristics. We then predicted mainstem and side channel habitats at all reaches throughout the CRB. Connected floodplain width was the most important factor for determining side channel presence, and was predicted by the National Land Cover Database (NLCD) land cover. We estimated a current CRB-wide decrease in side channel habitat area of 26% from historical conditions. Using NLCD data to estimate floodplain lost from anthropogenic activities, we found that reconnection of historical floodplains currently used for agriculture (cropland, rangeland) could increase side channel habitat by 25%. In addition, we used spring Chinook parr densities to estimate rearing capacity. Increasing active channel width in areas currently limited by agriculture could increase CRB-wide rearing capacity by 9% over current estimates. However, the benefit of floodplain reconnection varies greatly by sub-basin, with natural confinement limiting floodplains in many regions, while others have potential for substantial habitat increases if released from artificial confinement. Finally, we found that while some streams had extensive historical floodplains, much of the beneficial side-channel habitat could be created with reclamation of a fraction of the historical width.

1:45 – 2:00 **Johan Hogervorst, U.S. Fish and Wildlife Service**

*The Long Road to Stage 0*

River restoration has traditionally focused on maintaining sediment transport through a comparatively stable, single-thread channel connected to its floodplain during relatively infrequent flows. One of the common success criteria for a single-thread channel was, and remains, avoidance of aggradation and degradation through time. More recently, there has been recognition by the scientific community that increased floodplain connectivity is correlated to increased habitat complexity through fully integrated wetland-floodplain-channel systems; however, this level of connectivity is also associated with aggrading, depositional environments. Stage 0 (Cluer and Thorne, 2013) is a concept that recognizes the importance of the fundamental depositional processes that create and maintain alluvial valleys. Many depositional valleys have been converted into efficient transport reaches, either through incision or direct channel confinement. Restoring to a Stage 0 condition is becoming a more common goal, although there are numerous pathways to achieve this goal that are driven by site constraints, level of degradation, budget, time, and patience. This talk will recount the evolution of restoration techniques in the Pacific Northwest, and describe how a group of restoration practitioners made the slow transition from designing and implementing single-thread transport channels to construction of multi-thread depositional reaches.

2:00 – 2:15 **Phil Roni, Cramer Fish Sciences**, Jason Hall, D. Arterburn

*Advances in monitoring floodplain restoration projects: what has changed in the last twenty years and how should monitor future projects*

Floodplains are some of the most ecologically important and human impacted habitats throughout the world. Large efforts are underway not only in the Upper Columbia, but in North America, Europe, Australia, and elsewhere to restore floodplain habitats to increase fish and aquatic biota and restore ecological diversity. The scale, number, and complexity of floodplain restoration projects has increased dramatically in the last 20 year as has the need for rigorous monitoring and evaluation to demonstrate effectiveness and guide future efforts. Moreover, technological advances in remote sensing, genetics, and fish marking have been evolving rapidly and there is need to update guidance on the best methods for monitoring physical and biological response to floodplain restoration. A comprehensive review of the restoration literature located 180 papers that specifically examined the effectiveness of various floodplain restoration techniques; most of these papers were published in the last 20 years. The various methods historically and currently used to evaluate the physical (channel and floodplain morphology, sediment, flow, temperature, and nutrients), and biological (fish, invertebrates, and aquatic and riparian plants) effectiveness of floodplain restoration were reviewed and used to provide recommendations for future monitoring. For each major physical and biological monitoring method, we discuss their importance, how they have historically been used to evaluate floodplain restoration, newer methodologies, and limitations or advantages of different

methodologies and approaches. We then discuss monitoring the effectiveness of small (2 km of main channel length) floodplain projects, with recommendations for various study designs, parameters, and monitoring methodologies. Finally, we present specific examples from ongoing monitoring in the Upper Columbia and elsewhere in the Columbia Basin.

