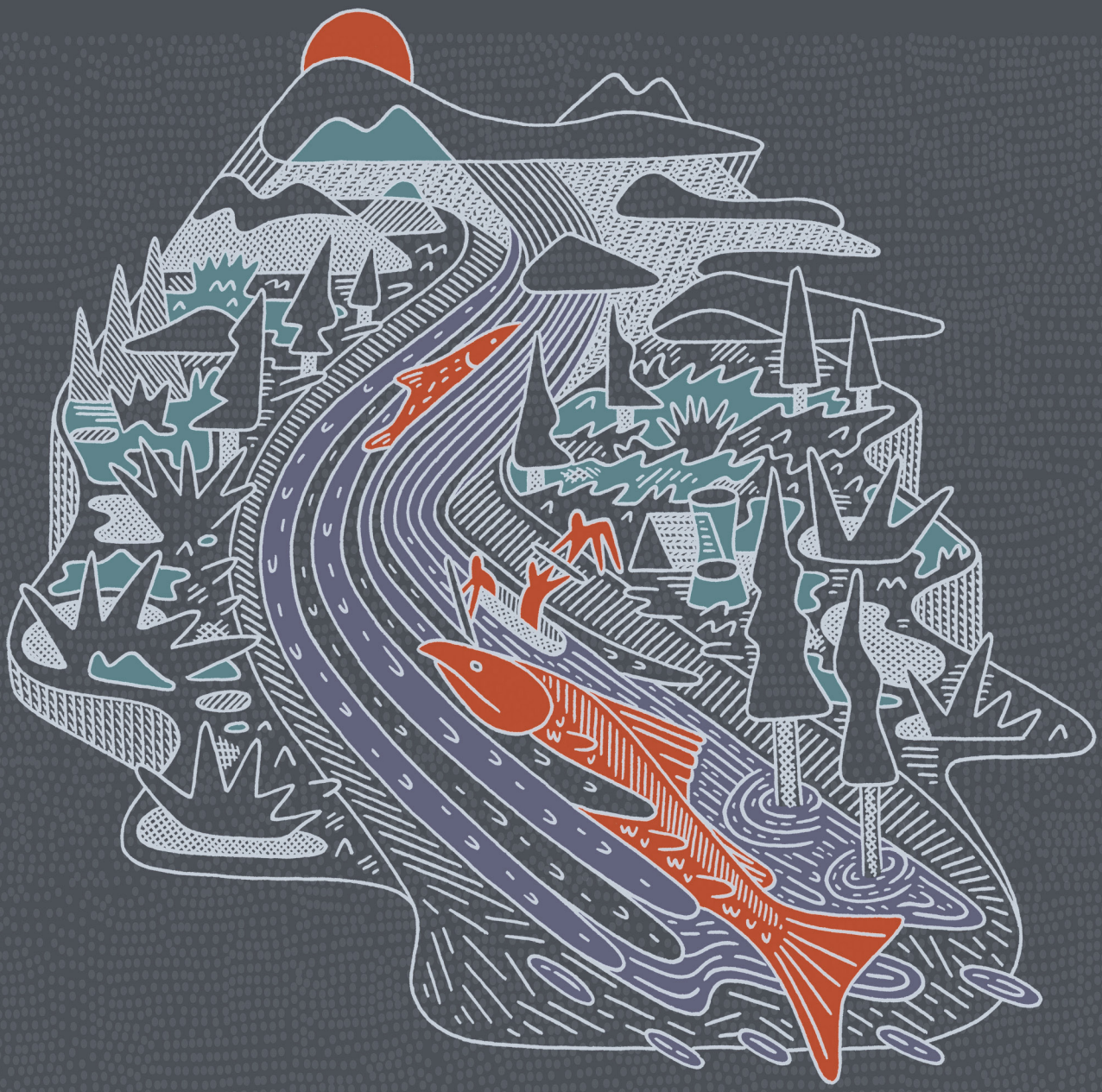
UPPER COLUMBIA SCIENCE CONFERENCE

The Science of Survival

2018



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Working to restore viable and sustainable populations of salmon, steelhead and other at-risk species through collaborative, economically sensitive efforts, combined resources, and wise resource management of the Upper Columbia Region.

Welcome to the fourth Upper Columbia Science Conference.

This year's theme is "The Science of Survival." Communicating and understanding current research by project implementers, scientists, managers, and the public is essential for effective implementation and evaluation of our regional recovery efforts. This conference is an opportunity to come together to discuss the state of the science and to collectively learn how to improve the work we do.

You will hear about topics such as salmon and steelhead survival, climate change, hatchery and wild origin fish interactions, and the use of models as a tool for restoration. You will also hear from two members of the Independent Scientific Advisory Board about their review of Upper Columbia Spring Chinook.

Our hope is that this conference provides all attendees with an opportunity to learn and discuss information about endangered fish species and their habitat in a way that leads to more informed recovery projects in the future. You will hear from speakers both within and beyond our region and we hope to provide the opportunity for ample networking and information sharing.

Sincerely,

Melody Kreimes

Melody Kreimes
UCSRB Executive Director

Bill T. Towey

Bill Towey
UCSRB Chair

ACKNOWLEDGEMENTS

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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

THE SCIENCE OF SURVIVAL

WED 1/24

7:00 – 5:00	Registration Open	
7:00 – 8:00	Welcome Social – Coffee and Light Breakfast	
8:00 – 8:10	Welcome – Greer Maier, UCSRB and Bill Towey, Colville Confederate Tribes	
8:10 – 8:30	Opening Remarks – Bob Bugert, SRFB	
8:30 – 10:30	Morning Session – Status of the Species	
8:30 – 9:00	Plenary Talk – Mike Ford, NOAA NW Fisheries Science Center	*p. 7*
10:30 – 11:00	Break and Poster Session – Coffee and Snacks	*p. 29*
11:00 – 12:00	Morning Session – Predation and Ocean Conditions	*p. 10*
12:00 – 1:00	Lunch – On Your Own	
1:00 – 1:30	Plenary Talk – Daniel C. Dauwalter, Trout Unlimited	*p. 12*
1:30 – 3:00	Afternoon Session – Watersheds	
1:30 – 2:00	Plenary Talk – Christian Torgersen, U.S. Geological Survey	*p. 13*
3:00 – 3:30	Break – Coffee and Snacks	
3:30 – 5:00	Afternoon Session – Upper Columbia Spring Chinook	*p. 15*
6:00 – 9:00	Evening Social at Pybus Market – Drinks, Appetizers and Silent Auction	

Wenatchee, Washington

2018

Upper Columbia Science Conference

THE SCIENCE OF SURVIVAL

THURS 1/25

7:00 – 12:00	Registration Open	
7:00 – 8:00	Morning Social – Coffee and Light Breakfast	
8:00 – 8:15	Opening Remarks – Andy Hover, UCSRB	
8:15 – 10:00	Morning Session – All-H	
8:15 – 8:45	Plenary Talk – Erin Rechisky, Kintama Research Services	
10:00 – 10:30	Break and Poster Session – Coffee and Snacks	*p . 29*
10:30 – 12:30	Morning Session – Habitat Restoration	
10:30 – 11:00	Plenary Talk – Phil Roni, Cramer Fish Sciences	*p . 19*
12:30 – 12:35	Triple Creek Project Partners present "Water, She Rise Up" Song & Slideshow	
12:30 – 1:30	Lunch – On Your Own	
1:30 – 2:00	Plenary Talk – Langdon Cook, Author	*p . 24*
2:00 - 3:00	Afternoon Session - Survival and Life History	
2:00 - 2:30	Plenary Talk - Hal Beecher, Washington Department of Fish & Wildlife (Retired)	*p . 25*
3:00 – 3:30	Break – Coffee and Snacks, *Upstream* Book Signing by Langdon Cook	
3:30 – 4:30	Continued Afternoon Session – Survival and Life History	*p . 26*
4:30	Closing Remarks – Melody Kreimes, UCSRB	

Wenatchee, Washington

2018

WED 1/24

7:00 – 5:00 Registration Open

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Morning Session Status of the Species

8:30 – 9:00 **Plenary Talk – Mike Ford, NOAA NW Fisheries Science Center**, Tom Cooney, Katie Barnas

Status of ESA listed Upper Columbia River spring Chinook salmon and steelhead

In this talk we 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. These populations have been listed under the ESA for approximately 20 years. Over this time there have been 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, 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.

9:00 – 9:15 **Nate Fuchs, University of Idaho**, Andrew Murdoch, Christopher Caudill

Evaluating the distribution and survival of adult Upper Columbia River summer steelhead using radio telemetry

Monitoring migrating adult anadromous fish species is essential to forecast and monitor run sizes, harvest quotas, and reach-specific survival through the Hydrosystem. Estimating survival of returning adult summer steelhead (Oncorhynchus mykiss) is particularly important as these fish display a distinctive life history strategy in which they overwinter for several months prior to a final migration to spawning grounds occurring in spring. For steelhead returning to the Upper Columbia this behavior occurs both in tributaries and in the Columbia River. We conducted a large scale radio telemetry study in part to track migration behaviors, distribution, and survival of adult summer steelhead in the Upper Columbia Basin. Between 2015 and 2016, 808 steelhead were tagged and released at Priest Rapids Dam with both intragastrically implanted coded radio transmitters and Passive Integrated Transponder (PIT) tags. A total of 548 tagged fish were detected in the Upper Columbia Basin with 296 overwintering in main-stem reaches (54%) and 252 overwintering in tributaries (46%).

The majority of main-stem overwintering fish resided above Wells Dam across both study years (0.57 and 0.56) while the highest proportion of tributary overwintering fish were detected in the Wenatchee River (0.39) in 2015 and the Methow River (0.56) in 2016. Main-stem overwintering survival ranged from 0.74 to 0.82 between years (2015 and 2016, respectively) while tributary overwinter survival ranged from 0.87 to 0.91.

Total estimated overwinter survival was 0.80 in 2015 and 0.86 in 2016, respectively. Mean overwinter survival in main-stem pools was greater in 2016 than 2015 and may be partially accounted for given the absence of a basin wide fishery in 2016. This research highlights the variability and importance of different overwintering strategies applied by adult steelhead returning to the Upper Columbia Basin.

9:15 – 9:30 **McClain Johnson, Washington Department of Fish and Wildlife**, Andrew Murdoch

Examining mechanisms that explain recent trends in abundance of spring and summer Chinook salmon in the Upper Columbia River

Successful conservation and recovery of Chinook salmon Oncorhynchus tshawytscha requires an understanding of life history characteristics to inform contemporary management actions. The Upper Columbia River harbors three extant populations of spring Chinook salmon and three populations of summer Chinook salmon. From 1989 to 2016, both races have seen wide fluctuations in interannual spawner abundance. Annually, mean summer Chinook spawner abundance is tenfold that of spring Chinook (mean 12,572 vs. 1,241). We examined life history differences between these races that may explain abundance trends. Mean arrival date at Bonneville Dam for returning spring Chinook is considerably earlier (May 13) than summer Chinook (July 4). Conversion rates between hydroelectric projects are modestly higher (8%) for summer Chinook than for spring Chinook, with travel times from McNary to Rock Island faster for summer (5.12 days) compared to spring Chinook (8.87 days). These differences suggest reach-specific survival is variable across space and time and often dependent on river conditions. Natural-origin juvenile spring Chinook exhibit a yearling emigrant life history, whereas summer Chinook display as many as three juvenile life histories. These differences may benefit summer Chinook during outmigration, synchronizing with spill and spring run-off more favorably. Summer Chinook may also be exposed to fewer survival bottlenecks (e.g. avian and fish predation) than spring race due to emigration date and time spent rearing in tributaries. Evolving hatchery practices may also be influencing the hatchery program success, as summer Chinook programs typically have greater levels of pNOB and lower levels of pHOS. Consideration of these differences is essential to ensure appropriate spatial distribution, genetic stock integrity, and adult spawner productivity of the Chinook races in the Upper Columbia River.

9:30 – 9:45 **John Rohrback, Colville Confederate Tribes**

Spring Chinook in the Okanogan – From eDNA to Section 10(j)

From the 1930s until the turn of the 21st century, reports of spring Chinook Salmon in the Okanogan river basin had been sporadic and anecdotal. However, since the year 2000, there have been several notable efforts to manage and monitor Okanogan spring Chinook Salmon. There have been releases of coded wire tagged spring Chinook in the Similkameen River and Omak Creek, eDNA presence/absence surveys for spring Chinook Salmon in the mainstem Okanogan River and its tributaries in the United States and Canada, and an extensive PIT tag array network that has led to detections of spring Chinook throughout the basin. Most relevant to the current status of Okanogan spring Chinook, a §10(j) nonessential, experimental population of spring Chinook Salmon was reintroduced to the Okanogan River by Colville Tribes Fish & Wildlife in 2015. This presentation will review the status of natural- and hatchery-origin spring Chinook Salmon in the Okanogan prior to reintroduction – including Okanogan-origin fish and use of the river by Upper Columbia Spring Chinook from other river systems, revisit past releases of spring Chinook Salmon from within the basin, and provide an assessment of the initial returns from the 2015 release.

9:45 – 10:00 **Jose Vazquez, U.S. Fish and Wildlife Service**, James Fletcher, Mark Inc, R.D. Nelle, Thomas Franklin, Kevin McKelvey, Michael Schwartz, Michael Young

Assessment of bull trout distribution in the Wenatchee River basin through the use of environmental DNA analysis

Environmental DNA (eDNA) collection and analysis is a novel fisheries technique that offers an efficient means of assessing the distributions of rare aquatic species in remote stream systems. In the Wenatchee River Basin in Washington, the distribution of Bull Trout in many headwater streams remains largely unknown due to limited historical data and difficulties associated with sampling habitat in remote headwater tributaries and wilderness areas. In this study, multiple entities collaborated to collect and analyze samples from 283 kilometers of potential Bull Trout stream habitat in 2016 and 2017. Sample analysis indicated Bull Trout eDNA was not detected in several tributaries where Bull Trout are presumed to be extirpated or absent, providing further evidence Bull Trout are not present in these locations. Bull Trout eDNA was found in 11 reaches where Bull Trout were previously undocumented, indicating Bull Trout may be utilizing these areas. Verification snorkel surveys conducted in a subset of reaches where Bull Trout eDNA was detected confirmed Bull Trout presence in the upper Little Wenatchee River and its tributaries. Bull Trout were not encountered during verification snorkel surveys performed in upper Ingalls Creek, indicating Bull Trout eDNA detected in this reach may have originated from migratory adult movements or incidental transport. Our results provide distribution information which will be relevant to regional recovery efforts and management decisions, and emphasize the value of verifying positive eDNA results with traditional fisheries techniques.

10:00 – 10:15 **Ralph Lampman, Yakama Nation**

Pacific lamprey: Keeping the 450 million year tradition alive and strong in the Upper Columbia through collaboration

Pacific Lamprey, *Entosphenus tridentatus*, is a species of great cultural and ecological value in the Pacific Northwest. The ancient eel-like fish is declining in abundance and distribution throughout their range, including the Upper Columbia region. The Yakama Nation Fisheries has led adult lamprey reintroduction projects throughout the Yakama Nation Ceded Lands between 2012-2017, with reintroduction focusing in the Yakima, Wenatchee, and Methow subbasins, areas where Pacific Lamprey are extirpated or functionally extinct. Successful spawning of reintroduced fish has been documented in all of the translocated streams within the Yakima Subbasin through sampling of larval lamprey and the use of parentage genetics analysis. The number of larval Pacific Lamprey and its distribution within the Yakima Subbasin has increased steadily since reintroduction began in 2012. However, Pacific Lamprey still face many threats within the Columbia Basin. Adult passage rates are still low (~50%) at many of the large hydroelectric dams and smaller diversion dams. Passage rates of juvenile lamprey at large hydroelectric dams are largely unknown, and entrainment of larval lamprey in irrigation diversions is a serious threat to their early life history. The specific threats and issues that lamprey face have become clearer over the years, partly as a result of the translocation success. As a result of partnership and collaboration, various efforts are underway to mitigate and reduce the existing threats for Pacific Lamprey, such as through the implementation of adult passage structures at dams, reduction of ramping rates at irrigation diversions, and larval lamprey salvage and rescue efforts within these diversions. Lamprey can easily take a backseat to salmon in terms of management priority (in the day to day decisions as well as long term planning), so collaborative efforts among all stakeholder agencies is essential to make Pacific Lamprey recovery successful.