2:15 – 2:30 Q & A

2:30 – 3:00 Break

## RESTORATION & PRIORITIZATION

3:00 – 3:30 **Plenary Talk – Warren Colyer, Trout Unlimited**

*The restoration intensity continuum: can the water do the work, or do we need the big yellow machines?*

The practice of restoring rivers and streams has evolved much in recent decades. Trout Unlimited has evolved, as well, from volunteers spending weekends rolling rocks into their favorite streams to increase cover for trout, to over 200 professional staff developing, designing and implementing watershed-scale projects to restore hydrologic and fluvial processes in streams and rivers across the country. Our members are still the engine that drives the organization, but now they are complemented by a staff of professional project managers, engineers, ecologists, and water quality and instream flow specialists. Together with partners we raise millions of dollars, volunteer thousands of hours, and restore hundreds of stream miles every year. In this presentation we will describe some of the tools we use, from the passive restoration projects that change land use, to low-intensity "hand-tool" projects that encourage beaver activity and increase instream wood, to massive construction projects that rebuild valley bottoms. The specific restoration approach is dictated by both ecological objectives and project-specific constraints, but the common thread among them is a focus on restoring the natural processes that build and maintain healthy habitat to support trout and salmon.

3:30 – 3:45 **Mackenzie Butler, Inter-Fluve**, Mitch Mumma, Jeff McLaughlin, Gardner Johnston, Tracy Hillman

*Methow Subbasin Habitat Effectiveness Monitoring*

The recent Methow Subbasin Habitat Effectiveness Monitoring Report (2019) summarizes the research, monitoring, and evaluation (RM&E) activities associated with tributary habitat improvements supporting salmon and steelhead in the Methow Basin that are listed under the Endangered Species Act (ESA). Numerous entities have implemented a host of aquatic habitat enhancement actions in the Methow Subbasin over the past two decades. These actions span a wide range of types, intensities, and sizes, and have resulted in a range of ecological responses. This talk will begin with a brief summary of the ESA-listed salmon and

trout status and trends monitoring in the Methow, especially as they relate to the effectiveness of habitat enhancement actions in improving fish population performance, and discuss relevant key findings summarized from action effectiveness monitoring, scientific studies and ecological models conducted in the Subbasin. The talk will conclude with lessons learned and recommendations to natural resource managers, including suggestions for future enhancement actions and prioritizations, pre-project assessments, and research and monitoring methods in the Subbasin. While this work is based on specific research in the Methow, these lessons learned and recommendations are relevant to future monitoring and enhancement action development efforts in other Upper Columbia watersheds.

3:45 – 4:00 **Jeff Jorgensen, NOAA Northwest Fisheries Science Center**

*Closing the loop: applications of life cycle models for evaluating management questions*

Across the Pacific Northwest, information has been and continues to be collected on salmonids, their habitats, and environmental conditions. This information comes from experimental and observational field studies of fishes and their habitats, fish tagging and tag detections, laboratory investigations, remotely-sensed data, and from ocean surveys. And, existing and emerging techniques allow us to quantify changes to habitats through sophisticated climate and hydrology modeling. Life cycle models are a useful framework to 'close the loop' by integrating information about fish and their freshwater and marine habitats. They provide a method to estimate effects from changing climate conditions, to evaluate restoration strategies, and to explore potential effects from management alternatives. For example, we have used life cycle models of Upper Willamette River Basin populations to assess potential effects of climate and evaluated the importance of habitat above flood control projects. In the Chehalis basin, we used detailed habitat modeling to compare restoration strategy alternatives. In the Upper Columbia, the Wenatchee River Basin spring Chinook salmon life cycle model has been used to evaluate possible alternatives for BPA targeted solicitation, for informing the Biological Opinion, and its associated EIS. These and other examples have shown the value of this tool to inform management questions.