10:15 – 10:30 Questions/Discussions

10:30 – 11:00 Break and Poster Session – Coffee and Snacks

Morning Session Predation and Ocean Conditions

11:00 – 11:15 **Brian Beckman, NOAA NW Fisheries Science Center**, Brian Burke, Laurie Weitkamp, Cheryl Morgan

Ocean update 2017

Marine survival of Columbia River salmon is one of the main factors driving overall abundance of adults returning to the river. A number of climatic, oceanographic and ecological factors have been found to correlate with marine survival of Columbia River salmon and thus trends in these data sets are of interest. In this talk we will report on patterns of basin-scale climatic indicators such as El Nino/La Nina (ENSO) and the Pacific Decadal Oscillation (PDO), and then more local scale indicators such as sea surface temperatures (SST).

In summary, these indicators suggest that the Northeast Pacific Ocean continued the dynamic and unpredictable trend it has followed since 2014 into 2017. Then, we report on results from NMFS ocean trawl surveys for juvenile salmon. Catches of juvenile Chinok and coho salmon were extremely low in June of 2017. In addition, abundance of a number of other species were anomalous, suggesting continued ecosystem disruption from the combined effects of the blob (2013 – 2016) and the recent El Nino (2016). These results provide cautionary insight into potential adult returns for 2018 and beyond.

11:15 – 11:30 **Mark Sorel, NOAA NW Fisheries Science Center,** Brandon Chasco, Michelle Rub, Rich Zabel

Temporal trends in marine mammal predation of Chinook salmon

The abundance of marine mammals has substantially increased along the West Coast, leading to greater predation on salmon and steelhead. I will discuss two recent studies that assess the degree that predation has increased. The first study used a bioenergetics approach to estimate predation rates on all life stages of Chinook salmon originating from different regions along the West Coast, as they migrated throughout the northeast Pacific Ocean. They found that the total biomass of Chinook salmon consumed by marine mammals doubled from 1979 to 2015, and the number of individuals consumed increased six fold. Killer whales consumed the greatest biomass coast wide, and harbor seals consumed the greatest number of fish, due to differences in the proportions of age classes in their diets. Within the lower Columbia River, Steller and California sea lions consumed the greatest biomass and harbor seals consumed the greatest numbers.

In the second study, we estimated the percent decrease in survival of adult spring Chinook from the estuary near Astoria to passing Bonneville Dam in 2013-2015, coinciding with increased sea lion abundance, relative to historical survivals. Survivals declined to a greater degree for earlier migrating populations, which overlapped with more California sea lions and spent more time in the lower Columbia River.

Average survival in 2013-2015 was 13% lower than in 2001–2012 for the Methow River population. The Entiat River population experienced an 8% decline in survival between these periods, and survival of the Wenatchee River population was 4% lower. These reductions in survival will be used in life-cycle models to assess the effect that recent conditions could have on recovery efforts and population viability. If pinnipeds remain abundant in the estuary, restoration efforts in the Upper Columbia may want to focus on the Methow River spring Chinook population to offset declines in adult survival.

11:30 – 11:45 **Quinn Payton, Real Time Research,** Allen Evans, Nate Hostetter, Brad Cramer, Aaron Turecek, Ken Collis, Dan Roby

Predation and survival of Upper Columbia River steelhead: An evaluation of cumulative avian impacts

Avian predation has been identified as a factor limiting the survival of juvenile salmonids during out-migration and management actions to reduce the number of piscivorous waterbirds nesting in the Columbia River Basin have recently been implemented. Studies of avian predation, however, have largely focused on the impact of a single predator species and colony and not the cumulative impact of multiple predator species and colonies on fish survival. Data describing the relationship between avian predation rates and survival rates are also generally lacking, but are paramount in evaluating the efficacy of management plans to increase fish survival. To address these needs, we developed a model that jointly estimated survival and predation probabilities of juvenile steelhead PIT-tagged (n=71,043) at Rock Island Dam (RIS) on the Columbia River during 2008-2017. Survival data from three river reaches between RIS and Bonneville Dam (BON) and predation data from 11 different bird colonies were analyzed.

Results indicated that avian predation was one greatest sources of steelhead mortality during out-migration, with cumulative annual rates of predation between 23.0% (95% CRI 18.8-29.1) to 41.9% (95% CRI 32.8-50.6) of Steelhead between RIS and BON. Results indicated that efforts to reduce the number of Caspian terns at managed colony sites was associated with lower rates of predation and higher rates of survival. Results also indicated that predation by unmanaged tern and gull colonies was substantial and has partially off-set the lower rates of predation observed at managed tern colony sites. An investigation of predation rates and survival rates indicated that bird predation was largely an additive source of steelhead mortality during out-migration, indicating that efforts to reduce the number of piscivorous waterbirds in the region will be successful in increasing rates of survival if management actions can be implemented across predator species, nesting colonies, and years.

11:45 – 12:00 Questions/Discussions

12:00 – 1:00 Lunch – On Your Own

1:00 – 1:30 **Plenary Talk – Daniel C. Dauwalter, Trout Unlimited**

Remote sensing applications to salmonid conservation and management

Remote sensing has been pivotal to our understanding of freshwater fisheries, and its accessibility to fisheries scientists has increased substantially in the last decade. Historical applications emphasized spatial variation in the environment (e.g., watershed land use and in situ primary productivity).

However, new sensor platforms and technology now yield imagery with higher spatial, temporal, and spectral resolutions than ever before, and free access to imagery archives, cloud computing, and availability of derived products has greatly facilitated its use by fisheries professionals. These advances in remote sensing have allowed new questions to be answered at finer spatial resolutions while emphasizing temporal dynamics in aquatic ecosystems. This plenary will highlight how remote sensing is providing a new big-picture perspective to native trout conservation, including a high-resolution characterization of desert redband trout habitat, evaluations of grazing management effectiveness, and a novel application of population viability analysis to Lahontan cutthroat trout.

Afternoon Session Watersheds

1:30 – 2:00 **Plenary Talk – Christian Torgersen, U.S. Geological Survey,** Aimee Fullerton, Francine Mejia

Everything you always wanted to know about cold-water refuges but were afraid to ask

Cold-water refuges for salmonids in the Pacific Northwest have been a topic of increasing interest in freshwater science and management over the last 30 years. Early work on the Yakima River in the early 1990s inspired research throughout the region that led to increased awareness of cold-water refuges in fisheries and water quality management at local, state, and federal levels. In this presentation, we provide a retrospective from the last three decades on the many questions that have been raised about what cold-water refuges are, how they can be identified and quantified, and how they can be conserved, enhanced, and restored. We highlight questions that pertain to understanding cold-water refuges in space and time and across multiple dimensions of riverine landscapes–laterally, longitudinally, and vertically–particularly in the context of the many perceptions (and misperceptions) of technological tools such as thermal infrared remote sensing and quantitative modeling.

2:00 – 2:15 **Christopher Fisher, Colville Confederate Tribes**, Ian Courter, Forrest Carpenter, Kevin Ceder, Sonya Schaller, Dennis L. Papa

Changes in native salmonid production potential in response to forest fire

Fire suppression can have a significant influence on flow conditions and salmonid habitat availability in streams by increasing tree stand density and water loss due to evapotranspiration. To quantify the impact of fire suppression on flows in the Omak Creek basin, Washington, stream discharge, physical stream habitat types (cascade, glide, pool, or riffle), and fish densities were measured in two tributaries to Omak Creek, Stapaloop and Swimptkin Creeks between 2014 and 2017. A wildfire burned 76% of the Stapaloop Creek watershed in 2015 while the Swimptkin Creek watershed remained intact.

Stream flow measured in Stapaloop Creek in 2014 was 48% higher relative to Swimptkin Creek. Similarly flows measured in 2017 were 66% higher relative to Swimptkin, a 17.6% increase from measured difference in 2014.