4:00 – 4:15 **Greer Maier, Upper Columbia Salmon Recovery Board**, Tracy Tillman

*Finding Focus in Shared Science: How new information is informing the future of salmon recovery in the Upper Columbia*

Over the past 20 years the UCSRB has worked to put science on the ground in the Upper Columbia. Recently, this effort has led to the completion of comprehensive reports on Habitat (2014), Hatcheries (2017), Hydropower (2019), and Harvest (expected early 2020). At the same time, data and information being collected on the ground has been put to use prioritizing habitat restoration and protection actions. These efforts, alongside the robust RM&E programs being supported and implemented by local and regional partners are setting the stage for the next 10 years of recovery efforts.

The Upper Columbia can be seen as a model for how good data and good collaboration between scientists, managers, and practitioners can work to frame the future for salmon recovery. The challenge will be how to use this information and the power of our partnerships to frame and facilitate the conversations that are necessary to truly achieve the recovery goals we have set out for the region.

4:15 – 4:30 Q & A

4:30 Closing Remarks

## POSTER SESSION

*Posters will be set up in the lobby of the Conference Center and authors will be on-hand to answer questions during the two morning breaks.*

### MONITORING

**Wesley Tibbits, Confederated Tribe of the Colville Reservation**, Brooklyn Hudson, John Arterburn

*Evaluation of coded wire body tag (CWT) retention with runs of summer steelhead in the Upper Columbia River Basin*

Identified in regional overviews of codded wire tagging of anadromous steelhead is the need for standards in tagging levels, tagging techniques, improved tag loss estimates, and the accuracy of counts of released fish. In this study we looked at tag retention of coded wire tags (CWT) placed intramuscularly in hatchery summer steelhead. Fish were captured and sampled during migration; after juvenile release to adult recovery. Preliminary results identified the average tag retention (no tag loss) to be 96.27 percent for adult returns from 134 fish sampled over a period of six release years. Tag retention in juvenile steelhead averaged 99.05 percent over two sample years. Our preliminary results indicate that coded wire body tagging could be used as an effective marking tool for quick identification of fish stocks when it is desirable to keep fish alive. Size of fish at tagging and dorsal ventral placement of tags was also looked at during this study.

**Tatum Gunn, Confederated Tribes of the Colville Reservation**, John Pakootas, Vertis Campbell, Jesse Marchand

*Pit tagging chinook salmon*

Our topic for the day is pit tagging Chinook salmon how it is important for us. Plus the data we can use to help us try and figure the percentage of our out migrant that make it two the ocean that we have tagged and percentage that return that we have tagged. Plus the two different methods we use from screw trapping to beach seining.

**Hayley Muir, U.S. Fish and Wildlife Service**, Christopher Griffith, Michael Murray, Mathew Maxey, Matt Cooper

*Refining Hatchery Salmonid Enumeration Techniques using Passive Integrated Transponder (PIT) Tags*

Leavenworth NFH, like many hatcheries, can suffer from undocumented predation during rearing on-station prior to release. This results in lower than reported in-hatchery survival and reduced smolt-to-adult return metrics. Our study describes a methodology that utilizes known fish tagged early in the rearing cycle (prior to overwinter predation) followed by a passive census of fish to accurately estimate predation using PIT antenna arrays at release. The results from our study quantify levels of predation and can describe where predation is occurring on-station. It is important to share this effort with the local fisheries community as results could refine future hatchery predation studies and increase the accuracy of data fundamental to evaluating propagation programs such as fish release and return estimates.

**Hannah Mortensen, Wapato Valley Mitigation and Conservation Bank**, Kelley Jorgensen

*Monitoring thermal refugia and groundwater inputs to inform large-scale floodplain habitat restoration*