Additionally, fish assemblages in Stapaloop Creek changed from predominantly invasive Eastern brook trout (Salvelinus fontinalis) to a higher relative abundance of native rainbow trout (Oncorhynchus mykiss). Wetted stream channel width and maximum pool depth also increased from 2014 to 2017 in Stapaloop Creek. Our preliminary results corroborate the theory that reintroduction of a historical fire regime increases stream flow and may also increase native salmonid production and habitat quality.

2:15 – 2:30 **Mike Mertens, Ecotrust**, Jocelyn Tutak, Melody Kreimes, Greer Maier

A decision-support tool to support salmon recovery with targeted forest restoration

UCSRB, in partnership with Ecotrust, has developed a free, online decision support tool that will help forest and stream restoration practitioners support salmon recovery across North Central Washington. The easy-to-use website informs salmon recovery by assessing the effects of forest restoration activity on snowpack retention and subsequent water supply and timing.

UCSRB has a whole-watershed, Ridgetop-to-River approach to salmon recovery. Water availability, especially during the late summer, is one factor that affects salmon populations in the Upper Columbia. One of several approaches to increasing the amount of water available for instream flow in the late summer is by increasing the capture and duration of storage of mountain snowpack. This tool builds on Pacific Northwest National Laboratory's Distributed Hydrology Soil Vegetation model (DHSVM) to identify both how forest restoration activity affects downstream flows, and where to target upstream restoration activities to benefit specific in-stream locations.

UCSRB and Ecotrust have spent the past two years developing this tool, and will present a beta version, giving an overview of its capabilities and illustrating how restoration practitioners can use it to inform their work and benefit salmon recovery efforts.

2:30 – 2:45 **Christopher Konrad, U.S. Geological Survey**

Streamflow and salmon recovery in the Upper Columbia River basin

Streamflow is an essential resource for people and fish in the upper Columbia River basin, but its value for society and ecosystems is complex, changing, and difficult to forecast into the future. A basic understanding of the physical controls on streamflow quantity and quality is essential for efficient and effective salmon recovery planning and to anticipate future conditions that may require adapting management strategies.

The variation in precipitation and temperature across the upper Columbia River Basin leads to distinct types of rivers and streams with water balances that range from "energy-limited" to "water-limited".

These differences affect how rivers and streams respond to extreme weather events. Groundwater is another fundamental aspect of basin hydrology that leads to differences in the response of rivers and streams to weather and, importantly, local variation in the condition of river and stream habitats. The responses of rivers and streams to extreme weather are important for assessing how future climate could affect habitat conditions. Insights about these responses begin with an appreciation of hydrologic processes in the landscape surrounding rivers and streams.

2:45 – 3:00 **UCSRB Thermal Refugia Video** (2 Minutes) and Questions/Discussions

3:00 – 3:30 Break – Coffee and Snacks

Afternoon Session Upper Columbia Spring Chinook

3:30 – 5:00 **Stan Gregory, Independent Scientific Advisory Board**, Alec Maule, Dr. Steve Schroder

Independent Scientific Advisory Board (ISAB) Review of spring Chinook salmon in the Upper Columbia River

In April 2017, the Independent Scientific Advisory Board's Administrative Oversight Panel with representatives from the Northwest Power and Conservation Council, NOAA Fisheries, and the Columbia River Inter-Tribal Fish Commission noted that despite a decade of habitat restoration actions guided by the 2007 Recovery Plan, Upper Columbia River spring Chinook populations remain at high risk of extinction. The Panel asked the Independent Scientific Advisory Board to conduct a review to inform Upper Columbia River spring Chinook recovery and research efforts and to address four questions (simplified for abstract):

1. Is the identification of limiting factors for Upper Columbia River spring Chinook based on sound scientific principles and methods?
2. Are habitat recovery actions being prioritized and sequenced strategically, given existing knowledge and data gaps?
3. Is a research, monitoring, and evaluation (RME) framework in place that can adequately address the questions above?
4. Are the life-cycle and habitat models in development for the Upper Columbia ESU useful for informing the identification, prioritization, and evaluation of restoration actions?

Restoration practitioners and researchers in the UCSRB program led a field tour of the Wenatchee and Entiat basins and provided technical presentations for the ISAB in July 2017. Regional scientists presented additional information at ISAB meetings in September, October, and December 2017.

As part of the analysis of limiting factors, the ISAB evaluated whether Snake River spring Chinook are doing better than Upper Columbia spring Chinook in terms of abundance, diversity, spatial structure, and productivity. We also compared the life histories and status of spring and summer Chinook in the UCR and examined whether recent increases in pinniped predation could be a significant source of mortality for Upper Columbia spring Chinook.

The ISAB reviewed available studies for evidence that past projects have improved habitat for this ESU. Current processes in the UCSRB for prioritization of habitat projects, based on both anticipated ecological outcomes and economic analysis of benefits and costs, were evaluated.

Additionally, the ISAB examined whether hydrosystem and hatchery operations and harvest management were coordinated with habitat actions to achieve recovery goals.

A major aspect of the ISAB review of the RME program was the extent to which fitness of Upper Columbia spring Chinook ESU has been negatively or positively affected by historical and current hatchery programs, including evidence for demographic benefit to the natural populations by contemporary supplementation programs. We also evaluated current methodology in the PUD hatchery monitoring and evaluation program and its adequacy to measure effects of hatchery programs on fitness and demographic responses to supplementation.

The ISAB recently reviewed NOAA Fisheries life-cycle models in the interior Columbia basin (https://www.nwcouncil.org/fw/isab/isab2017-1/), and we specifically examined the life-cycle models in the Wenatchee, Entiat, and Methow basins for this UCR report. We described strengths and limitations of these models and identified future directions and applications as these models evolve.

Our presentation will highlight information and findings that the ISAB has found useful in our review of Upper Columbia River spring Chinook. The ISAB report will be submitted by the end of January 2018, therefore final conclusions and recommendations will be available soon after the 2018 Upper Columbia Science Conference.

6:00 – 9:00 **Evening Social Event – Complimentary Drinks and Appetizers, Silent Auction**
Pybus Public Market, 3 N. Worthen St., Wenatchee

THURS 1/25

7:00 – 12:00 Registration
7:00 – 8:00 Welcome Social – Coffee and Light Breakfast
8:00 – 8:15 Opening Remarks – Andy Hover, UCSRB

Morning Session All-H

8:15 – 8:45 **Plenary Talk – Erin Rechisky, Kintama Research Services**, David Welch, Aswea Porter

Salmon survival beyond the river

Smolt-to-adult return (SAR) rates of yearling and subyearling Chinook show marked declines in almost all regions of western North America, from highly altered rivers such as the Columbia to the pristine rivers of southeast Alaska and Northern BC. I will review these SAR time series and explore potential mechanisms which may contribute to low SARs for yearling upper-Columbia River populations in light of our previous telemetry studies. We captured and acoustic tagged Columbia River yearling Chinook smolts in 2010 and 2011 at John Day and Bonneville dams, respectively, and subsequently estimated estuary and early-marine survival to as far as northern Vancouver Island (570 km north of the Columbia River). There was high survival in the lower river (below Bonneville Dam) and estuary, and then a marked decline in survival after ocean entry for mid- and upper-Columbia River yearling Chinook populations and for fish identified post-release as interior Columbia River summer/fall Chinook (holdover fall Chinook). Our telemetry data also allowed us to establish a direct record of migration behavior for individual smolts in the ocean including distance from shore and speed of movement, and to contrast the movement behaviour of mini-jacks (smolts returning to the river within weeks to months after ocean entry) and jacks. Smolts returning as minijacks or jacks did not migrate as far as the northern tip of Vancouver Island and (in common with all tagged Columbia River smolts) did not enter the Strait of Juan de Fuca. Jack returns are frequently used for forecasting adult returns, but our data show that jacks may occupy a smaller geographic range relative to smolts destined to return as adults, so are not exposed to ocean influences occurring farther away. Although our telemetry results found that downstream freshwater survival and survival during the first month of the marine phase contribute roughly equally to determining adult SARS, survival declines later in the marine phase may help explain why Chinook survival has fallen so drastically across the entire west coast of North America.

8:45 – 9:00 **Steve Parker, Yakama Nation**

Harvest control systems for fisheries affecting UCR spring Chinook and steelhead

ESA-listed UCR spring Chinook and steelhead are susceptible to capture in fisheries distributed broadly across the Pacific Ocean, lower Columbia River, and upper Columbia tributaries. Federal, state, and tribal fishery co-managers negotiate agreements in a variety of international and regional settings that regulate harvest impacts to salmonids in mixed-stock fisheries for the purposes of conservation and fair sharing of available fish. This presentation briefly describes the harvest control systems employed by fishery co-managers to sustain fishery benefits for tribal and general publics while supporting regional recovery efforts for ESA-listed species.

9:00 – 9:15 **Dan Rawding, Washington Department of Fish and Wildlife**

Juvenile survival and smolt-to-adult return of upper Columbia River salmon and steelhead

The survival of upper Columbia River salmon and steelhead populations are negatively impacted by the operation of hydro-electric facilities in the Columbia Basin. In 1996 fisheries agencies and tribes initiated the Comparative Survival Study (CSS), funded by the Bonneville Power Administration, to establish a long-term data set of annual estimates of the survival probability of generations of salmon from their outmigration as smolts through their return to freshwater as adults to spawn (smolt-to-adult return rate). To estimate the survival of salmon and steelhead from the upper Columbia, PIT tagged juveniles are detected at Columbia River mainstem dams as they emigrate toward the ocean as smolts and return to their natal spawning sites as adults. Annual estimates of instream juvenile survival and smolt-to adult survival rates of upper Columbia Chinook, sockeye, and steelhead populations will be presented.

9:15 – 9:30 **Greg Fraser, U.S. Fish and Wildlife Service**

Spatial and temporal overlap in spawning between spring and summer Chinook Salmon runs in the Entiat River and the potential implications for ESA-listed spring Chinook Salmon

In recent years summer Chinook Salmon returns have increased in areas where spring Chinook Salmon also spawn. Although peak spawn times and locations are separated, spatial and temporal components of the spawning for each run overlaps. Superimposition of summer Chinook Salmon redds over spring Chinook Salmon redds and hybridization between the runs are a concern for the ESA-listed spring Chinook population. As summer Chinook Salmon return in greater numbers and move further upstream to spawn, risks of superimposition and hybridization between runs increases. Annual redd surveys document superimposition levels of 10-27% (2013-2017) but in some surveyed areas superimposition levels are near 100%. Genetic samples collected from the rotary screw trap and in-stream sampling resulted in of hybridization between runs. Widespread hybridization between these runs could have detrimental impacts for ESA-listed spring Chinook Salmon in the Entiat River.

9:30 – 9:45 **Mark Sorel, NOAA NW Fisheries Science Center,** Jeff Jorgensen, Rich Zabel

The use of life cycle models to estimate population responses to management actions and environmental change

Life cycle models that incorporate multiple life stages of a population and that integrate information across space and time can be used to predict how actions targeted at one or more life stages might move a population toward recovery goals. We used a life cycle model of Wenatchee spring-run Chinook salmon to evaluate a combination of management actions, including freshwater habitat restoration, hatchery management, mainstem hydropower system operations as estimated through COMPASS modeling, harvest rates, and environmental conditions from freshwater habitats to the ocean. We compared suites of combined actions and population responses measured in terms of spawner abundance, extinction risk, and viable salmonid population (VSP) scores. Among these particular scenario combinations, the population responded most from changes in pinniped predation, hatchery operations, and from ocean conditions. Models and analyses such as these benefit from tests of parameter influence through sensitivity analyses. This allows us to test model assumptions and to determine the impacts of parameter variability and uncertainty on model outputs, both of which can help inform monitoring and research efforts. Parameters related to the prespawning period and in the freshwater survival of juvenile fish to their second spring were among the most influential. These are two active areas of model development. In the latter case, for example, we are using long-term juvenile monitoring data to characterize their downstream movement from streams where they were born, and how the different habitats in which fish rear affect their survival to adulthood. This information will help to evaluate tributary habitat restoration placement, priorities, and objectives, as well as other management actions outside the basin. This model is one example of several life cycle modeling efforts being applied to salmonid populations in the Columbia basin and throughout the Pacific Northwest.

9:45 – 10:00 Questions/Discussion

10:00 – 10:30 Break and Poster Session – Coffee and Snacks

Morning Session Habitat Restoration

10:30 – 11:00 **Plenary Talk** – **Phil Roni, Cramer Fish Sciences**, Tracy Hillman, Jen O'Neal

Effectiveness of tributary habitat enhancement projects

Each year, the Action Agencies (Bonneville Power Administration, Bureau of Reclamation, and Army Corps of Engineers) spend tens of millions of dollars under the Federal Columbia River Power System (FCRPS) Biological Opinion (BiOp) and the Columbia Basin Fish Accords to improve habitat quantity and quality for Columbia River basin Chinook salmon and steelhead populations. Habitat

enhancement projects include flow acquisition, riparian enhancement, improved instream complexity, removal of fish passage barriers, nutrient enrichment, improved access to stream habitat, including off-channel and floodplain habitat, and riparian/floodplain protection. The Action Agencies continually assess where habitat projects and which habitat projects can be most effective. To assist with this, we conducted a comprehensive review of published and unpublished literature on the effectiveness of habitat improvement to address the following management questions:

1. What are the effects of habitat actions on habitat conditions?

2. Which actions are the most effective in producing desired habitat conditions for salmonids?

3. How do salmon and steelhead (and other salmonids) respond to changes in habitat conditions?

4. What are the effects of individual habitat actions on fish at the site, reach, and watershed scales?

5. What are the post-enhancement trajectories (are benefits to fish sustained over time)?

6. Which actions provide the greatest benefit to fish?

We identified a total of 617 papers or reports that examined effectiveness of habitat enhancement or restoration projects. Of these, most were from the United States or Europe; 56 were from studies in the Columbia River basin and the majority were published in the last 20 years. We then summarized the results of these studies for each of the major categories of enhancement including: fish passage, instream structures, off-channel/floodplain habitat, riparian improvement, sediment reduction, flow augmentation, nutrient enrichment, and acquisition and protection. In this talk we highlight the results from this review and provide responses to the above management questions based on the available literature with an emphasis on studies from the Columbia River basin.

11:00 – 11:15 **Stephen Bennett, Utah State University**, Scott Shahverdian, Nicolaas Bouwes, Reid Camp, Joseph Wheaton

Cheap and Cheerful restoration – What is it and why do we need to do a lot more of it

The scope of degraded streams throughout the Western United States is enormous; therefore, we need alternative restoration approaches that are efficient and can be used to treat larger sections of streams for a given cost than in the past. We describe several restoration approaches to address various impairments and objectives across a variety of ecosystems. Project areas range across alpine, high elevation meadows, and desert wadeable streams.

We give examples of how we work with beavers or install simple and inexpensive wood structures to influence stream processes. We use these restoration approaches to effect stream hydrology, geomorphology, and riparian areas to improve habitat for fish, amphibians, sage grouse, and vegetation. We call these approaches "Cheap and Cheerful" because we embrace a less engineered approach to restoration that emphasizes increased density of structures and the length of stream treated – not detailed design drawings and an over emphasis on structure integrity.

Watershed Experiment: Asotin Creek, WA
The Asotin Intensively Monitored Watershed (IMW) started in 2008 with the goal to determine the effectiveness of large woody debris (LWD) restoration at increasing the production of wild steelhead. We are using a staircase experimental design where three streams have a 4 km section of stream restored in sequential years and two sections in each stream are kept as controls. We implemented a novel large wood restoration action where the emphasis is on the density of structures and the length of stream treated – not individual structure integrity. We constructed almost 700 LWD structures we call post-assisted log structures (PALS). We are measuring a wide variety of fish responses and have tagged almost 40,000 juvenile steelhead with passive integrated transponder tags (PIT tags). We use both mark-recapture methods and mobile PIT tag surveys to assess survival by age class across all four seasons. We will present survival estimates from five years pre-restoration and four years post-restoration from treatment and control sections. We use our staircase model to assess how both the restoration treatment and other factors (stream temperature, flow, and habitat) affect survival. These findings will provide important insights into how juvenile steelhead survival varies seasonally and annually and how LWD restoration can effect this aspect of fitness.