Salmon recovery in the Columbia River is limited by increasing water temperature. Migrating salmon and steelhead require thermal refuge throughout their range for adults returning to spawn, and for juveniles rearing and outmigrating. Wapato Valley Mitigation and Conservation Bank (Wapato Valley), located in the Columbia River floodplain at the confluence of the Lewis River at river mile 87, is restoring 876- acres of diverse floodplain habitat types including off-channel areas for rearing juvenile salmonids, wetlands, Oregon white oak woodlands, and streaked-horned lark breeding areas. The Lewis River has been identified as one of only a handful of cold-water tributaries to the lower Columbia (below Bonneville Dam). As part of the restoration design process, Wapato Valley has been monitoring baseline water temperature and water level data across the site to identify areas of cold-water input that could benefit salmonids with the removal of habitat barriers. Five years of baseline data collection have demonstrated that the floodplain at Wapato Valley is influenced by groundwater including seeps and springs and groundwater fed beaver-created channels, and hyporheic inputs from the adjacent Columbia and Lewis Rivers.

Temperature data was collected over five years using twenty water data loggers deployed in surface water and ground water locations, including impounded sites and connected side-channels, floodplain wetlands where beavers were intercepting groundwater by digging channels, Gee Creek, the Lewis River and the Columbia River. The data shows seasonal trends in water temperature and documents a high degree of interannual temperature variability driven by water surface elevation, snow pack and precipitation, and river management. Extensive baseline data collection enables Wapato Valley to measure changes in temperature after habitat restoration to document performance standards in the ten years of required post construction monitoring.

**John Box, U.S. Fish and Wildlife Service**

*Differences in juvenile release behavior in 1-year and 2-year smolt summer steelhead at Winthrop National Fish Hatchery*

Winthrop National Fish Hatchery (WNFH) transitioned its 1-year steelhead program to a local, upriver "Methow Stock" program, necessitating a 2-year smolt rearing strategy. This followed hatchery reform recommendations from the USFWS Columbia Basin Hatchery Review Team (HRT) and the Hatchery Scientific Review Group (HSRG). The goal was to integrate the natural and hatchery populations, maintain local population structure, and reduce hatchery based domestication of the Methow population One of the primary impacts of hatchery programs is when hatchery released fish do not migrate out to the ocean. This is referred to as residualism. This occurs in a 1-year smolt program primarily due to an inability to raise juveniles to a smolt stage. To reduce residualism juveniles were released using a volitional release. This method was successful at retaining the immature parr that were the predominate type of residual. As WNFH transitioned to the 2-year smolt program it became clear that residuals were now more likely to be precocial parr(sexually mature). Precocial parr do not tend to stay in their raceways through the volitional release. Juvenile monitoring in cooperation with NOAA's Northwest Fisheries Science Center staff has allowed a clearer understanding of precocial parr migration timing as well as additional studies relating to mitigation of precocial parr residualism.

## BIOLOGY & ECOLOGY

**Jose Vazquez, U.S. Fish and Wildlife Service**, R.D. Nelle, Thomas Franklin, Kevin McKelvey, Michael Schwartz, Michael Young

*Assessment of Bull Trout Distributions in the Upper Entiat Basin through the use of Environmental DNA Analysis*

Environmental DNA (eDNA) analysis offers an efficient means of assessing rare aquatic species distributions in large geographic areas. The USFWS-MCFWCO has been using eDNA analysis to assess Bull Trout distributions in the Upper Columbia Basin since 2016. Recent regions of study include the Upper Entiat Basin, where the imperiled Entiat River migratory Bull Trout population is thought to be restricted to 9.2 rkm of spawning and rearing habitat below Entiat Falls, a putative Bull Trout barrier. In the fall of 2017, eDNA samples were collected from approximately 56 rkm of potential Bull Trout habitat upstream of Entiat Falls, representing the first census of potential Bull Trout habitat above the putative barrier. Quantitate PCR analysis did not detect Bull Trout DNA in any of the collected samples, implying that spawning or rearing Bull Trout were likely not present above Entiat Falls. Our results provide valuable distribution information about the Entiat River Bull Trout population, and imply that a large portion of the Entiat River's potential Bull Trout habitat is likely not occupied by the species.