11:15 – 11:30 **Hans Smith, Yakama Nation,** Matt Abrahamse, Scott Ladd

Fish use trends in a groundwater infiltration gallery habitat restoration project – The Methow River 1890's side channel

In 2014, Yakama Nation Fisheries constructed a groundwater infiltration gallery along the Methow River near Twisp, Washington to restore surface flows within an abandoned side channel to improve juvenile salmonid rearing habitat. This was the first habitat restoration project of this type conducted in the Upper Columbia Region to support recovery of ESA listed salmonids. The 1890s Side Channel Project restored perennial flows to over 4,000 linear feet of side channel using infiltration gallery discharge. The advantage of reliance on infiltration galleries to create or augment surface flows include thermal buffering of surface water temperatures from extreme seasonal heating and cooling trends and provision of a dependable surface water discharge into the side channel despite main channel discharge rates during low flow events. Since 2014 Yakama Nation Fisheries has collected fish use data and tracked seasonal changes in the side channel discharge rates and surface water temperatures to help document the performance of this type of restoration action. This presentation will provide an overview of how the 1890s Side Channel Project was constructed and how the project has performed since 2014, including a presentation of the hydrology and fish use data.

11:30 – 11:45 **Karl Polivka, U.S. Forest Service PNW Research Lab,** Joseph R. Mihaljevic, Shannon M. Claeson

Mechanistic models of individual growth and capacity: Habitat restoration for Chinook and steelhead juveniles

In-stream habitat restoration effectiveness studies benefit from mechanistic approaches to habitat selection, including the study of movement, and the effect of habitat occupancy on fitness-correlated traits such as growth. Here we use Bayesian methods to fit mechanistic models to data from Chinook Salmon and Steelhead Trout in the Entiat River (WA), but with applicability across study systems. In a multi-year study of behavioral and growth patterns, using mark and recapture of young of the year, we examined the ability of restoration to increase capacity for these species. Fit of a modified Ricker model indicated that pools with restoration structures could support more Chinook individuals immigrating into the pool than unrestored pools across the observed range of density in both habitat types. However, the confidence intervals around the parameter estimates were fairly large. A mechanistic growth model fit to size-over-time and to recapture data showed that early parr-stage individuals of both species experienced a growth benefit to occupying restored pools, which is also indicative of added carrying capacity. Although this did not result in larger fish by the end of the season, these growth benefits may have survival implications early in the rearing season, and/or for vulnerable size classes. Finally, comparison of growth results with occupancy results indicates that growth studies are a good indicator of restoration effectiveness. Thus, we show the importance of these conceptual approaches to evaluating in-stream habitat restoration, although it is unclear whether, and to what extent capacity increases in rearing streams can affect population growth.

11:45 – 12:00 **Robby Fonner, NOAA NW Fisheries Science Center**

Prioritizing habitat restoration for salmon recovery: Cost effectiveness analysis and beyond

In the Pacific Northwest of the United States significant resources are allocated to restoring habitat for salmon populations. Allocating these resources poses a challenge for restoration managers. Part of this challenge is evaluating alternative projects, which is necessary since undertaking one restoration project usually implies foregoing other worthwhile restoration projects or conservation activities. Providing restoration managers with information on the relative cost-effectiveness of candidate restoration projects is a first step towards improving the allocation of restoration resources. We discuss the use of cost effectiveness analysis (CEA) for salmon habitat restoration prioritization, and present an application to illustrate its utility. Key biophysical and economic processes that drive CEA outcomes are identified and assessed. Finally, we discuss future directions for habitat prioritization research in the Pacific salmon context.

12:00 – 12:15 **Julie Vanderwal, Okanogan Highlands Alliance**, Robes Parrish, Crystal Elliot-Perez

Step it up: Using beaver dam analogues (BDAs) to restore an incised meadow system

Beavers are well known for their role in creating and maintaining stable, complex ecosystems, as well as supporting an abundance of species diversity. In locations where beavers are no longer present to maintain dams, particularly in low-gradient systems, channel incision and degradation often occurs. Mimicking beaver dams with human-made structures can both jumpstart ecological recovery and create hydraulic and biological changes that are attractive to wildlife recolonization. BDAs can reduce stream velocities, induce lateral channel migration, and cause rapid aggradation. This allows riparian vegetation to become established, while also creating pools and stable anchor points for beavers to utilize.

The Triple Creek Project (Okanogan County) was constructed in 2016 and 2017 to improve geomorphic and ecological function by aggrading the streambed through a severely incised meadow system. 26 structures were installed in 2016, and 25 of those were repaired or altered in 2017. After the initial freshet, many structures were flanked, which increased sinuosity and provided material for rapid aggradation— almost five feet of sediment in places. Immediately following construction in 2016, the reach was recolonized by beavers and in 2017 dam-building began on a yet-unwoven BDA. Beaver occupancy is desirable since BDAs must generally be maintained until site- or reach-specific objectives are met. An aggressive planting effort is ongoing to restore the riparian buffer and provide materials for beaver to maintain grade-control into the future.

BDAs offer a low-cost, simply constructed and easily scalable technique for inducing significant geomorphic change to restore beaver-dependent stream ecosystems. By slowing flows and forcing more water to be stored in the hyporheic zone, cooler water is released into the stream in summer, which may ameliorate the warming and drying of streams anticipated in the future. Information is being collected on groundwater, surface water levels, and channel morphology to quantify spatial and temporal changes.

12:15 – 12:30 Questions/Discussion

12:30 – 12:35 **Triple Creek Project Partners present "Water, She Rise Up" Song & Slideshow**
Sandy Vaughn, Deb Vester, Julie Vanderwal

12:30 – 1:30 Lunch – On Your Own

1:30 – 2:00 **Plenary Talk – Langdon Cook, Author**

Upstream: Searching for Wild Salmon, from River to Table

For some, a salmon evokes the distant wild, thrashing in the jaws of a hungry grizzly bear on TV. For others, it's the catch of the day on a restaurant menu, or a deep red fillet at the market. For others still, it's the jolt of adrenaline on a successful fishing trip. Our fascination with these superlative fish is as old as humanity itself. Long a source of sustenance among native peoples, salmon is now more popular than ever. Fish hatcheries and farms serve modern appetites with a domesticated "product"—while wild runs of salmon dwindle across the globe. How has this once-abundant resource reached this point, and what can we do to safeguard wild populations for future generations?

Langdon Cook goes in search of the salmon in Upstream, his timely and in-depth look at how these beloved fish have nourished humankind through the ages and why their destiny is so closely tied to our own. Cook journeys up and down salmon country, from the glacial rivers of Alaska to the rainforests of the Pacific Northwest to California's drought-stricken Central Valley and a wealth of places in between. Reporting from remote coastlines and busy city streets, he follows today's commercial pipeline from fisherman's net to corporate seafood vendor to boutique marketplace. At stake is nothing less than an ancient livelihood.

But salmon are more than food. They are game fish, wildlife spectacle, sacred totem, and inspiration—and their fate is largely in our hands. Cook introduces us to tribal fishermen handing down an age-old tradition, sport anglers seeking adventure and a renewed connection to the wild, and scientists and activists working tirelessly to restore salmon runs. In sharing their stories, Cook covers all sides of the debate: the legacy of overfishing and industrial development; the conflicts between fishermen, environmentalists, and Native Americans; the modern proliferation of fish hatcheries and farms; and the longstanding battle lines of science versus politics, wilderness versus civilization.

This firsthand account—reminiscent of the work of John McPhee and Mark Kurlansky—is filled with the keen insights and observations of the best narrative writing. Cook offers an absorbing portrait of a remarkable fish and the many obstacles it faces, while taking readers on a fast-paced fishing trip through salmon country. *Upstream* is an essential look at the intersection of man, food, and nature.

Afternoon Session Survival and Life History

2:00 – 2:30 **Plenary Talk – Hal Beecher, Washington Department of Fish & Wildlife (Retired)**

Fitting tools to our understanding of the problem – Habitat Suitability Modeling (HSI and PHABSIM)

Fish habitat management affects the public whose taxes support fish management. They demand efficient decisions based on sound science. Models should fit the issues being addressed. Ecological models should be consistent with Hutchinson's n-dimensional niche concept, addressing dimensions that will be affected. PHABSIM has been used for water management for fish. Key assumptions of PHABSIM have been validated while others have less clear validity. More efficient models or versions should replace less efficient models as we learn more. PHABSIM, as well as HEP, CHAMP, or other models, may have merit for decisions other than water management, but alternative models should be carefully evaluated. HSI are key part of PHABSIM and may be used in other models. Development of HSI consists of relating use to availability along a habitat or niche dimension. Validation of HSI involves applying HSI independently to evaluate if fish act as HSI would indicate they should. The next step is evaluating the model using the HSI: does population respond as model says it should? If not, how is it modified and the evaluation repeated? WDFW did some validation for steelhead, coho, and Chinook, but coho results have led to uncertain conclusions, perhaps because of population density. Hydraulic models in PHABSIM seem sound, but further refinements may improve model. Model uncertainty stimulates us to improve knowledge of autecology of these fish.

2:30 – 2:45 **Kevin See, Quantitative Consultants, Inc,** Mike Ackerman, Chris Beasley, Mike Edmondson, Jude Trapani

Empirically estimating carrying capacity – Methods and applications

Improving carrying capacity through tributary rehabilitation is a focus of recovery efforts for endangered Chinook salmon and steelhead populations in the Pacific Northwest. However, estimating carrying capacity for rearing juveniles and spawning adults, as well as identifying important habitat components that influence capacity, are ongoing but necessary challenges. To address this, we have developed models to predict habitat capacity using quantile regression forest (QRF) methods. The QRF models can be used to 1) identify important habitat components associated with juvenile or adult Chinook salmon and steelhead capacity, 2) empirically describe the fish-habitat relationships and 3) predict carrying capacity using measurements of those habitat variables. To date, QRF models have been developed to predict habitat capacity for juveniles rearing during summer months and for adult spawning (i.e., redds) for both spring-summer Chinook salmon and steelhead. Here, we present capacity estimates that have been made for watersheds in the upper Salmon River Basin, Idaho, and how they are being used to identify life-stages where habitat capacity is limiting.

Moreover, we demonstrate how QRF models can be used to predict improvements to capacity resulting from proposed rehabilitation actions, helping to identify the types of restoration and areas where such actions can be most cost-effective. In conjunction with before/after habitat sampling of restoration actions, QRF models can provide an estimate of how much capacity was gained by that action, potentially providing a new cost metric: capacity (or fish) per dollar.

2:45 – 3:00 **Chris Johnson, Washington Department of Fish and Wildlife**, Trenton De Boer, Phil Roni, George Pess, Andrew Murdoch

Environmental factors influencing Wenatchee River Basin spring Chinook egg-to-fry survival

Mortality of Chinook salmon and other salmonid species is thought to be greatest during early life stages, particularly during incubation when alevin are most susceptible to environmental factors such as temperature, substrate scour, and the accumulation of fine sediment. Unfortunately, perhaps in part due to difficulties associated with sampling, field estimates of survival over large spatial scales are not common for this life-stage. Such estimates however, are necessary for identification of factors most limiting to specific populations when productivity is low, and to inform recovery efforts. A three-year cooperative project between the Washington State Department of Fish and Wildlife and NOAA Fisheries was initiated in 2014 to compare relative survival of spring Chinook salmon (Oncorhynchus tshawytscha) among six study reaches of the upper Wenatchee River Watershed; representing 72.1 river kilometers of Wenatchee spring Chinook spawning habitat. Eighty-eight artificial redds were constructed annually over a two-week period at the peak of spawning activity and the subsequent data used to compare relative survival among study reaches, while controlling for adult mating and spawn time. Annual survival ranged between 24.5 and 48.3 percent (mean, 32.6; SD, 13.5) and was variable both within and among study reaches in each year. Preliminary results indicate significant relationships between egg-to-fry survival and key environmental factors (e.g. fine sediment accumulation, substrate scour) in the upper Wenatchee River basin, suggesting differentials in habitat suitability within areas of known Chinook salmon spawning. This study serves to expand our understanding of environmental factors affecting survival of upper Wenatchee River spring Chinook salmon, and provides an example of applied standardized methods for the identification and assessment of factors limiting to survival over broad spatial scales.

3:00 – 3:30 Break - Coffee and Snacks
Langdon Cook, Author - *Upstream* Book Signing

3:30 – 3:45 **Eric Doyle, ICF**, John Arterburn, Paul Wagner, Ryan Klett

The Methow EDT model: A tool for species conservation planning in the Big Data age

Significant investments in monitoring and rapid advancements in technology have produced a large and ever-expanding body of habitat data in salmon-bearing watersheds in the Upper Columbia region.

The effective application these data is a critical component of regional salmon recovery efforts. A core challenge is the ability to compile and synthesize habitat data into useful information for decision making. The current generation Ecosystem Diagnosis and Treatment model (EDT3) is explicitly designed for this purpose. EDT3 is a life cycle-based habitat model that uses the recursive properties of the Beverton-Holt stock-recruitment function to quantify relationships between ecological conditions and habitat capacity and productivity. EDT3 is built on a powerful SQL database engine that can systematically compile large amounts of habitat data and calculate life stage-specific habitat performance metrics across multiple spatial scales. The result is a disciplined data analytics platform that produces documented and repeatable results and can be updated to reflect new knowledge and information over time. EDT results often challenge existing assumptions about habitat conditions, leading to new insights and hypotheses. We will provide an example of these capabilities using the recently updated EDT3 model developed for the Methow River subbasin. We will describe how the existing Subbasin Planning Methow EDT model was migrated to the EDT3 platform and reconfigured to meet current management needs. We developed a new analysis scenario for the Methow based on habitat monitoring data collected by various entities between 2005 and 2014. We will present EDT results for spring Chinook to demonstrate how EDT can be used to identify habitat bottlenecks and prioritize limiting factors, characterize trends in habitat conditions, and target key data gaps to guide future monitoring efforts.

3:45 – 4:00 **Lance Campbell, Washington Department of Fish and Wildlife**

Life History strategies of selected Chinook salmon spawning populations in the Columbia River, as inferred from otolith microchemistry

Growing evidence in the Columbia River suggests juvenile Chinook salmon (Oncorhynchus tshawytscha), utilize portions of both the natal and non-natal freshwater environments as well as estuarine habitats on their juvenile migration. However a clear link between these varied life history pathways and the success of returning adults is not well understood. To test the hypothesis that non-natal rearing is important for juvenile Chinook, we recovered adult otolith samples on the spawning grounds of upper, middle and lower Columbia River tributaries. Laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) was used to analyze chemical patterns in otoliths. Otolith microchemistry was used to estimate the size and timing of juvenile outmigration for selected adult populations. The success (i.e. survival) of juvenile life history will be discussed in context to stock recovery and habitat needs.

4:00 – 4:15 **Jeremy Cram, Washington Department of Fish and Wildlife,** Dan Rawding

Spatially continuous abundance and age-structure of juvenile steelhead in an important wild-fish production area

Estimating juvenile abundance using spatially continuous mark-recapture methods for stream fishes may provide a viable alternative to site-based approaches that are less robust to patchy fish and habitat distributions. This presentation will focus on preliminary results from two years of investigation in Peshastin Creek, a key wild steelhead production area for the Wenatchee River. Results include fall parr abundance, distribution, and age-structure, estimates of spawner-to-parr survival, emigration patterns, and other life history patterns. The survival, distribution, and life history information will also be discussed in a conservation and recovery context.

4:15 – 4:30 Questions/Discussion

4:30 Closing Remarks by Melody Kreimes

POSTER SESSION

Posters will be on display in the lobby throughout the conference and poster sessions will be held during the morning breaks. Posters are listed alphabetically by first author's last name.