**Carlos Polivka, U.S. Forest Service PNW Research Station**, Rachel D. Hosman, David A. Beauchamp, Matthew Polacek, Jennifer Hadersberger

*Non-lethal effects of predation risk on sub-yearling Chinook salmon in Lake Wenatchee, Washington*

Non-lethal effects of predators affect the behavior of prey species, resulting in an "ecology of fear" where habitat use, vigilance, and foraging are all modulated by predators with potential effects on life history traits of individuals of the prey species that may be correlated with future fitness. Foraging behavior can further be driven by predation risk according to an individual's current condition. One possible response is "asset protection" in which individuals in poorer condition take greater risk and sometimes, but not always, succumb to predation. Individuals in good condition have more to lose when body condition is correlated with future fitness and forgo foraging for vigilance. Asset protection results in many individuals remaining near the mean value of condition; thus, measured variation may be lower relative to that among individuals exposed to fewer predators. Non-lethal effects of predation on Chinook salmon by piscivorous fish are not well understood, particularly in areas with recovering populations. In the Wenatchee River (WA), sub-yearling Chinook rear in the Little Wenatchee and White Rivers, but encounter predation risk from bull trout during movements into Lake Wenatchee and/or outmigration of smolts. Recent observations in the tributaries and lake indicated patterns consistent with asset protection: 1) individuals that remained and were recaptured in tributary pools that offer protection from predators varied less in condition than those that emigrated to the lake. 2) growth variation among individuals was lower in the lake relative to tributaries, and 3) size and condition variation among individuals decreased with increasing time in the lake. These observations suggest that further experimental study of the energetic cost of predation may inform how non-lethal effects of predators affect the population status of Chinook in this sub-basin.

## MANAGEMENT

**Michael Humling, U.S. Fish and Wildlife Service**, Mary L. Moser, Andrew Dittman, Christopher Tatara, John Box, Teresa Fish, Chris Pasley, Matt Cooper

*Use of olfactory cues to guide movements and manage releases of non-migrant juvenile summer steelhead at Winthrop National Fish Hatchery*

Salmonids use olfaction to locate spawning habitat and identify mates on the spawning grounds. Juvenile hatchery steelhead trout typically migrate downstream after release; but, precociously mature males often remain, overlapping with spawning anadromous adults spatially and temporally. They can pose ecological and gene flow risks to wild and integrated populations. Methods to differentially retain non-migrant males during volitional hatchery releases could help to mitigate these risks. We tested whether olfactory cues could be used to control fish movements in both experimental and hatchery settings. Using experimental Y-maze trials, we tested whether precociously mature males were attracted to female odors, relative to immature males. We found that precociously mature males exhibited significantly more entries into Y-maze arms with female odors introduced and remained in them significantly longer than in control arms lacking odors. We also tested if precociously mature male steelhead could be differentially retained in the presence of ovulated anadromous female steelhead in hatchery raceways during volitional release. We were not able to replicate the Y-maze results in actual hatchery trials.

## RESTORATION

**Carlos Polivka, U.S. Forest Service PNW Research Station**, Shannon M. Claeson, Rachel D. Hosman, Rhiannon A. Volking, Joseph R. Mihaljevic, Spencer Carran, Greg Dwyer

*Methodological lessons from a decade of restoration effectiveness studies in the Entiat River sub-basin, 2009-2018*

From 2008-2016, the Entiat River sub-basin was an Intensively Monitored Watershed (IMW), wherein multiple in-stream habitat restoration projects were implemented at reaches in key ecological valley segments of the basin. We found that, although it is relatively easy to determine that fish are attracted to in-stream structures (usually ELJs), spatial and temporal variability in the results requires approaches that more closely examine behavior, the response of life history traits (e.g., growth), and the spatial scale of the monitoring studies themselves. Importantly, the positive effect of ELJs is often very localized and it is difficult to distinguish this effect with whole-reach-scale survey techniques. In fact, increasing the areal extent of surveys to even 2X the area of pools created by ELJs dampens the observed effect. We have developed a technique that accounts for this issue and thus demonstrates that the habitat capacity of a reach has increased due to treatments. Novel behavioral approaches, that examine immigration and emigration into and out of restored pools, indicate that restoration not only increases fish habitat capacity, but also partially mitigates space competition between sub-yearling Chinook salmon and steelhead. These detailed studies often, but not always, support simple observations of abundance when conducting effectiveness monitoring studies. Additionally, they help identify benefits of restoration that go beyond any perceived or real increases in fish abundance.

**Marjorie Wolfe, Wolf Water Resources**, Nick Legg

*Getting its Jam Back – Tuning in on Methods to Design and Construct Wood Habitat Structures*

The Sandy River originates on the slopes of Mount Hood and drains 515 square miles of sediment-rich volcanic terrain. The river is confined by steep valley walls, with a combination of variable high flows and extremely erodible soils, creating dynamic river conditions. Historical flows have ranged from as low as 400 cfs in the summer to 84,400 cfs in the 1964 flood. After the 1964 flood of record, the U.S. Army Corps of Engineers removed wood accumulations and large wood from the stream channel and floodplains. In addition, many sections of river and tributaries were bulldozed, diked and stream banks were armored with sandbags.

Wolf Water Resources (W2r) has partnered with the Portland Water Bureau (PWB), Metro, Natural Systems Design (NSD), and Bair LLC to design and construct engineered log jams at several restoration locations along the Sandy River. The approach to the design of the jams varied significantly based on the location, project goals, and stakeholder requirements. This poster will discuss the design considerations for the different engineered log jams and how the design approach influenced construction. Log jams implemented with the PWB and NSD were buried deep in the main flow path of the river and had rigorous design criteria for side channel engagement and jam stability. The wood structures designed with Metro and Bair LLC were constructed to simulate natural racking wood such as apex jams and emulated landslides, and had logs above the 100-year event, reducing the potential for failure due to buoyancy. The wood structures were different in many ways, but together the Sandy River log jam projects have placed over 2,000 logs in the river and reconnected more than 4,000 feet of side channel.

**Robyn Pepin, Aspect Consulting, LLC**

*Fish Barriers vs. Funding: A GIS Tool for Accelerating Salmon Habitat Restoration*

Removing man-made barriers such as culverts and dams is a top priority for salmon recovery goals in the Upper Columbia region. However, there are thousands of barriers, limited resources to remove them, and a diverse group of stakeholders with issues to address. To evaluate current fish barrier removal projects in the Wenatchee basin, Aspect Consulting, the Upper Columbia Salmon Recovery Board, and a technical support team developed a GIS-based prioritization of barriers using species, habitat, and barrier metrics. This repeatable, adaptable tool provides the region with a common language and an apples-to-apples comparison of ecological conditions surrounding each barrier to inform project and funding decisions.

**Ryan Klett, Confederated Tribes of the Colville Reservation**

*A method for increasing the temporal resolution of culvert passage assessments*

Fish passage assessments used by habitat practitioners typically consist of relatively simple field data collection and office approaches that use a single size class, species of fish, and flow level as benchmarks. More data intensive assessments are available using the USFS FishXing software program; however, the result lacks strong temporal resolution without running and cataloging dozens of iterations for each assessment site. We present a method to evaluate month-wise passage probability for multiple salmonid age classes using basic survey data, a site-specific synthetic hydrograph and simple, explicit solutions for normal depth and velocity.