Chris Butler, Yakama Nation

Chewuch River side channel project 2015

In 2015 Yakama Nation Fisheries restored a perennial flow through side channel on lands managed by WDFW along the Chewuch River near 8 Mile Creek. The project created thousands of feet of new side channel habitat and restored floodplain connectivity in part of the Lower Chewuch Assessment Unit. The project used innovative restoration techniques to minimize soil and vegetation disturbance and created new wetlands in areas previously used as a parking lot. The project has shown direct benefit as adult holding and juvenile rearing habitat for spring Chinook salmon and steelhead.

Chris Clemons, Yakama Nation, Jason Breidert, Matt Wilberding

Large wood restoration in the Upper Columbia Basin

Yakama Nation Fisheries is focused on restoring habitat and ecological processes related to the presence of large woody material in the spawning and rearing tributary subbasins of the Upper Columbia Basin. Large wood restoration is a key component of our habitat related salmon recovery efforts under the 2008 Fish Accords. We employ a mutli-faceted large wood restoration approach which seeks to 1) Address the root causes of large wood depletion including sources, recruitment, and retention, 2) place large wood to restore in-channel geomorphic processes including pool scour, capture of spawning gravels, secondary channel formation, increased recruitment of riparian trees and increased retention of recruited wood, and 3) place large wood for immediate, direct benefits to fish including hiding cover, habitat complexity, velocity refuge, and a source for macroinvertebrates. Since 2009 the Yakama Nation Fisheries Upper Columbia Habitat Restoration Project has implemented dozens of large wood restoration projects throughout the Upper Columbia Basin. Our poster reviews some differing types and purposes of large wood restoration projects in East Cascade river systems, and provides an overview of the variety of techniques we employ to accomplish large wood restoration in a complex river environment.

Ken Muir, Cascadia Conservation District, Jason Sims, Amanda Newell, Mike Cushman

Empowering the community through creative education and outreach

The most challenging aspect of any project, new management effort, or changing paradigms is how to communicate and engage the general audience. Proper outreach and education will connect the public and help them be engaged in our efforts and projects. At Cascadia Conservation District, we have been creative in our ways to communicate with our landowners, schools and the general public. Whether it's through social media, or public presence, we encourage landowners, our partners, and our local community to get involved with projects and programs the conservation district offer.

We work with local school districts to educate students about their natural surroundings, from river ecosystems to forest and even agricultural practices. We also collaborate and coordinate with our partners to enhance projects and expand funding possibilities. The combination of our efforts is quantifiable and with sustainable, positive results. With our outreach practices, we have created a grassroots movement where our community helps drive our mission as a conservation district.

Katy Pfannenstein, U.S. Fish and Wildlife Service, Jakub Bednarek, Gregory Fraser, Matt R. Cooper

Use of digital applications to improve spawning ground survey quality and efficiency

Spawning ground surveys are often conducted as a means to monitor annual trends in spawning escapement through the enumeration of redds. A variety of factors can influence the accuracy of redd counts including spawner density, redd life and observer bias. Traditional surveys often utilize flagging and written descriptions to mark previously identified redds. These methods at times can be problematic as flagging is occasionally lost and written descriptions vary between observers. Utilizing mobile digital devices such as smart phones or tablets with data collection applications can greatly assist the surveyor in improving redd survey accuracy. These devices allow the capture and quick retrieval of meta-data associated with each redd including a time series of photos and aerial maps along with written descriptions. We have found that these enhancements greatly assist redd identification especially in areas of high redd density or when data documenting redd superimposition is desired.

Karl Polivka, U.S. Forest Service PNW Research Lab, Shannon M. Claeson

Abundance, capacity, and the effectiveness of habitat restoration in the Entiat River, WAA

Restoration of riverine habitat for salmonids is undertaken in order to increase the capacity of the river to support more rearing juveniles; however, a persistent question is whether, and to what extent, capacity is actually increased by placement of in-stream structures (e.g., ELJs). We extended a previously-developed sampling technique that uses comparisons of unrestored habitat at restored reaches with unrestored reference reaches, in combination with observations in restored habitat, to detect small-scale increases in capacity for young of the year Chinook Salmon and Steelhead. Combining multi-year observations indicated that restoration might increase the capacity of a treated site several-fold, depending on species, and individual site. In the Upper Entiat River (WA), our reference reach also had natural structures and, for four post-treatment study years combined, abundance in pools with man-made habitat structures (ELJs) tracked that in reference reach pools with naturally occurring log structures reasonably closely. Furthermore, this represented a 1.5-8 fold increase in capacity for Chinook, depending on the reach, but only increased Steelhead capacity at one of these sites. Similarly, in the Lower Entiat, reaches treated since 2014 indicated increased capacity, and these effects were more consistent for Chinook than for Steelhead. This was not only demonstrable as increased abundance at pools with structures, but untreated habitat in these treated reaches had more fish, post-treatment, than untreated habitat at reference reaches. Thus, the effect of restoration on juvenile capacity was even more pronounced in the Lower Entiat. It is unclear, however, whether the scale of these capacity increases is sufficient to contribute to population growth.

Hayley Potter, U.S. Fish and Wildlife Service, Trista Becker, Steve Croci, Travis Collier, Matt Cooper

A comparison of rearing water source and the impacts on juvenile fish health

The rearing of healthy juvenile fish at Leavenworth National Fish Hatchery has been challenging in recent years due to an aging infrastructure and changing river conditions, specifically elevated surface water temperatures and increased pathogen loads. As the predominant water source, these changes in surface water and the ability to deliver it efficiently are considered significant threats to fish health at the facility. In 2017, a trial to mitigate poor surface water conditions by rearing juveniles on 100% well water was conducted. Here we present the impact of water reallocation on juvenile fish health. Additionally, we discuss the lessons of those actions and indications for future rearing of spring Chinook Salmon at Leavenworth National Fish Hatchery.

Hans Smith, Yakama Nation

1890s and Fender Mill side channel restoration – Using groundwater to restore fish habitat

Two Posters – The 1890s Side Channel and Fender Mill Side Channel restoration projects were implemented as salmon recovery actions by Yakama Nation Fisheries in 2014 and 2015 along the Methow River in Okanogan County. These 2 projects utilized groundwater infiltration galleries to restore perennial surface flows within disconnected side channels of Methow River. The groundwater infiltration galleries have provided multiple habitat benefits including increased surface water discharge throughout the side channel areas, continuously optimized thermal conditions for rearing salmonids, and enhanced sediment transport capability which reduces sediment deposition in the aquatic habitat. Fish response to the projects has been positive.

Gabriel Temple, Washington Department of Fish and Wildlife, Christopher Frederiksen, Zack Mays, Ryan Fifield, Todd Seamons

Yakima steelhead VSP project: Resident/anadromous O. mykiss studies

The steelhead trout Oncorhynchus mykiss exhibit some of the most diverse life histories of any Pacific salmonid. Included in the diversity of this species is the variable expression of anadromous and resident life histories. The anadromous form may smolt and migrate to the ocean after one or more years of freshwater residency and return to its natal stream after spending one or more years in the ocean. In contrast, the resident life history form, also known as rainbow trout, spends its entire life in freshwater. Our understanding of this species complicated by the fact that both forms can interbreed and produce offspring of the opposite type. It is unclear how this interaction between life history forms influences the recovery of the anadromous form (steelhead trout) as mandated under the Endangered Species Act (ESA). Our project provides information on the Viable Salmonid Population (VSP) metrics for the upper Yakima O. mykiss population while generating status and trend monitoring information for both resident and anadromous life history forms. Improving our understanding of the interaction between O. mykiss life history forms will help fill critical data gaps and will lead to informed and targeted recovery actions that will benefit steelhead trout throughout the Basin.

EXHIBITORS + CONTRIBUTORS

NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

Confederated Tribes and Bands Yakama Nation Treaty of 1855

inter·fluve inc.

ICF International

UCUT Upper Columbia United Tribes

Washington Water Trust

Rocky Reach Habitat Conservation Plan

Rock Island Habitat Conservation Plan

Wells Habitat Conservation Plan

Four Peaks Environmental Science & Data Solutions

HABITAT SUBCOMMITTEE of the Priest Rapids Coordinating Committee

Cascadia Conservation District

PNP Pacific Netting Products Incorporated

AFS American Fisheries Society Washington-British Columbia Chapter

Washington State Conservation Commission

CONTECH Engineered Solutions

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