**Ryan Niemeyer, University of California Santa Barbara**, Richard D. Woodsmith, Kevin D. Bladon, David W. Peterson

*The Entiat Experimental Forest: Evaluating Short and Long-term Impacts of Wildfire and Post-fire Management on Water Quantity and Forest Ecology*

The Entiat Experimental Forest (EEF) is a long-term catchment study in north-central Washington State. The study site includes three steep (mean slope ~50 %), headwater catchments—Burns, McCrea, and Fox Creeks—each with a mean area of ~500 ha. The U.S. Forest Service (USFS) initiated measurements in 1957 with the objectives of quantifying the effects of forest management practices (forest harvesting and road building) on streamflow and water quality. However, in 1970 a severe wildfire burned all three catchments, creating a unique opportunity to investigate the effects of wildfire and post-fire forest management on streamflow. Two of the catchments were salvage logged and aerially seeded and fertilized, while one catchment was left as a burned, unlogged control. After seven years of post-fire measurements, instrumentation was decommissioned in 1977. These data resulted in a first-of-its-kind study of the impact of wildfire on water quality and quantity. In 2003, the stream gauges were re-commissioned and new meteorological instrumentation was installed. These data were collected until 2011. Over the last several years, vegetation surveys have been collected to document differences in the forest communities in each catchment. A forthcoming publication in the journal Hydrological Processes analyzing these long-term hydrologic data demonstrates how differences in post-fire forest management (i.e. salvage logging) produced long-term (35-41 years) differences in vegetation and streamflow. Specifically, in the two catchments that received post-fire management, streamflow has mostly returned to pre-fire levels, while the catchment without post-fire management still has elevated streamflow. Results from this study demonstrate that wildfire and post-fire management can have long-term impacts on ecosystems and streamflow in north-central Washington.

**Ryan Niemeyer, University of California Santa Barbara**, Naomi Tague, Jennifer Adam, Will Burke, Chris Schnepf, Andrew Perleberg

*Forest Restoration, Streamflow, and Stakeholder Engagement: Integrating Forest Owner & Manager Input with Hydro-Ecological Simulations*

Historically, wildfire was common in the dry ponderosa pine and mixed conifer forests of the interior Pacific Northwest. These frequent fires produced a mosaic landscape with varying stand ages and densities. Fire suppression has produced uncharacteristic dense forests. Policy makers and forest managers have begun to focus on forest thinning and prescribed fire to restore these landscapes. This forest restoration may increase forest drought resilience or increase downstream flow. However, tree drought resilience and streamflow longevity increases will vary across the the Pacific Northwest's steep biophysical gradients. Our primary research objective is to evaluate where forest restoration will augment tree-drought resilience and downstream flow under current and future climates. Our secondary research objective is to evaluate forest owners and managers' perspectives on forest restoration, drought, and streamflow. We simulated forest restoration across interior Northwest forests with the hydro-ecological model Regional Hydro-Ecologic Simulation System (RHESSys). Preliminary RHESSys simulation results reveal forest thinning increases downstream flow to a much greater degree in forests with more precipitation. Forthcoming results will reveal the degrees forest thinning can increase downstream streamflow in

future climates. We also surveyed forest owners and managers of dry forests in Washington, Oregon, and Idaho, as well as downstream water managers, about their perspectives of forest restoration, drought, and streamflow. Across all respondents, the median ideal percentage of their forests to thin was 70%. However, the median percentage of forests that would be thinned with realistic constraints was 20%. In regards to the use of computer simulations for forest management, while 60% of respondents identified computer simulation results as generally helpful, only 29% regularly use simulation results. Results of this work can help inform forest managers and policy makers.

## THANK YOU TO OUR EXHIBITORS

Yakama Nation Fisheries

W2R Wolf Water Resources

UCUT Upper Columbia United Tribes

Washington State Recreation and Conservation Office
Governor's Salmon Recovery Office

inter·fluve inc.

Bonneville Power Administration

PNP Pacific Netting Products Incorporated

Natural Systems Design

Northwest Power and Conservation Council

BioSonics®

ATS Advanced Telemetry Systems

Since 1984 Wenatchee Valley Fly Fishers

Rocky Reach Habitat Conservation Plan

Rock Island Habitat Conservation Plan

Wells Habitat Conservation Plan

Tierra Right of Way™ A Land Services Company

HTI part of innovasea